The adaptation of traditional agriculture: socioeconomic problems of urbanization

E K Fisk, editor
The adaptation of traditional agriculture
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The adaptation of traditional agriculture: socioeconomic problems of urbanization

E K Fisk, editor

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Summary

This book examines the problems found in adapting traditional systems of agricultural production to the needs of urban markets. Particular emphasis is given to root crops, and for this reason some emphasis is also given to the Pacific region, where the problem being examined is still relatively fresh. The twenty chapters thus include contributions from a number of Pacific countries, but there are also major contributions from specialists from other parts of the world where such problems are of importance, and from people who are world authorities on some special aspects of the problem.

The book arises from a week-long conference held at Honiara, Solomon Islands, in November 1977 and brings together the experience and ideas of a number of the world's leading workers in this field.
# Contents

## SECTION A

Introduction and theme paper

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Adapting traditional agricultural systems to serve urban food markets</td>
<td>11</td>
</tr>
</tbody>
</table>

## SECTION B

Pacific case studies

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Custom and money: integration or breakdown in Melanesian systems of food production</td>
<td>25</td>
</tr>
<tr>
<td>4</td>
<td>Indigenous agriculture in the Solomon Islands</td>
<td>46</td>
</tr>
<tr>
<td>5</td>
<td>Food shortages in Western Samoa: towards a solution</td>
<td>72</td>
</tr>
<tr>
<td>6</td>
<td>Problems in stimulating outer islands saltfish production for the urban market in Tarawa, Gilbert Islands</td>
<td>93</td>
</tr>
<tr>
<td>7</td>
<td>Adapting traditional agricultural systems to serve urban food markets: the Niue experience</td>
<td>111</td>
</tr>
<tr>
<td>Chapter</td>
<td>Title</td>
<td>Page</td>
</tr>
<tr>
<td>---------</td>
<td>----------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Chapter 8</td>
<td>Co-operative yam gardens: an adaptation of a traditional agricultural system to serve the needs of the developing Tongan market economy</td>
<td>R.R. Thaman 116</td>
</tr>
<tr>
<td>Section C</td>
<td>Studies raising special issues</td>
<td></td>
</tr>
<tr>
<td>Chapter 9</td>
<td>Some ideological considerations relating to tropical root crop production</td>
<td>D.G. Coursey 131</td>
</tr>
<tr>
<td>Chapter 10</td>
<td>Progressing with the past: environmentally sustainable modifications to traditional agricultural systems</td>
<td>W.C. Clarke 142</td>
</tr>
<tr>
<td>Chapter 11</td>
<td>Organizing production and producing organization: the sociology of traditional agriculture</td>
<td>Peter B. Huber 158</td>
</tr>
<tr>
<td>Chapter 12</td>
<td>The Kwai of Malaita: old values and new discontents</td>
<td>R.M. Keesing 180</td>
</tr>
<tr>
<td>Section D</td>
<td>Studies of other regions of the world</td>
<td></td>
</tr>
<tr>
<td>Chapter 13</td>
<td>Root crops and their utilization in West Africa</td>
<td>D.G. Coursey 199</td>
</tr>
<tr>
<td>Chapter 14</td>
<td>Options for Latin American countries in the development of integrated cassawa production programs</td>
<td>John K. Lynam 213</td>
</tr>
<tr>
<td>Chapter</td>
<td>Title</td>
<td>Page</td>
</tr>
<tr>
<td>---------</td>
<td>----------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>15</td>
<td>Focussing farming systems research on smallholder agriculture: experience from West Africa</td>
<td>257</td>
</tr>
<tr>
<td>16</td>
<td>Some reflections on traditional Indian agriculture</td>
<td>277</td>
</tr>
<tr>
<td><strong>SECTION E</strong></td>
<td>Studies with more economic emphasis</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>A note on balance of payments considerations in expanding traditional agriculture</td>
<td>299</td>
</tr>
<tr>
<td>18</td>
<td>The production, marketing and consumption of root crops in Fiji</td>
<td>303</td>
</tr>
<tr>
<td>19</td>
<td>Grower response to commercial crop production: a theoretical approach with practical policy implications</td>
<td>324</td>
</tr>
<tr>
<td><strong>SECTION F</strong></td>
<td>Major emerging issues</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Traditional agriculture and urbanization: policy and practice</td>
<td>345</td>
</tr>
</tbody>
</table>
SECTION G
The structure of rural supply to the Honiara market

M.A. Bathgate

(This section, owing to its length, has been published separately as Development Studies Centre Occasional Paper No.11.)

References 379

Contributors and Participants 397
Section A
Introduction and theme paper
Chapter 1

Introduction

E.K. Fisk

This book arises from a conference held in Honiara, Solomon Islands, in November 1977. The topic of the conference was 'The Adaptation of Traditional Systems of Agricultural Production to serve the Needs of a Developing Market Economy'. Particular emphasis was given to root crops, and to problems of their production to supply urban markets in developing countries of the Third World. In this context, the term 'Traditional Systems of Agricultural Production' was taken to include all aspects of the organization of production from the tilling of the soil and the allocation of land and labour resources to the distribution, processing, transport and marketing of the product, and its eventual preparation and consumption.

There was some emphasis in the conference on the Pacific region, where the problem being examined is still relatively fresh, and where there remain substantial rural populations whose agricultural production systems have as yet been only modestly affected by commercialization. There were participants from most of the Pacific countries where these conditions prevail, and many of these were professional people concerned in practice with the problems of this adaptation in the context of the social, economic, political and agronomic conditions of their own countries.

However, the conference was by no means confined to the experience of the Pacific region, and a special effort was made to secure the attendance of specialists from many other

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1This conference was organized by the Development Studies Centre of the Australian National University with substantial financial assistance and encouragement from the British Commonwealth Secretariat, the Agricultural Development Council Inc., and the Australian Development Assistance Bureau.
parts of the world, in order to benefit from experience gained in other regions where similar types of problems have been encountered, and where various adaptive processes have been attempted.

The book comprises, in addition to this introduction, the main papers presented at the conference, together with two papers written by participants subsequently to fill a specific gap in the coverage of the subject, plus a final chapter which presents some ideas and conclusions arising out of the conference.

The origins of this particular conference date back to early 1972, when I presented a paper entitled 'Adapting traditional agricultural systems to serve urban food markets' to the biennial Conference of Directors of Agriculture conducted by the South Pacific Commission in Lae, Papua New Guinea. That paper questioned the relative neglect of the highly productive indigenous root crop production systems in most agricultural development programs. This theme struck a chord of response from a number of the Pacific regional delegates, and suggestions were made by the Directors of Agriculture of Papua New Guinea, Fiji, Samoa and Niue, that it would be profitable to arrange a wider discussion of these particular issues at a high level conference devoted solely to that objective. The Honiara conference, and this book, are the result.

Not all the persons invited to the conference were able to come. Notable, and particularly felt, were the absence of the Director of Agriculture of Western Samoa, Tauiliili Ouli, and that of the District Commissioner Northern Fiji, Ratu Epeli Kanaimawi, who were both active original proposers of the conference. Another serious disappointment was the absence of Dr H.N. Ntephe of the Nigerian Tuber and Root Crops Board, whose government was unable to release him at the last moment. A list of the participants is at the end of the book as Appendix A.

The papers presented at the conference have been arranged here in six sections, to which is added in effect a seventh section which is being published separately by the Development Studies Centre. The arrangement is as follows:

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Section A. Introduction and theme paper

Section B. Pacific case studies

Section C. Studies raising special issues

Section D. Studies of other regions of the world

Section E. Studies with more economic emphasis

Section F. Major emerging issues

and separately

Section G. A long paper by Dr Murray Bathgate entitled

*The Structure of Rural Supply to the Honiara Market in the Solomon Islands.*

This arrangement was reached only with considerable difficulty and after much shuffling. In fact most of the papers bridge more than one section and as a result the arrangement is somewhat artificial. This is particularly so in the division between sections B and C because three of the papers in the latter section are also case studies from the Pacific, and whilst they do clearly raise some particularly important issues and concentrate largely on them, so also are important issues raised in the papers in section B. However, it seemed desirable to reduce the large number of case studies in B, and those that have been transferred into C seemed sufficiently different to merit such alternative classification.

Section A is a short section and comprises, in addition to this introduction, only the theme paper that was distributed to participants at the time they were invited to attend the conference. It outlines the problems that the conference was organized to discuss and provides the background to what follows. It has been lightly revised to make it fit in with its role as a chapter in this book, but is fundamentally as originally sent to participants.

Section B comprises six case studies from the Pacific region. The first is an outstanding chapter by Dr Joel Bonnemaison of the French institute Office de la Recherche Scientifique et Technique Outre-Mer (ORSTROM), based on his many years of village-level grass roots research in the Condominium of the New Hebrides. This is followed by a discussion of traditional agriculture in the Solomon Islands by Mr Graham Eele, Agricultural Statistician of the Solomon Islands government, who had recently completed a most
detailed survey of traditional subsistence agriculture in that country. This account was supplemented by a most valuable field day arranged by Mr Eele on behalf of the Solomon Islands government, in which participants were given the opportunity to see at first hand examples of Solomon Island indigenous agriculture ranging from simple subsistence gardens with small market surplus, through subsistence gardens with quite major participation in the market, to gardens where subsistence production had been largely dropped and almost complete specialization for the market had replaced it. Next, Mr Sam Leong Wai of the Development Bank of Western Samoa discusses the problems of his country where productive potential is adequate to meet internal food needs, but where weaknesses in the linkage between producers and the market have led to major irregularities in supplies and prices, and to some discouragement. Mr R. Lawrence of the Victoria University of Wellington, New Zealand, who had recently completed a long period of field work in Tuvalu, then looks at a completely different situation found on one of the smaller islands of the group. On this island the basis of subsistence living is fishing, but in the long term this has become dependent on some export of goods or services, because the timber for making the boats on which the fishing is dependent is not available from island resources and has to be imported.

Next Mr Morris Tafatu, Director of Agriculture of the small and remote island of Niue describes aspects of agricultural production in his relatively affluent, but heavily aid-dependent, nation. This is a particularly interesting case study, not only because of the high level of living that has been achieved, where all villages have all-weather roads, reticulated water supplies and mains electricity, but because all Niueans, including the Premier and heads of government departments, produce their own staple foods, and money is used basically for imported goods and services. Finally Dr Thaman of the University of the South Pacific describes an interesting co-operative group system for yam production developed in Tonga, and considers its potential as a basis for production for the market.

Section C opens with a chapter by D.G. Coursey of the Tropical Products Institute, London, in which he discusses what he calls the 'culture-historical processes in the evolution of root-crop-oriented societies' and the effect this and associated prejudices have had on their utilization in the process of economic development. He is followed by
Professor W.C. Clarke, now of the University of Melbourne, who uses his long field experience of Papua New Guinea as the base from which to discuss some advantages and disadvantages of traditional tropical agricultural. He emphasizes the energy efficiency, freedom from pollution and polycultural characteristics of such agricultural systems, and examines how these benefits could be enhanced by support of intelligently applied scientific knowledge - 'Progressing with the past' as he calls it.

Then Dr Peter Huber of Princeton University, USA, presented a rather unusual case study of a small group of self-subsistent agriculturalists in the West Sepik Province of Papua New Guinea, amongst whom he has recently spent long periods on field work. The special feature of this chapter is the emphasis Dr Huber gives to what he calls 'the social mission of shifting cultivation', and the fact that he considers the chief function of agriculture in that society to be social rather than economic. This has a number of most interesting implications, and is sufficiently different to warrant the placement of this chapter in section C. Dr Huber has substantially revised his chapter in the light of the discussions at the conference.

Finally in this section Professor Keesing of the Research School of Pacific Studies, Australian National University, discusses a small group of people in the central mountains of the Island of Malaita in the Solomons, which he has been studying for fifteen years. These people take little part in the market economy, having an average cash income per caput of only a few dollars a year. Professor Keesing has described them as thus being in one (monetary) sense some of the poorest people in Melanesia, but in another sense (subsistence affluence, and by traditional values) among the richest. In the late 1970s they are definitely being tempted by the attractions of market goods, and have developed some, as yet quite modest, ambitions for increasing their cash incomes to about $50 or $100 a year - though Keesing doubts that they would be satisfied with that for long. His comment is that these affluent subsistence farmers in their isolated Eden seem to be just about ready to become underdeveloped.

Section D turns to the wider perspective, bringing in relevant experience from other regions of the world. It opens with a chapter by D.G. Coursey discussing the utilization of root crops in Africa where yams and other root crops,
especially cassava in various forms, supply very large urban concentrations and where trade in such products has a history covering many centuries. Cassava is also of importance in Central and South America, where production and trade systems have developed rather more along the western small and large farm commercial patterns, as explained by Dr John Sanders and Dr J. Lynam of Centro Internacional de Agricultura Tropical from Cali, Colombia. The original paper presented by John Sanders was rewritten by Dr Lynam at the former's suggestion after the conference, and the chapter here presented concentrates on the particularly relevant experience with cassava in that region. Of special interest in this regard is the intrinsic difficulty built in to those types of agricultural system that makes it difficult for the advantages of new technology and markets to flow on to the small, as distinct from the large, farm producers.

Next Dr John Flinn, from the Institute of Tropical Agriculture in Ibadan, Nigeria, discusses some of the interesting differences between West African and Pacific experience, and from this he develops an approach to agro-economic research for root crop production that should be applicable in any region. Finally, Professor Nitish De, at that time Director of the National Labour Institute in India, gives an account of the very different Indian experience, and discusses some of the problems of rural development and agrarian reform under difficulties that have matured to a more intractable stage.

Section E is devoted to some of the more economic approaches to the problems of adapting traditional systems of agriculture to meet the needs of urban populations. First, Dr Kym Anderson, of the Research School of Pacific Studies, Australian National University, contributes a simple and brief review of some balance of payments problems that affect the choice between importing urban food requirements and producing them locally. Next, Dr Satish Chandra, the acting Director of Research, Department of Agriculture, Fiji, describes the experience of production and marketing of root crops for urban food supplies in Fiji, where urbanization has reached a high level by Pacific standards. Finally Dr Alan Bollard of the South Pacific Commission describes how some useful policy implications and guidelines can be derived from the careful application of even quite sophisticated techniques of economic analysis within the limitations of data and structure imposed by a small basically subsistence island economy, using as illustration his own
experience during a prolonged period of field work on the island of Atiu in the southern Cook group.

Section F comprises one chapter only, and in it the writer has attempted to draw together some of the main conclusions and lessons which he learnt from the conference. As is to be expected, bringing together in one place such a wide diversity of experience and approaches provided the conditions for a lively and profitable exchange of views on practically every subject discussed. These exchanges contributed as much to the conference as the formal papers presented to it. Moreover, special mention must be made of the many contributions by those participants who did not present papers.

Section G, which is being published separately by the Development Studies Centre, Australian National University, as Occasional Paper No.11, is a long paper by Dr Murray Bathgate of the Institute of Applied Social and Economic Research, Port Moresby, Papua New Guinea, entitled The Structure of Rural Supply to the Honiara Market in the Solomon Islands. Although much too long for inclusion as a chapter in this volume, and although some parts of the data presented have been published elsewhere, this material was considered of such unique value and relevance that it warranted separate publication in full.

No attempt has been made in this book to reproduce the actual discussions that followed each paper. Such attempts are always exceedingly difficult, and would in this case have added unacceptably to the length of what is already quite a long book. An attempt was made in the last session of the conference to draw up some conclusions on the basis of a general consensus, but time, and the spate of new ideas sparked by earlier discussions, which were still bubbling up in the final session, precluded the passing of formal conclusions by the conference as a whole.

On the other hand a great number of important issues had been carefully discussed, and a number of original and sometimes exciting views formulated. There was also a substantial measure of agreement, rising virtually to unanimity on some matters.

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3P. Rimmer, D. Drakakis Smith and T. McGee (eds), Food, Shelter and Transport in Southeast Asia and the Pacific, Department of Human Geography, Australian National University, 1978.
Section F has attempted to capture those points on which consensus appeared to be greatest, and those many other points that arose in discussion and appeared to me to be of greatest interest, and which have substantially influenced my thinking on the subject since the conference. In this, full use has been made of comments, some written, some verbal, communicated by participants since the conference.

However, time has not permitted the prior circulation of this chapter to all, or even most, of the participants to canvass their views. Therefore, whilst it is hoped that most participants would agree with a large part of what is said in this final chapter, it remains a personal view, and the writer must take personal responsibility for the selection and mode of presentation of the chapter's content.
Chapter 2

Adapting traditional agricultural systems to serve urban food markets

E.K. Fisk

There is no doubt that tropical root crops are potentially a valuable source of food for at least part of the world's rapidly increasing populations. They are widely cultivated in the tropical regions, and in many cases the technologies developed by the indigenous peoples of those regions for their production have been very efficient in terms of the use of the resources available to them. In particular, where land has been a relatively abundant factor, techniques have evolved which have produced good and palatable food in large quantities with relatively little input of labour. In the traditional societies where population pressure on land resources has not developed to serious proportions, and where weather conditions have usually been favourable to agriculture, these systems and techniques have formed the basis of a socio-economic condition of subsistence affluence.

It has been shown that many of the technical agronomic problems of adapting these excellent food crops to the changing needs of the modern world, including problems of intensification (and thus more efficient land use), and problems of transport and storage, can be successfully tackled with modern research and development methods. However, the productive system required for the modern world requires considerably more than simply the solution of those technical problems. This production process starts with the soil and ends in the stomach of the consumer. Moreover it starts many months, and sometimes even many years before the final act of consumption can take place, with the preparation of the land for planting. The process therefore involves forethought, planning and organization in order that the fruits of production may become available not only in the required quantities, but also of the required types, in the required place, and at the time they are needed. There is needed a network of decision making, a coming together of factors of production in finely judged proportions and
quantities, responding not to the needs of the small local producing group now, but to the needs of very large distant populations some considerable time into the future. There is in fact a need for an agricultural system of village level small-farm production that fits effectively into a wider economic system of a type and complexity for which the traditional agricultural systems were not designed.

There has been a tendency in the past to deal with this problem, as indeed with the agronomic problem, by importing large parts of proven agricultural productive systems from other more advanced countries where answers to the needs of the larger and more complex modern societies have been developed over long years of experience. These imports have ranged from exotic crops, such as storeable grains, to foreign systems of land tenure and corporate organization. In some extreme cases a large part of the agriculture of the country has been converted to purely export-oriented crops such as rubber in Malaysia or sugar in Fiji, with the producers becoming market dependent, and even import dependent, for a large part of their food and other essential requirements. Although this procedure has had some success, it has also produced very many disappointments, and in the utilization of the enormous potential of the tropical root crops as a source of food for the growing urban populations of tropical countries it has been a relative failure. Nowhere has this failure been more evident than in some of the developing Pacific countries where the reasons in favour of reliance on indigenous root crops are economically and socially exceptionally strong.

The agricultural techniques of production have been discussed elsewhere in this volume. My concern here is primarily with the socio-economic aspects which determine the allocation of land, labour, capital and management at farm level in the various parts of the production process; my paper is concerned not only with the quantities of each input, but also with the determination of who shall supply how much of each input and when; with the decision of how much of each good or service is to be produced and when; and with how the product is to be distributed, to whom, and when.

For the solution of such problems the people of the Pacific have developed a number of institutions of a socio-economic nature designed to produce the necessary decisions to sustain an efficient production process for the necessities
of their lives in their own particular conditions and environments. These institutions, however, are specifically designed to meet the local essentials of life in the traditional setting, and with few and very specially limited exceptions (such as the kula ring), are not directed at, nor adapted to, production for a market distant in space and time.

These traditional institutions provide for the allocation of land, labour, capital and management to the production process in a way that differs considerably from that under the western commercial farming process. To start with, under most traditional systems of land use, there is no 'market' for the factor land. Land belongs to the clan, tribe or other larger group, and commonly (though it must be admitted not invariably) the family or extended family production group acquires only a usufruct over a part of the land for its own productive purposes. There is often provision for inheritance of the usufruct, or for temporary transfer of some of the short-term rights, but anything in the form of sale of land rights is quite uncommon.

Next, the supply of labour is basically determined by the population of the family production group, and by a complex of obligations and counter obligations built up in the past, together perhaps with some mutual group arrangements, but the idea of a pool of labour from which the requirements of the farm could be obtained for a wage or fee is usually an introduced one, and is seldom found in traditional society. When the labour requirements of the farm operation are less than the internal resources of the family production group - which is a common occurrence - they receive their full share of the group income or product available. It is not open to the family entrepreneur under traditional circumstances to reduce his labour costs by putting off labour in slack periods. As a corollary, it is not normal in traditional society to have a considerable section of the population deprived of all sources of income for considerable periods during the slack season, unless crops have failed and most families are in the same boat.

Third, the supply of capital in traditional society is normally confined to the products of family labour, whether in the form of cleared improved land, tools or buildings self-produced, and perhaps an accumulation of obligations of work and/or goods from other families or individuals to whom good turns have been done in the past. In some cases a supply of traditional valuables may be accumulated, and
these may provide some basis for gaining control of other resources in times of need, but status rather than goods and services are usually the primary objectives of such accumulations. This apparently applies even to the accumulation of tambu shells by the Tolai people of New Britain, despite the fact that small quantities of these shells were commonly used in exchange at times, and in some respects the tambu did fulfill many of the functions of true money.

Fourth, the system of management and control is not only traditionally determined along lines often different from that of the commercial small-holdings, but its objectives may be different also. Maximization of product beyond the requirements for direct family consumption and for status acquisition through customary prestation or feasts has little point where the products are mainly highly perishable and where scarcities of them are rare. One result of this is that in a traditional society beginning to participate in monetary exchange and production for the market, at the stage when market production is merely supplementary to subsistence production, there is often a clear distinction drawn between the essentials of life (which include status as well as food and shelter, etc.) on the one hand, and the things for which money is required on the other. The former are of the greatest possible importance to the life of the individuals and families concerned and are treated (including status) as essentials that must be provided at all cost. The latter, however, are luxuries, which are nice to have, but can fairly easily be done without.1 This distinction is eventually eroded as the economy becomes more completely monetized, but its effects on attitudes continue to be of importance for a considerable period. One aspect of this difference that perhaps does not receive the attention that it deserves is the effect it has on discounting values over time, and thus on one of the main dimensions of farming planning.

Traditional society has been accustomed to planning a season and more ahead to ensure the security and livelihood of the society group. In a society where the essentials of

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1This does not apply of course to certain classes of monetary requirements that may sometimes be artificially institutionalized into essentials, as through the introduction of money taxes or rents, or of money payments to a church as part of the status requirements of social organization.
life have not usually been difficult to acquire, but which can on occasion be rendered suddenly scarce by natural disasters such as cyclones, planning ahead to ensure an adequacy is an inbuilt feature of competent living. Under these circumstances, in evaluating the worth of a particular work task, the future production of essential foods, or supplies for a status important feast, is often not greatly discounted against the product of more immediately essential tasks. However, with money and the things it can buy, the case is frequently quite different in the early stages of transition from subsistence to monetized production, and the rate of discount is very much greater. Under these conditions for a given amount of effort directed at money-earning, a small immediate reward may be often preferred to a very much larger one in the distant future.

In contrast to this let me describe briefly, in caricature, the quite different model assumed to apply with the introduction of the western commercial farm enterprise. Here the farmer is an entrepreneur and he has three factors of production to play with, labour, capital and land. All of these can be bought or sold freely on the market for that factor, so that the quantity of each used depends not on any original endowment, but on the price of the factor on the market relative to the productive capacity of that factor in the production mix. Even a peasant who has inherited a hectare of land is regarded in this way, because he has several options with that land; he can sell it; he can rent it out; he can operate it himself in combination with capital and labour, each of which he values at its opportunity cost - that is at the price he has to pay for using it, whether by payment of rent to somebody else for its use, or by cost to himself in doing without the rent he could get for it. The assumption is that he will use as much of each factor as he can obtain, bidding for it on the market so that he pays the minimum price he can get it for, and he will use as much of each as will maximize his net profit in money terms. This means, in accordance with the underlying theory of this model, that each factor will be used in quantities until the net returns from its use diminish to the point where the return producible from the use of the last marginal unit of that factor is just equal to its cost.

In this model, the entrepreneur is assumed to be perfectly selfish in so far as his production decisions are concerned, aiming to maximize his own personal gain from the operation by getting as much as he can for each item of
his product, and by giving as little as possible for each component in the production mix. Once he has acquired the gain, however, he may use it in whatever way he pleases, giving it to his family with or without stint, or even to his church or to the poor. But these are independent decisions, entirely unrelated to the question of how much land, labour or capital to use, or for what purpose to use them, or how the total product of the farm is to be disposed of between alternative uses. The product is distributed in the most profitable way to those who pay the highest price for each item, and the entrepreneur pockets the proceeds. He pays for his inputs, including labour, the lowest price he can contrive, and for the shortest time he can do with it. Labour that is marginally unproductive will be immediately discarded.

Now this particular commercial small farm model has not worked very well in most developing countries where it has been tried. Where it has worked, it has usually been after the effective destruction of traditional society, or with the introduction of an immigrant race, with no roots in that society locally, who have left their own traditional institutions behind.

On the other hand, in most countries growing tropical root crops as a major food staple, the adaptation of traditional systems of agriculture to the supply of an urban market has not been very satisfactory either. It is in fact for these reasons that attempts have been made in many countries to find effective alternatives either through the import of alternative foods such as storeable grains, or through the introduction of exotic systems of agriculture that have been found capable of supplying urban markets elsewhere.

In many parts of the world where tropical root crops provide the main staple foods, the traditional socio-economic systems developed to organize the production and distribution of these foods have been as adequate to the traditional requirement as have the traditional agronomic techniques and practices. It is changes in these traditional circumstances that have made, or are making, necessary the adaptations to both these sets of factors.

Let us first consider the main dimensions of these changes and the types of adaptation which they make necessary.
First, there is the dramatic increase in population which new standards of health, medicine and nutrition have brought about suddenly. Whilst it is perhaps true that one of the most urgent tasks facing civilization is that of bringing this population increase under control, nevertheless the whole socio-economic structure has to be adapted to provide for the large increase that has already taken place, as well as those further increases that are to be expected whilst mankind thinks up ways of controlling it. This dimension of change has increased the world's population from about 1.2 billion to about 3.9 billion in the last hundred years and thus has effectively reduced the areas of land surface available per person for agricultural and animal production by two-thirds during that period. This means not only that much more food and fibre has had to be found from the practice of agriculture and animal husbandry, but also that the process has had to be intensified very considerably relative to the factor land.

Another major dimension of change is the development of new means of production of goods and services through commerce and industry, and the more or less simultaneous growth of aspirations to consume such goods and services.

This increase in the demand for food, and this addition of a vast range of new goods and services in high demand, has meant that both man and the land have had to become very much more highly productive than had been generally necessary in many tropical regions a hundred years ago. In many parts of the world this productivity has been achieved to a degree that might well have astonished Malthus, by the development of specialization, the division of labour, and the use of large quantities of capital in sophisticated forms. This has meant that a large proportion of the population has gone out of farming into other occupations, and in increasing proportion of mankind has become dependent upon markets for food and fibre, instead of relying on the production of their own family groups.

A further dimension of change is that a large part of this non-agricultural population now lives in urban areas where the scope for self-production of foodstuffs is extremely limited, and often impossible. These large urban populations can only exist if very large quantities of suitable foodstuffs are supplied to their markets in the towns at frequent intervals and with complete regularity.
The requirements to be met are fairly clear. These are for certain very large quantities of suitable types of food in appropriate condition to be delivered at the right place and at the right time in the urban areas a long way from the farms producing them.

There are many aspects of this problem, and those concerned with collection, transport, storage and processing on the way to the urban market are as important as any. However, here my concern is mainly with the socio-economic systems at the farm level, and with the manner of their response to meet the urban needs. We shall look at this as two groups of problems: first, those dealing with the farm level decision about what to produce, and how much of it, and when; second, those dealing with the problems of how to produce this in terms of acquiring and applying the necessary factors of production, land, labour, capital and management, to produce them.

With regard to the first set of problems, if we return to our caricature of the commercial farm, the assumption is that the farm decision-maker makes a sophisticated estimate of what the urban demand and supply situation for farm products will be from six to twelve months ahead and more, leading to an estimate of the expected price of each commodity he can produce. On the basis of this, and a calculation of his expected costs for each commodity, he arranges to produce what will give him the maximum profit when his products are ready for sale at the end of the growing period.

In the case of large corporate farming organizations, this may occasionally represent more or less how production decisions are in fact made, but it can seldom be realistic for the small farm operator, especially one from the traditional sector with little or no knowledge or experience of towns and their conditions. Even in the sophisticated western rural economies, the small producer, and often the medium to large producer as well, is quite inefficient in adjusting his short-term production to future market needs. The most commonly used basis for estimating future market prospects appears to be a rule of thumb either that current prices will continue, or that current trends in prices will continue. The application of these rules to planned production for maximizing profits leads to phenomena such as the well documented 'hog' cycle in the United States in which periods of scarcity and high prices lead to periods of glut.
and low prices and vice versa. This is a wasteful process from the point of view of the economy as a whole, and a discouraging one from the viewpoint of the farmer.

The pattern where traditional agriculture is still a major component is liable to be similar, but rather shorter and less continuous, and this has been one reason for the as yet inadequate supplies of root crops for urban food supplies in many places. The pattern emerges somewhat as follows:

1. In anticipation of a shortage, or a rise in price of imported foods, government or other institutions may seek to stimulate the production of local root crops for the market. Some years ago this was attempted in Western Samoa with the stimulating offer of loans from the Development Bank for the planting of additional taro.

2. Traditional agricultural institutions being essentially conservative, the initial response to such offers tends to be sparse, but is carefully watched by others. If the anticipated shortage or price-rise eventuates, the few traditional producers who have taken the lead will receive high prices and a very satisfactory monetary return for their produce. This being observed by the other farmers in the area leads to a rush of producers planting large quantities of additional taro with high hopes.

3. As a direct result, a season later, all this additional crop becomes available at about the same time, so that the market price collapses and nobody gets a good return.

4. This leads to a disappointment and discouragement, and there is a tendency for withdrawal from the market to take place.

For a traditional farm leader this is devastating. He has no effective means of assessing the future market prospects in the urban centres himself, and he only has three real alternatives. Either he accepts the guidance of some outside authority in the matter, or he withdraws from the market, or he just keeps muddling along. Of these the first is clearly the best alternative, but it requires that the authority should be competent and able to give advice or directions that do in fact work out reasonably well. The creation of such an authority, with perhaps the means to offer a guaranteed
minimum price, and the determination of its way of operation, is one strategy that requires careful examination. It is one that has been tried with some success in certain cases.

But given the assistance of such an authority, the small commercial farmer could operate more effectively also. The Fiji cane farmer is a case in point. The question is whether it is still necessary, or even desirable, that the traditional institutions evolved for the production of root crops should be replaced with foreign institutions on the purely commercial model, or whether it is possible to adapt what is already there to make a more acceptable alternative that will nevertheless effectively provide the urban food supplies required.

It is on this question that very considerable rethinking appears to be necessary, for in fact it has hardly ever been seriously investigated. There are so many disadvantages in the relatively unsuccessful alternative of small commercial food farms, including the destruction of the traditional social values and the development of large-scale indebtedness, the development of landlord and tenant relationships and the growth of a class of landless labourers, the decay of the social security inbuilt in the traditional system, the growth of inequality and many other undesirable features that the traditional systems had avoided or controlled. All these considerations make it necessary that we should re-examine the possibilities of adapting the traditional systems to meet the food needs.

To this end, the Development Studies Centre of the Australian National University, supported by the Commonwealth Fund for Technical Co-operation and the Agricultural Development Council, Inc., held a conference, in Honiara in the Solomon Islands, from 3 to 7 October 1977. The intention of this conference was to bring together some of the leading world experts with grassroots experience of traditional and other socio-economic systems of organizing the production of root crops for remote markets, together with a number of people from the Pacific region with experience of indigenous agricultural systems there, plus a few academics who had specialized in the analysis of such systems, and one or two economists. The conference was intended to discuss the basic problems involved in this process of adaptation, including:

1. **Information.** On what information does the decision-maker base his planning (a) for the subsistence and traditional status requirements (the two are probably not the same)
and (b) for the market? The problems of market forecasts need to be considered, and the organization of production to meet market needs without over- or under-supply, and perhaps with a guaranteed minimum price.

2. **Land tenure.** The problems of land utilization and supply for market as well as subsistence production under traditional systems of tenure, and the assessment of what changes, if any, are necessary to permit effective production for the market.

3. **Labour.** Consider the supply of family labour and its limitations, and the means of supplementing it when necessary; what are the means of allocating it, directing it, rewarding it, and the incentives or constraints operating to ensure its availability.

4. **Capital.** Consider indigenous systems and their potential, as well as their shortcomings, for the supply of capital for the enhancement of market-oriented production; consider the possible means of relating to capital-supplying institutions in the advanced monetary sector. How can these be bridged without excessive cost and without incurring the social and economic disadvantage so common with systems of the western model and land mortgages, etc.?

5. **Organization and management.** Consider the means of selecting authority, enforcing it, and the powers and functions of the decision-making authority in the traditional systems. What are the objectives aimed at in such decision making, and how far are these adequate to the needs of the market situation?

6. **Distribution of proceeds.** Consider how the proceeds of subsistence and market production are to be distributed amongst members of the producing family group, and how this will affect incentives. What changes, if any, are necessary, and how should they be introduced?

In my view, many of these problems had not been adequately explored, mainly because those making the macro-economic planning decisions have had their eyes on the proven western model systems that had been successful elsewhere, and those that had any adequate knowledge of the traditional socio-economic systems had either not understood the macro-economic needs and aspects of the problem, or had not been consulted.
by those that did. It is hoped that the conference shed some light on these questions, and that a more satisfactory indigenous traditionally based system can be devised. The relative inefficiency and the high cost in social strains and inequalities of the introduced alternatives have certainly made the idea worth investigating.
Section B
Pacific case studies
Chapter 3

Custom and money: integration or breakdown
in Melanesian systems of food production

J. Bonnemaison

Both the profound cultural diversity of the islands and peoples of Oceania and the variety of natural environments have their influence on the types of food production. In fact, Melanesian civilization constitutes a 'whole', a kind of harmonious 'agro-cultural' equilibrium inside which not one of the component parts can be treated separately. Groupings and types of habitat, social structures of families and 'clans', types of 'chiefdom', methods of exchange, land tenure, choice of food crops and rhythm of work are all mutually interdependent, typifying a social and cultural organization where the economic choices are governed by the logic of a system of cultural exchanges and prestations.

This link between agricultural structure and cultural foundation is one of the essential characteristics of the Melanesian systems of food production. Under the effect of plantation agriculture, and more recently of urban growth and of the demand for food products, an evolution has occurred that, as we shall see, has an enormous significance. Great innovative capacities are in fact intermingled with astonishing barriers; and faithfulness to the cultural heritage goes hand in hand with a search for new procedures. The present evolution can only be understood by reference to a world of the very recent past which still remains alive and is in fact making a resurgence: that of 'custom'.

Principles of traditional agricultural food production

Oceanic agrarian systems are founded on meticulous horticulture and the almost complete dominance of root crops. Every cultivated plot is a carefully tended garden where a variety of plants are mixed together - each of them being the object of special or almost individual attention.

On the numerous small coral atolls of Polynesia and
Micronesia, where the exposed surface never lies more than several metres above sea level and where the sandy soil is barren and permits little more than a good growth of the coconut palm, the people establish their gardens in the lowest areas. There they dig out 'pits' up to several metres depth in order to reach the underlying pocket of soft water (Barrau 1961; see also Doumenge 1966). Each of these pits will become a micro-garden: the Polynesians will make it into a kind of 'basket' filled with earth and humus gathered from the highest parts of the atoll, or sometimes transported from neighbouring islands. Taros and breadfruit are then planted in these pits.

On the hilly islands of Melanesia, the yam is similarly the subject of meticulous attention. On middle and lower slopes of volcanoes or coraline raised plateaux, Melanesian gardeners use a single digging stick for hand-boring holes of up to 1 or 2 metres in depth. These holes are then filled with light soil (humus and surface layers) that has often come from other holes specifically dug for that purpose; finally a mound of similar light soil is built up over the hold, the dimensions of the mound being determined by the size of yam desired and sometimes reaching 1 metre in height and 2 metres in diameter. Thus in each garden the farmers reconstitute a series of vertical micro-sites that are in effect ecological 'islands' where soil conditions have been artificially recreated. The yam seed planted at the crest of the mound is the 'queen' yam, in other words a giant yam whose growth, if properly guided, will occupy the entire depth of the hold. On the same mound, and all around the giant yam, smaller secondary yams, taros and kava roots are planted in concentric circles.

In New Caledonia, the billon replaces the raised mound as the nutritive matrix: this is a crescent of raised earth several metres in length where several giant yams are planted 'in company'. Here too the unit of cultivation is not the garden but the billon, around which the secondary plants are grown.

Such scrupulously careful preparations are not confined to the yam. In New Caledonia in particular, but also in the New Hebrides, the taro grown in the most mountainous areas forms the basis of an intensive horticulture with complex hydraulic arrangements. Water is led through stone or bamboo channels to a system of levelled terraces, each of which constitutes a small irrigated garden of several square
metres; together, the terraces will often cover an entire slope.

The more intensive the Melanesian method of horticulture, the greater the corresponding tendency towards miniaturization. On individual garden plots that are never very large (between 500 and 1000 sq. metres on average) each man opens between three and four gardens according to the size of his family and the amount of his needs, cultural or economic. The object is to recreate a series of favourable micro-sites — sometimes dug vertically, sometimes raised up and spread out horizontally — that in effect are entirely artificial ecological islands in relation to the prevailing natural conditions of the plot. In each of these islands the growth potential of the chosen plants is encouraged to the maximum.

The aim of this horticulture is not production in quantity. It is less desirable to harvest a large number of yams than to obtain a few tubers which in relation to cultural norms will be luxury products. Traditional food production is thus based on a concept of hierarchy: each micro-site in the yam garden has been created in order to develop a giant tuber which will figure prominently in systems of exchange and social obligation; around the giant tuber grow secondary plants for day-to-day consumption. Food production appears to follow a hierarchy set by cultural and aesthetic criteria. The same principles apply to the production of large fleshy taros that are cultivated with maximum care in the best parts of the garden — sometimes in the centre, sometimes on the periphery, often on the colluvium and scree at the base of slopes. Their production allows each person to maintain his position in the system of obligations that in traditional villages constitutes the rhythm of social life.

When the 'ceremonial' tubers have been harvested, the plot is then put back into cultivation for a second season, although this time the crop production has more orientation towards foodstuffs and is thus much more extensive: crops grown are second-grade taros and yams, but also, and more frequently, sweet potatoes, manioc, Xanthosoma taros ('dry taros'), maize, sugar cane, papayas, bananas, kava roots, etc.

In the Melanesian environment, the hierarchical nature of traditional crop production has been developed to its
logical extreme. The plants of patrimonial custom, i.e. *Colocasia* taros and *Dioscorea* yams, are the subject of an elaborate study and classification which goes as far as distinguishing 80 sub-varieties or types of taro and 50–80 types of yam. Each variety has a particular name, its own vegetal characteristics and a particular cultural weighting or 'price' codified in the system of exchange. Criteria for classification vary according to island and cultural practices, but generally speaking fleshy tubers with the greatest growth potential are accorded the highest place in the traditional classification, and are thus planted in the best parts of the garden.

The concept of a hierarchy among the cultivated plants leads on to one of a selection of particular agricultural techniques for different varieties of plant. Littoral villagers (*man solwota*) thus specialize in yam culture, each small area possessing its own varieties and techniques of cultivation. Similarly, upland or interior villagers (*man bus*) specialize in taro culture, either dry or irrigated, the cultivation always being linked to a choice and a hierarchy of varieties which varies according to place and cultural practice.

In this careful and highly intensive horticulture aimed at the production of luxury goods, enormous demands are made on working time, particularly since traditional agricultural tools and equipment are, or were, primitive and less used. Clearing was done by fire and stone axe – today, by bushknife – and the huge task of preparing the garden was, and still is, largely performed by hand or with the aid of a digging stick; it is the same with weeding and cleaning of the garden, erection and maintenance of yam supports, construction of terraces for cultivation, etc.

In the systems of traditional custom, man lives in symbiosis with the garden, and adjusts his rhythms to those of vegetal production. Even outside the periods of clearing and activity, families will visit their garden every day and spend several hours there: for in addition to being a place of work, the garden is also a social territory where small groups come together for meetings and discussions.

**Economy of exchange, economy of abundance**

It cannot really be said that there is scarcity in the Melanesian economy, unless there has been some cataclysm
such as a devastating cyclone. On the contrary, there is a significant surplus of production over and above simple subsistence. This is not the case with the horticulture of the small Polynesian and Micronesian atolls, where natural conditions are so harsh that without the additional contribution of fishing the crop gardens would be incapable of feeding a very dense population. In Melanesia, particularly in the higher islands, the overall fertility of the natural environment and the skillful character of farming procedures give rise in the majority of cases to high yields. In the context of the traditional milieu, the Melanesian garden - the 'coral garden' alluded to by Malinowski - is the origin of an economy of abundance.

It has been calculated that diets in the 'custom' environment are largely adequate - 2600 to 3000 calories per day - and relatively varied. To sugar cane, numerous fruits, tubers and basic starchy foods are added small quantities of farmyard animal products. Although the consumption of pork only occurs during ritual ceremonies, it is nevertheless eaten regularly since such feasts are numerous.

If the Melanesians spend long hours each day in their gardens it is not because they are driven by a problem of subsistence. They could in fact ensure their subsistence with less expense and with much less work. The intensive horticulture is aimed at the acquisition of cultural wealth whose value lies in the economy of exchange. Furthermore an attractive and well-maintained garden is always a source of pride to its owner and there is also a certain sense of competition between neighbouring cultivators. In the years where a ritual cycle is planned, an even greater effort will be expended on the gardens and more attention will be lavished on the giant tubers; on the other hand, tension and activity decline during normal years, when nothing is to happen; thus the economy of abundance goes hand in hand with an economy of leisure.

This economy of abundance thus produces a surplus that is systematically exchanged along cultural circuits whose pattern varies from island to island. There is, for example, the principle of the grade system that operates throughout the northern islands of the New Hebrides. This is based in fact on competition in exchanges, at the end of which emerge the 'Big Men' - the most powerful men in the social group. Social organization is therefore based on a stratification into grades or hierarchical titles. Most men will attain
the lowest grades, for which it is sufficient to kill one, two or three pigs of different value, to have an adequate number of mats, taros and yams to feed and supply the participants, and to 'pay' further for the lifting of taboos and the wearing of badges and ritual masks, etc. The total cost of taking a grade increases with the rank of the title: for the highest grade of the hierarchy, sometimes more than a hundred pigs will be sacrificed.

In such a system, the acquired wealth is never hoarded, but systematically given. The Big Man who is a candidate for admittance to a higher grade will on the eve of the ceremony have no more wealth than any other person. It is just that over the years he will have given generously of his surplus taros, giant yams and tusked pigs to other clans and family lines. On the day of the ceremony he is only rich to the extent of the number of gifts he has made to those around him which are going to be repaid. Very often, the Big Man will receive more than he previously gave out: from then on he is in debt, and later on will need to redeem himself, often by additional borrowing. The circle is endless.

The winner, or the person who reaches the highest grades, is the one who not only settles his debts, but succeeds in making the others his debtors. He is the strongest because he has been the most generous. It is through adroit and generous manipulation of the exchange networks that the Big Man accedes to power. Thus there is nothing capitalistic about the system: the economy is based on the debts by which men are 'bound' rather than on the control of the means of production. As with horticulture, traditional stock-rearing specializes in the production of luxury goods that are systematically redistributed through the mechanism of debt.

The same system is followed in the southern islands, where there are such complicated procedures as the tokā. The tokā is a ritual cycle which brings together several local groups and leads to a whole complex exchange of dances and material goods, particularly of the huge glabrous (smooth-skinned) pigs that are the most esteemed variety on Tanna. For one or two years a tribal group prepares for the tokā as follows: it not only composes new songs and dances, but also rears a sizeable herd of pigs and plants large gardens for the cultivation of the giant yams and kava roots that will be offered. On the day planned for the ritual, the cycle of dances will be exchanged between the participants and then all the material goods that make up the group's
wealth will be freely offered to the invited villages - on condition that they return the favour later on, of course.

Through these different processes - of which only the most spectacular are being described - the traditional economy reveals another of its basic principles: that of association.

The Big Man who emerges at the head of a social group is always there through the work of the 'company' that he has been able to regroup around him, even if this has been done by him individually making each of its members his debtor. It is the success of an individual, but has only been made possible by the emergence of a group structure. In the toka, similarly, the chiefs who govern the exchange mechanism and thereby attain prestige are only there through the association of all the men in the local group, who work hard together over a long period and undergo severe discipline for the sake of a successful toka.

In a sense, the genius of Melanesian civilization lies in this concept of association. Each person is his own master - master of his own garden, his crops and the pigs he has raised. The ground is the inalienable property of the clan, and each member has the right to its usufruct. In the traditional economy there are thus no wage-earners, no employers or workmen and certainly no proletariat. Everyone is lord of his own domain and master of his work. Yet, even with such freedom, the men like to form groups: they create what in Pidgin are known as 'companies' that are bound by common allegiance to a chief or Big Man, and within which the wealth acquired by horticulture, rearing of ceremonial pigs and manufacture of mats or shell money, circulates unceasingly. The traditional company is therefore a more or less formal institution that meets to plan a common goal, with the social partners practising the exchange of ritual goods both amongst themselves and externally.

Consequently the traditional economy functions on two levels. The first, assuring the maintenance of current alimentary needs, remains confined to the household and forms the unit of production that can be termed 'domestic'. The second, concerned with the production of valuable or ritual wealth, can only be understood in relation to the 'company' and to a much larger unit of production, that of the totality of social partners linked together by the same project and involved in the same current of exchange. The scale of the
unit varies according to the degree of political organization or influence of the Big Man who has been able to define the structure of the group; it ranges from the simple family network to the clan or to alliances between different lineages; it can even unify the entire social group, several villages or a whole island region.

I have tried in this analysis to explain how Melanesian civilization forms an indissoluble whole, and how traditional food production is inseparable from an economic context where the aim is the exchange of ceremonial wealth between the various members of the social group; and how this leads to the typically Melanesian institution of the 'company', in other words an association of free men bonded to each other by debts and counter-debts that are constantly being contracted between individuals.

The challenge to the traditional economy: 'Christ and coconuts'

The problems arising from the contact between Melanesian and European civilizations are complex. Let us simply note here that the arrival of the missionaries, followed by traders and planters, was expressed in the island worlds as an association of two themes - the Christian religion and the coconut plantation. For the majority, conversion meant to embrace a new faith and a new pattern of production. This change was once expressed to me in very simple terms by Melanesians: 'We abandoned the rod blong kastom for the rod blong mane - that of the Whites. Thus one day we killed our pigs and made fewer gardens, and instead we planted coconut palms' (see also Allen 1968; Brookfield 1972; Bonnemaison 1974).

In fact, it was on the islands where Christianity spread the most rapidly that coconut plantations developed to their maximum extent. Preoccupied with other subjects, the most heavily 'Christianized' Melanesians abandoned the production of ceremonial wealth.

In certain littoral zones, coconut palms have taken over most of the available space; the economy of exchange and the intensive horticultural cropping already described have disappeared altogether. The gardens, deprived of their cultural aspects and denied their 'necessary space', have declined in both number and area and have ceased to be the pivot of social life. Most of the sophisticated techniques
of cultivation have been abandoned. An important fall in yields has resulted: compared with individual yam roots of 15-20 kg obtained annually in the traditional system, average yields in the littoral areas today are only 5-6 kg per root. The gardeners compensate by growing new plants under easier techniques - Xanthosoma taros, manioc and sweet potatoes. On the island of Aoba, where coconut palms occupy the whole of the area below an altitude of 300 m, the yam has been practically abandoned and gardens are confined to a few manioc roots and beds of sweet potatoes.

But what does it matter if gardens are inadequate! For with the money earned by copra, it is possible to buy rice and tinned meat or fish. In addition to the convenience it provides, imported food has for a long time been doubly attractive because of a certain inherent social prestige it possesses.

In some islands, an equilibrium has nevertheless been maintained between those areas used for food cultivation and those devoted to plantations. But this equilibrium is very quickly upset once population densities exceed a threshold of more than 30 persons per sq. km (Bonnemaison 1977).

However, on man bus’ land above 300 m in altitude, where the coconut palm grows poorly, food production has remained important. It has even developed to the point of sales to the man solwota whose shrunken gardens are no longer adequate. The man bus’ are finding that such a bias gives them the means of integrating themselves into the market economy and of having access to the 'rod blong mane' which until now was closed to them. Furthermore, this practice renews a very old barter relationship between littoral and mountain peoples, who constantly exchanged taros for yams and mats for pigs; the man bus thus negotiated their rights of access to the seashore whence they collected salt water, crabs and coconuts; and the man solwota obtained the food surpluses that would otherwise be lacking between two yam harvests.

Today the commerce is most often carried out between one man and another, or between related families, but in some cases small local markets have been established close to transit zones or to littoral stores; the bush women come there to sell tubers grown on the mountain slopes. The change from a littoral peasant society into a society of planters has brought about a society that is absolutely dependent on others for food production.
It is within this overall context of change and spontaneous integration into the commercial economy that we can place the general problem of food supply to the towns in an island environment. Following the development of commercial plantations, urban growth constitutes the second great economic and social phenomenon introduced by the western world. The effects of the latter on Melanesian island societies are also extremely important.

Urban growth and patterns of food supply

Two urban zones exist in the New Hebrides: Vila, the administrative capital, and Sante (Luganville). The population of these two towns showed a marked increase after World War II. Melanesian migration to the towns accelerated during the early 1960s, culminating between 1970 and 1973 with what has been called the 'boom'. In 1967, the urban population made up 13.2 per cent of total population. In June 1975, the urban population was estimated at 20,656 persons, or 21.7 per cent of the total population of the New Hebrides; of these, 15,887 were in Greater Vila. More than two-thirds of the urban population are Melanesians - inhabitants of peripheral villages and, more particularly, migrants from rural areas. These migrants, cut off from their original environment, constitute an important market; at the present time they number almost 6000 in Vila. In addition, nearly 20,000 tourists pass through Vila every year and are catered for by various hotels and restaurants. The demand for food products is thus increasing from year to year.

Generally speaking, the dependence on overseas foodstuffs remains pronounced. Total food imports by sea rose in 1975 to 595 million FNH, or 25 per cent of the total value of imports. Rice is the most important component with 3217 metric tons imported in 1975 at a value of 97 million FNH; in the same year there were imports of canned meat to the value of 54 million FNH. Imports of vegetables by sea reached 443 metric tons or 12 million FNH, to which must be added nearly 50 metric tons (11 million FNH) that were imported by air.

There are several reasons for the importance of these imports. New consumption habits were essentially adopted during the era of large plantations, when workers were fed with plates of boiled rice on to which tins of meat had been inverted. These habits were then transmitted to the home villages of the workers, and then to the urban areas.
The priority given to copra production throughout the Group, the prestige of having imported foods that are linked to an external power, and the policies of commercial enterprises, have all favoured the continuation of this state of affairs. Other factors contributing to the emphasis on 'food dependency' are the lack of organization in the local market for food production and the internal logic of traditional agricultural systems whose aim is not commerce but exchange.

For several years, government officers have been systematically trying to develop the local food production, and restrictions on vegetable imports - particularly potatoes - are applied during the season of local production. Yet this policy would hardly have achieved any success had not the Melanesian society itself organized its own response to the new conditions of economic demand. Today an increasingly important component of traditional food production is being integrated into the commercial circuits, whilst the cultivation of fresh and European vegetables is being augmented so as to better respond to the needs of urban populations. The most noticeable evidence of this is provided by the development and recent importance of the local town market, entirely managed by the Melanesians themselves.

The Vila market. The Vila market, established by Tonkinese market-gardeners after the war, was taken over after their departure by the villagers of Efate. The market has been studied by Brookfield in 1965, (1969), Philibert in 1972 (1976) and more recently by Ward and Smith (1976). Ward is the most up-to-date and the best qualified to discuss the market. I will simply cite a few of its characteristics.

For several years the market has been held on three mornings per week in the streets of the town. One of its features is that the market is held and conducted almost entirely by women, with very few men participating in the commerce. Apart from a few curios and shells, the goods sold in the market consist largely of tubers and fruits produced in Melanesian gardens - taros, yams, manioc, sweet potatoes, Chinese cabbages, bananas, coconuts, limes and kava roots, etc. In 1965, Brookfield found only a sporadic and peripheral market activity, indicating only a slight integration of villages on Efate into the commercial economy. Philibert and Ward, on the other hand, discovered a very different situation; Ward found that the total number of vendors in the market reached 365 in one week. Some vendors travel in by taxi from villages at considerable distances from Vila,
forming themselves into groups to pay for transport. Over one year, the total annual sales in the Vila market can be estimated at $A220,000 (20 million FNH). The quantity of vegetables, tubers and fruits available each week in the market is around 17 metric tons. Such figures are very significant and point to a solid integration with the commercial and monetary economy.

In addition, comparison between products sold in 1965 and 1976 shows a marked advance in sales of root crops, which are mainly consumed by Melanesians. In 1965, sales of root crops in the market represented only 17 per cent of total sales, whilst those of European plants and vegetables reached 27 per cent. In 1976, sales of European vegetables counted for no more than 5 per cent of total sales, whilst those of Oceanic tubers had risen to 41 per cent. This change in goods on sale is partly caused by the disappearance of non-Melanesian producers and vendors; it further parallels the alterations occurring in the demographic composition of Vila, being a response to the demand created by the influx of Melanesian migrants to the urban area.

It can thus be estimated that the urban market produces 10-15 per cent of Vila's supplies of fresh and European vegetables, and probably as high a figure as 70 per cent of the town's supplies of Oceanic tubers.

The official system of collection and distribution. Melanesian cultivators on Efate have another means of selling their produce in the town. The co-operative departments ('Fed Coop' and 'SCAF') organize transport circuits, in conjunction with agricultural technicians from the Department of Agriculture, for the collection of food products over the whole of the island - particularly from the northernmost villages. Those in the south, nearest to Vila, direct their sales exclusively towards the urban market. A central distributive store in the heart of the town then redirects the collected produce to hospitals, schools and other institutions and to small retail stores; it also sells to individual buyers.

The disposable production, three-quarters of which comprises Xanthosoma taros and bananas, reaches almost 200 metric tons per annum, representing a total value of some 3 million FNH; to this must be added another 50 metric tons of tubers collected by boat from neighbouring islands. Following the advice of agricultural technicians, the
Proportion of European vegetables is tending to increase from year to year - particularly tomatoes, which fetch a good price. Furthermore, SCAF exported 50 metric tons of tubers to the New Caledonian market during 1975, although none in 1976. In point of fact the market is still too disorganized for stable patterns to be established, and the situation appears to vary considerably from one year to another.

At the present time, according to a survey by the Joint Office of Development Planning, this official collection system provides 24 per cent of the supplies of market products and European vegetables, and a similar proportion of the total supply of tubers; it particularly provides food for schools and hospitals.

From the above it can be seen that the total quantity of root crops and Melanesian fruits sold in Via approaches 700 metric tons - 500 metric tons in the Melanesian market (estimated from Ward's figures) and 200 metric tons collected by the official agencies. With the 'unconnected' Island population and that of the peripheral villages reaching almost 8000 persons, the consumption of tubers per head in the urban areas can be estimated at between 0.2 and 0.3 kg per day under existing conditions of supply. Yet this figure is misleading: for firstly it takes no account of the numerous invisible inflows coming from relatives in the villages - each visitor arrival being accompanied by a gift of tubers; secondly it disregards the numerous tiny food gardens that have been cleared by the migrants inside the urban perimeter, even though their production is difficult to evaluate. It can be assumed that this production together with the invisible inflows is equivalent in quantity to the amount sold in the market or by SCAF. Thus individual consumption probably reaches 0.4 kg per day, which is well below the amounts of 1.2-1.4 kg consumed daily in the rural areas. It follows from a study of 1975 figures and the present pattern of consumption that between 50 and 60 per cent of the total food consumption of the urban Melanesian population is dependent on imported products, particularly rice and tinned foods.

Nevertheless, the dynamism inherent in the present situation may in the long term change the facets of the problem. Whether it is occurring through the official agencies or whether the greater part is due to the spontaneous growth of the urban market, Melanesian food production is clearly
being integrated to an increasing extent into the commercial circuits. Food cultivation is becoming the second largest source of profit, after copra, for the Melanesian villages of Efate and some of the neighbouring islands. However, it is generally known that the greater the fall in copra prices, the greater the emphasis on food products, and that the latter tend to decline when the copra market rises. Thus the adaptation is not taking place without a certain degree of speculation.

The response of Melanesian systems of crop production to the demands of urban markets: the case of Efate

With few exceptions, Melanesian food production has adapted itself to the growing demands of the urban markets without any revolution in methods of production. Indeed the Efate gardens that feed Vila continue to be cultivated according to traditional rhythms and horticultural techniques.

During the first year of cultivation, gardens are essentially devoted to yams; these occupy the centre of the plot and are surrounded by alternating bananas, manioc (cassava), Xanthosoma taros, etc. Yam plantings are largely of the soft variety, which are particularly valued on Efate and from amongst which the giant yams were formerly chosen for rituals. Although of a lesser complexity than in the past, the techniques of this soft yam cultivation are still intensive and meticulous (small mounds, holes, supports, etc.) and are essentially oriented to family consumption and to social prestations.

Once the soft yams of the first season have been harvested, the plot ceases to be a custom garden. Essentially it becomes commercialized. Instead of further plantings of soft yams, there are only sweet potatoes, manioc, 'strong yams', Xanthosoma taros, cabbages and sporadic European vegetables. Sometimes the cultivation is continued for a third year, if soil quality is favourable. The ground will then lie fallow for several years before the cycle is resumed.

In North Efate, where the available space is greater, this double aim of production - customary on the one hand and commercial on the other - is expressed by having separate plots. Thus gardens used for family consumption and custom yams can be distinguished from other plots where the predominant plants are root crops of external origin destined for sale.
In this way Melanesian society differentiates between those tubers which are part of the customary heritage - *Dioscorea alata* yams and *Colocasia* taros - and the imported tubers that are outside the custom system of reference. The former belong to what is customary rather than what is commercial. The latter, even though they have featured for a long time in the eating habits, are free from custom; they form a part of the 'rod blong mane' in the same manner as the *buluks* (livestock) and European plants, and for this reason can be sold without restriction. This distinction between customary and imported plants explains why the former are rare and sold at a higher price in the Vila market. For example, *Colocasia* taro - a custom plant - is sold in the Vila market at 39 FNH per kg, while *Xanthosoma* or Fiji taro - of external origin - only sells at 19 FNH per kg. In the same way, manioc sells at 19 FNH per kg and sweet potatoes at 23 FNH, while yam roots attain a price of 41 FNH (Ward 1976).

Thus the content of the urban market shows features that can only be explained by reference to an underlying cultural system. Yams are particularly lacking. The New Caledonian market's demand for this tuber can find no source of supply for the same reason. Furthermore the economy remains domesticated and individualized within the framework of the restricted family, with agricultural techniques such as the organization of work showing only a slight evolution. This response of Melanesian society through its own customary structure indicates a flexibility of adaptation but at the same time it may in the long term prove a handicap. For in the general context of conservatism, technical innovations are poorly accepted; thus the imported tubers, whose methods of culture are closest to those of the plants of the customary heritage, are much more easily adopted than the European crops and fresh vegetables, whose techniques of cultivation differ from the normal habits. And the types of company or society that work well in relation to 'rod blong mane' - stock rearing, copra, production co-operative - encounter many more difficulties as soon as they touch upon the sensitive and personalized food garden - the heart of custom and the economy of exchange.

Women appear to be particularly active in this dual context of change and fidelity to the principles of custom. For it is the women who have exclusively cornered the commercial functions. This is largely because custom is the business of men, and it would be a loss of 'face' for a man
to sell tubers that are for gifts or exchanges. Women, however, have shown that they are freer to undertake the commerce in tubers. In most cases, it is not the men who have imposed a commercial role upon the women: it is the latter who have seized it for themselves. The Vila market is the creation of the women of Efate, who have allocated the selling areas amongst themselves and who form themselves into groups for organizing the conveyance of their produce by taxi to Vila. Women appear to be an agent and motor of development in Melanesian society - something that has not yet been sufficiently grasped in Melanesia.

The other novelty in the pattern of food-growing is the recent appearance of Melanesian 'entrepreneurs' specializing in the production of imported root crops and European vegetables. There are several of the small-scale entrepreneurs in North Efate. Their manpower no longer comprises family helpers, but is salaried, and the extent of their exploitation is greater than that of other villagers. From the point of view of the techniques of cultivation used, the more speculative choice of cultivated plants and the volume of commercial produce, they have gone beyond the domestic economy. Those entrepreneurs very often link their agricultural exploitation to the creation of livestock pastures, and they would seem to act as 'animators' of their village communities.

These small- or medium-sale entrepreneurs are immigrants from neighbouring islands who have married women of the island; this advantage has been used to obtain rights to land, which is then developed. They have a 'de-territorialized' attitude; they have no more 'custom', neither do they feel in any way attached to that of Efate. They look to the future and to the ways of 'bisnis blong mane'. Their uprooting has caused a break with the custom world. At the present time they supply almost 10 per cent of the vegetables consumed in Vila. The agricultural technicians are finding them the best pupils and are advising them to orientate their cultivation further towards the production of fresh vegetables.

The case of the agricultural and market gardening societies of Tanna

For over ten years, Tanna has been the scene of a most interesting micro-case of development: the GAMs (Groupements agricoles et maraîchers) and various other agricultural and market gardening companies are particularly noteworthy as they are modelled entirely on pre-existing traditional structures.
Custom is still very strong on Tanna, especially on the central plateaux of the island known as Middle Bush. In this area, which probably because of faithfulness to its own customary heritage consistently refused to accept Christianity and then later on the cargo cult that spread throughout the island, the coconut palm grows but does not yield fruit. Thus copra is not a profitable activity. When the local agricultural companies were created, they set themselves the task of supplying the Vila urban market with home-grown vegetables, particularly potatoes.

Agricultural difficulties are non-existent; soils are fertile, the climate is more temperate than in the rest of New Hebrides and the men are naturally skilful gardeners. The problem was to form and then guide the production societies and to plan a system of disposal and regular distribution to Vila.

These local agricultural companies have brought out quite naturally the clan and village solidarities. In this respect, the failure of the first attempt was significant. A large GAM was created for the whole of Middle Bush, grouping together several different villages: although it was essentially based on neighbourhood ties, it disintegrated very quickly, showing that the grouping will only exist to the extent of its foundation on small territorial groups corresponding to clan and 'allied' family lines. The present GAMs, comprising the fruits of this disintegration and others created later on, correspond to small or medium-sized societies fused together by the bonds of common territory and the circulation of customary goods of exchange.

The fragmentation of individual rights in the traditional environment has never constituted an obstacle. Each local agricultural company groups together the fields belonging to different owners in such a way that the whole corresponds to one and the same territorial unit. In fact, there is nothing in custom to oppose a communal use of the ground. Each person knows his territorial rights very precisely, but in practice he may cultivate in a completely different area. It is even considered good manners to lend one's own land and to agree to work the ground that one is offered; this strengthens the bonds between the members of the social unit. The use of garden lands is thus open to most of the members of the group, on condition, of course, that they do not indulge in perennial culture or the plantation of trees. The society thus has no difficulty in creating its land base out of the dispersed land rights of individuals.
From the beginning, the work of those 'agricultural companies' was directed and guided by the officials and the agricultural technicians; but the latter took care to let the people organize themselves and to leave them masters of their own choice. The profits were at first retained for repayment of the loans of seeds and for use in future investments; later, they were for the purchase of a vehicle to serve as transport and during the rest of the time as a taxi. Some companies have opened a store, where imported products are sold according to co-operative procedures. The allocation of work takes place through the society, which itself nominates its own officers.

The society formed in this way reactivates a traditional structure - the principle of 'association' - but within the context of a modern economic project. The 'rod blong mane' is added to the ancient ways of custom, but does not interfere: for the way of giant yams, glabrous or smooth-skinned pigs, rituals and exchanges is still maintained separately with other leaders and under other conditions.

Moreover, it is significant that the local agricultural companies have only succeeded on Tanna among local groups whose custom-based cohesion has remained very strong, particularly among pagan and John From peoples. The Christians, who are often much more involved in the plantation economy and in migrations to the towns for work, and whose social structures would appear to be much more fragmented, have not succeeded so much in forming agricultural companies.

We should finally note that the technical advice of the agronomists is readily accepted if it concerns new plants, fresh or European vegetables that do not form part of the heritage. On the other hand, within their yam or taro gardens the men of Tanna still recognize only one agricultural law, that of their ancestors, and one sole aim - that of the economy of exchange. The market economy is unable to obtain a foothold in anything concerning custom (traditional gardens and pigs). The people of kastom believe that this is the price of their preservation and their identity, no doubt they are right.

Nevertheless the 'agricultural companies' are running into a grave problem - that of transport and communication with Vila, their principal outlet, situated at a distance of several hundred kilometres. The company Air Melanesia accepts loadings of vegetables on three of its flights per
week, but this entails the addition of around 28-30 FNH per kg to the price of the transported cargo. The Tanna produce thus runs into direct competition with the market gardens of Efate, which are favoured because of their proximity. In addition, one cannot be sure of the regularity of the arrivals, for as a unit of tourist weight transported to Tanna is more valuable than that of tomatoes or lettuces, Air Melanesiae frequently sacrifices the latter for the former. Similarly, even if maritime links are beginning to be organized in response to the needs of the largest island of the southern district, they are neither sufficiently regular nor rapid (one or two boats per month). There is therefore much loss through poor connections, bad weather and defective packing. Those responsible are thus trying to orient the island's production towards the most easily-preserved vegetables, potatoes in particular, whose storage and transport can be carried out without too many shipping problems. Although the market for early vegetables is more particularly the preserve of the market gardeners of Efate, such a system of regional division of production would appear too difficult to carry out without rigorous planning.

To obtain a production that is regular, diversified and phased into different periods is not easy in an island environment in view of the problems of transport, of conditions and especially of organization. Nevertheless it is thought that the Group's requirements of vegetables will soon be met, at least during the 6-month season of production; the next goal is to arrive at complete self-sufficiency.

In 1976, Tanna produced nearly 150 metric tons of potatoes, or the equivalent of 3 million FNH value: in 1977 200 metric tons are anticipated. Yields are easily reaching 12 to 15 metric tons per hectare without fertilizer. This production, predominantly achieved through the local agricultural companies, can be increased still further. The production of other vegetables is equally important. The principal problem is to spread out this production over time in such a way that it can meet urban needs not only for a few select months but throughout the whole year.

In the meantime, the example of the local agricultural companies of Tanna shows that the adaptation of a modern-type economic project to a very traditional society is not only possible but even facilitated when the cohesion of community structures based on custom links is maintained. Yet equally this implies the introduction of a certain number of
conditions, namely:

(a) the prior organization of a collection and distribution pattern;

(b) the taking into consideration not of particular individuals, but of the whole traditional territorial group (with its inherent structure and hierarchies) as the most suitable receptive structure for a development scheme. In the traditional environment, the individual can only be understood as a member of a territorial group, and it is at this community level that the first approach must be made;

(c) finally, the existence of discreet 'advisers' who are sympathetic to this type of society and who leave the people to organize themselves according to their own criteria.

Conclusions

Obviously development is not a cultural problem in the Melanesian environment. Melanesian societies are sufficiently supple and pragmatic to adapt to the new conditions set by urban growth - the astonishing success of the Vila market is significant in this respect. Furthermore, the problem is not an agronomic one either: the islands are fertile and Melanesians are born gardeners who readily absorb the advice they are given. The principal barriers at present are of a structural nature, relating to the disorganization of the market and the insufficiency of collection and distribution networks.

The micro-cases of development and integration into the commercial economy reported above all have a common factor. The increase in food production has almost immediately followed the organization, whether official or otherwise, of a system of collection and distribution. This has been the case for the whole of North Efate and is even more the case on Tanna, where the agricultural potential released is now greater than the capacities for outflow to Vila. In fact every development scheme should be integrated. Attention is paid to the agricultural adviser only to the extent to which a collection network has been established for permitting the outflow of the produce he is suggesting. Up to the present time, it is at this level of organization of the distribution system that the chief bottleneck has occurred
in a food production that is still far from having attained its optimal capacity.

Besides this, the importance of alimentary products in the balance of New Hebridean external trade (25 per cent) poses in the long term a general problem. One of the principal bases of food of town-living Melanesians is not the tuber, which is very expensive for them, but the rice and Fijian or Japanese tinned fish which, as we have seen, make up almost half the daily food intake of the urban inhabitants. To change food habits is not easy, and after all rice is a healthy food much appreciated by Melanesians. From a strictly agronomic point of view it could easily be cultivated in the New Hebrides, especially since techniques of terraced irrigation constitute a part of the traditional milieu and are used on certain islands for growing taro.

At the present time the effort being expended in the New Hebrides on the development of market gardening and vegetables is aimed at the limitation, even the suppression, of imports. This is a necessary stage, but other avenues must also be pursued – that of root crops, to start with. The yam still remains the preferred food for many Melanesians. For cultural reasons, it is sold little and at a high price. But the development of rapid varieties capable of growth in any season, as is already happening in Martinique with the so-called yam, would permit the extension of harvests and a cultivation that is easier, more rational and even mechanized, as in Fiji.

Perhaps it is also necessary in the collective institutions, particularly schools, to stop the systematic preference for diets based on rice and tinned foodstuffs or European products.

The next development plans should thus be on two levels: on the one hand they should encourage the supply of vegetables and tubers to the towns by rationalizing non-custom production, and further by organizing regular collection networks throughout the Group. On the other hand there must be a start on the study and setting up of trials for a rice production system that in this fertile archipelago could not only meet the country's requirements but even provide surpluses for export.

The rupture of 'food dependency' remains the goal of the New Hebrides, and it is clear that no real development can take place without it.
Chapter 4

Indigenous agriculture in the Solomon Islands

G. J. Eele

In any discussion concerned with traditional agriculture there is a basic problem of definition of terms used. Many words such as traditional, customary, subsistence, are used without rigorous definition and consequently are imbued with connotations depending on the social and cultural background of the reader. There is a tendency on the part of people with experience of intensive European agricultural systems to equate the terms traditional or customary with primitive, backward, and low technology methods of cultivation (Haynes 1975). In addition, the word subsistence has different connotations depending upon the experience of the user. Someone with experience of subsistence activities in the Sahel region of Africa, for example, will have a somewhat different mental picture of subsistence from a person with knowledge of the South Pacific countries. Similarly, the words custom and tradition in the minds of many Melanesians have, as a reaction against the situation outlined, become compounded with ideas of cultural identity, anti-colonialism and the development of a 'Melanesian way'. It is difficult, therefore, to have a productive discussion without a clear definition of the concepts involved and a very careful use of particular words and phrases.

In this paper I shall attempt to show that traditional systems of agriculture, in the sense that this refers to systems practised by Solomon Islanders in pre-colonial times and described by Maenu'u (1975), do not exist except in some isolated areas. I shall, therefore, use the phrase 'indigenous

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1This paper will discuss the state of traditional agriculture in the Solomon Islands and will be based on my work here as an Agricultural Statistician over the past four years. Whilst I have had many useful discussions with and criticism from my colleagues the views expressed are my own and should not be taken as representing the policy of the Solomon Islands government.
agriculture' to describe the prevailing system of cultivation used by Solomon Islanders today. Instead of using the term subsistence I shall rather use the phrase 'non-monetary economic activity' to refer to those parts of economic activity, production, consumption, accumulation, and exchange which take place without the intervention of money (Dommen 1974).

To a large extent indigenous systems of agriculture in the Solomon Islands have suffered from a lack of attention from administrators, academic economists and agricultural research workers. While there have been several investigations conducted by anthropologists and sociologists, these have had little impact on policy. There is, however, much useful information in the published literature on the Solomon Islands and this will be quoted where appropriate. There is an information gap between academic researchers and government administrators, and because of this there has generally been an underestimation of the role of indigenous agriculture in the development of the Solomon Islands.

There is a danger that with the advent of independence, the Solomon Islander administrators, in a desire to be part of the modern world and influenced by external advisers with experience of other areas, will move away from an understanding of indigenous agriculture in the Solomon Islands and that the present policy of neglect could turn to one of active discouragement.

The systems used by the majority of people have changed quite dramatically over the last one hundred years. I will use some results from recent agricultural surveys of the Solomon Islands to try and describe the prevailing system of agricultural production. Many of the changes that have occurred can be shown to be a direct result of certain external influences and illustrate the fact that Melanesian farmers are adaptable and ready to change their systems of agriculture to fit in with changing circumstances. These changes, however, to be fully understood need to be viewed from the point of view of the rural farmer rather than that of government policy makers or economic theorists.

The environment of the Solomon Islands

The ecology and land resources of the Solomon Islands have been described in detail by other authors. Recently the Land Resources Division of the Ministry of Overseas Development
completed an extensive study of the land resources of the Solomon Islands (see Hansell and Wall 1976). Briefly, the country consists of a central linear group of six major islands in a double chain extending over about 860 km. In addition there are many smaller islands, atolls and reefs, some as much as 850 km from the nearest major island. The total land area is 27,750 km², the largest island, Guadalcanal, having an area of 5310 km². The major islands are volcanic in origin and consist in the main of a coastal area formed by raised reef complexes, an area of low foothills and an interior of narrow, steep-sided, high ridges. The interiors of most major islands exceed 1000 m in places and the highest point in the Solomons, on Guadalcanal, is over 2300 m. There are few areas of alluvial plains, the major one being on North Guadalcanal which covers an area of about 400 km². Elsewhere floodplains are generally narrow, prone to flooding and often swamp filled.
Brookfield with Hart (1971) place all of Melanesia within the humid tropics and apart from one or two areas most of the Solomons can be classed as continually wet. Most islands have an average annual rainfall of between 3000 and 5000 mm, but there is little information on the rainfall in the interiors. The highest recorded rainfall in the Solomons has been at Chikora on South Guadalcanal (Ash et al. 1974) with an annual average of 8304 mm. Hansell and Wall (1976) consider that there are even wetter places. Generally rainfall is unreliable and frequent short-lived falls over small areas are common. This, combined with the steep slopes and shallow soils of the inland areas means that flash flooding of rivers occurs frequently and that there is a continual threat of soil erosion, particularly where vegetation is cleared.

Temperature is fairly uniform and the monthly mean varies by little more than 1°C in lowland areas; air frosts are possible in the highest mountains on Guadalcanal. The Solomons are in an area subject to tropical cyclones, and these often originate in the area between the Solomons and Wallis (Brookfield 1971). Since 1948 the average frequency has been just over one per year; these cyclones can cause considerable localized damage to settlements and crops.

Most of the country is covered by dense tropical forest, although the distribution of species is irregular and in many areas the rainforest is broken with gaps filled with regrowth species. These gaps have been caused by cyclones and the influence of man.

**Population**

The population of the Solomon Islands as in the 7 February 1976 census was 196,832 (Solomon Islands 1977a). Since 1970 the population has increased at an average annual rate of 3.4 per cent which is remarkably high by world standards. As is typical of countries experiencing recent periods of rapid growth a high proportion of the population is very young; 48 per cent are under 15 years. The large majority of people live in rural villages, only 9 per cent live in urban areas and another 9 per cent in rural locations other than villages.

At the time of the census most of the population over the age of 14 were not working for money. Only 15 per cent were working for a wage and salary, while a further 6 per cent were self employed, mostly as copra farmers or market gardeners. Apart from Honiara there are no other major
concentrations of population; overall 60 per cent of people live in localities with fewer than 100 inhabitants and more than 80 per cent in localities with fewer than 200. Most localities are near the coast or on low-lying land; only 8 per cent of the population were enumerated in villages located above the 200 metre contour.

A snapshot picture of the people of the Solomon Islands, therefore, shows a rapidly increasing population with a large number of young children, living in small settlements mostly on the coastal plains of the islands, only intermittantly involved in earning money.

Solomon Islander agriculture

The Solomon Islands is a predominantly agricultural country. Agricultural, forestry and fisheries products accounted for more than 90 per cent by value of exports in 1976 (Solomon Islands 1977c). Of those people working to earn money 45 per cent were employed in agriculture, forestry and fishing. For the majority of people not dependent on regular cash incomes, agriculture provides people with their food, housing and in some cases clothing and other necessities of life. It has been estimated that non-monetary economic activities account for about half of gross domestic product at market prices in 1975 (Solomons Islands 1977b).

Using results obtained from, as yet, unpublished sample surveys of smallholder agriculture in the Solomons in 1974, 1975 and 1976 this section will describe some of the features of indigenous agriculture in the Solomon Islands. The most important agricultural activities undertaken by rural households are the cultivation of coconut palms and the growing of staple food crops in small areas or gardens. From the surveys it has been established that 65 per cent of all rural households were involved in the cultivation of coconuts and 94 per cent, at the time of enumeration, had at least one area of food crops. While other activities are undertaken these are by no means widespread; about 5 per cent of all households were involved in cocoa production, one per cent in the growing of chillies, spices and other minor cash crops and 13 per cent in cattle production. This last figure is inflated, however, because most cattle projects are run by groups or lines and many families may be involved in just one project.
<table>
<thead>
<tr>
<th></th>
<th>Central District</th>
<th>Eastern District</th>
<th>Malaita District</th>
<th>Western District</th>
<th>Total Solomon Islands</th>
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<tr>
<td><strong>Total area of gardens in rural areas</strong></td>
<td>2,332</td>
<td>657</td>
<td>1,963</td>
<td>963</td>
<td>5,915</td>
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<tr>
<td><strong>Total number of households</strong></td>
<td>10,149</td>
<td>4,422</td>
<td>10,252</td>
<td>6,067</td>
<td>30,890</td>
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<tr>
<td><strong>Average garden area per household</strong></td>
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<td>0.15</td>
<td>0.19</td>
<td>0.16</td>
<td>0.19</td>
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<tr>
<td><strong>Total number of gardens</strong></td>
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<td>9,287</td>
<td>16,010</td>
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<tr>
<td><strong>Average number of gardens per household</strong></td>
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<td>2.1</td>
<td>1.6</td>
<td>1.9</td>
<td>1.8</td>
</tr>
<tr>
<td><strong>Average garden area per head of population</strong></td>
<td>0.044</td>
<td>0.027</td>
<td>0.034</td>
<td>0.025</td>
<td>0.034</td>
</tr>
</tbody>
</table>

Source: Agricultural Statistics Survey, 1974-75.
Food crop production

Table 1 presents some information relating to the total area of food gardens in the Solomon Islands. The data are provided separately for each of the four administrative districts. These figures can be compared with those quoted by Hansell and Wall (1976) and also by Chapman and Pirie (1974) who provide data on garden areas from a variety of sources. The range of the average area of cultivated gardens per household was from 0.17 to 1.11 ha. Many of these figures, however, are for gardens measured in one or two villages only. Allen (1957) quotes the result of measuring a sample of 873 gardens owned by 505 families. The average area per family was 0.77 ha which is well in excess of the figure quoted above. A survey of Papua New Guinea in 1961 showed an area of 0.09 ha per person at the time of the first visit to the household (Walters 1963).

There could be several reasons for the difference between the results from the sample survey and those reported elsewhere, particularly; (a) an underestimate from the 1974 sample survey, (b) a genuine reduction in area under cultivation or (c) the effect of the time of the year that the survey was carried out. Barrau (1958) classifies six stages of agricultural development in Melanesia ranging from foraging to semi-sedentary agriculture with rotation and manuring. Within most of the Solomons the system of food crop production can be classified as either shifting agriculture or agriculture with bush fallow. During the year a farmer may have some gardens under cultivation, he may abandon others and clear some new ones. In some cases he may harvest more than one crop from the same area. The measurement of the amount of land under cultivation at any one time, therefore, will not necessarily provide information on the total amount used during the year. Without knowing how each of the individual measurements referred to above were made, it is difficult to compare simple measurements of areas of gardens.

During 1977, however, the Statistics Office in the Solomon Islands was engaged on a survey of food production by rural households over the period of a year. Preliminary analysis indicates results of the same order as these obtained from the previous survey. The 1974 survey also included those rural families that had no gardens under cultivation at the time of enumeration. If these are excluded the average area under food crop cultivation is increased to 0.20 ha per household.
Table 2 provides details of the major crops grown. Gardens generally contain one or more plots planted with a main crop or crops. In addition, however, several other crops will be grown in small amounts throughout the garden and also around the perimeter. During the survey only the areas of major crops were measured. The presence of minor crops were noted, but information on these has not been analysed.

The remainder of the total area is accounted for by other crops and by major crops grown in mixed plots. The importance of sweet potato (*Ipomoea batatas*) is well illustrated by Table 2. Almost two-thirds of the total garden area was taken up by the crop; in the Western District it accounted for more than 80 per cent. This confirms the trends observed by Allen (1957) and Belshaw (1950). The Western District of the Solomons has for long been the area with the greatest participation in the cash economy, and the highest per capita income.

Taro (*Colocasia spp.*) and yams (*Dioscorea spp.*) which are often described as the traditional staple crops of Melanesia (Brookfield 1971), together account for only 27 per cent of the total area. The survey was conducted from July to October which is the traditional planting season (Frazer 1973). It is possible, therefore, that the area under yam and taro will be underestimated since areas cleared but not yet planted were not included in the survey.

In recent years taro has suffered from the spread of several diseases, particularly leaf blight or *Phytophthora colocasiae* and virus disease known as alomae and bobone on Malaita (Solomon Islands 1974b). In many low lying areas these have almost resulted in the complete eradication of the crop. It is still significant, however, in the inland high bush areas, particularly in Malaita where there are still considerable numbers of bush settlements.

Table 3 gives some information on the distribution of the land under garden cultivation by the length of time of the present cultivation and the period of fallow between cultivations. The average period of fallow for all gardens was estimated to be about 13 years which compares with the optimum period of between seven and 20 years quoted by Hansell and Wall (1976). The average length of cultivation is between six and seven months.
Table 2

Percentage of total garden area accounted for by major crops grown in plots

<table>
<thead>
<tr>
<th>Crop</th>
<th>Central District</th>
<th>Eastern District</th>
<th>Malaita District</th>
<th>Western District</th>
<th>Total Solomon Islands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweet potato (kumara)</td>
<td>68.7</td>
<td>51.4</td>
<td>61.3</td>
<td>81.0</td>
<td>66.3</td>
</tr>
<tr>
<td>Taro</td>
<td>8.9</td>
<td>17.5</td>
<td>31.5</td>
<td>12.8</td>
<td>18.0</td>
</tr>
<tr>
<td>Yam and pana</td>
<td>16.6</td>
<td>5.1</td>
<td>6.0</td>
<td>0.5</td>
<td>9.2</td>
</tr>
<tr>
<td>Cassava</td>
<td>1.1</td>
<td>0.4</td>
<td>0.8</td>
<td>2.4</td>
<td>1.1</td>
</tr>
<tr>
<td>Banana</td>
<td>-</td>
<td>11.6</td>
<td>-</td>
<td>-</td>
<td>1.3</td>
</tr>
</tbody>
</table>

Source: Agricultural Statistics Survey, 1974-75.
Table 3

Distribution of cultivated garden area by length of cultivation and length of fallow

<table>
<thead>
<tr>
<th>Length of cultivation</th>
<th>%</th>
<th>Length of fallow</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 months or less</td>
<td>26.6</td>
<td>Less than 2 years</td>
<td>13.5</td>
</tr>
<tr>
<td>4 to 6 months</td>
<td>36.7</td>
<td>2 to 4 years</td>
<td>17.5</td>
</tr>
<tr>
<td>7 to 9 months</td>
<td>19.3</td>
<td>5 to 7 years</td>
<td>14.8</td>
</tr>
<tr>
<td>10 to 12 months</td>
<td>10.3</td>
<td>8 to 10 years</td>
<td>9.8</td>
</tr>
<tr>
<td>More than 12 months</td>
<td>7.2</td>
<td>More than 10 years</td>
<td>12.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Never cultivated or</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>length of fallow unknown</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>but more than 10 years</td>
<td>31.6</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
<td>Total</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: Agricultural Statistics Survey, 1974-75.

The length of fallow is determined usually by the presence of certain plant associations which do not appear in young regrowth (Maenu'u 1975). Where population pressures have restricted the availability of suitable land the ideal conditions may not be met and the length of fallow will therefore be reduced. A survey of a heavily populated area of North Malaita (Solomon Islands 1969) showed that the length of fallow can be reduced to as little as two years, although the local people themselves did not complain of declining yields, or a shortage of food.

While overall there is unlikely to be a shortage of land available for food crop production, in some areas rapid population growth coupled with the introduction of permanent cash crops or pasture can lead to land pressure and the consequent need to shorten the fallow period. In areas where this is happening, therefore, there is a need for extension work on food crops to complement the cash crop development. While Solomon Islander farmers do appear to react to land pressures by reducing fallow periods and introducing crops
such as cassava which will grow on marginal land, there is a general lack of knowledge of ways of increasing soil fertility.

**Sweet potato production**

Since sweet potato is the most important crop grown in food gardens, the methods of cultivation will be described in more detail. This has been covered in some of the literature, for example Hansell and Wall (1976), Frazer (1973), Bathgate (1973) and Chapman and Pirie (1974). Basically ground is prepared by clearing the bush but leaving large trees. The cuttings are burnt and the ash is usually taken away from the garden. The actual site for a new garden will be determined by many factors; the rights of the household to use the land, the suitability of the soil type for the crop to be grown and the appearance of the vegetation. In the inland, high bush areas, virgin forest may be cleared, elsewhere the regrowth forest will be used. Kumara may be planted as the first crop in the garden, but it is also often planted after one crop of taro or yam has been cultivated.

When the land is cleared the soil is prepared into mounds. These are dug *in situ* and are spaced between 1 and 2 m apart. Four or five vines from an old garden will be planted in each mound. Solomon Islanders recognize many different varieties of sweet potato and are readily prepared to experiment with new ones (Solomon Islands 1969). After about 30 days the plants effectively cover the surface of the garden and require little attention from then on. Most varieties are ready for harvest after 90 to 130 days. The large tubers from the mounds are harvested first and taken as required by the household. The remaining tubers from the mounds are taken at intervals up to about 180 days. Further tubers are often harvested from runners that are established between the mounds and in this way the length of the garden may be extended up to as much as two years. When the return from the garden is low enough harvesting will cease. The crop may then be cleared, the ground prepared again and a new crop planted or the garden may be abandoned to return to secondary regrowth. In many gardens, particularly those close to the shore or a road, coconuts may be planted in the gardens at this stage (Frazer 1973).

Barrau (1958) gives the average yield of kumara to be between 7.5 and 15 tons/ha. Other surveys in the Solomon Islands have produced yields in the range from 0.5 to 41.6
tons/ha (Hansell and Wall 1976). Studies at Dala Research Station on Malaita have shown that yields of different varieties ranged from 4.3 to 16.4 tons/ha. A fertilizer trial has been conducted to show the effect of continuous cropping and response to fertilizer. The yield in the control plots had fallen by nearly eight times by the fifth crop, and application of potassium significantly increased yields of all crops except the first.

During the sample survey a yield survey was carried out in a sample of gardens to try and measure the average yields of the major crops. Yields were measured from small sample areas located at random in the plot and the total weight of the crop harvested from this area was measured. Kumara yields were measured on 256 sample plots and produced an average yield of 15.7 tons/ha. This figure appears high when compared with other results and is being checked during the current food crop production survey. Problems were encountered during the yield survey, not least of which were the lack of frequent visits to gardens and the difficulty in accurately marking out the sample areas. Yields of taro and yam derived from 43 and 39 sample areas respectively were also high when compared with results from Fiji (Casley 1969) and Papua New Guinea (Walters 1963 op. cit.).

Coconut production

Following the definition given at the beginning of the paper it is clear that the cultivation of coconuts should be considered as part of indigenous agriculture. Table 4 reproduces some results from the 1976 Population Census which show the importance of coconut production to rural households. These results agree well with the 1974 sample survey. Apart from Malaita District more than 60 per cent of rural households are involved to some degree in the cultivation of coconut palms; in the Western District the figure is over 84 per cent.

<table>
<thead>
<tr>
<th>Table 4</th>
<th>Percentage of rural households involved in coconut production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central District</td>
<td>Eastern District</td>
</tr>
<tr>
<td>62.7</td>
<td>70.6</td>
</tr>
</tbody>
</table>

Coconuts have been a part of Solomon Islander agriculture for some time. Before 1910 copra production of 1000 to 2000 tons per year almost all originated from Solomon Islander owned trees (Hansell and Wall 1976). In a survey of a Malaita village in 1951, 36 out of 50 households owned coconuts and more than 60 per cent of the palms were over 40 years old (Head 1951). As well as providing a cash income through the sale of copra, coconuts are also an important source of food and drink for almost all Solomon Islanders. At the time of the survey only 3 per cent of rural households said that they did not consume coconuts. In considering, then, the adaptation of traditional or indigenous agricultural systems, it will be useful to use the illustration of coconuts to show the ways in which the need of the market and of family consumption interact. There is a well-established market for copra in the Solomon Islands and this is well documented. In addition the actions of individual producers have no effect on the price, which is fixed by the state of the world market.

Coconut planting is carried out as part of the garden cycle (Bathgate et al. 1973). As mentioned above they will often be planted as the garden is about to be abandoned. Coconuts are also important in terms of establishing rights to use land and are included in the system of modern customary land tenure. This has produced problems of adaptation of customary land tenure systems which were designed around a system of shifting cultivation.

As well as the planting of coconuts in small areas on old garden land the Solomon Island government has also been attempting to encourage copra production by providing grants for people to plant new areas and rehabilitate old plantations. Farmers planting at least 3 acres (1.2 ha) are provided with a free issue of fertilizer and a cash payment for the first five years. This is dependent on the farmer planting according to the recommendations of the Ministry of Agriculture and Lands and maintaining the area during the period of the grant. Since 1969 more than 8600 ha have been planted under this scheme (Solomon Islands 1976), the majority being in Malaita District. Although some of the palms planted under this scheme will now be bearing there is, as yet, little effect on smallholder copra production.

Tables 5 and 6 give information on the average age of palms owned by rural households and the average area of holdings respectively. As is to be expected a high
proportion of the palms are young and not yet bearing.

Table 5

<table>
<thead>
<tr>
<th>Percentage of coconut palms owned by rural households by apparent age of palms</th>
</tr>
</thead>
<tbody>
<tr>
<td>immature, not yet bearing</td>
</tr>
<tr>
<td>37.3</td>
</tr>
<tr>
<td>young mature, not fully bearing</td>
</tr>
<tr>
<td>39.9</td>
</tr>
<tr>
<td>mature</td>
</tr>
<tr>
<td>19.7</td>
</tr>
<tr>
<td>old, senescent</td>
</tr>
<tr>
<td>3.1</td>
</tr>
<tr>
<td>total</td>
</tr>
<tr>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: Agricultural Statistics Survey, 1974-75.

Table 6

<table>
<thead>
<tr>
<th>Average area in hectares of coconut palms per rural household</th>
</tr>
</thead>
<tbody>
<tr>
<td>central district</td>
</tr>
<tr>
<td>1.2</td>
</tr>
<tr>
<td>eastern district</td>
</tr>
<tr>
<td>1.2</td>
</tr>
<tr>
<td>malaita district</td>
</tr>
<tr>
<td>1.0</td>
</tr>
<tr>
<td>western district</td>
</tr>
<tr>
<td>1.5</td>
</tr>
<tr>
<td>total solomon islands</td>
</tr>
<tr>
<td>1.2</td>
</tr>
</tbody>
</table>

Source: Agricultural Statistics Survey, 1974-75.

Consumption of coconuts and copra production

Various estimates have been made of the average consumption of coconuts per head per day in the Solomon Islands. Head (1951) gives a figure of 1.2 based on a survey of one village in Malaita. Taysun and Hagaai (1975) consider that in the Solomons the number of coconuts used for copra production is exceeded by the number used for food and drink. This last statement is probably an overestimation, but the rate of consumption is undoubtedly significant. Information on consumption of coconuts was collected during the Agricultural Statistics Survey and results indicate a rate of 4.2 per household or approximately 0.8 per capita per day. Using an average per capita figure of one coconut per day would give an annual consumption in 1976 of 73 million coconuts, which is nearly equivalent to 12,000 metric tons of copra.
Total copra production from the smallholder sector in 1976 was 12,939 metric tons.

The yield surveys carried out in 1974 and 1975 gave an average annual yield of 6900 coconuts per hectare of bearing palms. The total area of smallholder coconuts of bearing age was estimated to be 23,500 hectares. This indicates an annual yield of 162 million coconuts from smallholdings. With 73 million nuts allowed for consumption the surplus available for copra production is 89 million, which at 6000 unimproved nuts per ton of copra gives a potential production level of 15,000 metric tons per annum.

Since 1962 production has exceeded this only once, in 1974; production during that year reached 17,650 metric tons. For the second half of 1974 the price paid for copra was at its highest ever level at $A336 per long ton. During the five months that prices maintained this level, production from the smallholder sector was running at an equivalent annual rate of over 20,000 metric tons. It is clear, therefore, that at this price Solomon Islanders were suppressing their own consumption of coconuts in order to produce copra.

At prices of less than $A300 per long ton production, to a certain extent, is determined by price. For the period 1970 to 1976, 53 per cent of the variation in quarterly production of smallholder copra was 'explained by' a linear relationship with the price prevailing that quarter. The linear equation is:

\[ Q = 2216.38 + 7.91 P \]

where \( Q \) is the quarterly production in long tons and \( P \) is the price paid for first grade copra at an export port. The b coefficient is significantly different from zero at the 0.01 per cent probability level. Thus an increase in the price of $1 per ton will lead to an increase in production of 7.91 tons.

The strategy of a Solomon Islander coconut farmer, therefore, appears to be first of all to guarantee a sufficient supply of coconuts for his family's own consumption needs, and then to make copra from any surplus production. The amount of copra he makes will depend upon the price he will receive, which he has perfect knowledge of. He can be seen, therefore, to be acting in an economically justifiable way; only at very high prices is he willing to forgo
consumption. The limiting factor on copra production is not, therefore, the area of land under cultivation, nor the yield per hectare of coconuts, but rather the price which the farmer receives.

If this analysis can be applied to other crops which are important as part of non-marketed as well as marketed production, for example, staple food crops sold in urban markets, then there are implications for government policy. Where it is thought important to encourage the sale of local food crops in urban markets, government strategy should be directed more towards improving marketing facilities, and hence the price to the producer, rather than concentrating on increasing production by encouraging cultivation of larger areas and the use of more intensive agricultural techniques.

Government policy towards indigenous agriculture

Until fairly recently the policy of the administration towards indigenous agriculture can best be described as one of 'benign neglect'. The earliest surveys of agriculture in the Solomons either ignored the role of non-marketed production, for example see Tothill (1929), or dismissed the systems of indigenous agriculture as inefficient and inadequate (Turbett 1944 and Shepherd 1945). It was largely as a result of political pressure from movements such as Marching Rule that more attention was paid to the development of Solomon Islander agriculture. Initially emphasis was placed on the production of cash crops, particularly coconuts and cocoa and it was not until the middle sixties that attention was directed to local food crops. Government policy as laid down in a White Paper (Solomon Islands 1964) had as its basic aims 'to strengthen the economy' and 'to raise the level of subsistence'. A research station to study food crops was set up on Malaita. In practice, however, more or less inevitably, most effort in terms of extension was expended on the introduction and expansion of cash crops. The Sixth Development Plan (Solomon Islands 1971a) listed eight objectives of policy. In order of priority 'increasing productivity in subsistence production' ranked fifth.

In the present National Development Plan the importance of non-marketed production, particularly foodstuffs, is recognized (Solomon Islands 1975), but the 1975 Annual Report commenting on the plan contains the following statement:
The overall concept behind the Plan policy is to continue the move away from dispersive and often destructive subsistence farming towards a more disciplined commercial approach, this being the only form of agriculture which can be acceptable to, viable for, and provide job opportunities for, future generations (Solomon Islands 1976).

There is obviously considerable doubt within the government as to the value of indigenous agriculture and its role in development. In particular the wastefulness of shifting agriculture is deplored, although considerable advantages can accrue from this system and it can be an efficient means of meeting subsistence requirements (Charles 1975).

The process of change in indigenous agricultural systems

As Coursey (this volume) has shown, cultures based on root crops are often considered as being in some way inferior to those based on grain crops, in Europe as well as in Asia. It is understandable, that, when considered from the point of view of an agriculturist trained in a developed country, the indigenous systems of agriculture in the Solomons may seem primitive, at a low level of technology and wasteful of resources. On closer study, however, it becomes clear that the situation is by no means as simple as it appears at first sight. Belshaw (1950) has argued that indigenous agriculture is both progressive and competitive and that it satisfies the wants of people at far less social cost than most forms of plantation agriculture.

Given the environment of the Solomon Islands, the occurrence of irregular, but more or less certain disasters such as cyclones, floods, earthquakes, etc., and the relative low density of population, the indigenous system of agriculture can be considered as an efficient and logical development. It is also clear that the system adapts to external influences, both social and physical. It seems reasonable, therefore, to study the ways in which the system changes and to attempt to guide and assist these rather than attempting to replace it wholesale.

From a comparison of the description of indigenous agriculture given above with earlier writings on the Solomons, for example, Barrau (1958), it is obvious that many fundamental changes have occurred in recent years. While many of
these changes have originated with the impact of Europeans on the islands, it is not sufficient to try and explain them by reference to a European cultural framework.

Initially the provision of steel axes and knives considerably shortened the time required to clear land. The suppression of local warfare and head hunting led to a general movement of people from the safer interiors of the islands to the easier but more vulnerable areas on the coast. More permanent settlements were established and cash crops, particularly coconuts, cultivated. Sweet potato was grown more extensively as it was more productive, required less labour than taro and did not suffer from the same destructive pests and diseases. Young single men, particularly, moved away from the village to undertake paid labour and on their return were able to purchase trade goods that were not available before.

More recently there have been intensive efforts by the government to develop cash activities in the villages. At first coconuts and cocoa were encouraged, later emphasis was placed on beef cattle production. Forestry and fishing have also been very actively promoted. All this has meant a reduction in the labour available for food production and an increase in the opportunity cost of using land for growing crops for non-marketed production.

As Fisk (1971a) points out, however, in most of Melanesia the limiting factor in rural production is not a shortage of resources but rather the incentive to produce. There is more possibility of running out of markets than out of the factors of production. In these circumstances then it is not accurate to suggest that subsistence farming is destructive and undisciplined or that it does not have a commercial approach. In game theoretic terms indigenous farmers can be said to be risk minimizers; they place a high shadow price on their own consumption. It is not true to suggest, however, that they have a decreasing utility function for money. As was shown in the case of copra, production increases with price.

The marketing of staple food crops in the Solomon Islands

To conclude, I would like to apply some of the concepts that have been introduced to the particular problem of supplying staple food crops for an urban market. Since Honiara is the only urban area of any size in the Solomons, and since most of the available information refers only to
Honiara market, I shall restrict my comments to this one area.

Even in traditional Melanesian society, subsistence production did not necessarily mean that each household produced exactly its own needs. There were, in several areas, systems of exchange usually in the form of markets. Typical examples are found in many areas of Malaita where bush people would trade root crops for fish caught by the 'salt water' people (Rofeta 1974 and Frazer 1973). It is not sufficient, however, to assume that because there is this history of marketing that markets can be set up in all areas. Bathgate et al. (1973) quote the case of a market that was set up in Vella Lavella, where, after initial enthusiasm, it failed because producers were attempting to sell the same type of produce to each other. For a market to be successful there needs to be specialization of production.
Honiara Market

Honiara is a new town, having only been established at the end of World War II on the site of a major American base. During the 1950s and 1960s the town grew rapidly with a growth rate of 11.9 per cent per annum between 1959 and 1970 (Groenewegen 1970). Since 1970 growth has been slower; the population in February 1976 was 14,942 which indicates a recent average annual growth rate of 4.9 per cent. The history of the market in Honiara is described in detail in Lasaqa (1968) and Bathgate (1973). It was initially established by the Agriculture Department to sell produce from a vegetable farm taken over from the American forces. This did not prove successful, however, and the market was soon handling produce brought by local farmers from the areas adjacent to the town. As the North Guadalcanal road extended to the east and the west so more farmers were able to gain easy access to the market and the range of goods available increased.

Initially the main produce sold consisted of root crop staples particularly sweet potato. As the population of the town expanded, however, and incomes increased, exotic vegetables were introduced. Many farmers now supplying Honiara are growing exotic vegetables almost entirely for sale in the market (Bathgate 1975).

Table 7 gives some information of the estimated annual turnover of the market at different dates. The data refer to the central market only; other small local markets also operate in Honiara and nearby areas.

In 1966 it was estimated that two-thirds of all produce sold in the market was kumara. In 1974 the average daily volume of kumara sold was 3860 kg; in 1977 the figure was 1680 kg. The market for kumara, therefore, will be considered in more detail.

Following a method developed by Sackett (1975) it is possible to estimate the demand for kumara in Honiara. In 1970 for each dollar spent on staple food requirements 22.4 cents was spent on kumara, 34.0 cents on bread, 31.9 cents on rice and 11.7 cents on biscuits (Solomon Islands 1971b). In 1977 the cost of obtaining 1000 calories from each type of staple was 7.5 cents for kumara, 22.5 cents for bread, 11.1 cents for rice and 24.8 cents for biscuits (Jansen and Willmot 1971 and Solomon Islands 1977d). For each dollar
### Table 7

Estimated annual turnover of Honiara market

<table>
<thead>
<tr>
<th>Date</th>
<th>Period of survey</th>
<th>Crops included</th>
<th>Total estimated annual turnover ($A)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1966</td>
<td>March - August</td>
<td>All crops sold</td>
<td>23,167</td>
<td>Lasaqa 1968</td>
</tr>
<tr>
<td>1971</td>
<td>5 Nov. - 6 Dec.</td>
<td>All crops from Guadalcanal sellers</td>
<td>92,024</td>
<td>Frazer 1973</td>
</tr>
<tr>
<td>1974</td>
<td>21 Jan. - 8 Feb.</td>
<td>Sweet potato only</td>
<td>80,000</td>
<td>Solomon Islands 1974a</td>
</tr>
<tr>
<td>1977</td>
<td>25 - 30 July</td>
<td>Sweet potato, tomatoes, coconuts, neka, onions, pumpkin tops</td>
<td>109,603</td>
<td>Solomon Islands 1977f</td>
</tr>
</tbody>
</table>
spent, therefore, kumara provides 2987 calories, bread 1511 calories, rice 2874 calories and biscuits 472 calories. Using the same figures as Sackett (1975) the daily requirement per adult is 10.4 megajoules or 2483 calories; 60 per cent of this requirement is provided by staple foods and of that kumara accounts for 38.1 per cent. Thus the requirement per adult is 568 calories from kumara or 473 grammes per day. Assuming that children under the age of 15 on average consume half the adult requirement, the total number of adult equivalents in Honiara in 1976 was 12,079; giving a total annual requirement of 2100 metric tons.

At the time of the 1974 market survey turnover of kumara was estimated to be about 1200 metric tons per year and in 1977 520 metric tons. The market therefore apparently satisfies between 25 and 60 per cent of total demand. At the time of the 1977 survey, however, supplies from Tasimboko region were reduced because of flooding in the area two months earlier. From a Honiara housing census conducted in 1976 it was estimated that about 14 per cent of households' staple food requirements are met from urban food gardens, thus indicating a production of around 300 metric tons of kumara per year.

Prices in Honiara market

Prices fluctuate considerably from day to day and week to week but in the long term there is no discernable trend. Table 8 shows the average monthly price recorded for kumara from January 1974 to June 1977. In times of shortage the price can increase by as much as 100 per cent over its lowest value. While there is not sufficient evidence to determine whether the market operates efficiently it is clear that the price does change in response to changes in supply. Periods of high prices are associated with periods of low supply usually because of climatic factors. The high prices prevailing between April and October 1976 were largely the result of supply shortages caused by very heavy rain and flooding in January and February; there was a similar reason for the high prices in July and August 1977. This would also indicate that the estimate of annual turnover from the July 1977 survey is too low.

Over the period covered in Table 8 there is no significant trend in prices, the average during the period being 4.3 cents per pound. Over the same interval prices generally in Honiara rose by 29 per cent (Solomon Islands 1977e). For
producers, therefore, the terms of trade have worsened compared with urban households.

Table 8

Average monthly price of kumara in cents per lb at Honiara market

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>3.8</td>
<td>3.9</td>
<td>5.2</td>
<td>3.4</td>
</tr>
<tr>
<td>February</td>
<td>3.6</td>
<td>4.4</td>
<td>4.2</td>
<td>3.7</td>
</tr>
<tr>
<td>March</td>
<td>4.9</td>
<td>3.8</td>
<td>4.5</td>
<td>3.9</td>
</tr>
<tr>
<td>April</td>
<td>4.2</td>
<td>4.2</td>
<td>5.3</td>
<td>3.6</td>
</tr>
<tr>
<td>May</td>
<td>3.6</td>
<td>4.1</td>
<td>4.4</td>
<td>3.6</td>
</tr>
<tr>
<td>June</td>
<td>3.0</td>
<td>3.8</td>
<td>5.2</td>
<td>3.8</td>
</tr>
<tr>
<td>July</td>
<td>3.6</td>
<td>4.0</td>
<td>5.8</td>
<td>5.0</td>
</tr>
<tr>
<td>August</td>
<td>4.9</td>
<td>3.9</td>
<td>7.5</td>
<td>6.0</td>
</tr>
<tr>
<td>September</td>
<td>4.9</td>
<td>4.5</td>
<td>6.8</td>
<td>–</td>
</tr>
<tr>
<td>October</td>
<td>4.9</td>
<td>4.4</td>
<td>4.9</td>
<td>–</td>
</tr>
<tr>
<td>November</td>
<td>4.8</td>
<td>3.9</td>
<td>4.0</td>
<td>–</td>
</tr>
<tr>
<td>December</td>
<td>4.3</td>
<td>3.9</td>
<td>3.5</td>
<td>–</td>
</tr>
</tbody>
</table>

Source: Statistics Office

Adaptation of indigenous systems of agriculture to the urban market

The indigenous system of agriculture described above can adapt in several ways to the proximity of a relatively large urban market. These can be described in increasing order of complexity. Initially a rural household may decide to market some of the surplus they normally produce from their own gardens. At this stage very few changes will occur in the system of agriculture and attendance at the market will be sporadic. During periods of shortage or large social commitments in the village no surplus will be produced.

At the second stage of development certain areas of traditional crops may be planted specifically for the market. The area cultivated will depend upon the availability of land and of labour. At this stage, initially, traditional methods of planting with long periods of bush fallow will probably still be used, but where land is in more short
supply or market gardening has to compete with other possible land uses, the period of fallow may be reduced considerably. If this does occur then more sophisticated agricultural techniques may be adopted including the use of fertilizer and in some areas mechanical cultivation.

At the third stage of development new crops will be grown for sale. Bathgate (1973) has noted the phenomenon of some villagers in West Guadalcanal using most of their land to produce exotic vegetables for sale in the market and using the proceeds of the sales to purchase starch substitutes such as rice, bread and biscuits. Where exotic crops are being grown, depending on the scale of production, more complicated techniques may be used, including irrigation, fertilizer and pesticides.

Limitations on the supply of food crops to Honiara market

At present most of the food crops sold in Honiara market originate from East and West Guadalcanal. At most times of the year the Tasimboko region on the Guadalcanal Plains is the most important source of the major crops. It is clear, however, that both the social and individual opportunity costs of using the land for growing food crops using long bush fallows is high. The Guadalcanal Plains is one of the few areas of the Solomons suitable for intensive large-scale farming. Already considerable development has taken place with the establishment of an oil palm plantation, the large-scale production of rice and the development of extensive cattle farms. It is unlikely, therefore, that production of food crops in this area will be capable of much expansion.

Secondly concentration of production in one area makes supply vulnerable to climatic disasters such as periodic floods. Although the market does appear to adjust to supply shortages this can have considerable short-term effect on urban workers, particularly those on or near the minimum wage. This in turn can lead to pressure for increased wages for urban workers which can lead to a further worsening of the terms of trade between the rural and urban areas, particularly when supply increases and prices fall.

Some approaches to developing the marketing of food crops

The problem of the increasing opportunity cost of using land for food production can be approached in two ways. One is to develop more intensive methods of land use, particularly
introducing rotations of crops with the use of artificial fertilizers. This would require fairly extensive research and extension work and would have the effect of concentrating development and cash earning potential in an area where there are already many different possibilities.

A second approach is to try and develop production and the sale of food crops from other areas of the country. At present some produce sold in the market originates from other areas of Guadalcanal and nearby islands but the total is small. The main problem here is that, since initially most households will only be able to sell crops surplus to their own subsistence needs, the volumes produced will be small. Because the cost of transport is relatively high, the returns will be low for most producers and in many cases could be negative. One way to solve this problem would be for producers to transport their produce in bulk by selling to an intermediate agency. This might be a marketing co-operative or even a full-scale Marketing Agency. Such an approach was advocated by the Committee on Food Supplies (Solomon Islands 1974a) but, as yet, it has not been taken up by the government. Such an agency or co-operative would be able to stimulate development in other areas of the country and would directly benefit rural households.

Conclusions

I have attempted to show that the use of the term 'traditional' to describe the systems of agricultural production practised by Solomon Islanders is misleading. The word has developed connotations of primitiveness, lack of understanding, inability to change and being a barrier to development. This has arisen largely as a result of a lack of knowledge and understanding of the indigenous agricultural sector. This sector in the past has shown a readiness to adapt and change which has generally been disregarded by planners and policy makers.

Solomon Islander farmers, in common with people of many other countries, are involved in production both for their own consumption and for sale for cash. At present this involves the production of coconuts and the production of staple root crops where there is access to a market. The systems of production used in growing these crops have arisen as a result of the needs of both the families and the cash market. As can be seen from the example of coconuts, farmers are responsive to price changes, but place a high value on
their own consumption. In the case of the marketing of food crops in urban markets changes have occurred in the methods of production in response to the needs of the market.

If development is to achieve its ultimate goal, that is the improvement in the standard of living of the people of the Solomon Islands, then it must be based on the needs and resources of these people. In the past much of the development has been encouraged from the top. It may be that in the future the greatest progress will be made by promoting development from the bottom; that is by recognizing the natural ability of people to solve their own problems in their own way by assisting and occasionally directing the changes that occur.
Chapter 5

Food shortages in Western Samoa: towards a solution

Sam Leung Wai

This paper seeks to establish the connection between local food shortages and the structural transformation that is taking place within Western Samoa's dual economy and considers why Western Samoa should maximize its food production and minimize its food imports. It analyses the production and marketing structure of staple foods, identifies specific problems, and then suggests a rationale for a program towards a solution of local staple food shortages.

The basic cause of food shortages

The genesis of food shortages in Western Samoa lies primarily in the interaction of the monetary and the traditional economies of its developing economic system (Leung Wai 1975a). Because of pests and diseases, population pressure on land and other problems, the average productivity of labour within the traditional economy is declining whereas the wage level within the expanding monetary economy is rising (Fairbairn 1973; Table 1). The evidence suggests that the wage level has probably exceeded the average productivity of labour.\(^1\) This may be conceptualized diagrammatically in Fig.1. The vertical axis represents the wage and the average product of labour. The horizontal axis represents time. MW represents the wage curve and SP the average product curve over time. The current situation in Western Samoa is somewhere beyond point T where the monetary wage exceeds the average product of labour. Evidently this excess of wages over the average product of labour is sufficient to make the movement of labour\(^2\) out of the traditional economy and into the

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\(^1\)It must certainly have exceeded the productivity of labour in districts, villages and farm families where population pressure on land is serious.

\(^2\)At the micro-economic level, this movement of labour out of the family farm into the wage sector can be explained using the Nakajima models (Nakajima 1970).
### Table 1

Wage rate changes between 1942 and 1954

<table>
<thead>
<tr>
<th>Type of labour</th>
<th>March 1942</th>
<th>May 1945</th>
<th>September 1954</th>
</tr>
</thead>
<tbody>
<tr>
<td>Casual labour in commercial employment in Apia</td>
<td>0.30</td>
<td>0.50</td>
<td>0.86</td>
</tr>
<tr>
<td>Casual labour Public Works Department</td>
<td>0.30 to 0.50</td>
<td>0.50</td>
<td>1.00</td>
</tr>
<tr>
<td>Plantation labour (N.Z.R.E. Multifanna)**</td>
<td>0.19 to 0.26</td>
<td>0.40</td>
<td>0.66</td>
</tr>
<tr>
<td>Plantation labour (private sector)**</td>
<td>0.19 to 0.26</td>
<td>0.30 to 0.40</td>
<td>0.50 to 0.60</td>
</tr>
<tr>
<td>Working foreman (public works)</td>
<td>1.00</td>
<td>0.90 to 1.20</td>
<td>3.00+</td>
</tr>
<tr>
<td>Stevedoring foreman</td>
<td>1.00</td>
<td>1.60 to 2.00</td>
<td>2.80</td>
</tr>
</tbody>
</table>

* Rates in shillings and pence converted to WS$.
** Including rations and shelter.

**Source:** Stace 1956.

**Notes:** Current minimum wage for casual labour is WS$2.00 per day.
monetary economy profitable enough to compensate for the costs of movement, the loss of leisure, the lack of flexible working hours, the loss of freedom to vary the pace of work, and the other factors noted by Fisk (1973).

![Wage and Average Product of Labour](image)

Fig. 1: The levels of wages for labour in the monetary economy and the average productivity of labour in the traditional economy over time (idealized)

The economic system of Western Samoa is therefore undergoing an economic transformation, with labour moving out of the traditional economy into the monetary economy. In recent years this movement of labour out of the traditional economy has accelerated because of the expansion in the monetary economy and emigration abroad. Table 2 indicates that the working population in the traditional economy (village agriculture) declined both absolutely and relatively over the period 1966 to 1971, and that labour had been absorbed in other sectors of the monetary economy. In nearby American

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3 The monetary wages in New Zealand and American Samoa are considerably higher than the local wage in Western Samoa so that emigration is actively pursued from within both the monetary and traditional economies.
Samoa there was an even more rapid loss of labour from traditional agriculture, which either moved into non-agricultural occupations or emigrated to Hawaii and mainland USA. Consequently, domestic and export markets for Western Samoan traditional staple foods have emerged and expanded rapidly over the last ten years.\(^4\)

Faced with the declining productivity of labour and a declining labour force (and in consequence a higher dependency ratio), the traditional West Samoan economy has not been able to expand the surplus of traditional foods for the domestic and export markets adequately in addition to the production of traditional foods for subsistence. Official assistance to raise agricultural productivity has failed because of a combination of factors discussed below on pp.88-9.

Referring specifically to staple foods, local shortages have arisen because the need to control the production and marketing of taro and the need to co-ordinate this with the production of bananas has not been recognized or fully appreciated by the planners and policy-makers. Both crops are consumed as subsistence food. Both are cash crops. But their production requirements differ. Whereas taro can be produced under the traditional technology, bananas can only be produced using the 'new technology'. Whilst some villages or districts have adequate land resources for the production of taro under the extensive system of long fallow cultivation, others do not. These factors strongly suggest that specialization of taro production for sale using the traditional technology in districts with surplus land and of bananas under the 'new technology' in land-deficient districts can be developed without causing any hardship to Samoan farmers. Rather, such specialization will result in a better utilization of scarce resources to the benefit of both the farmers and the nation.

The need for self-sufficiency

In recent years there has been an expansionary trend in the money supply within the Western Samoan economy due to

\(^4\)Unfortunately, no statistics are available for the local market except for a study by Lockwood (1969) based on fieldwork in 1966. Statistics on exports are available from various sources but they are fragmentary and rather confusing. A start has been made to rectify this situation by Rhee with his work on taro exports to New Zealand.
the growth in the wage sector generated by capital inflow and foreign aid, the high prices for both copra and cacao, and the increased inflow of cash remittances from overseas Samoan emigrants. Under conditions of excess liquidity, the occurrence of recent shortages in traditional staple food supplies led to both domestically generated and imported inflation.

Local shortages led to high prices for traditional staple foods, and a sharp rise in imports such as rice, flour and other essential foodstuffs. The rise in food imports and imported inflation exacerbated balance of payments problems. Official measures to counter balance of payments problems through restrictions and control of foreign exchange allocations, coupled with the irregularity in shipping and the rising costs of ocean freight and prices of imported foods, have resulted in general shortages of imported essential foods as well as other goods.

Increasing traditional staple food production will directly overcome local food shortages and help resolve Western Samoa's balance of payments and inflation problems by reducing food imports and increasing the supply of exportable subsistence-commercial crops, e.g. bananas, copra, taro. Furthermore, if this increase is obtained through raising the productivity of both labour and land, instances of excess population pressure on land in some areas can be defused whilst the withdrawal of labour from the agricultural sector to fill the employment opportunities generated in the industrial sector would be facilitated.

The alternatives open to the government of Western Samoa for overcoming its food shortage problems are limited. It can increase traditional food production or, if this is not possible, it can import substitutes such as rice and flour. The most likely situation is that it will do both. However, as a developing nation relying heavily on imported capital equipment, raw materials and technology for its development, it is in Western Samoa's interests to produce rather than import its food requirements.

The development of a balanced and integrated economy requires capital formation and investment, both human (social services like education, health, family planning, etc.) and physical (infrastructural development of roads, power and water resources, communications, factories, etc.). Both of these require substantial amounts of imported capital.
equipment and materials, skills and knowledge. By maximizing domestic production and minimizing imports of basic foodstuffs, more of Western Samoa's limited foreign exchange reserves can be devoted to the acquisition of essential goods and services for capital formation.

The dependence on imports can also be problematical for Western Samoa for two reasons:

(a) there is no guarantee that Western Samoa will always receive imported food supplies in amounts or at times it needs them most; and

(b) it is never certain that Western Samoans on temporary 'visitor' permits to New Zealand and American Samoa will continue to earn 'holiday pay' or that Samoans with relatives resident overseas will continue to receive the cash remittances upon which so many Samoans now rely for the purchase of imported foods, etc.

Dependence on imports is risky because of factors beyond Western Samoa's control. Good illustrations of these external factors are the irregularity of shipping which Western Samoa experienced especially severely in 1973-74 and the recent decision of the New Zealand government to require Western Samoan visitors to obtain work permits because of the worsening unemployment situation in that country. Samoans there may lose their assured jobs. If so, the volume of incoming cash remittances may diminish.5

The available evidence also suggests that, given a choice, most Samoan consumers (comprising 88.9 per cent Samoans, 10.1 per cent part-Samoans, 0.5 per cent Europeans and 0.5 per cent others) would probably prefer traditional staples to imported substitutes. Finally, Western Samoa has adequate resources, land and labour, for the production of most of its food requirements.

Moreover, the production of traditional foods for the market represents additional sources of income for the farm family. The production of a variety of crops, livestock and fish for food also widens the available range of commercial productive opportunities. The Samoan farm family which has

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5This, in fact, is what is happening as reported in an article 'Economy in dire straits', in the Samoa Times, 11-17 July 1975.
Table 2

Working population* by industry, 1966 and 1971

<table>
<thead>
<tr>
<th>Industry</th>
<th>1966 Census ('000)</th>
<th>Per cent of total</th>
<th>1971 Census ('000)</th>
<th>Per cent of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Village agriculture</td>
<td>24.03</td>
<td>68.1</td>
<td>22.85</td>
<td>60.5</td>
</tr>
<tr>
<td>Other agriculture**</td>
<td>2.13</td>
<td>6.0</td>
<td>2.56</td>
<td>6.8</td>
</tr>
<tr>
<td>Manufacturing and construction</td>
<td>1.36</td>
<td>3.9</td>
<td>2.44</td>
<td>6.5</td>
</tr>
<tr>
<td>Commerce</td>
<td>1.77</td>
<td>5.0</td>
<td>2.42</td>
<td>6.4</td>
</tr>
<tr>
<td>Transport and communications</td>
<td>0.84</td>
<td>2.4</td>
<td>1.25</td>
<td>3.3</td>
</tr>
<tr>
<td>Services</td>
<td>5.16</td>
<td>14.6</td>
<td>6.23</td>
<td>16.5</td>
</tr>
<tr>
<td>Total</td>
<td>35.29</td>
<td>100.0</td>
<td>37.75</td>
<td>100.0</td>
</tr>
</tbody>
</table>

* Persons of age 10 and over gainfully engaged in industry.

** Includes forestry, fishing and mining.

hitherto depended on the perennial tree crops—coconuts, cacao and bananas—now finds itself with a more flexible mixture of crop/livestock/fishing commercial enterprise from which it can select what is best to maximize its utility according to its resources of land, labour and capital. More importantly, the wider range of saleable commodities a farm family can produce presages a development of regional specialization based on comparative advantage. This should raise the productivity of both land and labour as well as the efficiency and effectiveness of limited support activities by the government extension and credit services.

Finally, the potential productivity of land and labour must be pursued vigorously in order to stem the flow of labour into Apia and its environs. Hitherto, the urban drift has not created conspicuous unemployment, rising crime rates, overcrowded and substandard housing, and other urban problems to any notable extent. Fortunately, the existence and combination of certain factors peculiar to Western Samoa have kept these problems to a minimum. These factors include the expansion of the monetary sector; emigration to and remittances from New Zealand and American Samoa; the geographically small size of the country and therefore low cost of travel which allow for ease of mobility between village and town; and the influence of the aiga and the Matai system.⁶ However, as the current high rates of job creation, emigration, and remittances from abroad level off and decline, urban problems will intensify. One way to stem the 'urban drift' is to make farming more profitable. Food production has an important role in maximizing the profitability of farming in the traditional economy.

The production and marketing structure of staple foods

Here we are concerned only with traditional staple foods—taro, banana, breadfruit, taamu, yams, etc.—of which taro and bananas are the most important.

To begin with, there are two parties to any exchange transaction of traditional staple foods: a farmer/seller and a consumer/purchaser. However, because of the physical separation of the farmers from the consumers, a third party is usually involved as a buyer and a seller: the intermediary

⁶In the Apia 'urban area', intervillage feuds and fighting often require Matai intervention before satisfactory settlement is obtained.
or middleman, of which there may be more than one depending on the extent of the geographical separation and other factors.

Others are also involved: public servants in research, marketing, advisory and extension, and credit institutions; the producers and merchants who trade in imported substitutes like flour and rice; owners and employers of transport services; and so on. Here attention is focused on the main actors in the process of production and marketing of staple foods: farmers, intermediaries and consumers. The marketing structure of taro is represented diagrammatically in Fig. 2, and that of bananas in Fig. 3.

Consumers. Demand for staple foods depends on taste and social status. Most consumers prefer taro and other traditional staples to imported substitutes like rice and potatoes.

Consumers who purchase their staples would like to obtain taro at least as cheaply or cheaper than imported and other local substitutes. Moreover, consumers would like to be able to buy taro from conveniently located market places or stores at times when they need it. Secure and regular supplies are important to the consumer.

The needs of consumers who produce their own staples are included in the discussion of farmers below.

Intermediaries. Several intermediaries or middlemen are involved in the production and marketing of staple foods for export (see Figs. 2 and 3). Within Western Samoa, export bananas to New Zealand are marketed solely by the Produce Marketing Division (PMD) of the Department of Agriculture (WSDA). However, besides the PMD, private shippers are free to export taro and other traditional staple foods to New Zealand (Rhee 1974). For the American Samoan export market, only the PMD is allowed to market bananas, taro and other staple foods.

The comments in this sub-section apply directly to consumers within Western Samoa. Some of the comments may be valid for consumers in New Zealand and American Samoa. However, the needs of consumers there may be affected by other factors as well, e.g. differences in incomes, ethnic status (Samoan, Tongan, Fijian, etc.), variety of substitutes including taro of different variety from Tonga, etc.
* Taro are also consumed as a subsistence food on the farm.

Fig. 2: Marketing structure of taro
Fig. 3: Marketing structure of bananas

* Bananas are also consumed as a subsistence food on the farm.
In American Samoa, the intermediaries are the licensed importers under the control of the Taro Board and the Department of Agriculture (ASDA) - a public organization. In New Zealand, all intermediaries are private individuals or firms including Fruit Distributors Limited (which is a monopsony for the import of bananas into New Zealand), Turners and Growers, etc., and the owners of the more familiar fruitshops and corner groceries which retail taro and bananas.

Private intermediaries are motivated chiefly by profit. However, besides the need to balance their books, public institutions like the PMD and the ASDA are motivated by other equally important considerations as prescribed by law under which they were established and within which they must operate.

The PMD was established to promote the welfare of the farmers by providing efficient marketing facilities and services (transport, etc.), stable prices, regular incomes and impartial treatment (for example, in the allocation of limited cases for taro shipments). In addition to promoting the welfare of the farmers in American Samoa, the ASDA also indirectly controls the importation of staple foods and their prices, as well as the operation of the Pago Pago marketplace. As will become obvious below, these additional powers of the ASDA give it advantages of considerable importance over the WSDA in fulfilling the dual responsibilities of promoting the welfare of both producers and consumers of traditional staple foods.

In marked contrast to staple foods exported, sales to consumers within Western Samoa do not involve intermediaries. The farmers themselves are the sellers who sell directly to consumers. The physical proximity of farmers to consumers in Apia and the availability of regular transportation makes it possible for the small individual farmers to market their own produce, albeit at high cost in time lost and inconvenience in the process. However, in the absence of intermediaries, sellers are willing to put up with this inconvenience and high cost. For some, this may be lessened by combining it with other motives for coming into Apia, like the purchase of a specific article paid for with proceeds from the sales of his produce.

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8 Many farmers sleep overnight at the Apia market place, returning to their villages only when their produce is sold.
There is only one organized market place within Western Samoa - Savalalo in Apia. Outside of Apia, there is very little trade in staple foods (and other village-produced commodities) between the villages or between families within a village. But each village has one or more stores from which rice, flour, biscuits and other imported commodities can be purchased. The Apia market not only serves residents within the Apia 'urban area', but also a considerable number of residents in adjacent northwest and northeast Upolu who commute to Apia for work.

Hitherto, the sale of staple foods and other produce in Apia has been largely a spontaneous development. Since Lockwood's study of 1966 (1969), the Western Samoan government has established the Savalalo central market place in Apia. This, and a brief early morning radio market report (which is of greater value to consumers than to farmers), represents the total official contribution to the marketing of staple foods and other produce in the local market.

In the absence of a middleman participating in the marketing of staple foods, and with the recurrence of staple food shortages in the face of expanding taro exports, government action in co-ordinating the production of taro and other staple foods for both export and the local market has become a necessity. Government interference is further justified by the need to investigate the feasibility of establishing other markets in order to relieve the traffic congestion\(^9\) in Apia and the overcrowding of the Savalalo market and to cater for the emergence of the other growth centres\(^10\) with a growing proportion of their population dependent on the market for their foods.

**Producers.** Almost all farm families produce staple foods such as taro, bananas and coconuts for home consumption. There are no specialist commercial taro or banana growers. Staple foods may also be sold for cash. In addition, the Samoan farm family produces other subsistence commodities and non-edible cash crops like cacao, besides participating in *aiga* and village communal activities (Leung Wai 1975b).

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\(^9\) Traffic congestion is a growing problem in Apia, and the buses, etc. transporting sellers and their produce to the Savalalo market are one of the main causes.

\(^10\) For example, Salelologa and Asau in Savai'i, and densely populated northwest and northeast Upolu areas.
They also undertake many activities which include fishing or may work for wages (Leung Wai 1975b).

Subsistence production is important to both farm and urban budgets. A 1972 household survey\textsuperscript{11} showed that for an average rural household the value of subsistence income per month was $40.89. In percentage terms, this is made up of 40.3 per cent taro, 23.1 per cent bananas, 8.6 per cent taamu, 12.7 per cent coconuts, 5.6 per cent cacao, with pigs, chickens, etc. making up the balance. For urban households, the average value of monthly subsistence income was $9.45. Of this, taro made up 38 per cent, bananas 35.8 per cent, coconut 4.7 per cent, cacao 3.3 per cent and taamu 3.4 per cent (Government of Western Samoa 1972).

Many farm families, however, are finding it difficult to grow staple foods for subsistence consumption and surplus for sale because of one or more of the reasons enumerated below.

**Problems**

**Land shortage.** Northwest Upolu from Apia to Falelatai District and from Apia to Falefa are good examples (see Fig. 4). Here, much of the land has been alienated to WSTE C (Western Samoan Trust Estates Corporation) and other freehold or leasehold property owners. Moreover, northeast Upolu is rugged country whilst northwest Upolu is the plantation belt and a significant amount of the Samoan customary land has been planted to cacao and coconuts. At the same time, the population of these areas has expanded through in-migration from the outer regions of relatives seeking opportunities for wage-employment and education in Apia.

Consequently, the population to land ratio has increased. What land remains for the cultivation of foodcrops is marginal land or else land with soils depleted of nutrients from overcropping so that it is now very difficult to grow foodcrops successfully using the traditional long fallow system.

Outside of northwest and northeast Upolu are other individual villages which are in a similar situation. Even in villages where there is an abundance of land, some individual farm families are short of land.

\textsuperscript{11} This survey excluded estimates of the value of subsistence income from fish.
Figure 4
Increased cash cropping. In many villages encroachment by commercial plantation crops like coconuts and cacao has reduced the amount of land available for food production. For some villages and farm families, there may be a lot of land but all or most of it may be unsuitable because the best land is covered with plantation crops. Thus, in Faleasium'uta, Sale'imoa and Satapuala villages in northwest Upolu, much of the cacao plots were removed in order to plant more profitable bananas.

In addition, the expansion of plantation crops has widened the distance between the villages and the foodcrop areas making the production of foodcrops that much more time-consuming.

Diseases and pests. Bananas can no longer be grown without the use of fertilizers and chemicals for disease control. These must be imported, are in very short supply and expensive. Few can afford to buy them.

To be profitable, bananas must be grown on a commercial scale rather than for subsistence purposes. The application of the inputs of the 'new technology' must be adequate and regular. Credit needs for capital investment and maintenance are substantial and these are not available to all farm families.

Traditional technology. Taro and other root crops can still be grown under long fallow by farm families in villages where there is adequate land — for example, southwest Upolu from Lefaga to Falealili and most of Savai'i. In villages where land is short, taro cannot be grown profitably without the use of fertilizers. This is difficult and expensive for the farm family if the production of taro is purely for subsistence purposes. Coconuts and cacao continue to be established without the use of fertilizer and other inputs of the 'new technology'.

Poor marketing organization. Unlike cacao, copra or bananas\textsuperscript{12} the taro export and Apia markets are limited. There is therefore a need to find out how much taro is required, in each market, and to organize and advise farmers accordingly so that they will produce the right amount at the right time and for the right market.

\textsuperscript{12} Current exports are less than 100,000 cases per year whereas the New Zealand market can absorb 1,000,000 cases.
For instance, Rhee (1974) has shown that either too much or too little taro is exported to New Zealand. In order to maximize total revenue to producers of taro exports to New Zealand, fortnightly shipments must be limited to 2700 cases. Similar studies for the Apia and American Samoan markets must be undertaken.

'Rural-urban' drift. With the expansion of the monetary economy and emigration abroad, many farm families are relying more and more on wages and less on agricultural production. This is not a bad thing in itself. Amongst other things, wages and remittances add to the incomes of farm families. It also expands the markets for staples and other traditional foods. This widens the range of income-earning opportunities for farmers remaining on the land.

The problem arises when farm families do not and are not helped to avail themselves of these opportunities through specialization and proper market organization. If the supply of staple foods is inadequate to meet the demand food imports will rise, adding to balance of payments and other problems.

Towards a solution

From the preceding analysis of the production and marketing structure of staple foods and identification of the problems, the following rationale is offered as the basis for a program towards the solution of staple food shortages.

The need for specialization. Specialization is one way of raising the productivity of land and labour and of exploiting the comparative advantages between regions, which arise from differences in climate, soils, and other characteristics of the environment which suit the agronomic and physiological requirements of different crops. Differences in population pressure on land may also give rise to comparative advantages between regions as to the type of agricultural system of cultivation that can be practised.

In Western Samoa, this latter type of comparative advantage seems to fit in with the climatic and agronomic requirements of taro and bananas. For instance, in villages and districts (e.g. northwest and northeast Upolu) where land resources are limited, the use of fertilizers for rehabilitating the depleted soils and specialization in the intensive use of these and other scarce resources for the production of subsistence and cash crops seem to be the
logical policy. Bananas, which, in any case, require the use of chemicals and strict supervision of plantings for purposes of disease and pest control if they are to be grown successfully and profitably, represent the ideal subsistence and cash crop. The drier regions of northwest Savai'i and northwest Upolu have a comparative advantage over wetter regions for the production of cacao because of the greater losses caused by the blackpod disease, prevalent under wet conditions. The policy objective here is to raise the productivity of the land.

In areas with ample land, taro can still be grown profitably under the extensive long fallow system of cultivation. Moreover, taro grows best under wet conditions and is relatively free of pests and diseases. For these reasons, southwest Upolu and other wetter regions of Savai'i represent good taro planting areas. The policy objective here is to raise the productivity of labour.

If regional specialization in the production of these two staples is undertaken, the subsistence and cash needs of farm families will be better met. Limited resources of fertilizers, etc. required for banana production will be concentrated in areas where it should obtain the best results. On the other hand, labour-saving technologies like weed sprays can be encouraged in areas where taro is grown.

The government (through the Department of Agriculture and the Development Bank) can concentrate its limited resources in producing taro and bananas in specific areas rather than spreading and dissipating them ineffectively on a nationwide basis. In consequence, the assimilation of new techniques by farmers should improve substantially, thereby raising the productivity of land and labour.

Transport costs into Apia for bananas if produced within the northwest and northeast Upolu regions will be reduced. Furthermore, concentration of specific crops in particular regions will allow the establishment of both central packing (or processing) stations and the formation and development of economic co-operatives all of which would obtain benefits from economies of scale and improved quality of product. As more resources become available and if markets exist, the banana growing areas can be expanded.

The need for market organization. The export of taro needs to be rationalized. In order to maximize income to
growers, the amount of taro exported must be controlled. This can best be done if a central marketing authority\textsuperscript{13} controls the marketing of taro as it does the marketing of bananas.

If a central marketing authority is established, this, together with regional specialization in the production of taro and bananas, will facilitate the forward planning of times for plantings by districts, villages and farmers. This should ensure that regular supplies of the exact quantities of taro required for export are available at the right time.

For the local market, the Department of Agriculture (or the Produce Marketing Board if established) should administer the Savalalo market place in Apia so that, like its counterpart in American Samoa, it could monitor the local demand for food crops. Once this has been established, as has been the demand for exports of taro to New Zealand, farmers can be organized and advised about what, when, and how much to plant to ensure that adequate and regular supplies of various food crops reach the Savalalo market.

In the villages, the development of village markets for traditional commodities should be encouraged. The best way to achieve this is to make use of established institutions in the villages. For example, in villages where women's committees possess committee houses, these can be used as a village market place in addition to the other uses they now have. Village sellers can leave their products for sale with the committee members on duty. If sold, the committee takes a percentage of the selling price. If unsold, the producer-owners can repossess their commodities at the end of the day.

This removes any social problems associated with the exchange of commodities for cash which may arise because of the tradition of reciprocity between persons well known to each other (who may even be related) as they are in a village.

The need for research. Marketing studies of the kind Rhee (1974) has pioneered are urgently required for taro exports to American Samoa, and for the Apia market. Feasibility studies for establishing other domestic markets

\textsuperscript{13} The government is at present considering the need to establish a general Produce Marketing Board.
in the emerging centres of growth like Asau and Salelologa on the island of Savai'i must also be studied.

Improving the efficiency in the production of subsistence foodcrops and other subsistence commodities represents considerable potential savings in labour and land. One estimate of subsistence production amounts to $11 million compared to the value for exports of cash crops of $2.3 million.

Research has been done on uses of composts for vegetable production, and fertilizer and time of planting for taro production, but these have not been extended to the field. Likewise, research on extending the productive season of the breadfruit was begun long ago but has not received adequate attention. Crop rotation (including pasture for livestock) for maintaining and improving soil fertility under the traditional long fallow system needs to be investigated since a considerable number of farmers still use this system for the production of taro and because fertilizers are expensive. There is also a need for investigation into methods and forms in which the storability of traditional subsistence foods can be prolonged. Research also needs to be done on sugarcane, pandanus, and other traditionally important plants. Most households use pandanus mats and some 80 to 90 per cent of Samoan houses are thatched. If the production of these types of subsistence commodities can be improved, more labour and land at present used for their production can be diverted to the production of food and cash crops.

These are a few examples, but they serve to highlight the government's preoccupation with commercial export crop production and neglect of the need to improve the production and marketing of subsistence food crops and other subsistence commodities.

In conclusion, it must be stressed that the solutions suggested, if implemented, involve a considerable amount of government interference or control in what, how much, where and when to plant food crops, etc., if current food shortages are to be overcome. The fact is that the freedom of Samoans to grow sufficient of what they want as their forefathers did in the past when they were in a state of 'subsistence affluence' is lost forever. Expanding population pressure on land; rising aspirations and expectations; out-migration to New Zealand and inter-migration between regions; the
growing sophistication of the economy and the expansion of the monetary sector; changing production and market conditions; and the need for imported technology and material resources for the control of new diseases and pests and for the rehabilitation of depleted soils; these have reduced Samoans' freedom to produce what they want under the traditional long fallow system of production.

In developed economies, considerable government control in the production and marketing of many agricultural commodities exists. If Western Samoa is to develop as other nations have, then Samoan farmers must accept greater government interference, whether this be in the form of incentives or restrictions, provided it serves the public or national interest. Indeed, Samoans have already accepted significant government controls but these are concerned with products of international trade - cacao, copra and imported goods.

So far as Western Samoa is concerned, the existence of the pule or Alii ma Faipule in the villages can be a major obstacle or a most useful ally in obtaining the controls necessary for implementing solutions which would prevent the recurrence of food shortages. In the past, the support and co-operation of the Alii ma Faipule in the districts and villages have always been forthcoming in instituting changes which affected their lives but which they understood to be necessary and relevant to the times. For this reason, their help in implementing the solutions necessary for overcoming current food shortages can be obtained provided the government adequately explains to them the changing conditions under which the production and marketing of the various traditional staple foods and cash crops have to be undertaken.
Chapter 6

Problems in stimulating outer island saltfish production for the urban market in Tarawa, Gilbert Islands

Roger Lawrence

In 1973 the urban population of Tarawa, the administrative centre and only sizeable urban centre in the then Gilbert and Ellice Islands Colony, totalled 14,861 or 25.71 per cent of the group's total population of 57,813. The proportion of total population living in urban centres has risen steadily over the years and this has been paralleled by a steady increase in the value of the colony's imports. Foodstuffs account for approximately one-third of total imports. On 1971 estimates (Draft Development Plan:17) this puts a value of $1,994,000 on imported foodstuffs of which $1,096,700 (55 per cent) was consumed in urban Tarawa. Urban food bills thus account for nearly a fifth of the colony's total imports. This suggests that the government could make considerable import savings if it could stimulate production in the local sector to provide foodstuffs for the urban areas of Tarawa. That the government do this is imperative because there is no indication that urban drift to Tarawa is diminishing, and, more importantly, because the colony faces drastically reduced export incomes with the working out of Ocean Island phosphate reserves. This paper aims to consider the scope for and problems confronting any attempt to stimulate local production to provide foodstuffs for the urban market on Tarawa. It must be stressed that the islands in the group differ considerably from each other; thus material presented here relates

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1This paper is based on fieldwork carried out on Tamana Island over the period 1971-74 as a member of the Victoria University of Wellington Rural Socio-economic Survey of the Gilbert and Ellice Islands carried out for the Government of the Gilbert Islands and Tuvalu under United Kingdom Technical Aid Project No. R2875 A & B. Other islands studied were: North Tabiteuea - W.H. Geddes, Nanumea - Anne Chambers, Butaritari - Betsy Sewell, Abemama - Ray Watters.
mainly to Tamana, a small, dry, isolated island in the south, and may not be generally applicable to the group as a whole.

The scope for expanded production of local foodstuffs to supply outside markets

Subsistence affluence. Subsistence affluence is considered a condition common in traditional societies and results from the absence of population pressure on land resources, favourable climatic conditions and the efficiency of locally developed systems of agriculture which together ensure that household food needs are adequately met with the input of relatively little labour. Subsistence affluence is also argued to embody the potential for expanded production which might be harnessed to supply distant urban markets.

I am not sure of the extent to which this argument can be applied to outer island subsistence economies in the Gilbert Islands. These are, in most instances, strong and capable of producing most household needs. Although the cash economy is well developed, it is not a time-consuming element in most households' activity patterns and remains a supplement rather than an alternative to the subsistence economy. The subsistence economy, on Tamana in particular, is slanted heavily towards the sea and its resources. The land provides coconuts, breadfruit, pandanus, te bero (Ficus tinctoria, a small fig), pawpaw and the root crop babai (Cyrtosperma chamissonis). The former are tree crops which receive very little agricultural attention. Planting, where it occurs, is usually to ensure productivity in the long term rather than for short-term gain. The areal extent of coconut land may have been increased through planting in response to the stimulus of the copra trade. Copra now provides a major source of locally generated cash income. Babai is the only crop cultivated in the sense of being planted in a prepared site in predetermined quantities and tended throughout its growing season.

The island environment. The paucity of potential agricultural crops in the region is a direct reflection of the limited atoll environment. The Gilbert Islands are a chain of atolls and reef islands strung across the equatorial dry zone. They consist of low deposits of calcareous sands, gravels and boulders. Nutrient levels are low and since the soils often lack humus, water-holding capacities are also low. Babai can only be grown in pits excavated to the water table and enriched with specially prepared soil and compost.
Without continued composting breadfruit would not survive. On the drier islands even coconut and pandanus palms are killed by periodic drought. Rainfall is a limiting factor. The islands to the north have the highest rainfall and it diminishes steadily southwards. Butaritari has a mean annual rainfall of 3163 mm while Tamana in the extreme south receives only 1172 mm. Unreliability and drought frequency increase southwards as well. The lowest annual rainfall recorded for Butaritari between 1947 and 1973 was 1444 mm; on Tamana it was 254 mm. During such droughts most shallow rooting plants die and the growth and productivity of deeper rooting plants is curtailed.

The scope for expanded food production. Under such physical conditions the scope for expanding agricultural production is very limited and likely to be restricted to the wetter islands to the north. Crop choice will probably be limited to those crops which already persist. Attempts to introduce bananas, sweet potato, maize and vegetables have been singularly unsuccessful. Any expansion in babai production would be limited by the enormous labour input required to excavate pits to the water table and transport the necessary soil and compost. The effort involved in babai cultivation in the southern islands is such that babai features more as a ceremonial food than an everyday food. In the lower wetter islands in the north it is eaten more frequently but its role in people's scheme of values is such that it would be immoral to sell babai. Land availability could also be a limiting factor to expanded crop production. Rural population densities are high. On Tamana densities exceed 290 people per square kilometre, while Kuria and Aranuka, relatively depopulated islands, still have densities of 67 per sq. km and 50 per sq. km respectively. Finally remoteness from markets is a very real problem in this island chain. Tamana is 600 km from the urban market of Tarawa. Although served by a regular service, weather and landing difficulties are experienced, freight is often not accepted because the boat is already full, and pilfering is a constant threat. Some islands are served by the internal air service and this is used to freight bananas, pawpaws and crayfish to Tarawa for sale to expatriates who can afford such luxuries. Thus the hope for many of the drier more remote islands will be limited to compact, non-perishable, relatively high value goods, perhaps kamaïmai, a molasses made by boiling down toddy, and saltfish. It is to the latter which I propose now to turn.
The present situation

Fishing and surpluses. Tamana households already produce more fish than they themselves consume. A very large part of this surplus is distributed among kin and neighbours fulfilling rights and obligations; some is preserved by salting and drying and a small quantity of fresh and saltfish is sold through the Tamana Co-operative Store. As yet the trade exists in a nebulous and undeveloped form. Over the years 1971-73 monthly sales of saltfish to the store averaged 71 kg. 1972 was a peak year when 1356 kg were sold to the store. Even this figure represents only 5 kg per household per year. Few, if any, households specialize in saltfish production. Rather sales seem to be made from a stored stock, surplus to immediate subsistence needs, when a call for ready cash arises which cannot be met immediately by other cash earning activities. Fresh fish sales represent a much smaller volume and averaged 16 kg per month over the two years. Practically all saltfish sold to the store on Tamana is resold on the island, usually to government employees. Small amounts are sometimes sent to Tarawa for sale by the Co-operative Federation. Some saltfish is sent direct to Tarawa and sold through agents there. Several instances of batches of 300 fish being sent to Tarawa were recorded but no estimate of sale frequency can be made. Professor Watters recorded five fishermen from Abemama 90 miles from Tarawa who sold perhaps 100 fish each every month to Tarawa.

Present inputs. Tamana people exploit the resources of all marine zones of the island from the reef flats and beaches exposed at low tide to depths well in excess of 55 metres and areas perhaps up to two kilometres from the island. The inshore areas are largely the preserve of women, children and old men. While they provide a relatively sure supply of fish at present, the fish tend to be small and less favoured than deep sea fish. The areas could easily suffer from overfishing because they are limited in extent and remote from possible sources of recolonization. They are also the only areas readily accessible to deprived households without the necessary capital equipment or manpower for deep sea fishing.

Most attention is focused on deep sea fishing. It is clearly regarded as the 'proper' pursuit for men and it is the aspiration of most men to be akawa - a successful fisherman whose family eat deep sea fish often and who has a surplus for distribution among kin and neighbours. There
appears to be a respectable length of time to be seen fishing regardless of need. Fishing is the activity rather than a means of getting a predetermined quantity of fish.

The equipment necessary for deep sea fishing includes canoes, braided nylon fishing lines, hooks and bait. Scoop nets and canoes are necessary in catching flying fish which are the most frequently used bait. Deep sea fishing is thus a series of related activities. The cycle begins with kababa fishing for flying fish. This occurs at sunset and surfacing schools of flying fish are chased with canoes and caught with scoop nets. Tatae or flare fishing is another means of catching flying fish at night. The fish are attracted towards the canoes by the flares and caught with scoop nets. The fish are used for bait; if a large number are caught they may be eaten as well or salted. Line fishing is the most frequently followed and time-consuming fishing activity. Since the canoes are paddled rather than sailed and because the island is so small (only 4 km long), the area which can be exploited and the ability of fishermen to follow schools of fish or get into favourable positions is limited. The fear of being swept away by wind or currents is real and constantly in the minds of the fishermen. It limits their willingness to venture far from the island.

Table 1 summarizes the data on the deep sea fishing activities of 13 sample households over a five-week period. Eight households fished reasonably regularly; two households had canoes and active males but did not fish by preference or laziness; the remaining three did not own canoes and did not have active males to crew on other canoes. The range of fishing effort within the eight active households varied greatly from three expeditions every two days for the most active to once every three days for the least active. The average household engaged in 4.64 fishing expeditions per week. Line fishing (2.23 expeditions per week) and kababa fishing (1.86 expeditions per week) were the most frequently used methods. Tatae fishing accounted for 0.55 expeditions per week. The average household spent 14.36 hours per week deep sea fishing: 11.49 hours line fishing, 1.24 hours kababa fishing and 1.63 hours tatae fishing.

The data on success rates suggest that fishing is still a fairly uncertain activity. For most methods at least one expedition in four would produce no fish at all, let alone a surplus, and there is no surety that an increase in the length of time spent fishing will increase the catch and
### Table 1

Fishing expeditions and fish caught over five separate weeks by thirteen sample households

<table>
<thead>
<tr>
<th>Fishing method</th>
<th>Number households using method</th>
<th>Total hours spent</th>
<th>Mean hours spent per household per week</th>
<th>Mean hours per expedition</th>
<th>Number of expeditions</th>
<th>Successful expeditions*</th>
<th>% of expeditions successful</th>
<th>Fish caught</th>
<th>Mean fish per expedition</th>
<th>Mean fish per hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line fishing</td>
<td>8</td>
<td>459.75</td>
<td>11.49</td>
<td>5.17</td>
<td>89</td>
<td>62</td>
<td>69.66</td>
<td>633</td>
<td>7.11</td>
<td>1.38</td>
</tr>
<tr>
<td>Kababa</td>
<td>9</td>
<td>55.75</td>
<td>1.24</td>
<td>0.66</td>
<td>84</td>
<td>31</td>
<td>36.90</td>
<td>177</td>
<td>2.11</td>
<td>3.17</td>
</tr>
<tr>
<td>Tatae</td>
<td>8</td>
<td>65.00</td>
<td>1.63</td>
<td>2.95</td>
<td>22</td>
<td>16</td>
<td>72.73</td>
<td>258</td>
<td>11.73</td>
<td>3.97</td>
</tr>
</tbody>
</table>

* Success defined as catching at least one fish.
provide a surplus although the probability of this occurring is presumably increased.

The data overall suggest some scope for increasing the intensity of fishing, probably by providing an incentive for fishermen to go out more frequently or to encourage the use of presently unutilized equipment and manpower. At least two of the households are at the physical limits of utilization of available resources and manpower. They are both among the largest sellers of saltfish to the store.

Co-operative efforts show some interesting assessment of commercial prospects. To date mronrons have concentrated on flare fishing. the method has a high success rate in terms of fish caught for hours fished; it can be carried out for a short period at a set time with only limited preparation. It does not require bait stocks. For these reasons expeditions are relatively easy to operate co-operatively. Women members are directed to provide a set number of flares and men are required to fish for a set period in the evening, perhaps once a month at present. The catch is processed by the group as a whole. Efforts to expand intensity of fishing could conflict with customary concern to husband flying fish resources.

At present prices of 10 cents per fish and without considering labour costs in processing, returns are something less than 20 cents per hour, rather lower than copra returns at prices of 6.6 cents a kilo. Low returns may not be a disincentive because Tamana people do not assess cash-earning simply in terms of cents per hour worked. They consider the goal of the work and whether the means are appropriate to the ends. They also favour cash-earning methods which produce large sums at irregular intervals over those which produce small sums continuously. Working for a mronron achieves this end.

2 A mronron is a small indigenous co-operative of around 16 members. They usually function by buying goods from the store and reselling to the public in small quantities at higher prices and accepting coconuts as currency. The profits are put into a common fund which is distributed periodically among members. Several mronrons on Tamana are attempting to set up the saltfish trade with Tarawa to increase the scope for cash earning.
Expansion of saltfish production

Strategies for expanding the trade. Assuming that fish stocks are capable of more intensive exploitation several strategies for expanding production suggest themselves. Increased production could be achieved by employing new techniques, particularly power boats, long line and trolling equipment, which would allow larger areas to be more intensively and perhaps more efficiently exploited. Such an approach would require investment beyond the reach of most individuals, implies new forms of organization and action, and in terms of the Tamana situation is probably inappropriate. Two other strategies utilize present technologies and could be accommodated within present frameworks. The first would involve the intensification of effort using existing technology and household labour supplies to produce a surplus which could then be preserved and exported. The second approach uses similar technology but with a labour force pooled especially for the occasion and involving the co-operation of many household with a common focus of economic interest and the express aim of producing for the market. Both strategies were observed on Tamana during fieldwork.

Problems. Two areas of investigation suggest themselves. The first concerns itself with the availability of capital and labour to service expanded production; whether existing stocks of equipment are adequate to meet more intensive use and if not, whether individuals or groups have access to necessary capital sources for expansion. On the labour side the concern is focused on the existence of surplus labour, whether labour can be diverted from other activities without affecting the 'quality of life' and whether new forms of organization could be developed to service intensified effort. The second major area is concerned with the willingness of individuals or groups to produce a surplus and participate in the trade. This involves consideration of present sources and levels of income, the value systems of a society and the incentives or disincentives that it generates. Of importance here would be:

(a) present income levels and sources and the effect these have on the incentive to produce;

(b) conflict with ideologies concerning the husbanding of resources and the traditional regulation of fishing activities;
(c) the role of surpluses in fulfilling kin obligations and expectations;
(d) pressures against efforts to increase income and accumulate wealth;
(e) the utility of money and Tamana perception of the types of money and the uses to which it can be put.

Capital and the availability of labour

Capital. The most important items in fishing are obviously canoes, heavy fishing lines and nets. Although canoes are locally manufactured the planking is imported, as are lines, hooks and the nylon line now used in scoop net manufacture. Thus fishing is heavily dependent on imported materials and the cash necessary to buy them. Employment on Ocean Island and Nauru is invariably the origin of the cash and the purchase point for such goods.

In our survey 16 households were studied intensively, and all but four owned canoes while five possessed two, usually a double and a single. Only one household had potential fishermen without access to canoes. The head of the household was young, had never worked at Ocean Island or Nauru and had not inherited a canoe. There seems to be little evidence to suggest that access to capital equipment is at present a limiting factor to fishing activities. There is some under-utilization of equipment which may in some cases result from shortages of active experienced men in the household. More often it reflects individual goals and preferences, some individuals choosing to ignore fishing and concentrate on other activities. Only two households contained members whose fishing potential could not be fully utilized because of equipment shortages.

The foregoing is typical of present conditions. It may not apply in the future. Purchase of capital equipment depends very closely on employment for short periods at Ocean Island and Nauru. It is considered impossible to raise the sums necessary from locally based cash-earning activities; a viewpoint borne out by the fact that the goods are never stocked in local stores. In the long term the prospects for continued contract employment are dim. Phosphate mining activities are running down. Tarawa provides some alternative employment but its nature and relation to the needs of outer island life is different. Employment on Tarawa is seen, both by employer and employee, as an alternative to outer
island life. Wages are lower, cost of living is higher and hence savings are harder to make. Because remuneration and promotion are based on length of service the individual is less free to move between the two lifestyles. In addition the desired goods are not usually stocked by stores on Tarawa. In the long term the capital goods necessary to efficient fishing could become increasingly scarce and limit the scope and importance of fishing activities.

Availability of labour. Conclusions on the availability of labour suffer to some extent from problems experienced with the conceptual framework employed during fieldwork. Following numerous previous studies of small communities I started with the assumption that the household was a concrete and enduring entity directly reflecting kin relations and the social organization of the community. I also assumed that the household formed the basic economic unit and that the time allocation pattern of its members were determined in relation to the household's needs. Both assumptions needed modification. The household on Tamana proved to be a very fluid and varied unit. Only two of the 16 households studied remained unchanged during the survey. At the other extreme one household experienced 27 changes. The mean household experienced ten changes in personnel over the seven weeks of the intensive survey. This leads me to conclude that the household is a unit of convenience rather than an enduring social entity and it is brought together by relatedness, the stage reached in its various members' child-rearing histories, real or imagined responsibilities towards more distant kin, together with the modifying influence of social interaction, particularly the results of friendship and quarrels. It lacks a fixed resource base in either land or personnel and is not unified by readily identifiable long-term goals. The second misconception relates to the decision-making structure within the household. While I did not think to question this in the field, on looking back I can find no evidence of the decision-making process having taken place within an organized and centralized framework. Even in the households where I spent very long periods of time, no conferences were called where particular individuals were allotted particular tasks. No individual assumed the role or right to direct another's activities. Decisions appear to have rested with the individuals. With a women the decisions regulating many of her tasks were taken by the committees of the various co-operative work groups to which she belonged. Time allocation appears to have been governed by norms and these relate to a relatively
small range of tasks appropriate for a particular age and sex group, and these are followed for reasonably consistent lengths of time. This allows little scope for the economizing of time or the allocation of what might be surplus labour into particular avenues of production.

The importance of these factors to time allocation patterns is evident in Fig. 1 which compares total time allocated by each household to subsistence, social and cash-earning activities with the size of the household labour force (expressed in labour units). There is a strong linear relationship between labour force size and the total time allocated which suggests that the time allocated per labour unit is constant and bears little relation to the size of the household.

The relationship reflects mainly the importance of subsistence and social activities. Cash-earning does not respond in the same way. By considering time allocated in relation to the ratio of consumer units to labour units some measure of need to work is introduced. There is no evidence to show that households with high CU/LU ratios work longer hours. Only in social activities is any significant relationship evident and it is negative (that is households with high CU/LU ratios tend to spend less time in social activities). Since households with high CU/LU ratios have younger heads, this may reflect the presence of more dependent children, but it could equally reflect the fact that younger heads are not expected, or called on, to participate in social activities to the same degree as older men. The per capita refinement of mean hours per labour unit per male fails to show any significant relationship and since the distribution is a narrow one it seems reasonable to conclude that workers tend to allocate much the same amounts of time regardless of the number of workers in the household or the ratio of dependants to workers. These findings form the basis of conclusions that norms rather than needs best explain the time allocation pattern and also perhaps the absence of a central decision-maker directing the activities of individuals.

The general data findings are mirrored in fishing activities. My observations suggest that there is a minimum length of time which a self-respecting fisherman should be seen fishing. To spent less is laziness. Because of this individuals may stay out fishing some time after enough has been caught for immediate needs. Fishing is usually the task
Figure 1

TAMANA: HOUSEHOLD SIZE, STRUCTURE AND TIME ALLOCATION

A. Scatter diagrams and linear regression for labour units on 13 sample households and time allocated to grouped activities.

B. Scatter diagrams and linear regression for CU/LU ratios on 13 sample households and time allocated to grouped activities.

C. Scatter diagrams for CU/LU ratios on 13 sample households and time allocated to grouped activities.

Note: The data includes those households with complete data. It excludes those with less than 5 weeks data.
begun after toddy-cutting is finished and is expected to last for at least the rest of the morning. If an individual has other tasks to attend to he may choose not to use the remaining time fishing because of this.

The expansion of fishing activities for market supply could take place in several ways; by the individual household fishermen increasing the length of time spent on fishing expeditions, by increasing the number of occasions on which fishing is carried out, or alternatively, as in the case of maronron organized activities, fishing on particular days specifically for market production. The decision involves the choice between spending more time fishing and less time in other activities. Returning again to the data on time allocation, testing for relationship between time allocated at present to subsistence, social and cash-earning activities based on all weeks' data for all households showed no relationship between time allocated to subsistence, social and cash-earning activities. The average household spent approximately 36 hours per week in activities which it regarded as distinct and worth recording. The rest was spent on eating, sleeping, personal hygiene and unorganized leisure. The lack of relationship suggests that time is not a scarce resource and an increase in the time allocated to cash-earning does not automatically lead to a decrease in time allocated to either subsistence production or organized social activities. Such increases are accommodated out of unallocated time, mainly non-organized leisure, resting and relaxing. The choice involves a weighing up of the need for the money against the value of the leisure foregone.

In the case of fishing for a maronron the choice is influenced by the enjoyment of working with others and the hope of getting money in larger quantities at one time than is thought possible by individuals working alone. At the present this choice does not appear to be socially regulated in the same way as time allocated to subsistence and social activities, but the value system and other regulatory mechanisms obviously influence an individual's choice. These conclusions apply only to present conditions. If current trends of outmigration of young men to Tarawa continue the adequacy of labour for expanded fishing could be in question.

Incentives and disincentives

Given the probable adequacy of labour and capital to meet the demands of expanded production the likely success of any government-sponsored scheme to encourage the expansion
of saltfish production for sale on Tarawa will still depend on the willingness of the local producer to participate. Individual decisions will be made with reference to the value of time foregone, individual needs for cash and the utility of the money earned. The latter can only be made with reference to existing sources and levels of income although the value system of the society in which the individual lives must also impinge on decisions made.

**Existing levels and sources of income.** The annual income of the average Tamana household is in the vicinity of $146 of which only 25 per cent derives from local income earning activities. The major part of the household income derives from the remittance sector of the colony economy. Telegraphic money orders account for at least 15 per cent of total household income and a further 32 per cent of income comes from untraced sources which probably reflects cash gifts, money sent with individuals rather than through the post office and the redistribution of remittances on Tamana. Compared with these other sources of income locally-generated income tends to be of little significance and its earning occupies only 7 per cent of the average household's active time. Incentives to expand locally derived income are not strong. Income earning patterns over the 1971-73 period show that households entered and withdrew from cash-earning activities in response to the attractiveness of returns and needs. They showed little evidence of being committed to particular levels of cash use which were sustained regardless of rates of return. All households experienced a significant drop in locally derived income during 1972 as a result of falling copra prices. No attempt was made to increase production in other areas to make good the loss in income. Households retreated from local cash earning and relied more heavily on remittances. Consumption of store goods diminished.

While this situation continues to apply the government cannot hope to get a sustained response from the local sector unless prices are high and returns particularly attractive. Returns per hour to producers from saltfish sold on private markets in Tarawa are lower than those gained from copra and are not likely to attract substantial individual participation. In the longer term, however, with the prospect of declining employment at Ocean Island and the drastic effect this will have on income levels on outer islands, the government must be ready to step in with incentives to encourage production and utilize the potential for local income generation.
Of less direct influence but still of considerable importance are aspects of the value system which impinge on individual decisions.

**Concern for the regulation of fishing and the conservation of resources.** The Tamana Island Council (Fishing) Bylaws 1970 prohibit the use of pressure lamps in night fishing for flying fish because they are believed to be too effective. The bylaws also restrict the number of canoes allowed to go after each school of flying fish and trolling is strictly prohibited. Punishment for breaking the bylaws incurs a $20 fine and up to six weeks imprisonment. To date punishment has involved the banning of transgressing fishermen from fishing for a set period of time. The existence of the regulations and the willingness with which they are accepted and enforced indicate a basic concern for the husbanding and orderly exploitation of resources and the assurance of a continued and viable subsistence fishing industry. Against this, careful thought must be given to any scheme which seeks to increase the pressure on fish resources.

**The role of present surpluses.** Fish represent the only source of protein available to most Tamana households. The most active fishing households ate fish, on the average, slightly more frequently than once a day. Some households without active fishermen ate fish less than once a week. Kin obligations and the responsibilities of neighbourliness set up a framework within which surpluses are traditionally dispersed. Requests cannot be easily refused. The expectation of others to share in a surplus could be a disincentive to expanded production. Because the catch belongs to the mronron and not the individuals, production for this purpose would be exempt from such claims. Alternatively if the trade did develop and surpluses gained a more immediate cash value, redistribution might be curtailed with serious dietary consequences for those dependent on the surplus.

**Value systems.** Tamana is a staunchly democratic society which adheres very strongly to the ideals of equality and conformity. The term boraoi signifies the belief that all must have an equal share and that no one, through amassing wealth or pursuing other non-normal activities, should seek to raise himself above his fellow men. On this level such ideals tend to dampen individual aspirations to raise incomes by indulging in new and unfamiliar ventures which might excite comment and censure. To amass wealth beyond his
fellow men would make the individual vulnerable to other cultural mechanisms which tend to level differences. *Bubuti* is an important custom here. It is simply a request, usually by kin, for assistance in either cash or kind and it cannot be refused. It leads to a flow of goods from those who have to those without. As well as being a positive mechanism for redistribution it operates to quell incentive to raise cash incomes. Again, being a corporate group outside traditional morality and having an existence beyond its individual members, the *mronrons* are exempt from *bubuti*.

The utility of money. In terms of incentives to expand production and raise incomes the utility of money is probably the most important single factor involved. The utility of money is closely tied up with the individual's perception of what money is and what it can be used for. Some individuals on Tamana distinguish between *karinimane*, money that you keep, and *kabirongorongo*, money that you spend. Money that you keep is money won in large quantities, usually from work off the island, and kept for special purposes such as buying special food to feed house or canoe builders, paying school fees, taxes and large institutional payments. On the other hand, *kabirongorongo* is small money easily won from everyday activities on the island. It is spent easily on everyday needs. People are certain that *karinimane* cannot be raised on Tamana and that *kabirongorongo* cannot be aggregated to produce *karinimane*. These attitudes are very important in determining the usefulness of money, its utility and the likely success of attempts to raise incomes from local activities on Tamana. If the sort of money which can be raised on the island is typed and used only in everyday expenditure on goods which produce relatively low levels of satisfaction this could act as a disincentive to production.

The potential situation is perhaps illustrated in the response to changes in copra prices and the effect this had on local incomes and expenditure. During weeks 2–5 of the survey copra prices dropped to an all-time low of 5.5 cents per kilo. Very little copra was made and store expenditure decreased. During the last two weeks of the survey prices rose to 6.6 cents a kilo, much more copra was made and store and *mronron* expenditure, in particular, rose as locally derived income became more readily available. The effect on meal patterns was interesting and illuminating. Prepared meals were eaten more frequently, up to three times per day for some households, and flour and rice appeared more frequently. These staples, however, did not replace local
foods. Consumption of local foods went up as well because the dishes prepared consisted of flour or rice plus coconut or breadfruit, etc. Respondents assured me that they did not particularly favour the imported foods above the local foods. In fact, store foods were generally considered inferior and no status was derived from being seen to eat these foods frequently. The only factor in the imported foods' favour was that they were considered easier to prepare. The significance I would draw from this is that the money from copra was easily got but came in small quantities which branded it as spending money and that food items were the items normally bought with this type of money. If imported food is not especially favoured there must be a ceiling to demand and a ceiling to the incentive to increase production to earn this sort of money. This could quite easily apply to ventures seeking to encourage individuals to expand production of saltfish.

The same limitations might not apply if income was received less frequently but in larger sums. This is obviously one of the positive factors which draws people to participate in mronrons as a means of cash-earning. Mronron divisions might yield $5 to $10 in a lump sum. Copra sales in amounts normally prepared and transported yield between $1.20 and $3. Other attractions would include the fact that they require a relatively low level of input even though it may be regular, the obvious enjoyment gained from working together, the fact that the individual is protected from censure which would accrue to individuals seeking to raise cash incomes by themselves, but above all it is that the monetary rewards come in large amounts at strategic intervals. People can see that by working for a mronron they will get a lump sum which can be put to a particular purpose. Working by themselves they could raise only small amounts and the temptation would be to spend rather than save these. For this reason a mronron organized saltfish trade could be more successful on Tamana than one relying on individuals.

Summary

In summary, the prospects for expanding agricultural production on Tamana, and probably most of the islands in the group, to supply urban markets is severely limited by the extreme dryness of the atoll environments. Some scope probably exists for the expansion of saltfish production, but in the absence of adequate research on fish population dynamics, the possibility of overfishing must be constantly
guarded against. The fact that fishing activities are already regulated by customary sanctions shows that concern already exists among the Tamana population for the careful husbanding and protection of fish stocks vital to their existence. At present the stock of capital equipment is probably sufficient to meet the demands of expansion, but in the long term sources of supply to replace the traditional avenues must be found. Sufficient labour is available to allow some expansion of fishing intensity without adversely affecting other aspects of subsistence and current cash earning, but outmigration of young men to Tarawa could alter this. The final decision to capitalize on opportunities will depend on the decisions of the individual, his weighing up of the benefits of increased monetary income against the value of leisure foregone. This decision can only be made against the wider value systems of society, the belief in equality and pressures against the accumulation of individual wealth, and the utility of the money earned. The individual may evaluate the situation differently with different approaches to action. As an individual his assessment of the unpleasantness of work, his responsibility to others, the sort of money earned and the uses to which it can be put could be very different from his assessment as a member of a co-operative group. For this reason ventures involving mronron participation rather than individuals could prove more successful. Given the fluidity of household membership the workforce is probably more stable and predictable in the long term and thus provides a more sound basis for planning long-term production. Mronrons are recent and their co-operative basis makes their income raising goals acceptable and exempt from the normal responsibilities of individuals. They also protect members from their own laziness. Above all the mronron aggregates cash into large units not considered attainable by individuals working alone and large units of money have a utility far more valued than small quantities of money. If production of saltfish could be organized on a mronron basis importers or the Co-operative Federation on Tarawa would have fewer individuals to deal with; the possibility of allotting quotas for the supply of specified lots of fish is also present and the incentive to produce is reinforced by group action and responsibility.
Chapter 7

Adapting traditional agricultural systems
to serve urban food markets: the Niue experience

M.H. Tafatu

Niue Island is roundish in shape, 18 km wide by 21 km long with a coastline of 80 km encompassing an area of 26,000 ha. It is situated 300 km east of the Tongan Group, 500 km south of the Samoas and 1000 km west of the Cook Islands.

There are 13 villages on the island, namely Alofi, Makefu, Tuapa, Namukulu, Hikutavake, Toi, Mutalau, Lakepa, Liku, Hakupu, Vaiea, Avatele and Tamakautoga. Of these the largest, Alofi, is the administrative focus for the 3896 persons at present (September 1976) living on the island. It is thought that the island was populated by Tongans and Samoans and that the first people came from Tonga early in the sixteenth century and settled on the northern part of the island. The southern half of the island was colonized by voyagers from Samoa whose departure from their homeland, Savai'i, was before the introduction of tattooing. In spite of these historic echoes, however, the present generation wants to believe they originated in Niue and, therefore, are 'true blue' Niueans.

In the history of Niue the worked farm was hardly known because the nature of cultivating land for crops is on a shift basis; however, plantations or plots are common, with an average size of 0.1-0.2 ha, planted on a progressive scale to ensure continuity of supply. This system continues until the parcel of land is all used up and the grower has to shift to another locality where his family owns another parcel of land. With this concept of land fragmentation, it is common practice for a Niue grower to plant his food crops - taros, yams, cassava (kapia), kumaras - in two or three different localities at one time.

The other strong reason for planting in this fashion is to protect family land from being used by someone else.
In most countries where commercial or semi-commercial growing is practised, it is essential that information on market demand and price forecast are obtained for planning purposes. In Niue, however, the only crops requiring this information are passionfruit and limes. No planning is needed for root crops. This is because everyone on Niue grows his own food crops and his main concern is to produce sufficient each year to feed his family. Any surplus is sold locally at quite exorbitant prices. The root crops grown on Niue are taro (main foodcrop), yams, cassava (kapia), kumara, and giant taro (kape: used only in time of famine).

**Land tenure**

Land tenure on Niue is by customary usehold - which means that traditional family lands remain under the jurisdiction of members of each family. Since many families are living in New Zealand and some have passed away without heirs to inherit their family land, certain holdings have either been taken over by distant relatives or else next-door owners have encroached on it and established their own history of uninterrupted usage, laying claim on it and thus adding more acres of land for their own families. Boundaries, too, are often poorly defined, for in many instances coconut trees, other large trees or rocks are used as landmarks and these are not permanent. The situation is further complicated by the high degree of fragmentation that has arisen as a result of intermarriage between families, or from common social practices such as the adoption of children within a wide family circle or from outside. Subsequent emancipation of these individuals, who by accepted custom may claim for a time to belong to one family but later secede to another family, may lead to land fragmentation.

Although under the new land law the Leveki Magafaoa (leader of the clan) is appointed to look after and allocate sections of land within the magafaoa (family), subject to agreement by all the members, there still remains a big problem as to how much land one should own. There has been a lot of 'griping' within families on boundaries, ownership, etc. and when there is no satisfactory resolving of these problems the faka magafaoa way, the matter is taken to the High Court.

Quite apart from problems arising from arguments between members of families living on Niue, there are also members living in New Zealand or elsewhere who put in their claim to
land being used by those in Niue. Where cropping is not on a permanent basis there are fewer problems with land usage; however, when it concerns semi- or permanent occupancy and where cash benefits are involved, there are bound to be problems, as has been proved with the development of passion-fruit and lime production on a larger scale (1.2–2.0 ha per family).

Labour

Labour in Niue is a very rare commodity, emigration to New Zealand and employment in government jobs being largely responsible. Census figures taken in September 1976 show that out of the total population of 3896, 763 are being employed by the government and in private sectors. The remainder (659) are engaged in non-wage family employment.

Because of this lack of labour, individual families depend on their members to carry out planting and maintenance of their own food crops as well as maintaining pollination and harvesting of their passionfruit and lime areas. Under the present system, it is apparent that the best growers on the island are mature public servants who probably owe a lot of their success to the discipline and organization learned whilst performing government duties. A good example of this has been provided by the retired schoolteachers and policemen who at present could be regarded as the best growers on the island.

Since Niue became self-governing, the government has been very conscious of the need to increase the productivity of the land. Realising that there is a shortage of labour and also that the best producers are employed in the government service, the Niue Public Service has tried negotiating with the State Services Commission in New Zealand in the hope of giving early retirement to those who have only a few years left to serve, on a full superannuation benefit basis, so that they will have a few more useful years working on the land. Consideration has also been given to working four days only a week with one day solely devoted to agricultural production, but for several reasons the idea was dropped in favour of early commencement of the working day as well as finishing at 2.30pm in summer and 3pm in winter, with only a half-hour break for lunch each day. The four-day week concept, however, has not been altogether discarded as the government has a continuing interest in its implementation provided it is feasible.
The source of capital for lending purposes on Niue is practically non-existent. The only body which assists with land development at present is the Niue Development Board which was established in September 1966 primarily to promote economic development on the island.

The Board is a statutory body whose power for development is limited by funds granted each year by the New Zealand Aid Programme. Currently the moneys provided are sufficient only to continue with the development of the 'cattle under coconut' project, the Passionfruit/Limes Scheme and the processing of fruit and meat. The procedure is that the Board develops passionfruit and lime areas or both on application by the growers and the cost of development is paid from the proceeds of the fruit on a 50/50 basis until such time as the debt is fully recovered. Then the grower receives all returns.

In 1960, the Agricultural Department operated a scheme whereby growers, upon application, could have their areas disc-ploughed for growing kumaras for export to New Zealand. The expenses for discing were paid from returns on the crop. The program ran smoothly for several years until it was discovered that the tubers were infected by the fungus, black rot, and the kumara weevil. Consequent upon these discoveries, the North Island markets were closed, and although the South Island market remained open, the quantities exported were not sufficient to make growing worthwhile. After the Kumara Production Scheme fizzled out, the discing program continued for the purpose of growing taro for supplying firstly the local market and then the New Zealand market if sufficient quantities were produced. During 1963-64 there were sufficient taros grown for a trial shipment to be made, but the return was not sufficient to meet even the local expense. So from that time on the growing of taro for export was deferred indefinitely, and it is very unlikely that it is worth reviving.

An island like Niue can be classed as one small rural area, so that an economic development program can be easily organized and managed by one controlling committee. The Niue Development Board is presently managing and organizing all the land development programs and in spite of experiencing certain difficulties, e.g. finance, is managing quite well within the scope of its responsibilities. At present its
main responsibilities are passionfruit, limes and pasturing cattle under coconuts. The addition of root crops to these could be a drain on resources, especially manpower. Too much diversification could also be a big danger.

**Distribution of proceeds**

Since there are no commercial ventures in rootcrop production on Niue, perhaps it would be feasible for the purpose of this exercise to show how proceeds are distributed to a family from the Passionfruit/Limes Scheme. All farming activities are carried out by the family. At the end of each month when the proceeds from the fruits are paid out, the head of the family, under whose name the area is registered, collects all the proceeds. The money is spent on food, clothing, etc. for the family. Already one or two farmers have purchased motor cycles and pick-up vehicles which make travel to the plantation easier than if on foot or push-bike. If the head of family likes drinking beer and smoking a lot, a substantial amount of the proceeds will naturally be spent on these. Often too much money is used on these commodities and the younger members of the family refuse to carry on with pollination and harvesting chores. The young members, especially those still attending school, wish to see their share of money given to them so that they can lodge them in their school banking accounts.

Before the 1.2-2.0 ha holdings came into operation, there were quite a lot of growers, especially the keenest, who would save the proceeds from passionfruit and limes to pay their fares to New Zealand to live. Some of these people, however, found life too restrictive and disciplined working in factories in New Zealand; also, to pay for everything they receive is quite out of the normal way of life for a Niuean when he is used to an island where a coconut can be opened to drink and the flesh eaten without paying for it.

The difficulties now encountered with the distribution of proceeds does suggest two things:

(a) that growers must be educated to spread their money into things that will further production; and

(b) that holdings of land must be increased so that the growers are really committed to something worth while, which also involves larger returns and rewards.
Co-operative yam gardens: adapting a traditional agricultural system to serve the needs of the developing Tongan market economy*

R.R. Thaman

My purpose here is to present the co-operative yam garden or *toutu' u 'ufi*, as practised in the Kingdom of Tonga, as an excellent example of a 'traditional' agricultural activity which has considerable potential for adaptation to serving the needs of developing market economies, both in Tonga and possibly elsewhere in the Pacific Islands. The paper is based on the preliminary analysis of survey data collected on Tongatapu, the main island in the Tonga group, during a one-year study of the Tongan agricultural system in 1971 (Thaman 1975b) and two month-long visits in 1977.

The basic underlying contention of this paper is that there are existing agricultural systems or 'agroecosystems' (Jantzen 1973) in the Pacific Islands which have evolved over many generations, and are ecologically adapted to the islands, require few modern technological or other imported inputs, provide an excellent supply of nutritious and preferred foodstuffs, are very socially acceptable, and, finally, have possibly greater commercial potential than many recently introduced crops, currently championed in the Pacific Islands. Walsh (1975), Fisk (1976) and Thaman (1975a, 1976) have previously stressed the need for greater focus on such systems as bases for agricultural development. Furthermore, if in fact we fail to try better to understand the technological, economic, ecological and social importance of such systems, and instead continue to focus almost singlemindedly on commercial crops such as coconuts, cocoa, bananas, coffee,

*The author was assisted in the data collection for this study by Dick Johnston, a friend and member of a co-operative yam garden in Tonga, and by three Tongan student research assistants from the University of the South Pacific, Laki Tupou, Taliai Niumeitolu and Hasiloni Fungavai.
ginger, sugar cane, etc., and to stress what Blaut (1967) has called the 'tropicalization' of mid-latitude agricultural technology, many of these systems may become extinct before we understand their true value and developmental potential. There are numerous examples of the deterioration or extinction of proven agricultural systems in the Pacific Islands, such as the cessation of flooded terrace taro cultivation in Hawaii, New Caledonia and the Cook Islands (Barrau 1958:21; Sevele 1972:9) and the deterioration of yam and paper mulberry gardening in Fiji. Similarly, the results of a survey in Tonga (Sevele 1972:9) showed that 'many of the older farmers expressed regret at the increasing discard of some of the 'proven' agricultural methods, and at the reduction, over the years, in the range and amount of commodities produced by the average farming household.

In short, before overseas agricultural education and introduced technology help to bring about irreversible modification of present Pacific Island agricultural systems, it is time to take a much closer look at these systems and their developmental potential before it is too late.

Nature of the toutu'u 'ufi

The toutu'u 'ufi or co-operative yam garden has been described by a number of people (E. and P. Beaglehole 1941; Maude 1965; Thaman 1975b; Rogers 1975). Rogers' description and analysis of these gardens (on the northern island of Niuatoputapu) which he describes as 'joint agricultural enterprises' is particularly good.

The principle of the toutu'u 'ufi is that a group of men or women band together, and on a single plot of land, which has been donated on a usufruct basis, clear and fence the land, and allot sections to every member for the cultivation of yams and associated crops. After or before the yams are harvested, a follow-on crop is commonly planted for harvest during the second or third year, and occasionally a third major crop is planted before the land is allowed to revert to fallow and returned to the donor. Clearing, planting yams, fencing and harvesting are usually done as a group, whereas the planting of supplementary crops, weeding, etc. are usually done individually by the section holders, but subject to periodic inspections to insure that the members have planted the required crops, have adequately maintained them, and that there is no harvesting of immature yams before a predetermined harvest date.
Although the *toutu'u* is a very old concept and was widely practised in the past, the number of households taking part in *toutu'u* activities in 1976-77 seems to have increased considerably since 1970-71, when only about one-third of 142 sample Tongatapu households had members in *toutu'u 'ufi* (Thaman 1975b:177). During 1976-77, however, well over 50 per cent in most areas (including the capital city of Nuku'alofa), and almost all households in some rural villages such as Niutoua, had members participating in *toutu'u 'ufi*. Rogers (1975:168) found that in one sample survey of 37 Niuatoputapu households, only three did not have sections in at least one *toutu'u* garden and that the average number of sections per household was 3.4, with some having as many as nine sections. Finally, before looking at these gardens in greater detail, it should be mentioned that, although the focus of this paper, the *toutu'u 'ufi*, is by far the most common, there are also similar co-operative gardens where sweet potato, sweet yam, taro, giant taro, kava, paper mulberry or even cassava is the first crop planted in the sequence.

**Membership.** In terms of the number of members, the range for the Tongatapu study was from two (the Minister of Lands and a high ranking member of the Agricultural Department) to 50 (in the case of a *toutu'u* for employees of the government prison farm in Huatolito-li). The average, however, was ten and the median 12.5 members. Church membership seems to be the basis for almost one-half of the 30 or more *toutu'u 'ufi* studied. Other bases were: membership of the same club (kava drinking clubs, school old-boy associations, social clubs, women's weaving clubs or Bible study groups); a common place of employment (e.g. teachers from a given village primary school or employees of the prison farm); co-operative work groups (*toungaue*) and registered co-operative organizations; or just friends from the same village. With the exception of *toutu'u* formed by residents of the capital city of Nuku'alofa, the members were almost always from the same village. The members of most *toutu'u* are men but there seems to be an increasing number with the sections nominally held by women (although male relatives generally do most of the heavy work).

**Nature of land tenure.** The land cultivated by the *toutu'u 'ufi* members is usually donated on a usufruct basis for a period of two to three years. The donors are usually at least nominally members of the *toutu'u*. In a number of cases where old men or widows who have rights to land, but
are unable to provide labour, have strips in the *toutu'u*, these are worked for them by relatives or friends. In some cases the *toutu'u* are planted on church or government land or on uncropped allotments of Tongans currently overseas. In return for the use of the land, the donor is almost always presented with yams at harvest time, receives his allotment cleared of heavy bush, or in some cases will have the members of the *toutu'u* plant coconuts and maintain them for a two or three-year period.

**Quality of land.** In the cases of all the *toutu'u* studied on Tongatapu, the land was in bush, degraded grassland or, in a few cases, forest, before its cultivation by the members. Mostly, the land was under dense bush or forest, except in a couple of cases where three to five year stands of guinea grass (*Panicum maximum*) were cleared and in one case of two year fallow which the *toutu'u* members cleared to free newly planted coconut palms which were being choked out by the guinea grass, thus providing a service to the landowner in exchange for usufruct rights to the land. The pattern on Niuatoputapu was similar in that most gardens were cleared from heavy bush. In contrast with Tongatapu, however, where most land is suitable for arable cropping, only just over one-third of the households studied had suitable arable land, and the remainder planted yams in *toutu'u* on arable land donated by others (Rogers 1975:137-8). Thus, *toutu'u* are almost always planted on relatively fertile land which has been under fallow for a considerable period, and in the process the members provide a service to the land donor by clearing the land.

**Size of gardens.** The size of the *toutu'u* depends on the number of members, the number of rows of yams or the size of the section that each member has, and the availability of land. The number of rows of yams per member per section or strip in the *toutu'u* ranges from five to 20 (people with more than one section or members of *toutu'u* with few members and abundant land), with the average being six to eight rows. The distance between yams in a row was usually 2-3 metres (depending on whether long or short yams were planted), and staggered at approximately 2 metres between rows. The length of the individual sections ranged from 20 metres to 160 metres with the average being 45 to 55 metres (distances are usually measured in fathoms or *'ofa* which are equivalent to 1.8 metres. An entire *toutu'u 'ufi* can range from under 0.4 hectare to greater than an entire 3-1/3 hectare bush allotment (the most common size for statutory Tongan bush
garden allotments), with the average size *toutu'u* ranging from 0.8 to 2.0 hectares, and the individual sections averaging about one-tenth of a hectare each. In Niuatoputapu, Rogers (1975:168) found the average *toutu'u* to be about 1.4 hectares, with just over 20 sections averaging 0.13 hectare each.

**Crop types.** On Tongatapu the first and major or dominant crop in the *toutu'u* cropping sequence was in all cases the greater yam (*Dioscorea alata*), except on one *toutu'u* *kumala* (co-operative sweet potato garden) which was planted on an allotment previously under a tumbledown fallow of cassava. On the 22 sample *toutu'u* 'ufi examined in detail, there were 23 distinct yam cultivars planted in these gardens, the most common being long yams of traditional importance ('ufi kali) such as *kahokaho* and *kawmeile* which were cultivated in all 22 sample *toutu'u* 'ufi (Table 1). Of lesser but also of considerable importance were the round or late yams ('ufi tokamui), such as *maho'a'a*, *paholo* and *voli*, which are also *Dioscorea alata*. Cultivars such as 'ufi Fisi (the Fijian yam), *ngu* and *tua'ata* are also commonly found in *toutu'u* 'ufi and may be cultivars of *Dioscorea nummularia*.

With respect to intercropping, the cropping combinations rarely included non-traditional plants, and plants of high traditional importance such as giant taro, plantain, and swamp taro were intercropped with yams in almost all instances (Table 1).

Other traditional crops such as Polynesian arrowroot, sweet yam, *pele* and sugar cane were sometimes planted around the borders, and paper mulberry and kava were often planted when the yams began to mature. Corn was often planted to provide support for the yams, while *Xanthosoma* spp. and bananas were found in only one instance. In one area, coconut trees were planted throughout the *toutu'u* as a gift to the land donor. In Niuatoputapu, however, Rogers (1975: 169) found that there was more heterogeneity, with yams, sweet yams and giant taro being most common as a dominant first crop.

With respect to the dominant follow-up crop to yams, 18 of the 22 *toutu'u* planted on the same land after the yam harvest. Based on these 18 *toutu'u* and data on 14 of the same respondents' previous year's *toutu'u*, the most frequent follow-on crops were *Xanthosoma* spp., paper mulberry and sweet potato (Table 2). Other follow-on crops included
Table 1

Frequency occurrence of specified crops planted during the first year of 22 sample toutu'u 'ufi on Tongatapu

<table>
<thead>
<tr>
<th>English name</th>
<th>Tongan name</th>
<th>Scientific name</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>greater yam</td>
<td>'ufi</td>
<td>Dioscorea alata</td>
<td>22</td>
</tr>
<tr>
<td>giant taro</td>
<td>kape</td>
<td>Alocasia macrorrhiza</td>
<td>21</td>
</tr>
<tr>
<td>plantain</td>
<td>hopa</td>
<td>Musa balbisiana</td>
<td>19</td>
</tr>
<tr>
<td>swamp taro</td>
<td>talo Tonga</td>
<td>Colocasia esculenta</td>
<td>17</td>
</tr>
<tr>
<td>corn</td>
<td>koane</td>
<td>Zea mays</td>
<td>5</td>
</tr>
<tr>
<td>Polynesian arrowroot</td>
<td>maho'a'a</td>
<td>Tacca leontopetaloides</td>
<td>4</td>
</tr>
<tr>
<td>sweet yam</td>
<td>'ufilei</td>
<td>Dioscorea esculenta</td>
<td>3</td>
</tr>
<tr>
<td>paper mulberry</td>
<td>hiapo</td>
<td>Broussonetia papyrifera</td>
<td>3</td>
</tr>
<tr>
<td>American taro</td>
<td>talo Futwa,</td>
<td>Xanthosoma spp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>talo tea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>bush cabbage</td>
<td>pele</td>
<td>Hibiscus manihot</td>
<td>1</td>
</tr>
<tr>
<td>kava</td>
<td>kava</td>
<td>Piper methysticum</td>
<td>1</td>
</tr>
<tr>
<td>coconut</td>
<td>niu</td>
<td>Cocos nucifera</td>
<td>1</td>
</tr>
<tr>
<td>sugar cane</td>
<td>to</td>
<td>Saccharum officinarum</td>
<td>1</td>
</tr>
<tr>
<td>banana</td>
<td>siaine</td>
<td>Musa (AAA triploid clone)</td>
<td>1</td>
</tr>
</tbody>
</table>
### Table 2

**Frequency occurrence of specified crops commonly planted as follow-on crop to yams in 18 sample *toutu'u 'ufi* continued during the second year**

<table>
<thead>
<tr>
<th>English name</th>
<th>Tongan name</th>
<th>Scientific name</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>American taro</td>
<td>talo Futuna, Xanthosoma spp.</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>paper mulberry</td>
<td>hiapo Broussonetia papyrifera</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>sweet potato</td>
<td>kumala Ipomoea batatas</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>swamp taro</td>
<td>talo Tonga Colocasia esculenta</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>kava</td>
<td>kava Piper methysticwn</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>giant taro</td>
<td>kape Alocasia macrorrhiza</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>cassava</td>
<td>manioke Manihot esculenta</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
swamp taro, kava, giant taro and cassava. In about one-half the toutu'u studied the members were all required to plant the same crop, whereas in the others the members could please themselves.

In only five of the above 18 cases did the toutu'u members plant crops during the third year before returning the allotment to the donor. In four cases cassava was planted and in one case Xanthosoma was planted a second time on the same plot before it was allowed to revert to fallow.

Nature of toutu'u activities. After acquiring land, the first task carried out by the members of the toutu'u is to measure and assign sections to the members (kelikeli). This is generally done by the leader of the group (angi) in June or July, and shortly thereafter the members, usually as a group, cut the bush or forest (kini) and burn the dried plant remains two or three weeks later. In two cases ploughs were hired to prepare the land, and approximately one-third of the sample toutu'u groups did not burn, in order to protect coconut trees. These activities might be carried out earlier or later depending on the desired harvest date.

The holes are dug (keli) and the yams planted in mounds (fakaheka) on a single date, usually between August and October, unless the toutu'u is specializing in early yams ('ufi tokamu'a) in which case the seed yams are specially prepared and planted earlier. Of the other crops, giant taro is often planted first to mark boundaries (kaufu) between sections, although it is also commonly planted after the yams. Other crops such as plantain and swamp taro are generally planted a month or two after the yams towards the wet season (December to April). Paper mulberry is often planted between yam mounds as the yams begin to mature. Approximately half of the sample toutu'u planted yams as a group on a predetermined date, and the rest planted individually. Other crops are generally planted individually, but in accordance with predetermined quotas and before dates set by the members.

Weeding (huo or epu) is done as needed, almost always on an individual basis, with the first weeding (huo manumua) usually coming from two weeks to two months after planting, depending on the amount of rainfall. For all phases of work, there are periodic inspections (a'ahi), and if a member fails to complete a task, for example, his monthly weeding, he is fined or must provide tea for the next meeting of the members.
The harvest date, or presentation of the first fruits (polopolo) when the first yams are dug up (utu), generally falls between April and June, often coinciding with a public holiday or an important religious occasion. The 'first fruits' are always harvested together, with kinsmen or friends helping the members. The activities on this day include: feasting in the yam gardens with yams, pigs and other delicacies being cooked in underground ovens ('umu); competitions for the longest, heaviest and often the 'most beautiful' yams; and the presentation of gifts of yams (usually three to five from each member), which are distributed to the donor of the land (this being the land rent or tau vao), to ministers and other church officials, to people who provide labour or food for the feast or to others such as the town officers, the local noble or even the Royal Family, when appropriate. Only a few of the best yams are dug up at this time and after this harvest and presentation each member can harvest the remainder as he pleases to eat, store, sell or save as planting material for next year's crop. Early yams are generally harvested from December to March.

The giant taro, plantain, swamp taro and other crops which were intercropped with the yams are harvested individually as they mature, and as need arises, the owners being free to dispose of them as they see fit.

After the yams are harvested, taro is often planted in the old yam hole (luo ki puke), or sweet potatoes, paper mulberry or kava are planted, almost always on an individual basis. These are likewise almost always harvested by individual members, and only infrequently is any of this second or a third follow-on crop such as cassava, if there is one, given to the donor of the land.

**Present and potential importance**

**Economic potential.** The present and future economic potential of the concept of the toutu'u 'ufi seems considerable. First, in terms of non-cash returns, these gardens provide the owner with abundant supplies of high quality yams, plus a two- to three-year supply of other products from the toutu'u, thus obviating the need to buy these products for subsistence and ceremonial purposes.

In terms of direct cash returns, yams command a very high price at the local market, Nuku'alofa, ranging from T$3 to T$14 per basket in 1977, and are sold both for direct
consumption and for use as seed yam. Returns for paper mulberry, one of the most common follow-on crops to yams, were also very high in 1977, a bundle of 20 mature stems selling for T$10-T$15. Based on these prices and the current shortage of paper mulberry for the tourist tapa cloth market, it is estimated that profits as high as $1200 to $1700 per hectare per year for two to four years could be obtained by planting paper mulberry. This is far above the yearly income of the average Tongan. Many of the other crops grown on a *toutu'u* basis also command good prices and if not sold can be consumed.

There is also an expanding overseas market for traditional produce. Yams, especially the round varieties like *maho'a'a* and *voli* are currently returning T$9 per 25-kg case from New Zealand (M. Anders 1977: pers. comm.). The current demand, primarily from the island communities there, is 1000 cases per month. Similarly, it is currently impossible to fulfill the present monthly demand of 3000-5000 23-kg cases of swamp taro and 1000-2000 cases of American taro, both commonly planted in the *toutu'u* cycle. There is also a good market for plantains which return T$12 per case to the farmer and a limited market for giant taro which fetch T$3-T$7 per stem. A market was also just opened up for cassava which, when cooled shortly after harvest, returns to the farmer T$3-T$6 per 11-kg case. There is also considerable scope for kava marketing both in Fiji and in the United States and Germany where it is used medicinally in the preparation of depressants (Anders 1977: pers. comm.). In short, although these are only estimates quoted to me by an employee of a shipping line currently transporting Tongan produce to New Zealand, they are a clear indication of the considerable potential for the marketing of the 'traditional' products cultivated in *toutu'u* gardens. With further market research and the opening up of other markets such as Pago Pago, Noumea or the West Coast of the United States the prospects might be even brighter.

Other economic benefits mentioned by Rogers (1975:165-7) include: a more equitable distribution of first-class land in a 'land poor' country; easing heavy work by joint effort; the mobilization of a youthful workforce (many young and often unemployed men and women work sections in *toutu'u* gardens, the women often planting and maintaining the paper mulberry); and finally the preservation of crops until they are mature, thus yielding maximum economic benefits. Similarly, land which is under-utilized because the owner
is too old or is overseas is often worked by *toutu'u* and many full-time wage earners are also members of *toutu'u* and consequently make productive use of their free time after work or on the weekends. Finally, in some cases the land donor may realize considerable long-term economic gain when the members of a *toutu'u* plant new coconut palms on his land as a form of land rent.

**Technological importance.** In the light of the limited number of successful introductions of totally new technologies into Pacific Island agricultural systems, the technological importance of the *toutu'u* gardens should be mentioned. First, the cropping complexes used in the gardens depend on traditional varieties which have evolved over thousands of years. They are well adapted to the local environment, require limited care, show low susceptibility to diseases and other pests, require few if any imported inputs or technology, and the required husbandry techniques are well-known to Tongans. Second, the co-operative effort of the *toutu'u* seems to encourage a higher standard of crop husbandry and, by working together, technological knowledge relating to the cultivation of yams and other crops is often shared. This is particularly important to young men who seem increasingly ignorant of the valuable traditional agricultural practices. Third, the garden ensures an abundant supply of nutritionally valuable crops, often nutritionally superior to many of the imported substitutes, as well as a reliable supply or 'genepool' of planting material. Most of these crops also store well in the ground until needed, thus obviating the need for sophisticated storage systems, a major problem facing the banana and fresh fruit and vegetables export industries in Tonga.

**Social importance.** Also of importance in terms of the ultimate acceptability of a given developmental model is its social importance or acceptability. First, the satisfaction derived through group participation is a commonly mentioned reason for the popularity of membership in *toutu'u* enterprises. Maude (1965:141) remarks that:

> Indeed, there seems little doubt that social considerations are dominant in the formation of many *toutu'u* groups, and one perceptive informant suggested that some are formed simply as an expression of the friendship between a group of men, rather than for any more practical reason.
The very fact that some of the more important social institutions, such as the churches, social clubs, etc. place such emphasis on toutu'u also reflects their social acceptability. A major social consideration also seems to be the very important place of the yam in ritual exchange. It is a very valuable commodity in maintaining prestige by fulfilling social obligations (kaveinga) through ritual exchange of yams which are given to older sisters (who have superior social rank to their brothers), nobles, members of the church, relatives, friends or the Royal Family. In fact, His Majesty King Taufa'ahau Tupou IV belonged to four toutu'u in 1977, three of which were worked for the King so as to fulfill traditional social obligations to him.

Similarly, all of the major plants cultivated in the early stages of the toutu'u - yams, giant taro, swamp taro and plantains - are all important foods for traditional Tongan feasts (faka'afe) on special occasions. These foods, the gardens themselves and the associated technologies of the toutu'u 'ufi would seem to have a considerable social or sentimental value in terms of the 'primordial belongingness' (Cohen 1976) attached to them. Because of the high standard of husbandry, the gardens would also seem to have considerable aesthetic value.

Problems. When questioned about the disadvantages of toutu'u gardens most informants felt that there were very few problems apart from differences of opinion within the group, lack of freedom to do as one pleased, and in some cases theft. In most cases, however, theft seems to be greater from individual gardens than from toutu'u, possibly because of the inherent social control associated with these gardens. One problem which might be most critical is the relative scarcity of land in Tonga. The question then arises whether a model along the lines of the toutu'u might in fact be the best way to utilize this land.

Conclusion

The inherent as opposed to externally induced importance of the toutu'u system to the Tongan society may mean that there is a greater chance for the success, survival and expansion of such a system to adapt to the increasing needs of a market economy. Sevele (1973:173-5), although never mentioning toutu'u in his study of Tongan socioeconomic development, remarked, when discussing obstacles to increased production that:
one of the most interesting points that emerged from discussions relating to this question was that practically all of the growers associated increased production with cash cropping. The growers' main concern was cash crop production. To them there was no obstacle to increased subsistence output.

In other words, the Tongan farmers themselves possibly see traditionally subsistence-based systems such as the *tou*tu*’u* *’ufi* as the easiest means of increasing production. Furthermore, if the market for these traditional crops is as good as it seems, increased cash production, and socially acceptable and nutritionally sound subsistence production might be accomplished simultaneously, thus protecting the Tongan society from the degradation of its traditional agricultural practices and from a state of 'agricultural involution' as described by Geertz (1963).

In short, the *tou*tu*’u* ’ufi* or communal yam garden is one example of a technologically sound, socially acceptable and very productive traditional 'agroecosystem' which seems to have been increasing in importance in the past three years, perhaps as a reaction against the difficulties faced by the banana industry. More important, it is done *faka Tonga* (in the 'Tongan way') and might serve as a model for agricultural development planners in the Pacific. As Walsh (1975:120-1) remarked after studying approaches to agricultural development in Niue:

If Pacific Islanders are not changing in the direction desired by economic planners, the fault lies not with the intrinsence [sic] of the subsistence farmer as is most commonly assumed, but with the plan or the planners. This, anyway, is the approach the subsistence farmer would probably take if he was asked to make a report on the activities of administrators and experts. And it is him we need to convince.
Section C
Studies raising special issues
Chapter 9

Some ideological considerations relating to tropical root crop production

D.G. Coursey

The problems of interaction of subsistence agricultural systems with western-style market economics are complex in the extreme, but form a subject area of paramount importance to the development of the tropical world. With perhaps a quarter or a third of the world's population living within, or at least dependent for food supplies on, tropical subsistence economies, these problems may well be crucial to the future of world civilization. Fisk (1977; elsewhere in this volume) has drawn attention to the comprehension gap that exists between those concerned with macro-economic planning and those with knowledge of traditional tropical subsistence societies: this gap appears to be just as great, whether the economists are capitalist or Marxist in their orientation.

This comprehension gap is even wider when subsistence agricultural systems based on vegetatively propagated crops - root crops, plantains, breadfruit, etc. - are being considered rather than those based on grain or other seed crops, and it is these vegetatively-propagated crops that are so often the basis of subsistence in the Pacific region. It is reinforced by differences in conceptual approach which make the underlying philosophies of those whose culture revolves around these crops seem alien and even antagonistic to those who have been enculturated under other patterns of thought. These differences have, I believe, extremely ancient culture-historical origins.

Viewed in terms of their contribution to world nutrition, the tropical root crops play a much greater role than is generally realized or than would be suggested judging by the attention they have hitherto received from agricultural scientists (Coursey and Haynes 1970). Recent production statistics (FAO 1975) indicate that the total harvest of root crops in the developing world is of the order of 170
million tons per annum which, expressed nutritionally, represents something of the order of $10^{14}$ joules of food energy. If it is assumed that the carbohydrate or staple component of a diet represents half the total food intake, the tropical root crops thus provide the food of around 500 million people in the tropical developing world: or, approximately a quarter of the total population of the areas embraced by that term. Cassava is the most important, globally accounting for almost two-thirds of the total (see Table 1).

Most of the subsistence food crops of the tropical world have been greatly neglected during recent decades compared with the plantation crops or other cash crops whose products enter directly into the international market economy. This seemed logical to the administrators in the first half of the present century when, in most of the tropical world, food shortages or famines were of relatively infrequent occurrence, comparatively localized and seldom exceedingly serious. Research and development inputs were concentrated on crops the production of which would draw the developing world countries into the international market economy, and at the same time generate the cash flows needed for the creation of modern administrative infrastructures (Hutchinson 1972). Even compared with other tropical food crops, however, the lack of research activity devoted to the root and other vegetatively propagated crops until recently is striking. Since the holding of the 1st International Symposium on Tropical Root Crops in Trinidad in 1967, there has been a marked upsurge of interest in these crops but before that time they had received extraordinarily little attention. That symposium, and those that have followed it in Hawaii in 1970, Nigeria in 1973 and Colombia in 1976, together with several more specialized local meetings, have done much to focus attention on the tropical root crops.

Partly as a result of this lack of research activity, the value of tropical root crops and the contribution that they can make to world food supplies are greatly misunderstood. The studies published by de Vries, Ferweda and Flach (1967) and Morgan Rees (1967) indicated the enormous yields that can be achieved with many of the tropical root crops, compared with the better-known grain crops, even in their present virtually unimproved state, and have done much to correct the earlier, very widely held view that the root crops are inefficient food producers. Cassava, in particular, is one of the most efficient producers of carbohydrate known.
Table 1

The principal tropical root crops*

<table>
<thead>
<tr>
<th>Crop</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cassava (tapioca, manioc or yuca)</td>
<td><em>Manihot esculenta</em> Cranz</td>
</tr>
<tr>
<td>Yams</td>
<td><em>Dioscorea spp</em> (principally <em>D. alata</em> L.; <em>D. esculenta</em> (Lour.) Burk; <em>D. rotundata</em> Poir. and <em>D. cayenensis</em> Lam.)</td>
</tr>
<tr>
<td>Sweet potato **</td>
<td><em>Ipomoea batatas</em> (L.) Lam.</td>
</tr>
<tr>
<td>Potato #</td>
<td><em>Solanum tuberosum</em> L.</td>
</tr>
<tr>
<td>Taro (eddoe, dasheen)</td>
<td><em>Colocasia esculenta</em> (L.) Schott</td>
</tr>
<tr>
<td>Tannia (Yautia, ocumo)</td>
<td><em>Xanthosoma sagittifolium</em> (L.) Schott</td>
</tr>
</tbody>
</table>

* A number of other, minor crops can be included; see Coursey and Haynes 1970.

** Although of central American origin, this crop has been developed most extensively as a summer crop in warm temperate countries (e.g. southern USA) outside the developing world.

# This crop, although of highland tropical origin, is far more important as a temperate, than as a tropical crop.

Their nutritional value is now better appreciated than before. Their role is primarily that of staple foods, providing carbohydrate (i.e. energy) in the diet. Current thinking on global nutritional problems is tending more and more to accept that the provision of an adequate energetic base for a diet is of greater importance than protein supplementation. The generalization that they contain little, if any, protein, and that their consumption is in some way 'responsible' for the incidence of protein deficiency diseases such as kwashiorkor is only partially justified. Cassava is admittedly exceedingly low in protein...
content, but some of the other crops, notably yams and the aroids, have protein contents which on a dry weight basis are comparable with those of some of the grains (Coursey and Haynes 1970). Under the humid tropical ecosystems to which most of the non-grain staple crops are particularly well adapted, their high yield capacity may often mean that they can out-produce grain crops in terms of both energy and protein per hectare per year (Coursey and Booth 1977).

The tropical root crops have suffered not only from misunderstanding, and lack of attention, but even, in some cases, positive opposition. A remarkable statement is quoted by Uchendu (1970) that these crops are solely 'the inferior foods of inferior peoples', a statement which few would seek to justify today. In much of Asia great civilisations have been grain-based. Rice especially has been closely linked philosophically with civilisation itself and afforded royal patronage and elements of sacrosanctity. Non-rice eaters are still normally regarded as poor and disadvantaged. This type of irrational and mythopoetic thinking has often surrounded the vegetatively propagated staple food crops.

Irrational opposition of this type is not confined to the tropical world, or to recent decades. The potato, which has now become one of the major temperate staple food crops, and which similarly is propagated mainly by vegetative means has not escaped similar approbrium. When it was introduced into Europe in the fifteenth and sixteenth centuries, it was initially adopted mainly by socially or economically oppressed groups of people (Salaman 1949) who recognized its virtues as a food producer. The potato and those who ate it were held in disdain by the more traditionally-minded established authority during the seventeenth, eighteenth and nineteenth centuries, at least partly because the crop was grown in what appeared an unnatural manner, that is from a seed tuber rather than from true seed. This, together with the fact that the edible portion is produced below ground, and that the plant is not mentioned in the Bible, was enough to cause the churches to preach sermons against it, as an invention of the Devil.

This leads to the primary thesis of this paper, which is that the neglect of and opposition to root crops, from which these and other vegetatively propagated food crops of the tropical world have suffered, arises not primarily from rational grounds, but at least in part from prejudices of cultural-historical origin.
The philosophical systems within which the development of science and technology occurred have very largely been formed in Western Europe during the past five centuries. Although many of the basic concepts and discoveries of modern science originated elsewhere, the synthesis took place in post-Renaissance Europe, and modern scientific thought has thus—almost unconsciously—become extensively interpenetrated with the pre-scientific, ethnocentric folklore and culture-historical myth of the European races. The earlier phases of technology which were generated in Renaissance Europe made possible the palaeo-Colonial expansion of European peoples—initially mainly Iberian, and later those from northern European countries—c. 500 Before Present (BP), and this expansion eventually led to the establishment of political and socio-cultural hegemony over the greater part of the world. In spite of the political changes of the last few decades, the socio-cultural hegemony still largely exists: and so strongly has it interacted with, and reinforced, the folk-ethnocentric elements in 'scientific' philosophy that virtually all those who have received a scientific education tend to think in traditional, pre-scientific European patterns, whatever their personal ethnic origin may be (Coursey 1972). Renaissance Europe that gave birth to modern 'scientific' philosophy was derived historically from the Mediterranean cultures of classical Rome and Greece, and culturally, through the Judaeo-Hellenic traditions to the much earlier Bronze Age civilizations of the eastern Mediterranean and southwestern Asia. These bronze-using cultures had in turn grown from the earlier cultures of southwestern Asia in which the domestication of grain crops and herbivores had initially taken place, in the process that has become generally known as the 'Neolithic Revolution' (Wright 1971). Thus, a direct continuous, culture-historical tradition exists, between the background philosophies of the science and technology of modern Europe and the so-called Neolithic Revolution. Throughout the entire culture history of modern Europe and these antecedent cultures, grains, together with some leguminous pulses and animal products have been the major foods. The vegetable foods, grains and pulses were all propagated from seed. The concept of 'seed time and harvest' has entered deeply into the thinking of peoples in all of the civilizations that have developed within this culture-historical continuum.

In these cultures food is thus instinctively and often indeed symbolically and ritually identified with bread grains, rice or other seed grains. Many of the pre-Christian
religions of the Mediterranean cultures and of early Europe were based on a reverence for corn and its products (Frazer 1922), as, indeed, is quite natural in view of the vital importance of the corn harvest to men's survival in these cultures. In more recent times, corn and bread have retained cultural significance, far beyond their nutritional role, within the framework of Christian symbolism (Jacob 1944). To the present day, the term 'daily bread' - a Biblical term, but with pre-Christian and even pre-Judean origins - remains virtually a synonym for food within European-derived cultures: it is even used in the modern, pseudo-scientific jargon of the advertising media. Vegetatively propagated crops were virtually unknown in European cultures before the introduction of the potato from America in relatively modern times. Although some root crops were known (the radish was extensively grown in ancient Egypt, while the carrot was domesticated in Europe during Roman times) they were all seed propagated and were accommodated within the conceptual framework of grain crop agriculture.

This influence of the cultural background on scientific thinking is aptly demonstrated by the fact that, when the FAO was first formed, to deal primarily with the problems of food and agriculture in the developing world, it took as its motto *Fiat Panis*: 'Let there be bread', and named its journal *Ceres* after the classical deity of corn, indicating dramatically the equation of grain and its product, bread, with food that exists in the European or European-influenced mind.

The root crop and other vegetatively propagated food plants of interest here are essentially plants of the humid or sub-humid lowland tropics, except for potato and some minor root crops, which are derived from the highland tropics of the Andes (Coursey and Booth 1977). Although the patterns of food production based on these crops have been greatly influenced in comparatively recent history, especially the last century, by contacts with grain-using peoples, predominantly Europeans, the origins of these crops and their domestication which brought them into symbiosis with man were almost completely independent of grain-based cultures. The cultural patterns that have developed in the tropical/equatorial regions where these non-grain staples are the basis of the food production system are most clearly seen today in the yam-oriented cultures of West Africa (Coursey 1967; Coursey in press; Coursey and Coursey 1971) and Melanesia (Coursey 1972; Tuzin 1972; Yen 1973), but there is
evidence for the existence, at a very early level of human cultural evolution, of 'a continuous ring of gardening cultures', based on the use of vegetatively propagated crops, extending right across the tropical/equatorial belt of the Old World from West Africa to Melanesia (Lomax and Berkoowitz 1972). This cultural continuum has been largely destroyed by the incursions of socially more highly organized, grain-using cultures into Northern and Eastern Africa, the Middle Eastern area, India, and to some extent the Indo-Chinese peninsula and Indonesia at periods in history which are fairly remote (c. 5000 BP), but nevertheless substantially more recent than the original domestication of either grain or root crops. In these intervening areas, except amongst a few relict peoples such as the non-Aryan Indian 'hill tribes' and the Negrito and Australoid forest peoples of Southeast Asia, cultural patterns associated with vegetatively propagated crops have been replaced by those that descend ultimately from the Neolithic Revolution. At the extremities, however, root crop oriented cultures have survived. In West Africa, the ancient yam cultures have in recent years absorbed the introduction of cassava. In Oceania, root crops, notably yam and taro, have remained prominent in Melanesia, and have absorbed the sweet potato in more recent times. The migrations which started from the Southeast Asian mainland, several thousands of years ago, carried rootcrop-oriented cultural patterns to the furthest islands of the south Pacific (Barrau 1965a, 1965b).

Somewhat similar cultural evolution with root crops as the nutritional base took place quite independently in early pre-Colombian times in tropical/equatorial areas of the New World. Here, cassava, *Xanthosoma* and sweet potato were domesticated, paralleling in many ways the yam and *Colocasia* cultures of the Old World (Bronson 1966; Lathrap 1973). Also paralleling historical events of the Old World, destructive culture contact took place in northern South America, firstly with indigenous Amerindian maize cultures, and secondly, even more disruptively, subsequent to the European 'discovery' of America in 1492. This latter contact, although it destroyed much of the existing social pattern, had the beneficial effect of disseminating New World crops to the Old, and vice versa. As far as food crops are concerned, perhaps the most important of these was cassava, whose cultivation has expanded almost explosively across the Old World tropics, mainly in the last few decades. This rapid dissemination was achieved often in the face of official opposition very largely through its spontaneous adoption by subsistence agriculturists,
already accustomed to other vegetatively propagated crops, who have recognized the production potential of the crop, its adaptability to marginal climatic and soil conditions, its immunity to many pests, and above all its high return of food per unit labour input.

Because of the identification of the civilizations ancestral to those of Europe and most of Asia with grain it has often been tacitly assumed that any non-grain-using culture must be an inherently low one; that only the grain-based cultures involve a real symbiotic relationship between man and plant; and that these must be contrasted sharply with all other cultures, where man is seen as being purely parasitic on his environment. This view has interacted with, and been reinforced by, the social and racial prejudices that have built up during the recent centuries of western hegemony over the tropical world. It is unjustified, however, as in many parts of the tropics peoples who use no grain crops, or use them only to a minor extent, have often achieved high indigenous cultural levels (Coursey 1972). The West African 'Civilisation of the Yam' is a good example: here throughout recorded history almost to the present, the yam-growing peoples have developed more sophisticated cultures than neighbouring grain-crop-oriented groups: it is conspicuous that it is in the Yam Zone of West Africa that the highest indigenous forest zone civilizations - Ashanti, Dahomey, Ife, Igbo-Ukwu and Benin - have emerged (Miège 1954; Coursey 1967; Coursey and Coursey 1971; Ayensu and Coursey 1972). To take a very different example, Bronson (1966) has shown that in spite of the reverence accorded to maize by the ancient Maya of Central America, an adequate nutritional base for their culture could not possibly have been supplied by this crop. Maize was extensively grown, but was used for ritual purposes, and as food by the priestly hierarchy, while such vegetatively propagated crops as sweet potato, jicama, cassava and Xanthosoma provided the staple food for the mass of the population. Although the Ipomoean culture of the New Guinea highlands may be historically fairly recent (Yen 1974), the existence of complex societies nutritionally based on the organized cultivation of yams, taro, and other root crops must be vastly more ancient; into the pattern of symbiosis between man and these vegetatively grown crop plants, the sweet potato fitted without difficulty (Watson 1965).

The philosophies of peoples whose cultures revolve round a nutritional base provided by vegetatively propagated crops as the staple are inherently different from those who
depend on the grain crop/animal husbandry complex. These differences may be seen as deriving specifically from the methods by which the different types of crop were originally brought into domestication by man. In the process of domest­
ticating plants man not only modified them to make them more suitable for food production, but, by initiating food pro­duction systems, was himself modified to become the product of an artificial nutritional/cultural complex. Human culture is itself in part the artefact of man's relationship with his crop plants and domestic animals: in domesticating them, he has himself been domesticated. The human consequences of the evolution of these contrasting food production systems have not been explored very extensively, but major cognitive and conceptual differences certainly exist, which have pene­trated deeply into human culture and ways of thought. An important difference in cultural behaviour between societies with grain-based agricultural systems derived from the Neolithic Revolution and those with vegicultural systems based on root and tuber crops of the Southeast Asian areas has been pointed out by Haudricourt (1964). The former, dealing with crop plants which require a direct, active and selective approach by man have led to an 'interventionist' type of mentality and ultimately to the type of cultural system that has now become dominant over most of the world. On the other hand, the more indirect and less positively active relationships developed between man and the vegetatively propagated crop plants of the tropical/equatorial regions have led to a 'non-interventionist' attitude of mind resulting in an altogether different view of man as an integral part of the overall ecosystem rather than as something above, separate, and dominating it.

The 'Neolithic Revolution' in which the grain crops were domesticated on the fringes of Mesopotamia 10,000 years or so ago was essentially a traumatic process, initiating rapid cultural changes which came about originally as a response to stress. The initial process of domestication arose from a series of events which took place in a location and a period that can closely be delimited, although its effects were ultimately to spread over the world, and through most of subsequent human history (Wright 1971).

The long culture-historical process that led from the Neolithic Revolution to the development of modern technology passed through two traumatic discontinuities that served to reinforce and emphasize the interventionist type of attitude that already had been inculcated by the initial stress-
reaction of the domestication situation. Firstly there was
the emergence of bronze-using cultures, whose metallurgical
base depended on fairly scarce, localized, mineral deposits.
The scarcity of the metal, whose possession conferred such
great military and economic advantages on those who controlled
it, favoured the development of more closely organized,
archonic social structures among those groups which had
access to copper and tin: these very groups, because of the
advantages conferred by the metals and organizations they
possessed, rapidly became dominant in the Southwest Asian
and Mediterranean worlds. Secondly, as has been discussed
in detail by White (1967), there was the adoption of medieval
Christianity, itself deriving from Asian and Mediterranean
sources, by the extremely vigorous but barbarian cultures
existing in northern Europe around 1500 to 1000 BP. This
event provided these peoples for the first time with a
theoretical basis for regarding themselves as a separate and
inherently superior creation from the rest of the biological
world, thus laying the foundations for the rapidly approaching
ecological crisis that the entire world now faces.

No such sudden break with the past, or with adjacent or
interpenetrating cultures was involved in the processes which
brought the non-grain staples into symbiosis with man in the
tropical/equatorial regions of Southeastern Asia, Africa and
America. No specific location or series of event was
associated with the process which took place in regions
diffuse in both space and time (Harlan 1971). The domesti-
cation of these crops can, indeed, be viewed merely as
another phase in the slow evolution of a symbiotic inter-
relationship between plant and man, emerging from the
concepts of 'protection' which non-agricultural peoples have
concerning their wild food plants (Burkill 1953; Barrau 1970;
Coursey and Coursey 1971; Coursey 1972). The beginnings of
this evolutionary process may indeed be as old as man himself:
it is possible that the relationship between pre-human hominids
and their plant foods may have contributed as much to
physical evolution as the more recent domestication process
has to man's cultural evolution (Coursey 1973b).

After the domestication of the vegetatively-propagated
crops, and the establishment of food production systems based
on them, had occurred, no further traumatic changes took
place in the cultural evolution of the tropical 'gardening'
societies comparable with those that have just been discussed.
Most of these cultures remained with only stone tools until
the ethnographic present, or made the transition directly
from Stone Age to Iron Age without any significant intermediate use of the copper-based metals. Highly socially stratified societies with technologically sophisticated artefactual complexes did not therefore emerge. The pagan religious systems that remained dominant throughout their history until very recent times laid much emphasis on maintaining a proper balance between man and the ecosystem of which he formed a part, and indeed those elements within traditional pagan religion that are concerned with plant life and food production are often very largely systems of ritual sanction designed to regularize and control the interaction of man and his crop plants to mutual advantage (Barrau 1965a, 1965b; Coursey and Coursey 1971; Tuzin 1972).

These inherent differences in approach to different classes of food crop, coupled with the interpenetration of scientific thinking by ideas derived from European or Asian traditions oriented to grain crops, have made the application of the conventional wisdom of the modern world to the problems of societies which have the vegetatively propagated crops as their nutritional and cultural base, inherently difficult. Resistance to these crops and the 'alien' cultures to which they belong is often felt, perhaps even at the unconscious level, in the mind of the European or Asian trained economist, planner or scientist, his psychological approach being necessarily influenced by the history of the culture in which he was brought up. The recognition of the significance of such culture-historical and even psychological factors is a major priority in overcoming the barriers that they have artificially created against developments based on tropical root crops that could lead towards greater realization of their potential for feeding the tropical world. An enhanced contribution could be made to improving future food supplies and a valuable cultural heritage preserved, that may well still be able to provide much of value towards the preservation of the global ecosystem.
Chapter 10

Progressing with the past: environmentally sustainable modifications to traditional agricultural systems

W.C. Clarke

Whereas geographers and anthropologists have for decades studied and greatly admired indigenous systems of agriculture in the tropics, it is only recently that more than a very few economists and others important in making policy decisions have begun to consider traditional tropical agriculture as worthy of attention beyond condemnation. What the anthropologist Conklin wrote about shifting cultivation almost 25 years ago is, happily, no longer so true (Conklin 1954:133):

It is often categorically condemned as primitive, wasteful, or illegal, with little or no regard for such pertinent local variables as population density, available land area, climate, or native agricultural knowledge. For most areas, detailed field reports against which such statements might be tested are totally lacking. There is a definite need for ascertaining what are the real facts about shifting cultivation.

Since Conklin made this observation, there have been many field studies carried out on shifting cultivation and other indigenous agricultural systems in the tropical world. The information available from these studies\(^1\) has helped to

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\(^1\) In the references are listed a selected few of the many publications on indigenous tropical agriculture that have come out in the past 25 years. For Africa: Johnston 1958; Allan 1965; Miracle 1967; Knight 1974. For Latin America: Denevan 1971; Harris 1971; Watters 1971; Nietschmann 1973; Ruddle 1974. For southeastern Asia and the Pacific: Freeman 1955; Conklin 1957; Barrau 1958; Geertz 1963; Alkire 1965; Spencer 1966; Rappaport 1967; Clarke 1971; Hanks 1972; Waddell 1972; Christiansen 1975. For more general treatments and listings of many more references see Ruthenberg 1971, and Manshard 1974.
bring about an increased appreciation of local methods of cultivation. During the same period of time, some features of highly industrialized, modern agriculture have been increasingly disparaged. This recognition of faults in industrialized agriculture is one of the reasons for the growing resistance to the idea that a simple transfer of agricultural technology from the industrialized nations offers a viable solution to problems of food production in the Third World.

In this paper I shall focus on some recent papers and ideas regarding (1) what is now considered to be one of the major faults of industrialized agriculture and (2) some of the merits and flaws of non-industrialized indigenous systems in the tropics, particularly those I am most familiar with in Papua New Guinea. Then I shall turn to a few thoughts as to how such indigenous systems could be modified so as to better provide a sustained yield from an energetically efficient system of cultivation. My emphasis, then, is on the production of food, not its later distribution; and my principal concern is with the development or maintenance of a 'sustained-yield tropical agroecosystem' (Janzen 1973), not with economic development or with supply to markets - though some sustained-yield systems can of course produce surpluses considerably above subsistence needs.

Energy returns in agricultural systems

Although the idea that industrial agriculture is inefficient in terms of energy production is not new (see e.g. Cottrell 1955), it is only in the 1970s that concern over this inefficiency has been widely expressed. Before that, value production in monetary terms, yield per unit of land, or yield per hour of a farmer's labour were the common measures of efficiency in agriculture. The spread of the concept of energy flows within ecosystems together with the facts of rising oil prices and diminishing oil supplies have strengthened the realization that agricultural systems can validly and usefully be analysed in terms of their energy efficiencies. In order to carry out such an analysis, it is necessary to measure and express the input and output of an agricultural system in standard energy units such as joules. In a non-industrial system, such as shifting cultivation, the input can be calculated in terms of how many joules of energy the cultivators use in preparing, maintaining and harvesting a certain area of land. (The constant and perpetual input of sunlight, or the solar radiation that energizes photosynthesis,
is not included in the calculation of energy input.) The joules of energy contained in the edible portion of food harvested from the same land can also be calculated; and the relationship of input and output stated as an efficiency or energy ratio, which is the output of joules in the edible yield divided by the energy input, in joules, supplied by man. Thus, a taro garden that required an input of 50,000 units of energy in human work and produced 1,000,000 units in its edible yield has an efficiency ratio of 20, or one joule input to produce 20 joules output. When human labour is supplemented by the work of draught animals or the energy contained in fossil fuels used for agricultural purposes and the energy required to create farm machinery, commercial fertilizers, pesticides and other similar factors of production, these inputs are also included in the calculation.

Since 1971, many researchers have published papers in which they considered agriculture in energetic terms; Leach (1976) refers to most of these publications and provides a summary of the relationship between energy input and food production in fully, semi- and non-industrial farming. Particularly relevant to the Pacific have been studies by Rappaport (1971) on the flow of energy in a community of Papua New Guinean shifting cultivators, by Chandra, Evenson and DeBoer (1976) on the efficiency ratios of a variety of crops planted by two distinct ethnic groups in Fiji, and by Lawton (1973), who briefly discusses Alkire's (1965) data from Micronesia.

Almost all these studies point to the conclusion that the gradient from a high to low efficiency ratio runs from the less intensive non-industrial systems such as shifting cultivation through the more intensive non- and semi-industrial systems to the fully industrial systems, wherein in some cases the efficiency ratio falls below unity - that is, there is a negative return with more energy going in than coming out. This trend is crudely illustrated in Fig. 1. No single figure can be given for the efficiency of shifting cultivation because (1) it is practised with a variety of techniques and crops under greatly varying conditions of slope, soil and climate; and (2) the polycultural mix of crops - each with a

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2 Leach (1976) uses the term 'pre-industrial' farming or agriculture. I prefer 'non-industrial' because, as this paper argues, there is a place in modern agriculture for non-industrial attributes; and the full replacement of non-industrial by industrial agriculture is not seen as desirable.
different efficiency ratio (see Chandra, Evenson and DeBoer 1976) - makes measurement difficult. Steinhart and Steinhart (1974:312-3) give a range of 5 to 50 for the efficiency ratios of non-industrial agricultural systems, with shifting cultivation and less intensive forms of wet-rice cultivation falling around 20 or above. Black (1971:274-5) gives a range of 3 to 34, with an average of 17, for a variety of crops cultivated entirely by hand in a number of different places.

Based on his detailed study of a group of forest-dwelling shifting cultivators in Papua New Guinea, Rappaport (1971:127) gave figures of 18 to 20. Lawton (1973:67) calculated a figure of 18.4 for food-obtaining activities on Lamotrek atoll in Micronesia. With intensification within non-industrial systems there is no simple linear decline in efficiency ratios, but within wet-rice agriculture the extreme involution so eloquently described by Geertz (1963:Chp.2) certainly leads to a low efficiency ratio. With other staples, including Pacific root crops, the common shift from forest-fallow cultivation toward grassland fallow and permanent-field cultivation frequently means more work put in for each joule of food output (e.g. Clarke 1966; Miracle 1967:159; Hodder 1973:97-8). In industrialized systems there is no doubt regarding either the low energy productivity or its decline over the past several decades as energy input to agriculture has risen far more steeply than has food production. For instance, Pimentel et al. (1973:445-6) report a decline in the efficiency ratio of highly industrialized corn production in the United States from 3.70 in 1945 to 2.82 in 1970. When energy costs for the entire food system of the United States are calculated (including farm inputs, food processing, transportation and preparation), they are found to have been rising from above unity since about 1920 and to have now reached 10 - that is, an average of 10 joules input (excluding solar radiation) is required to put one joule's worth of food on the table. If we look only at the farm, the increased energy input - accounted for in the form of fuel, machinery, fertilizer, irrigation, insecticides, herbicides and so forth - has of course dramatically decreased direct labour input to farms and often greatly increased yields. But, social costs aside, the costs to the natural environment have been great. For the United States, Pimentel et al. (1973:443) list depleted soils, pollution, disruption of natural plant and animal populations, and natural resource shortages; they go on to say:
Figure 1. Estimated energy inputs for various food-producing systems. The systems above the central horizontal line require an energy subsidy greater than the energy contained in their output of food. In a non-industrial system such a relationship is not possible as it would quickly lead to starvation. In industrial agriculture it is only possible because of an extra-system energy subsidy in the form of cheap fossil fuels. Also illustrated is the increasing energy cost of the total food system of the United States (including farm inputs, food processing, transportation, and preparation) over the past several decades. Since before 1920 the energy cost of that increasingly industrialized system has been over unity and has now reached 10—that is, an average of 10 joules is required to put one joule's worth of food on the table. Such a system is not permanently sustainable in a world with limited supplies of energy. (Figure is modified from Steinhart and Steinhart, 1974: 312.)
One nonrenewable resource fast being depleted is fossil fuel - the most important element in the impressive yields and quality of agriculture in the United States ... Fossil fuel inputs have, in fact, become so integral and indispensable to modern agriculture that the anticipated energy crisis will have a significant impact upon food production in all parts of the world which have adopted or are adopting the Western system.

Odum (1971:116) put it more pungently when he said, 'industrial man no longer eats potatoes made from solar energy; now he eats potatoes partly made of oil'. It follows that even if oil-dependent, industrial agriculture could be successfully transferred to the tropical world, such an agriculture could not provide a permanent food supply. As Steinhart and Steinhart (1974:315) wrote:

Food is basically a net product of an ecosystem, however simplified. Food production starts with a natural material, however modified later. Injections of energy (and even brains) will carry us only so far. If the population cannot adjust its wants to the world in which it lives, there is little hope of solving the food problem for mankind.

In further praise of traditional non-industrial systems of agriculture in the Pacific

At this point in history the Pacific peoples could be proud to have maintained, to a large extent, an energetically efficient agriculture that does not require external subsidies in precarious supply to keep it operating. Aside from the merit of permanence, Pacific systems - like other traditional tropical systems - can be praised for being pollution-free and polycultural. The benefits of avoiding (1) monoculture and its associated erosion of genetic diversity and (2) high inputs of artificial fertilizers, herbicides, pesticides, and other biological toxins are well known (Manners 1974; Dickinson 1972) and need not be described. A further merit of traditional systems less often mentioned in the ecological literature is their often surprising elasticity of supply. Fisk (e.g. 1964, 1971b and 1975) has highlighted 'subsistence affluence' as a characteristic of many Pacific societies; I would like to emphasize the variation in space and time of the technical basis of this affluence or, at least, potential affluence.
In the Papua New Guinean highlands and their forested lower fringes there is a clear relationship between population density, environment and techniques of cultivation. The peoples of the forested and sparsely inhabited fringes practise a long-fallow slash-and-burn cultivation of a wide variety of crops (see e.g. Clarke 1971). Groups of more densely settled peoples living in the anthropogenic grasslands of the highlands proper fallow their gardens for shorter periods and substitute various soil-enriching techniques for the labour-free regeneration of the forest (Brookfield with Hart 1971:Chs 3 and 4). There is also the tendency in the highlands to concentrate on the high-yielding sweet potato (although maintaining many varieties of this staple) at the expense of *Colocasia* taro, yams, and other crops that do better in forest-fallowed soil or at lower altitudes. These present-day spatial variations in agriculture can be arranged to represent a possible historical process wherein there have been continuing adjustments to changes in environment, crops and land availability — changes and adjustments that Golson (1977) and his team have now documented archeologically for part of the Papua New Guinean highlands for something like the past 9000 years.

This dramatically long period of experimental evolution — out of which have developed the varied techniques for meeting conditions such as frost, high water tables, and failing soil fertility — has continued into the historic period where cash cropping of coffee by the highlanders or of cacao and coconuts by the Tolai of New Britain has been successfully incorporated into subsistence systems with little external guidance — or sometimes in direct opposition to government policy. Similarly, alien crops such as *Solanum* potatoes, *Xanthosoma* maize and manioc have spread widely without formal introduction and in some cases have rapidly become important. Within such a framework of flexibility it is not surprising that surpluses are often available both normally and as a result of what Brookfield (1972:38) has called 'social production' — that is, production for social needs that exceed, often consider-ably, nutritional requirements. The work and produce associated with the ceremonial yams of the Sepik or the pigs of the highlands of Papua New Guinea are obvious examples of such social production. A would-be innovator, then, is not faced in the Pacific with static or rigidly conservative agricultural systems nor, generally, with systems at the upper limits of production. This is not to say that there is no room for improvement or that all suggested modifications will be eagerly accepted.
Flaws in present-day non-industrial agriculture

Environmental deterioration. Even though indigenous agricultural techniques may be finely adjusted to particular environmental conditions, the aggregate activities of the agriculturists are not necessarily in 'harmony' with the environment in the sense that they have no effect on it. In fact, environmental alteration is constant and inevitable. Less clear are the benefits and damages associated with some of the alterations. In Papua New Guinea, however, it is easy to point out certain detrimental trends. For instance, accelerated soil erosion is taking place on cultivated slopes in densely settled parts of the Chimbu Province. A more widespread and insidious process is the replacement of forest and well-developed secondary woodland by grassland and secondary scrub. For millennia, Melanesian cultivators have been transforming the occupied parts of the once-forested highlands into open grasslands, a transformation that has necessitated increased agricultural labour and diminished the availability of wild plants and animal foods (Clarke 1966). Following the cessation of tribal warfare and its associated firing and felling of enemies' trees, afforestation has occurred in some places, mainly by the expansion of groves of planted *Casuarina* rather than by the spontaneous development of a mixed forest. Countering this limited afforestation over the past few decades have been the rapid growth of population, cash cropping, the introduction of steel axes, and widespread transport developments that have made possible a new freedom of movement. All these factors - as well as commercial forestry - have led directly or indirectly to such expanded forest clearance that in Papua New Guinea as in the rest of the tropical world the continued existence of tropical forest can be seen as threatened. The far-reaching implications of the imminent demise of the tropical forest have been discussed elsewhere (Denevan 1973; Richards 1973). Here I stress only the potential loss of plants that are or could be useful. Any short association with forest-dwelling peoples in Melanesia shows the large number of wild trees and other forest plants that can be put to use (Lea 1976; Powell 1976; Clarke 1971, 1976). If the forest goes, so go most of its component plants. Such a loss would be tragic to both science and the local communities.

Slow and random experimentation. It was the long-term evolution of non-industrial agriculture that gave us most of the many food plants we have today. But that evolution has necessarily been slow, and the rise of improved varieties
has been largely a matter of accident. Much of the genetic potential for improved characteristics in crop plants remains unrealized. Similarly, new cropping systems or technical innovations result only from sporadic and unplanned invention.

**Vulnerability to pests and diseases.** The tendency towards the polyculture of many species or at least many varieties of a single species acts to protect non-industrial systems from heavy losses to pests and diseases. But, like crop plants anywhere, tropical crops even in a polycultural mix are still subject to attack—perhaps more than crops in non-tropical climates (Janzen 1973:1213). The ravages of *Phytophthora colocasiae* on *Colocasia* taro in lowland Bougainville serve as a vivid local example in the Pacific. Thirty-five years ago taro was the staple and a greatly favoured food. Now it has been almost wholly replaced by the less-favoured sweet potato because *Phytophthora* made taro's growth close to impossible. Government agricultural scientists may now be better prepared and are certainly more concerned to counterattack with scientific weapons against such threats to non-commercial crops; but within the subsistence system there has never been a remedy except substitution of another crop.

**Declining efficiency ratios with extended intensification.** Like most activities, non-industrial agriculture is subject to the law of diminishing returns. In Fig. 2 is abstracted a process of intensification that leads through successive stages to successive declines in efficiency ratios. The argument is the familiar one of Boserup (1965) that, within a given area and using a particular production technique, as population or agricultural labour input or both increase, the resulting intensification will in time push labour productivity beyond its optimum. Then, decreasing marginal returns and, often, induced environmental changes lead the cultivators to a new technology. A good example of this is a shortening of fallow period in a forest-fallow shifting cultivation followed by the development of some form of soil manipulation in the resulting grasslands. This process of continued intensification, recurrent falls in efficiency ratios, and the invention or importation of new technologies, is usually associated with continued environmental change—often detrimental—and a trend towards monoculture of the highest-yielding staple, a process that is usually unhealthy for both people and agroecosystems. If population growth continues and a stage is reached when no new technology is available, a condition of agricultural involutio...
Figure 2. Schematic representation of agricultural intensification. T₁, T₂, T₃, ... represent production technologies of increasing intensification. For each technology there is a labour input where average productivity is at an optimum and beyond which marginal returns begin to decrease. Population growth acts to push production to higher levels of intensification as the agriculturalists seek to maintain optimal productivity. If no new technology is available, a condition of 'agricultural involution' can develop. (Adapted from Brookfield, 1972; and Modjeska, 1977: 72.)
wherein labour productivity decreases well below its optimum, and aggregate production starts to level off. There are, in other words, limits to intensification aside from energy shortages and pollution.

Progressing with the past

It is now well recognized that traditional agriculture has been unjustly denigrated by agronomists and others and has suffered from low prestige because it has not had the backing of Big Science and did not fit the western model of agriculture divided into neat, cash-producing units. But as appreciation of traditional agriculture grows, there is a danger of over-romanticizing it to the neglect of benefits that could come from western science. What is needed is a 'progressing with the past' towards the goal of a sustained-yield agroecosystem, which could be a synthesis of bits from both traditional and modern fields of knowledge. Mostly, however, the bits must be site-specific and not the inappropriate injection of fragments of industrialized technology that Janzen (1973:1217) warns against. There can be no general program to achieve a single sustained-yield agroecosystem that would fit the many socio-economic and physical environments of the tropical world; but some components that might fit into individual programs can be briefly described. The list of components is far from comprehensive and in no way novel except, perhaps, for its emphasis on permanence of production rather than its maximization.

Plant breeding and genetic engineering. One of the major contributions that western science can make to non- or semi-industrial agriculture is the further development of types of plants with enhanced possibilities for characteristics such as nitrogen fixation and greater photosynthetic efficiency. But in these efforts the emphasis should be more on incremental evolution than on the 'revolution' of high-yielding varieties with their requirements for an associated package of high-energy inputs.

Fertilizers. The use of trace-element fertilizers, ground rock, and modest applications of, for example, potassium on deficient soils can result in significantly higher yields without large inputs of artificial fertilizers - given, of course, an effective soil-testing and extension service.

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3 For further discussion see Andreae 1974; Clarke 1976; Dickinson 1972.
Maintenance and rationalization of crop diversity. The traditional tropical technique of creating a miniature forest from a mix of many crops offers so many advantages that the pressures towards monoculture that arise from cash cropping and other forms of intensification should be resisted. Experimentation on cropping systems, timing of planting and various crop mixes can better traditional practices.

Extended use of under-exploited plants. Each area of the tropics has its own stock of domesticates, some of which—such as manioc, maize, Xanthosoma and sweet potatoes—have already had a tremendous impact outside their place of origin. But many other crops are known only within limited areas; the development and distribution of these could usefully expand food supplies and improve diet. The recent research work integrated by the U.S. National Academy of Sciences (1975a) on the winged bean (Psophocarpus tetragonolobus) and other under-exploited tropical plants (1975b) is a good example of what can be done in this field. Local Pacific crops such as Hibiscus manihot and Saccharum edule have great potential. And the semi-wild sago, in which there is a growing scientific interest, could provide a very large carbohydrate resource from what are now little used swamplands.4

Extension of soil-management techniques. Some local techniques of soil management—such as the mounding and composting practised by the Enga people of the Papua New Guinea highlands (Waddell 1972) maintain soil nutrients and structure to the degree that good yields continue with little or no fallowing. Where a changeover from shifting to permanent-field cultivation is desirable, such techniques, as well as terraces and other erosion-control measures, could be usefully introduced where not already present.

4Such interest is evidenced, for example, by the three-day conference entitled 'The equatorial swamp as a resource, with particular reference to starch-producing plants', which was held at Kuching, Sarawak, in May 1976. Proceedings of the conference will be published. Organizers of the conference were Professor W.R. Stanton (Department of Botany, Faculty of Science, University of Malaya, Lembah Pantai, Kuala Lumpur, Malaysia) and Dr K. Ruddle (Natural Resource Systems Planning Project, Technology and Development Institute, East-West Center, Honolulu, Hawaii 96822, U.S.A.)
Arboriculture. Certain trees have been enormously important commercially from the beginnings of trade between the tropics and the temperate world. But as providers of food—not to mention materials—to local peoples, trees have been almost wholly neglected by professional agriculturists until recently. As the natural vegetation of the tropics, trees deserve more attention for several reasons. They appear to be capable of sustaining yields for long periods with less cultural input than annuals. They pump nutrients from depth. They can provide a wide variety of foods; for example, in the Pacific region: starches and sugars from breadfruit and a great variety of fruit trees; protein-rich leaves from tree ferns, Ficus spp. and Gnetum gnemon; and oil rich seeds from Pandanus spp., Aleurites moluccana, Canarium spp., Terminalia spp. and many others. With intensification, which is almost always a move toward biological simplification, trees generally diminish as the agroecosystem is recurrently transformed to a pioneer stage that is quickly, but only temporarily, productive. A reversal of this trend so that trees were scattered through the agricultural lands would mean the development of a different sort of agroecosystem—one that had a permanent skeleton of productive diversity. Of course, such an arboriculture has traditionally been present in many Pacific villages and surrounding lands, where polycultural orchards of Gnetum gnemon, breadfruit, Pandanus, and many other trees form productive and pleasant parts of the mosaic of shifting gardens and secondary regrowth. Now, because of pressures for intensification, arboriculture could well do with official encouragement, and by means of further experiments with the 'corridor system' (Andreae 1974) could be used to improve fallowing practices as well as to provide food. Although trees and annuals by no means necessarily exclude each other, trees do take up space that could be used for short-term yields from annuals, but in return they provide long-term yields and a structure of permanence.

Conclusion

At the beginning of this paper I described the growing academic appreciation of traditional tropical agriculture over the past decades and the more recent penetration of that appreciation to the corridors of power. In recent years, coincident with recognition of the merits of traditional

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5 A recent book by Sholto Douglas and Hart (1976) has created new interest in forest farming; see, for instance, Hills 1977.
agriculture has been the realization that industrialized systems of agriculture based on low or negative returns of energy cannot be permanently sustained. It follows that it would be absurd to try to replace energy-efficient, less industrialized systems with a transferred system based on high-energy technology - to try, that is, to 'power our way out' of the food shortages that face many peoples in the world today.

In the Pacific, food shortages are generally not severe; the problem is more one of meeting local needs with local supply (McGee 1975). And the inadequacy in local supply is more the result of lack of motivation than a shortage of land. Given the high prestige, convenience, and often low price of imported foods together with decades of official encouragement to cash cropping of non-subsistence food products, it is surprising that traditional agricultural systems have met the demands of growing urban markets so much as they have. To a large extent, at least in Papua New Guinea, we can thank women, with their social proclivities and modest expectations, for the supplies of local food that do flow into urban markets. Now the aim is to increase that flow, which means an increase in local production to meet the admirable and, in the present world, prudent goal of local self-sufficiency. One way to try to achieve this aim is to devise ways to prod or persuade the rural agriculturists to meet the needs of urban dwellers, to serve urban markets. This means a move towards commercialization, which, if successful, will increase supply; it will also increase the dichotomy of country and city, pushing one to become more of a supplier servant and increasing the tendency of the other to be an energy and materials sink into which flow rural resources. The continuing growth of the city further speeds the treadmill of trying to maximize rural production to meet rising urban needs. In the immediately necessary pursuit of more food, I have suggested various components of traditional and scientific agriculture that could be combined to increase production and, to some extent, productivity within a framework of energy efficiency. But because a need for continued intensification will eventually bring diminishing returns, the only permanent solution to the problem of production is to limit demand in the form of more mouths and more goods.

To counter the disparity of town and country, of consumer and producer, one can imagine a community, all of whose members live in a landscape honeycombed with useful
trees and garden plots, and most of whom can devote at least some time to food production. Such an organization would also avoid the storage and transport problems particularly associated with tropical root crops. In other words, the vision is of landscapes that bear resemblance to those that were universal in the Pacific a century ago — but landscapes whose inhabitants would enjoy some of the benefits associated with modern science and technology. The guiding purpose of the vision is toward something near sustainable self-sufficiency for most of the community and optimal rather than maximal productivity within a healthy ecosystem.

Such a vision can only be realized with difficulty and, in some cases, by radical changes in socio-economic organization, mind-sets, and both short- and long-term expectations. Great changes in education, communication and extension services would be required. Janzen (1973:1217) has described a major component of the necessary 'cultural programming':

> the teaching of the socioeconomic rules of a sustained-yield, nonexpanding economy, tuned to the concept of living within the carrying capacity of the country's or region's resources. Incorporating such a process into tropical school systems will cause a major upheaval, if for no other reason than that it will involve an evaluation of the country's resources, what standard of living is to be accepted by those living on them, and who is presently harvesting them.

The greatest obstacle to initiating this kind of evaluation and cultural programming is communication between various groups of people within the country. More often than not, villagers and government officials are only tenuously connected; neither learns much from the other; nor are researchers linked effectively to those making policy decisions. Information and ideas are available on all sides but frequently they do not move. A method that has been an efficient instrument to introduce new technology is the hierarchical network of organization used by the Chinese. Wortman (1975) has recently described this system wherein commune administrators are tied into the government bureaucracy and the scientific information network. Within each commune are a number of production brigades, which may be considered equivalent to groups of villages; each production brigade includes a number of production teams, and each team includes...
a number of households. Within this organizational structure, information does move effectively, at least downwards. Whether or not Pacific or other tropical countries could or should follow the Chinese model, I cannot say. But I am convinced that for attempts to maximize income or production we should substitute here and everywhere a search for optimal ways of living within permanently viable and attractive landscapes.
Chapter 11

Organizing production and producing organization: the sociology of traditional agriculture

Peter B. Huber

In this paper I intend to expose and correct two related fallacies of conventional thinking on the subject of shifting cultivation. The first fallacy is that shifting cultivation does not 'improve' the environment, that it involves only the production of food for immediate consumption (cf. Brookfield 1971:105-19); the second is that the most important product of shifting cultivation is food. The first fallacy is easily exposed by the presentation of an ethnographic case in which the long-term 'improving' effects of shifting cultivation on the environment are clearly manifest. But environmental improvements then constitute, along with food, products of shifting cultivation. And this observation sets up discussion of the second fallacy, which is my central purpose. Whereas conventional wisdom has it that swidden cultivators organize to produce food, I am arguing that they produce food in order to organize. This paper is devoted to explaining this point by exploring the social significance that food, environmental improvement, and productive activities themselves may have.

Naturally I do not mean to claim that swidden cultivators are indifferent to the quantity and quality of the food that they eat: people like to eat well, according to their lights.

\footnote{In preparing this paper I have been much aided by the critical comments of my wife, Mary Taylor Huber, a Ph.D. candidate in anthropology at the University of Pittsburgh, and of Frederick Damon and Carl Thune. I gratefully acknowledge their contributions. I would also like to thank the participants in the Seminar on the Adaptation of Traditional Systems of Agriculture for which this paper was written. Their discussion of my paper was extremely helpful, bringing a number of weak or obscure points to my attention. I have attempted to satisfy most of their criticisms in this final version. Any shortcomings in my paper, of course, are entirely my own responsibility.}
Nor do I mean to claim that one can never usefully treat food as the product of agriculture. But I do claim that in practice production decisions rarely hinge on the question of which course of action will lead to the best eating. Even where choices are made between different scales of production, any alternatives which producers might seriously consider must - by definition - offer a reasonable expectation of providing adequate food. In the ecologically abundant circumstances which characterize much of Oceania, it may be imagined that many alternatives capable of meeting such a criterion would be available to producers. To understand the performance of cultivation systems under such conditions, one must understand the effects which producers expect various alternatives to have on the organization of their natural and social environments. It is only in relation to anticipated organizational consequences that the motives and patterns of choice can be apprehended. It is in this sense that I wish to regard organization as the product of agriculture, and I argue that it is not only possible but extremely desirable to view shifting cultivation systems in this light.

It may be helpful to note in passing that what I am talking about here is very much akin to what Polanyi and his followers refer to as the 'embeddedness' of economic transactions in non-market economies (Polanyi et al. 1957:252), or what Sahlins refers to as the 'social inflection of production' (Sahlins 1972). In fact, I am speaking of precisely the same phenomenon - the influence of social considerations on economic processes - but going a step farther in my treatment of it. Rather than view transactions or production as the central, irreducible element in the situation, surrounded in different cultures or localities by different, distorting cultural influences, I am treating the problem of creating and maintaining sociality as the central element. Agricultural production is simply one of a number of agencies through which the problem can be tackled, employed differently in different communities. This is a difference of emphasis or strategy, shifting attention from the technicalities of the relationship between labour input and food output to the ways in which agricultural activities are used to organize traditional village life.

The significance of this shift will be clearly illustrated in the discussion which follows. This discussion is oriented around the analysis of a single ethnographic case, a subsistence regime with which I am intimately familiar as
a consequence of several years' intensive research. I will examine the traditional system of swidden agriculture, setting it in the context of a more comprehensive system of subsistence activities, and demonstrating the ways in which the performance of these systems is oriented to the production of social organization. I will then examine the problem of adapting the system to the market production of food. In a concluding statement I will discount the singularities of the case and discuss in comparative terms some of the more general issues raised.

It is especially important to recognize the social mission of shifting cultivation if one wishes to explore the possibility of supplying urban food markets with produce from traditional swidden gardens. Any program which would seek to mobilize this produce for market supply must consider the intentions of traditional cultivators in undertaking agricultural production as they know it. The performance of the traditional system in relation to market demand cannot otherwise be reliably anticipated. My paper is particularly addressed to the problem of motivation. But it will be seen that because I address the problem in terms of the social functions of agriculture, my paper also deals with problems of land tenure, labour support, capital, authority and distribution. My approach—properly, I think—reduces these problems to secondary considerations, that is to functions of the social mission of agriculture.

The people referred to here and elsewhere (Huber 1974, 1975) as the Anggor are the speakers of a common language and may, I think, be referred to as members of a common culture in spite of considerably local variations in custom. This is particularly the case in the present context, since

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2Research took place during the periods 1969 to 1971, autumn 1976, and summer 1977; these periods were funded respectively by the NIMH, by Princeton University, and by the National Science Foundation. During the most recent field period I was ably assisted by Mary Taylor Huber, by Elliott Lee (Ph.D. candidate at Princeton University), and by Anton Gois (an undergraduate at the University of Papua New Guinea). This work consisted largely of extensive surveys of land use and daily diet and activities. The data collected at this time were extensive and complex, and analysis of them has only begun. Consequently, many of the generalizations contained in this paper are 'impressionistic', i.e. they are impressions of general tendencies in the data.
subsistence practices seem to be the least variable aspect of traditional Anggor life. The Anggor number approximately 1100 persons, distributed among approximately 12 villages which vary in population from about 15 to over 170. The total density of population is in the order five persons per km². They inhabit the Nai Faringi Census District, situated between Amanab and Green River in the West Sepik Province of Papua New Guinea. Their lands are largely coincident with the northern watershed of the Dio River, and are characterized by an intricate relief pattern of ridges and ravines, with hundreds of minute dendritic stream systems, steep hillsides, and narrow ridges. Regular administration of the area was begun in the early 1950s. The chief agency of modernization in the area has been plantation labour recruitment, from which most adult males have returned fluent in Pidgin, wealthy and well-provisioned with manufactured goods—all relative to local requirements, of course. In the past few years, since 1971, the CMML mission (Christian Mission of Many Lands) has become increasingly active and influential in the area, largely through a program of adult literacy education on the village level. The people of Wamu village, the primary research site, have become nominally Christian.

The Anggor subsistence regime is a thoroughly mixed one. It combines elements of swidden agriculture, sago industry, silviculture, gathering, and hunting, and it differentiates the landscape accordingly. Sago resources are distributed throughout the hundreds of ravines and valleys which comprise the territory of each village. Hundreds of palms are owned by each villager, each holding being dispersed throughout the village territory in small stands or even single palms. Although sago grows so profusely in the region that it appears to be a wild resource, closer investigation indicates that it is virtually all

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The Anggor people, I should note, substituted steel axes for stone in the early 1950s. Older informants observe that although steel is easier and better to use, gardens have not grown larger nor has the amount of labour time required been appreciably diminished. This is the case because Anggor gardens are unfenced; the only gardening task which has been greatly changed by the steel axe is initial clearing. Formerly this was a community endeavour, now it is largely individualized. The point here is that it seems unlikely that the introduction of steel has had any dramatic effect on the Anggor subsistence system.
cultivated. Even at the present time new areas are being
developed for sago. Complementing the sago resources, tulip
orchards (*Gnetum gemon*) stud the upper slopes of the hill-
sides. These orchards are carefully weeded and pruned and
may be harvested about once every six weeks for their yield
of shoots, young leaves and fruits - an important component
of the Anggor diet. Tulip is planted as a second stage in
swidden cultivation: the orchards begin producing after
about five years and continue for perhaps ten years more.
Thus each Anggor domestic unit, at any time, has in the order
of a dozen producing groves scattered across the village
landscape. Groves of pandanus are also cultivated as a
second stage in swidden cultivation, adjacent to the tulip
on the downslope side. But pandanus is far less important
in the Anggor diet. Finally, along virtually every ridge
crest, the secondary forest is dominated by nut-bearing
trees and by trees which are prone to massive grub infestations.
Some of the former are planted in the upper regions of
swidden gardens, while all are 'encouraged' through the
occasional removal of the seedlings of other, less useful
species. Thus each Anggor villager owns a number of stands
of nut and grub trees, again scattered throughout the village
territory. All of these resources, it must be noted, are
improvements made by swidden agriculture - a point to which
I will return later.

Anggor subsistence activities, then, are organized
against this background of resource differentiation and tend
to focus on sago production. Each Anggor domestic unit
processes eight to ten palms a year, one at a time, each
palm taking one or two months to complete. The work is quite
irregular and may be abandoned for a week or more at a time:
but some processing is done on an average of at least every
other day and there is rarely a period of more than a week
between the completion of one palm and the felling of another.
The point here is that domestic groups do not work through
a stand of sago in one particular region, but are constantly
shifting the production site from month to month. Other
subsistence activities are not strictly determined by the
sago site, but tend to be oriented around it. Tulip harvesting,
garden maintenance, hunting and gathering activities tend to
cluster in the vicinity of whatever sago site the group
happens to be working. Aside from the initial tree selection
and felling, sago work is performed primarily by women.
Often women of different domestic groups work in partnership,
arranged *vis-à-vis* a particular palm, and thus temporarily
intertwine the subsistence activities of their respective
families. En route to and from the processing site, and during breaks in the labour, the women may visit their various resources in the vicinity – harvesting some and keeping check on the state of others. Men may accompany them and help in the processing, visit nearby resources, or merely keep watch on the women. Sometimes the men go off in an entirely different direction, generally with specific purposes in mind: hunting pigs, hunting birds from a blind, weeding a garden, pruning tulip, checking on nuts, pandanus, or grubs. In short, much of Anggor subsistence activity could be described as 'nosing around', and the application of labour is quite dispersed: an hour here, a day there. The most concentrated applications of labour are found in sago processing and gardening, and even here the flow is very halting.

Swidden gardening is done on an annual basis with clearing begun during the dry season months from May to August and taro harvested at the end of the wet season, roughly from March to May. The clearing of underbrush may take from several days to a week and the felling of trees another two to four days depending on the character of the forest cover. For tree felling additional labour is often mobilized and the entire job completed in a single day or even in a morning. The workers are 'paid' with a meal which includes meat. After the felling of the large trees, the debris is left to dry and then the site is burned. In short, one to two weeks of labour are required over a four-month period in order to make garden sites ready for planting. Neither stumps nor trunks are removed, nor is any kind of fencing or soil preparation practised.

The timing of this phase of swidden gardening can be both critical and difficult. Anggor gardeners believe that it is crucial to achieve a good burning and consequently attempt to adjust the timing of their operations to meteorological conditions. If they cut too early, subsequent heavy rains may wash the drying foliage from the trees so that when the garden is finally dry the fire will not achieve sufficient intensity. If they cut too late the wet season may begin before the garden is properly dry and it may never dry thoroughly. Either way the result is insufficient burning. Thus they work in spurts with an eye on developing weather conditions.

Planting is begun any time after the onset of the wet season, that is, from September to November. The dominant
crops are taro and bananas, followed by yams, *pitpit*, tobacco, several kinds of greens, and sugar cane. A border consisting of one row of *pitpit* and one row of broad-leaved plants used for cooking is created to inhibit invasion by weeds. Otherwise, different kinds of cultigens are interspersed. All crops except tobacco are planted with digging sticks; only in the case of yams is planting accompanied by any working of the soil. Thus the major expenditure of labour during this period of the agricultural year is on the collection of planting stock. These operations are integrated with the patterns of daily activity, so that planting may take place over a period of several months, and is never entirely complete until January and February when seedlings of tulip and pandanus are transplanted from previously established nurseries. Weeding begins during the early planting period and is carried out sporadically over ten years. Gardens are sometimes neglected for months, and may be entirely abandoned if the gardener decides that he is too far behind — for example, as a result of difficulty integrating garden work with the pattern of movement generated by his other subsistence activities.

It is quite possible that, in relation to labour input, Anggor garden productivity is rather high. But, because of the obvious difficulties that Anggor patterns of labour application and product utilization pose for data collection, I am unable to provide even a crude quantitative estimate of this ratio. There are, however, some rather clear indications that garden output is quite low in relation to both population and land. In 1970, for example, the area of newly planted gardens per consumer for Wamu village was .047 ha. This is roughly half the area widely accepted as a subsistence minimum for swidden cultivators in Papua New Guinea (cf. Waddell and Krinks 1968). The figure appears to be even lower for 1976. At the same time, extended maintenance of tulip and pandanus orchards — though it contributes to total output — increases the fallow period for any tract of land to something like 40 years or more. Finally, it may be noted that failure rates for taro — based upon extensive sampling in 1977 — approached 100 per cent for one garden and often ran over 50 per cent. This was regarded by Anggor producers as a particularly bad year, but at the very least it may be said that Anggor swidden agriculture produces a very uncertain return over the short run.

Long run consequences, however, can be more reliably anticipated and so constitute the most significant frame of
reference for annual swidden planning. Consider a lecture delivered by a middle-aged man to his son and one other adolescent of his clan: the lecture concerned the proper way for adult men to act and its central theme was that men should clear gardens so that sago would grow. In part this exhortation can be taken literally. The clearing of hillsides is believed to encourage greatly the growth of sago stands formerly shaded by the forest. If the sago stands exposed to insolation by garden clearing are not the property of the gardener himself, ownership is normally transferred to him in recognition of the labour investment he has made; where no sago stands exist to receive the benefit of garden clearing, they are normally introduced by the gardener. In 1977 one garden site was chosen solely to encourage the growth of a stand of sago which the gardener felt was being choked out by the surrounding forest. Gardens do encourage the growth of sago, and people do make gardens with that purpose in mind — but sago is only one of a number of long-run improvements to the environment which are brought about through gardening, and to some extent the father's exhortation must be seen figuratively to invoke a broader range of considerations.

Most obviously, swidden gardening must be linked with and create a particular distribution of resources. Site selection is explicitly undertaken with considerations of distribution in mind. Naturally Anggor gardeners prefer a good short-run return on their labour, and since they consider soil fertility an important factor in garden productivity they prefer to garden on promising soils. But their ability to identify such soils is quite limited, beyond avoiding certain obvious hazards such as excessively 'hard' or stony soils or soils which have been gardened within living memory and proved unproductive and/or slow to regenerate secondary forest. This leaves them with a wide range of choice. Within this range they often make 'false choices' — gardening plots which look promising but yield very poorly. Sometimes gardeners choose sites for no other reason than that the soil looks exceedingly promising. But more often their decisions hinge on long-run environmental management strategies which involve the creation of 'pockets' of resources scattered in different parts of the village territory.4

4 Many gardens are undertaken as frankly experimental ventures, attempts to 'develop' new areas. The soil is tested for productivity and the site for convenience. If such gardens are successful, they will be expanded several times over a five- to ten-year period.
The relocation of Wamu village in 1973, for example, engendered a major revision of environment management strategies on the part of all village members. The move was undertaken in order to give access to the proposed government road from Amanab to Green River. The new village site was on the proposed right of way, but outside the ambit of the established garden resources of all of the village members and thus, initially, rather inconvenient. The immediate need was for the establishment of new gardens in the vicinity of the village.

Thus, in 1974, and again in 1976, one of my principal informants established a new garden immediately adjacent to the village at the head of a small valley to which he and several of his kinsmen had a particularly strong claim. Although these gardens had to be cleared from primary forest - at unusually high labour cost - he was not initially displeased at the extra labour, especially after the first garden produced well. The 1976 garden, however, suffered a taro failure rate of almost 100 per cent - a short-run disaster compounded by initially high labour investment.

Although displeased, the gardener was by no means distraught. The 1976 garden would produce some yams, bananas and *pitpit*, and the tulip was doing well. Moreover, his more important long-range plans were not in the least impaired by the garden failure. These involved developing garden resources in an area in which he had extensive holdings of sago and nut trees (a reasonable distance from the new village), but which had been too far from the old village for him to invest in. A major purpose of the 1974 and 1976 gardens, in addition to developing the immediate vicinity of the new village, was to create a fund of planting stock conveniently located for the ultimate development of a more distant but more promising valley over the long run.

Clearly Anggor agriculture is intended to organize the environment. It succeeds rather well in its way, creating a curiously domesticated ecosystem. Although this tends toward limiting rather than spurring intensification, it plainly

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5Although usufructuary privileges are normally more freely extended, the concentration of a large number of people trying to create gardens in a relatively short time over a relatively small area has led in this case to an unusually rigid definition of gardening rights. This has not involved adjudication or negotiation, but an especially scrupulous avoidance of anything that might be considered an encroachment.
constitutes an improvement from the Anggor point of view: given the Anggor subsistence system, the environment is rendered literally more useful and not merely more pleasing. The productivity of land and labour, over the long run, is increased. No doubt the Anggor commitment to silviculture is unusually heavy. Yet it seems reasonable to suggest that many other shifting cultivation systems have long-term consequences which form a definite part of the production aims of their practitioners. What remains is to examine the sense in which shifting cultivation produces specifically social organization, that is, serves to create and sustain sociality.

In the introduction, I observed that agriculture was only one of the agencies through which sociality is produced. This is certainly true of the Anggor, among whom both gardening and pig-hunting serve to produce organization in quite distinctive ways. The community produced by gardening, it will be seen, is an aggregate. It is composed as the sum of a number of specific, contingent, constantly changing personal relationships which overlap and interweave to form a very complicated fabric. In contrast, pig-hunting and pork distribution produce a totality, a community composed of abstract classes or categories of person. These categories stand in complementary relationship to one another and form a differentiated whole. Because both communities are really one, viewed from different perspectives, one cannot properly appreciate the social mission of agriculture without considering the social mission of pig-hunting. This is true both in relation to assessing the adaptive potential of the Anggor system and in relation to assessing its comparative implications. For in many Oceanic societies the most important social mission of agriculture is quite similar to that fulfilled by Anggor pig-hunting, that is, making the community into a totality.

If it is permissible to speak of social organization as a quantity, then it must be said that the Anggor have very little. At the very least it must be said that Anggor life is distinctly atomistic. There are no positions of authority in an Anggor village nor are there properly corporate groups which function as units in any context. Village life appears to be, and is, very unorganized. Participation in public activities on either a village or personal level is entirely optional. In principle, the village is composed of kin groups (patrilineal) and tied together by kinship relations. Yet these are so conceived that they do not
assign prerogatives or obligations to individuals; rather, they define a set of culturally possible forms of sociality which individuals may realize in practice or not, as they choose. The question of obligation arises, essentially, only in connection with pig distribution. The question of prerogative arises in connection with tenure, or ownership.

In the final analysis, the village is held together as a community as much by the landscape as anything. It is both a common frame of reference and an object of mutual interest. It is inhabited by spiritual guardians, which are the focus of religious life. These protect the community from sorcery and provide feral pigs for distribution; they serve the community as a whole but also pay special attention to the 'owners' of the sections of land on which they reside. Tenure of land, in fact, means nothing more than this. It is a relationship between man and spirit and conveys no particular privilege vis-à-vis other village members. Tenure of ownership of resources, on the other hand, does involve prerogative in the form of proprietary interest. Although such ownership can be inherited, it is primarily a consequence of labour investment. That is, it results from gardening - for example, if a man's garden clearing causes an adjacent sago stand to flourish, the sago becomes his. Thus gardening creates the patterns of ownership whereby the landscape can be viewed as a common frame of reference for the daily life of the village.

In short, kin relations are realized through daily acts of co-operation and exchange. These may include the activities or products of gardening, or they may simply have reference to facts of ownership which result from gardening. In principle, any Anggor man is either brother or brother-in-law to every other man of his generation and village. Such

6 This point is often difficult to grasp for persons who do not know the area - but it cannot be over-emphasized. What I am referring to here is not the 'loose structure' which has often been remarked by anthropologists in New Guinea societies but a condition of profound anarchy. It is most clearly seen in diffuse and almost chaotic discourse which attends an Anggor 'town meeting', or in the Anggor version of soccer in which teams play an uncertainly scored and officiated game until - according to a general consensus - they win wantaim, i.e. 'tie'. These games, though virtually unstructured, never lead to violence or quarrelling.
an ideal relationship is realized if one man invites another to garden with him in an area in which the host has developed a fund of resources. The garden thus cultivated embodies their social relationship; they labour together in the first instance and may continue to do so over the years as their orchards mature; they may harvest one another's produce from time to time or exchange food in memory of their past co-operation. The same thing is true of sago working, or simple labour support at any stage of garden working. The point here is that it is the history of such activities and their embodiment in joint or neighbouring proprietorship that Anggor people refer to in explaining their relationships to others, and not to abstract principles. In realizing relations as brothers, men become neighbours; and in realizing relations as neighbours, they become brothers. And because men are owners, they can be givers or sharers. Through exchange and co-operation and their attendant tenure facts, shifting networks of interpersonal relationship are sustained. These temper Anggor individualism and produce organization; fluid and shifting though it may be, to the Anggor it is quite thinkable. And it is all predicated upon gardening.

Pig-hunting, in contrast, 'freezes' the action. It organizes the entire village momentarily in a definite and enduring way - repeatedly, with each kill. One's place in the community in general is stressed rather than specific links with other individuals. In gardening one continually creates new prerogatives; in pig-hunting one discharges perpetual obligations.

Although data relevant to this point are presently under analysis, I anticipate that they will show the amount of labour time devoted to pig-hunting to be roughly equal to that devoted annually to swidden gardening. But the amount of 'psychic energy' devoted to pig-hunting is considerably higher. That is to say, the Anggor people worry more about pig-hunting than about any other aspect of the subsistence system. This worrying is both personal and collective. If an extended period of time passes during which no pigs are killed, pig-hunting gradually becomes an obsessive topic of village conversation. Hours are spent in public discussion, personal introspection, and seance; signs and omens and the entire history of village affairs may be repeatedly examined for some clue to the cause of the ill-fortune and the means of counteracting it. The same is true on a more personal level, if a man goes for several years without killing a pig.
Yet the amount of time and psychic energy that individuals devote to pig-hunting is somewhat remarkable, considering that a man who is successful in pig-hunting is absolutely forbidden to consume any part of the kill. Nor is he able to manipulate the distribution of the meat so as to create obligations on the part of others. The meat of a feral pig is always distributed communally and even-handedly according to a complicated scheme in which certain categories of people receive certain cuts of meat. The breast, for example, is given to the man's brothers-in-law as partial redemption of the perpetual bridewealth debt incurred upon marriage. The meat from the torso is given to the man's clansmen, while meat from the extremities - considered especially choice - is given to members of the other clans which constitute the village. It is then said that his clan is giving meat to the other clans. In neither case is the meat given as a group gift. Rather the shooter of the pig has the responsibility of making gifts to every village member, dividing the proper cuts equitably. In this process the underlying conceptual dimensions of village organization are made manifest: that is the categorical relationships which obtain between persons and groups, and upon which the more evanescent personal ties of co-operation and exchange are erected. And these distributions of meat are the only regular occasions on which this happens. In short, social organization on this level exists only in the distribution of meat and can be said to be produced by the hunter who kills the pig.

Among the Anggor it is pig-hunting which produces organization in this way, that is, by generating ceremonial events which manifest and recreate principles which organize the community as a structured whole. In principle, however, swidden agriculture could just as easily produce such events. And in many Melanesian societies this is precisely the case.

What are the implications of all this for the adaptation of subsistence agriculture to food market production?

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7The decision as to which persons fall into which categories is always made with the shooter of the pig as the reference point. There are always some ambiguities in this classification, certain persons being related to the shooter in several different ways. These ambiguities are sometimes manipulated to equalize the distribution, i.e. some members of other clans may be classified as 'brothers' and receive meat from the torso along with true clan 'brothers'.
Actually the Anggor people, at least those of Wamu village, do produce food for an 'urban market' - in this case the personnel of the government station at Amanab. At present this is a sellers' market, for demand far outruns supply. Station personnel are constantly complaining that they cannot get enough local produce, and any food brought in from outlying villages is quickly sold. Prices do not rise, however, partly because local people are intimidated by government personnel and partly because the market is for many people the only source of cash income available.

At present, at least as far as Wamu is concerned, supply is chiefly limited by factors external to the traditional agricultural system. One of these factors is transport cost. All produce must be carried to the station, which is three hours' walk away (nearly 13 km over very hilly country). Most of the heavy burdens are typically carried by women, and for most women the trip normally requires the carrying of a young child as well as the produce. A second factor is the limited utility of money. At present there is only one trade store regularly operating at Amanab. Because of the high cost of air freight, it is modestly stocked and highly priced. Consequently, people are reluctant to spend their money there. It is expected by the Wamu people and by at least some government personnel that both of these problems will be solved by the construction of the Green River-Amanab 'Highway' which has been eagerly awaited since at least 1969 when I first arrived in the area. Whether this road will ever be finished, or whether it would in fact solve the problems of transport and retail supply, are matters

8 In general, the Anggor people are distrustful of personal cash transactions. They would always prefer to buy goods from me, even when similar goods were available at comparable or even cheaper prices at the mission trade store. Consequently, every time I have left Wamu for Wewak I have been barraged with orders for clothing and equipment. These were not requests for gifts as I was assured that I would be repaid for any expenses I advanced - and I have always been scrupulously remunerated. I have rarely been able to meet more than a tithe of the requests, however. In spite of this, people would generally prefer to wait years on the hope that I would eventually produce rather than buy from an impersonal institution - in spite of the fact that people are on good terms with the mission and feel that they enjoy a personal relationship with many of its staff.
which I do not intend to consider. Instead — though I think it unlikely — I will assume that the road will satisfy the expectations that many people have for it, and proceed to consider the factors internal to the traditional agricultural/subsistence system which would serve to limit supply for the Amanab market.

The place to begin, I think, is with the uncertainty of Anggor agricultural technology. I have already noted that taro failure rates are often quite high and actually approach 100 per cent in some gardens. In most such cases the taro that 'fail' do not show signs of disease or depredation; they often produce a reasonable number of daughter plants, but simply fail to produce an edible corn. Anggor informants attribute this to soil deficiency. In addition, bananas sometimes fail to produce well. Again this is attributed by informants to soil deficiency. Sometimes entire gardens fail, which is to say that they are completely or largely abandoned to weeds. This is attributed to inadequate burning, which is in turn attributed to inadequate drying. In any given year there are normally at least one or two people who harvest no annual produce whatever from swidden gardens. Such failures clearly limit production in a very direct way, and may have the added effect of discouraging the investment of labour in agriculture.

Whether it would be technically possible to diminish the risks of Anggor swidden production is, of course, uncertain. To reduce the rate of crop failure one would have to know whether it was in fact due to soil deficiencies, and what specific deficiencies were involved. It is possible that deficiencies would be somewhat counteracted through acceptable modifications in site preparation techniques: some form of composting, for example, or shortening the period of soil exposure between clearing, burning and planting, or — over the long run — the introduction of specific fallow covers. It would be useful in any case to develop an understanding of the indicators of poor soils so that they might be identified and either avoided or improved. With respect to the problem of whole garden failure, due to inadequate burning, it is possible that the development of a system of short-range local weather forecasting would greatly improve the situation. If such forecasting were feasible, it would not only reduce garden failure in the currently practised annual cycle, but would also enable gardeners to begin new gardens during the extended dry spells which often occur during the months of the wet season.
Technical feasibility aside, it should be noted that Anggor styles of labour mobilization are extremely well suited to gathering together a large body of workers on short notice for a short period of time. It would be entirely possible, on one or two days' notice, to organize the clearing of four or five Wamu village gardens in a single day. The Anggor people very much enjoy this kind of collective enterprise. Such labour mobilization is limited only by the obligation to provide food to the workers: weeks of preparation would be required of the garden owners in order to assemble adequate provisions. In short, in order for the Anggor people to increase production by co-ordinating garden starts with the vicissitudes of climate, some facility for the extension of credit would be required.

The most promising institutional arrangement for the Anggor case would involve the combination of credit extension and marketing functions in the role of an individual buyer. The buyer would, in effect, commission gardens through the extension of small amounts of credit in the form of processed foods: cases of beer, meat and fish, bags of rice, sugar, tins of Milo or coffee, etc. The buyer would provide 'party foods' to 'pay' the workers. Under such a system the social occasions attendant on garden starts would in themselves create incentives to increase production - quite apart from the eventual cash income. Moreover, the extension of credit in this form would create a real lien against the crop in the form of a traditionally recognizable moral obligation. To this end, it is essential that the credit relationship be a completely personal one, involving exchanges of food, and that it be enduring and multiplex. Anggor gardeners would of course expect ultimately to be paid in cash for their crops - less the dinau advanced for the starting feast. In general, the Anggor like to receive cash, but are extremely distrustful of strictly impersonal money transactions. Since the establishment of Amanab patrol post, for example, the most enduring marketing arrangements have involved the creation of trade friendships between villagers and individual station personnel.

Marketing-credit arrangements along the lines suggested here would, to some extent, obviate what I foresee as the most serious supply problems arising in connection with taro production. First, an increase in the area cultivated per year necessarily entails an increased labour cost of garden maintenance: the garden owner would have to spend more time planting and weeding. Under the traditional system, labour
can be mobilized to assist in planting but not in weeding: once established, a garden site is a very personal affair.\footnote{Gardens are, for example, the place where married people (or unmarried people) go to have intercourse - which is expressly forbidden in the village houses.} Thus the labour demands associated with increased acreage are likely to conflict both with other subsistence activities and with regular social intercourse. This conflict has three possible consequences. One is that garden weeding will simply be stunted, with the result that the increase in area planted will be offset by a decline in yield per unit area. Another is that non-garden subsistence activities will be curtailed and increased garden production channelled into household consumption. (This is bound to happen to some extent in any case.) The third possible consequence is basically a variant of the second: namely that social intercourse will be curtailed, and increased garden production channelled into the informal exchange network in order to compensate. All of these consequences would be mitigated to some extent by the pressure of personal obligation arising from credit.

They should also be mitigated, of course, by the desire for cash income - but this is problematic. Although money (and the processed goods which it can buy) is much desired by the Anggor, it is in no way essential. Moreover, neither money nor goods are particularly useful in producing social organization. The main problem is the central role played in the production of social organization by the hunting and communal distribution of feral pigs. These pigs are not valued simply as meat, or even simply as pigs, but rather in terms of a complex system of associations which link religion, land tenure, daily life and social classification. It is because of these associations that the Anggor can produce organization by killing and distributing feral pigs. This system is so thoroughly grounded in hunting as an activity, and in the wildness of feral pigs, that even home-grown domestic pigs cannot be utilized for the same purpose. Consequently, it is difficult to imagine that money or anything that it can buy could ever be drawn into the system. Moreover, it is difficult to envisage the traditional Anggor subsistence system generating a sustained demand for cash income.

In sum, in spite of an abundance of land and a mobile labour force, the prospects for mobilizing Anggor agriculture for market production are not encouraging. This is because
social organization is maintained at a very low level and is produced mainly through dispersal—of labour and products—rather than through concentration. If social organization were produced through a concentration of things (say, of taro or pork) and public exchange between parties became a formal relationship (as in bridewealth payments), then augmenting gifts with money or beer or other commercial goods could induce an inflationary trend which might sustain the level of commercial production. But the Anggor system is not very inflation-prone.

The evidence of a single ethnographic case—however apt or unequivocal—will not serve to confirm or disprove an empirical generalization. Thus the preceding discussion cannot prove that shifting cultivation improves the environment or produces organization. Analysis of a single case, however, can illustrate the advantages of adopting a certain point of view. The improving and organizing effects of Anggor agriculture are plainly of central importance to Anggor cultivators, yet they are virtually invisible to a western observer. By looking for them and at them, one obtains an understanding of the traditional agricultural system which is more complete and useful than would otherwise be the case. Moreover, having identified these effects in the Anggor system it should be easy to discover them in various other forms in different systems.

This is true in spite of the fact that the Anggor are atypical of Oceanic cultivators in several important ways. For example, although silviculture does not appear to assume the central importance among other Oceanic peoples that it does among the Anggor, it is very widely encountered. Thus the significance of silviculture—and the related matter of the creation of tenure in general through cultivation—ought to be examined as part of any inquiry into traditional agriculture in Oceania. The degree and kind of importance attributed to the long-term effects of shifting cultivation in different societies may have significant implications for their adaptability to the commercial production of traditional foods. Similarly, one can easily see that agricultural production in various Oceanic societies might play the role assigned by the Anggor to pig-hunting and distribution.

The ethnographic record, in fact, is replete with instances in which agricultural production is quite explicitly linked—directly and/or indirectly—with ritual events
which organize communities on various levels. The Trobriand gardens which Malinowski describes, for example, involve the entire localized sub-clan in an extended series of co-operative ceremonial/technical activities which represent the organization of the hamlet. Large quantities of the yams these gardens produce are subsequently distributed ceremonially by individual gardeners as part of their continuing urigubu obligation to the husbands of their sisters and paternal aunts (Malinowski 1935). Among the Maring (and elsewhere in the highlands) large quantities of sweet potatoes, at times as much as 50 per cent of total production, may be fed to domesticated pigs. These pigs are subsequently mobilized as a medium of exchange in transactions which organize and reorganize social relationships throughout a wide area. Moreover, the siting of gardens and the agistment of pigs serve to organize networks of more intimate, personal relationships (Rappaport 1968; Clarke 1971). Similar phenomena may be encountered among the Kaluli (Schiefflin 1976), the Abelam in the Schouten Islands (Hogbin and Lawrence 1967), and so on - the list could be extended indefinitely.

Can such systems be adapted to commercial production for urban food markets? The preceding discussion cannot answer such a question, but it does say something about the conditions under which adaptation might be possible.

To speak of 'adaptation' in this context implies a contrast with what may be termed 'introduction'. Many Oceanic societies currently employ agricultural systems which are embedded in a rich and supportive community life, which are labour efficient and environmentally sound, and which are presumably capable of producing significant surpluses. 'Adaptation' implies building upon such systems; the alternative for providing food to urban markets would be to introduce new and alien technologies and organizational forms (rice, fertilizer, the family farm). It might appear that adaptation involves less risk than introduction - less likelihood of rejection by local people or, given wholehearted acceptance, less likelihood of undermining existing communities and disrupting the social services they provide. In practice, however, I doubt whether this would be the case, and I suspect that it might be very difficult in some cases to clearly differentiate the two strategies. Traditional systems would be modified by adaptation, and alien systems would be modified by introduction. The main difference between the two strategies involves the degree to which
they draw upon existing local resources, especially technical and managerial skills. And consequently, the main practical difference between the two strategies would be one of cost: introduction would require capitalization and retraining—an expensive extension effort.

The main thrust of my paper, then, concerns the assessment of the skills of the existing labour force, the practitioners of traditional agriculture— with special reference to managerial skills, and with reference to the difficulty in distinguishing them from technical skills. The first point, of course, is that these skills are highly specific—so much so that it is extremely important to avoid over-generalizing them. Indeed, what is required is not so much a set of empirical statements about traditional skills which are generally true, but an abstract language for comparing and contrasting them. To say that gardening produces organization, then, is to draw attention to the intimate linkage between managerial skills and social organization and to suggest that managerial skills ought to be compared and discussed in terms of the social systems which situate them.

The key question for the adaptability of managerial skills in specific traditional systems is the capacity of traditional organization to absorb money. In situations where organization is produced through ritual events which absorb large amounts of bulked foodstuffs—that is, in general, through feasting—it is quite likely that cash income could be converted into social capital. In such a context, traditional managerial skills might be mobilized for the production of food for urban markets. Much depends, however, on the specific form of events. Funeral feasts on the island of Koîl have an enormous absorptive capacity; Trobriand urigubu, on the other hand, might have none at all depending upon whether yams can be replaced or augmented by purchased objects or money itself. Similarly one must ask what social advantages and disadvantages attach to mobilizing labour and utilizing land in different systems. All of these considerations relate to managerial skills: they involve features of each situation which must be considered virtually incorrigible. Technical skills per se, on the other hand, may be susceptible to 'improvement' in very specific ways in certain places, that is on a very limited case by case basis. (For example, a national weather service providing reliable regional forecasts might have an enormous impact on productivity.)
At this level of discussion, the implications for national planning primarily concern assessment. Conventional, quantitative assessments of the purely technical productive capacity of traditional systems may be useful, but they are also very difficult to make—often they require prior assumptions, arbitrary and questionable, about social performance characteristics. Most important are estimates of social limitation on land and labour use and demand for money.

As far as intervention at the local level is concerned, most of the implications of the preceding discussion are negative. Policies which depend upon or encourage individual entrepreneurship or corporate responsibility should be avoided. Individuals operating in terms of an essentially business rationality, limiting labour costs and accumulating capital, are likely to call into question the very premises upon which labour support and usufructuary privilege depend. Conversely, traditional groups may not be able to bear burdens of collective responsibility created by market participation but not warranted in their traditional charter. In either case the result is a failed enterprise and a disruption of the traditional community. Communities can recover, but enterprises may not.

The proper context for government intervention is at the level of regional marketing. Although this really goes beyond the scope of my paper, I do offer some very sketchy and tentative suggestions. Credit and marketing functions might be consolidated in the role of an individual broker, as suggested with respect specifically to the Anggor (p. 173). Credit could be extended primarily for consumption goods used to mobilize labour for increased agricultural production along traditional lines. This credit could constitute a lien against expected production. But it should not have the status of a legal contract. Rather it should constitute a moment in a continuing personal relationship between producer and broker, not unlike the traditional trade partnership found in many parts of New Guinea and Melanesia.

Plainly any program incorporating these features would not constitute a development program in the conventional sense of the term. It would actually tend toward traditionalizing the market. It might, however, make the produce of traditional agricultural systems available to urban food markets—and very cheaply, too, in terms of administrative costs. The central difficulty to be overcome is the
fundamental contradiction between the motives and management skills normally entailed in market participation and the motives and skills that traditional village life normally generates. Any program truly aimed at harnessing rather than supplanting traditional agriculture must somehow mediate this contradiction by interpreting and respecting the rationality of traditional production. Such a program must come to terms with the constraints and incentives which operate upon people who are in business primarily to produce organization in their lives.
Chapter 12

**The Kwaio of Malaita: old values and new discontents**

R.M. Keessing

Some 2000 Kwaio of the central mountains of Malaita, Solomon Islands, continue to sacrifice pigs to their ancestors, follow ancestral taboos, give mortuary feasts using strung shell valuables, and subsist almost entirely on traditional foods they produce and gather. In their cultural conservatism, they are by no means typical of the contemporary Pacific. Yet they too, after a century of fierce autonomy, are being pulled by the forces of modernization.

First, they still manifest what Fisk has called 'subsistence affluence'; and they value its riches. The benefits, and costs, of their traditional way of life are still in view, within a hundred miles of Honiara. Second, in their long, partial and selective involvement in the international economy through plantation labour, the Kwaio can serve to dispel myths about primitive isolation. They illustrate how 'traditional sectors', even in the most peripheral corners of developing societies, are products of the colonial period, not simply leftovers from the past. Third, the growing demand of the Kwaio for greater participation in the cash economy, particularly in the last few years, illustrates a number of problems and contradictions. The Kwaio are being pulled toward the brink of a greater dependence on the world economy and an unrealizable demand for cash and western goods. They are moving toward a state of 'underdevelopment'—hence strikingly exemplify Andre Gunder Frank's thesis that this is a state created in the Third World by industrialized countries, not a natural state of traditional economies. The hopes of the Kwaio of being able to add a greater participation in the cash economy to the riches of their traditional

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1 This paper has been written in a remote mountain community where documentation of reference has been impossible.
culture illustrate (if we needed further illustration) the seductive powers of money as a lure. But at the same time there is a challenge: whether building on traditional agriculture as a source of income can, by preserving the fabric of social relations in rural communities, minimize the costs of participating in the cash economy while meeting growing new demands. Finally, the dilemmas of the Kwaio as potential participants in the internal marketing systems of the Solomons, as isolated and peripheral producers with an abundance of land but greater difficulties and high costs in shipping goods to markets, illustrate the uneven potentials for development, of this or any other kind, that beset small Pacific countries.

The Kwaio, in short, pose a paradox. They are, in their own terms, the richest people in the Solomons; and in western terms, the poorest. Can the riches of old ways be preserved? Should they? Can new kinds of riches be added without excessive cost? Are the Kwaio a vestigial anomaly? Or could the enduring riches of their old ways serve as guides for the re-enrichment of peasant communities in the contemporary Pacific?

The Kwaio pagans live scattered in tiny, shifting settlements through the interior of Malaita, in a belt across the widest and most mountainous part of the island. The most dense concentrations of settlement are above the east coast, particularly inland from Sinalagu Harbour. In the lowlands, both along the coastal margins beneath the mountain wall and in river bottomlands, most Kwaio are Christian; many have moved down from traditional lands in the mountains, most often to escape ancestrally-caused illness. These Christian communities are typical of those in the more remote parts of coastal Malaita, and I will refer to them only in counterpoint to those of the mountain-dwelling pagans with whom I have been working over a 15-year period.

The religious system of the pagans is completely intact. For 75 years they have heard the Christian message and rejected it. The actors on the social scene include unseen ancestors, both recent and ancient, with whom the living are in constant communication. Through sacrifice, the living seek to elicit from the ancestors the mana which must be added to human effort if crops and pigs are to grow well, feasts are to succeed, and health is to be preserved. The ancestors monitor human life to ensure that rigid rules (particularly regarding the containment of the pollution that emanates from women, and is antithetical to sacredness) are followed, and
violations are expiated. Pigs, which forage loose in the day and are fed at night to draw them back to the domestic dwellings where they sleep, are raised primarily for sacrifice. The ancestors consume the spirit of sacrificial pigs, men and boys consume their substance. Women partake of pork less often, at mortuary and marriage feasts; these secular pigs are now obtained mainly from Christians on the coast.

These feasts are a focus of productive effort. Mortuary feasting is geared with, and an incentive to, the cycle of pig raising. Taro, the primary starchy staple traditionally, is produced in quantities well beyond subsistence needs both by feastgiving groups and by families who contract to sell corms to feastgivers. Surpluses are also produced for *di'iliu*, 'chain feasts' where taro puddings, fish, pork and other foodstuffs are set out, claimed, and then reciprocated with some increment at the next feast in the series; at the final feast, each portion, considerably expanded, comes back to the original contributors.

Everyday subsistence depends, in terms of volume, on starchy root crops: taro, yams and plantains were traditionally most important, with the former undoubtedly the primary staple. In the last 20 years, taro production has been severely reduced by fungal and viral blights (although taro is now growing better, and used more extensively in daily subsistence, than at any time in my 15 years of observation). The slack in taro production has been filled mainly with sweet potato, introduced some 90 years ago, but used minimally until the taro blights forced a shift in subsistence diet. Sweet potato production is regarded as a necessary compromise, left mainly to women, and carried out without the ritual observations and first fruit presentations to ancestors that accompany taro and yam cultivation.

The starchy staples are augmented by a number of cultigens and wild foods. Seasonally, canarium almonds, wild fruits, lorikeets trapped in fibre nets, the once-a-year palolo worms, and other foods augment the year-round diet. Cuscus oppossums and birds are hunted year-round; feral pigs mainly disappeared with the advent of firearms a century ago. More steady sources of animal protein are fish, obtained from the coast by barter or purchase or caught in mountain streams, shellfish, and the edible insects and grubs consumed in substantial quantities in inland areas. Other wild foods include berries, the edible pith of cyathea, wild yams and *Ficus* leaves of various sorts. The most common greens, consumed
daily in many families, are *Hibiscus manihot* and taro greens. Coconuts augment the diet in communities on or near the coastal slopes.

If one measured food consumption only at mealtimes and in houses, the preponderance by bulk of starchy staples would be exaggerated, and the consumption of a range of animal and vegetable supplements partially overlooked. Both biomedically (as studied by a 1966 Harvard biomedical expedition) and in terms of physical strength, stamina and longevity, the diet seems entirely adequate. Only in highly anomalous individual cases are there signs of neurological damage or clinical protein deficiency. Physical maturation is somewhat slow by western standards; and there is little doubt that higher protein consumption would lead to increased stature. But despite introduced diseases, especially respiratory diseases, and a high infant and early childhood mortality (probably inevitable in a high-rainfall tropical zone with endemic malaria), longevity is impressive. Octogenarians, male and female, are common. Men typically remain vigorous, tightly muscled, virile and capable of sustained work through their sixties, and often beyond. Women in their seventies often do heavy work. The stamina and strength of Kwaio men has made their musclepower a mainstay of plantation production for many decades.

The Kwaio not only thrive on a traditional diet, but they value it highly. They appreciate rice obtained for cash, and tinned fish and meat. But most of the time these are beyond reach as daily foods. As feast food, any Kwaio pagan would opt for pork and taro pudding over rice and bully beef, without a second thought.

Kwaio have had steel knives and axes for a hundred years, and stone technology has long since faded from memory. But improvised digging sticks remain a basic tool. Kwaio can get along quite well without cooking pots, torches, hurricane lamps, spoons, and other standard items of Solomons coastal households. Bamboo serves for steaming foods and as the universal container for drinking water; and it provides torches, panpipes, carving knives and many other items. Forest fibres provide woven bags and baskets, umbrellas, mats, ropes, netting, beds and ornaments. The Kwaio economy juxtaposes introduced 'luxuries' and local equivalents which they regard as less convenient but basically as good: battery torch and leaf torch, spoon and shell, saucepan and bamboo tube, razor blade and bivalve, twist tobacco and
home-grown, are essentially interchangeable. Even where traditional technology has fallen largely into disuse (as with firemaking by friction), Kwaio combine the old and the new—striking of metal on flint, or use of a cigarette lighter if one is available to light a coal, which is then broken off into a pipe to give the desired combination of charcoal and tobacco. (Mostly, the home fires are kept burning, so that every passing visitor asks for a light.)

The Kwaio economy is structured around production and consumption by domestic groups, and elaborate systems of exchange. In the latter, foodstuffs play a secondary part. The main instrument of prestations, of the prestige economy, of bridewealth, and of legal settlement is bata. Bata consists of tiny strung cone shell beads (mainly locally manufactured by cutting, grinding and polishing) in standard lengths and denominations. The larger multiple-stringed valuables are usually presented publicly as tokens of prestige, of alliance and rivalry, and subject to precise standards of eventual reciprocation. But smaller amounts can be used to buy anything that can change hands in Kwaio, from an areca nut to a magical formula or a tract of land. Australian currency can be used in some of these transactions, but it is used reluctantly and only grudgingly accepted. Whatever cash people may have is regarded as useful for buying tools, pipes, cloth, rice or other items—or, as a last resort when evasion fails, for paying Malaita Council rates. (The latter, now $6 per adult man, substantially exceeds annual cash income for many families.) The cash economy is relatively tightly compartmentalized from the bata-and-subsistence economy. When cash is available, it selectively and marginally augments the quality of material life. A family must send a young man abroad occasionally (or let him follow his own inclinations for adventure) so as to obtain the few items that are genuinely needed—knife, axe, a bit of cloth for a married woman's pubic apron, perhaps a pipe or two—and whatever extra luxuries are possible. But when these needs are met periodically, a family can do almost as well, in their own terms, without cash as with it.

This at least approaches the 'subsistence affluence' of tribal economies as characterized by Fisk. Most of the Kwaio pagans have been well off both in my terms and their own during most of the time in my 15 years of study. They have been proud and adamant, in most contexts, that the quality of their lives is better than that of the people of the Western Solomons, who have abandoned their customs and become
peasants, or of the Christian Malaitans in Kwara'ae or To'abaita, living beside a road, growing cash crops, and eating bread, rice, sugar and tinned fish. The affluence the Kwaio enjoy is one of balance, of self-sufficiency, of material plenty and continuity with the past. Prosperity and bata-lessness, health and illness, life and death, are part of cultural order where human effort and ancestral control are woven into meaningful patterns. The preservation of this cultural fabric holds together a social network of mutual support and kinship obligation. The family afflicted with death, illness or crop failure is sustained by co-operation, caring and sharing. It is a social world where orphans do not grow without love, elders do not pine away without care; a world where no one goes hungry in the face of adversity.

We began with one paradox: that the richest people in the Solomons are its poorest people. Perhaps to that we could add a second: that the most Christian Solomon Islanders are pagans.

To see the richness of this way of life is not, I think, to adopt the woolly-headed romanticism and cultural relativism in which anthropologists have often indulged. The Kwaio of the 1970s, I think, are substantially better off than the Kwaio of the 1870s— not simply because of introduced technology, but because of externally imposed political changes. (They themselves are ambivalent about this, committed as they are politically to a fierce anticolonial independence.) The lives of the grandparents of contemporary pagans were blighted by blood feuding, and the danger of sudden death to the helpless and innocent, as well as to warriors. And this threat of death supported a system of sexual repression. Kwaio life has become more fulfilling for more people in the last 50 years under the Pax Britannica, however traditionalists may grumble about the younger generation and the decline of old virtues.

The way of life I am talking about is thus not one that, as bad travel writers put it, has remained unchanged 'since time immemorial'. It is a product of the impact of nineteenth and early twentieth century European expansionism and the subsequent imposition of colonial rule. This most 'traditional' of island Pacific societies has been part of the world economic system for more than a century; and both its 'subsistence affluence' and its incipient underdevelopment must be understood in this light. Beginning in the 1870s, young Kwaio men went off to sugar plantations in Queensland and Fiji. They brought back steel tools, cloth, pipes, tobacco, aged firearms
and new cultigens, transforming life over a 50-year period before pacification. In this period blood feuding probably escalated, and senior men substantially controlled goods brought from abroad.

In 1923 a head tax was introduced by the government of what had become a British Protectorate, forcing the Kwaio more heavily into a burgeoning internal plantation economy. Four years later, Kwaio warriors assassinated the District Officer and massacred his police patrol. The subsequent bloody punitive expedition forced the embittered survivors into capitulation to colonial rule. (In the wake of World War II, Kwaio anticolonialism was expressed overtly again when they joined in an island-wide resistance movement, Maasina Rule, which spilled over to other parts of the southeast Solomons.) Through most of this century, Kwaio young men have been recruited, along with other Malaitans, as indentured or contracted workers on copra plantations. Large companies, particularly Levers, either used independent recruiting agents or company recruiting ships to pick up and repatriate workers. Laden with trade goods from company stores, the returning workers enabled their kin to preserve their distant symbiosis with the world economy. The returns for two or three years work were modest but predictable; the employment was certain, and conditions — in terms of housing and rations and workload — were known and adequate. Since plantation work was a way-station on the path to adulthood, almost a rite of passage, the status of copra cutters and 'brushers' was familiar and respected.

In the mid-1960s this recruiting pattern effectively ceased. The subsequent decade, for the Kwaio, has been characterized by (1) the development of urban and town centres, particularly Honiara; (2) high and rising costs of getting to and from potential jobs, by private means; (3) high risks of unemployment or unstable transitory labour; (4) a decline in the standards of living associated with work (where housing and rations are often not provided and workers must fend for themselves); (5) reduced earnings, in terms of buying power, and high risks of dissipating earnings in urban settings on drink, food, gambling, etc. Moreover, the increasing prosperity of Honiara and other towns, and the emergence of an educated Melanesian population commanding white-collar, skilled or semi-skilled employment, has put Kwaio pagans at the absolute lower end of the scale of wages. The Solomons has developed an indigenous class system, and the Kwaio and other Malaita pagans are on the very bottom of
Kwaio pagans cutting grass by the side of the road for
the Honiara Town Council, or cutting copra in the plantations
outside the town, may be doing the same physical labour their
fathers and grandfathers did. But they look enviously at the
'highly paid' and 'prestigious' truck drivers as they go past
(from the standpoint of most Solomon Islanders, being a mere
truck driver is low-status). Kwaio pagans, then, have gone —
mainly in the last decade — from proud parity with workers
from other islands to a near-pariah status. They wander the
town looking at shiny goods they cannot buy; their blackened
teeth, decorated combs, and porpoise-teeth and bata necklaces
and earrings evoke a fear and fascination in the new urban
setting. Those few who have achieved a measure of prosperity
in the new Solomons have mainly done so by drawing on
culturally-sanctioned skills of theft.

Meanwhile, the self-satisfaction Kwaio pagans feel with
their traditional ways, particularly in comparison to their
kin in the Christian villages along the coast, has been
threatened by the impact of education and growing prosperity
in lowland communities. For decades, coastal Christians were
no better off even in European material terms than their
pagan cousins; and in fact they had fewer diversions, worse
food, and worse living conditions, in squalid malarial villages
with little garden land and often inadequate and distant water
supplies. Education was minimal, and brought no visible
benefits but a clumsy literacy in the vernacular which Kwaio
pagans drew on when they needed a scribe. But in the last
decade, substantial numbers of Kwaio Christians have gained
secondary educations, a few have gone beyond to tertiary
training or degrees. Many have secured white-collar or
skilled employment in towns. Many who continue to live in
coastal villages have developed steady incomes from producing
copra, growing introduced vegetables, raising chickens, manu-
factoring craft goods, etc., etc. The presence of a well-
equipped Seventh Day Adventist hospital a few miles down the
coast has created a small European market, air access to
Honiara, improved shipping, a visible reminder of European
prosperity and technology, and a marked improvement of health
standards on the coast. Malaria spraying has improved public
health on the coast as well.

In all these respects, the coastal zone has become a
visibly better place to live than it was ten or 15 years ago.
Its people have begun to enjoy rewarding fruits of European-
style prosperity, and an advantageous return for their work
and education. The satisfactions of the traditional
subsistence affluence remain little changed materially; but the standards against which they are measured have shifted noticeably, and will continue to shift.

The Kwaio pagans, like all of us, would like to have their cake and eat it too. For them, that means getting more European money, and some of the things one can buy with it, without giving up the riches of traditional life. It will be instructive to reflect briefly on their options – including ones they do not now perceive – and their potential consequences and costs.

The present situation is of course not stable. Although the government has through the years provided virtually no educational, medical, agricultural or other services for Kwaio communities in the mountains, in return for 50 years of reluctant tax-paying, there are signs of discomfort among the bureaucrats in Honiara about the big blanks on the development maps, and the political voices distantly heard from poor rural areas. Fifteen years ago, when Kwaio rejected ill-conceived government cocoa schemes, they could be dismissed as 'bloody-minded' obstructionists; but nowadays they are beginning to be an embarrassment to a government rhetorically committed to rural development. One consequence has been the promise that a coastal road will be extended so as to reach, eventually, the lowland margins of Sinalagu Harbour, beneath the mountain wall. If this promise is realized, many of the Kwaio mountaineers will be within two or three hours walk of a roadhead with truck access to Auki, the administrative centre of Malaita (which has its own town market with growing demand, and regular shipping overnight to Honiara). The Kwaio will be at the periphery of a potential marketing route – distant and disadvantaged in terms of transport, but not totally isolated. Their options, then, may be expanded. And among them might be the production of subsistence crops for export to urban markets. Unless government policies shift in the direction of subsidizing transport cost for such peripheral producers, however, their sheer marginality and distance will leave them at a sharp economic disadvantage.

Many Kwaio adults are convinced – wisely, I think – that if the rewards and strengths of traditional life can be preserved, and augmented with a new earning power, it will have to be through progressive disengagement from traditional migratory wage labour. It will have to come from creating new sources of cash at home, so that young men will not have to go in such numbers, for so long, at such cost. That cost,
from the standpoint of Kwaio adults - both men who have seen the outside world of plantations and trade stores, and women, who have not - is an erosion of traditional values, moral standards and knowledge; a succumbing to the temptations of bright lights, town girls and money. Kwaio adults realistically fear that the sons they have not seen for five or eight years will never come back; daughters fear they are waiting for potential husbands who will never return. For years, opting out by marrying 'Western' girls and going into copra production abroad has been a temptation; but not many have chosen that course. More are beginning to do so, although there has not yet been a mass exodus. Many young men, even men in their late thirties who have been abroad for a decade or more, are coming back, marrying, and having children, after their long but peripheral flirtation with the attractions of town (which for the urban poor are often vicarious) or peasant life: the rewards of the old ways, the attractions of home, are still visible and strong. The challenge many Kwaio now see is to strengthen these rewards and attractions through new earning power at home.

But there are problems in all this. First, it is easier to think about earning money in remote mountain forests than to do it, particularly for a people who are illiterate, uneducated, and fragmented and acephalous politically. (It would be only a slight oversimplification to describe Kwaio society as having all chiefs and no Indians, although during Maasina Rule and since, efforts at political reorganization and integration have been a prominent theme.) Second, it is easier to talk about keeping young men at home to make money than it is to persuade them to stay, when migratory wage labour has for a century been a rite of passage, an adventure on the path to manhood, and when bright lights beckon. At best some might be persuaded to stay at home, others attracted back more quickly and surely. Third, it is easier to talk about adding cash income to the traditional social system without a breakdown of custom and an escalation of demand than it is to achieve it; one would be hard-pressed to find places in the world where this has been successful.

But unless some changes are made by design - ideally, by Kwaio design, with, support by outside agencies - a progressive deterioration of present satisfactions without adequate compensatory gains seems virtually inevitable. So it is worth setting out some possibilities.
1. **Expand production of traditional root crops for market export**

This entails two possibilities, not necessarily mutually exclusive. (Some families, kin groups or individuals could opt for one pattern, others for the second, others for some combination.) First, production of root crops for cash could be separated from subsistence gardening - done by individuals or groups for export, in a secular framework, using introduced technology where feasible, to maximize crop yields. Second, families could use traditional technologies, magic, ritual, etc., to produce a surplus as best they can (as they presently do in producing taro corms for sale). Subsistence would then be integrated with cash cropping. Prospects that the Kwaio could compete effectively with less peripheral producers in growing sweet potatoes for market are not bright. The profits are now slim, and it seems doubtful that Kwaio could pay transport costs and still make a worthwhile return. Export of taro is potentially more feasible. Guadalcanal villagers can produce only small quantities of inferior taro for the Honiara market, where demand is potentially great. The problems are, on the one hand, the viral and fungal blights that reduce productivity and increase risk; and on the other, the relative perishability of taro, which renders the timing as well as the cost of shipping critical. The government could potentially contribute to this mode of development by the Kwaio and other bush peoples of Malaita by pushing ahead with promised road development, augmenting and subsidizing land and sea transport, and belatedly focusing some agricultural expertise on internal rather than export cash cropping, and on traditional staples (particularly taro and its disease problems). Fungal/viral blight-resistant strains are apparently evolving in pockets of the rural Solomons, including Kwaio; but because of biases against traditional subsistence crops, few resources have so far been devoted to what has been a major national problem for 20 years, substantially eroding the quality of life in many areas.

2. **Plant high yield/low bulk cash crops suited to high bush, for internal and export markets**

Here, small-scale family plantings of spices (e.g. chili, cardamom, pepper) or other high-altitude crops (passionfruit, coffee) could perhaps be added around settlements without markedly affecting swidden cultivation of subsistence crops. The abundance of secondary forest in relation to the relatively
sparse population, and the relatively light work demands on men in subsistence cultivation (which make large-scale labour migration possible today) give the Kwaio a latitude many Solomons populations do not now have. It seems possible that fairly minor augmentation of present agricultural systems could enable a family to meet presently conceived cash demands (say, $50 to $100 per year) without major changes in present social organization or economy. Farming projects which required larger concentrations of labour than family groups could build both on traditional patterns of temporary labour augmentation and on the patterns developed in communal farming during Maasina Rule (which in organizational terms were quite effective, and did not interfere seriously with subsistence cultivation by domestic groups). Such avenues of development would require: (a) the introduction of new agricultural expertise, which implies a commitment to agricultural extension work in the bush the government has not so far sustained, the provision of planting materials, and effective grass-roots communication. Where distrust of government has historically (and often realistically) been high, and local political organization is fragile and often anarachic, this latter is no small problem. (b) In the case of cash crops for internal markets, a shift in the concerns of agricultural officers towards production that will redistribute wealth within the Solomons and expand the range of locally available foods, rather than create export revenue. (c) In the case of cash crops for export, an effective and sustained system of crop buying and marketing, so as to reduce the risks and burdens to the primary producer (which, given fluctuating market prices, are considerable in any case). Otherwise, the chances of yet another government-sponsored failure are high. The possible export revenue of a high-value crop such as cardamon must be balanced against the possibility that, with world demand very limited and other countries entering the market, prices would collapse just as production in the rural Solomons began to create increased cash demands.

To these difficulties must be added the Big Question of whether, if the Kwaio could achieve the modest cash income they now seek, their demands for ever-increasing income would rapidly outstrip earning power - leaving them worse off, in their own terms, than before. Let us defer this question for the moment. Two other possibilities for increased cash income bear very brief mention.
3. The product of craft goods for export

There is now considerable competition for a limited craft market, with carvings, weapons, bowls and other items available for sale to tourists in Honiara, and exported to metropolitan countries. The Kwaio do produce attractive plaited combs, armbands, and other items, which - small but very finely worked - make ideal gifts. So far my attempts to organize and expand production have been unsuccessful.

4. Tourism

Air access to Atoifi (SDA Hospital) would render feasible the creation of a tourist 'village' near the airstrip, which could provide a venue for customary dancing, panpiping, *bata* fabrication, archery and fighting demonstrations and craft sales. Again, both organizational problems and competition loom large.

One means whereby new agricultural techniques and craft skills could be disseminated would be creation of a bush school. At such a school, traditional knowledge - musical forms, oral tradition, genealogies, religious lore, etc. - could be transmitted and hence preserved; at the same time, teaching of literacy in the vernacular and Pidgin, and of elementary arithmetical skills and perhaps some conversational and written English could usefully equip Kwaio pagans working in towns or engaging in cash enterprise at home with new skills. A school could also serve as a centre for teaching mass adult literacy. So far quite rigid requirements regarding age, curriculum (including 'Christian education'), athletic fields, etc., designed for large coastal villages impede development of a school which attempts to synthesize old knowledge and new.

We can now return to assess more generally the possibilities and prospects of the Kwaio participating more fully in the cash economy without excessive erosion of the 'subsistence affluence' they have enjoyed for decades. Given the flexibility Kwaio have shown in the last century in selecting specific desired elements of western economy and incorporating them into traditional life while preserving old values, I see no reason to be completely pessimistic. Development economists generally work with a premise that Third World peoples will inevitably be drawn by the attractions of western technology and hopes of a 'higher standard of living'. The Kwaio pagans have violated this premise
systematically for a century; we need not, I think, assume that their critical wisdom will desert them now simply because the bright lights have become brighter. Nor need we be pessimistic in organizational terms. Despite the contemptuous dismissal of Maasina Rule by European observers as a 'cargo cult', it was in fact a rationally conceived sociopolitical reorganization that held together remarkably well in the face of sustained repression by the colonial government;² and it achieved an indigenous synthesis of old and new that preserved old values in new institutional forms. I think it is realistic, given existing patterns of surplus production for sale and barter, their adoptions of new technologies and cultigens over the past century, and their postwar transformations of the social order, to hope that the Kwaio could incorporate export agricultural (or craft) production into their traditional way of life without excessive cost. The values of the traditional economy are in no way antithetical to individuals earning money. Men, women, even girls of ten, earn bata of their own by craft production, taro planting, pig breeding, and what amounts to wage labour (cutting firewood, building shelters, carrying water and taro for other people's feasts; attending mothers in childbirth; performing customary cures or magical services). Cash and bata are, if not interchangeable, mutually compatible: for many decades they have operated in separate spheres. I see no reason why Kwaio could not make quite successfully the minor organizational changes in production that would augment cash income without cutting away traditional satisfactions and relative self-sufficiency. In the case of an introduced and unfamiliar export crop, there would be the delicate task of conveying to the Kwaio the knowledge they would need to begin cultivation - to make it 'their' crop rather than yet another alien government scheme; and difficulties in establishing a marketing system. But once operative, such production could become, in effect, a part of Kwaio culture rather than a threat to it.

I am rather less optimistic about whether, if Kwaio families were able to earn the $50 or $100 per year they think they want, they could maintain a balance between earning power and new demands. If they could buy, say, a radio, a pressure lamp, and a few bags of rice a year as standbys for rainy days, would they be content with that? If I am doubtful, I am not completely pessimistic. If one is living in the

mountainous interior of Malaita on the lands of one's ancestors, surrounded by abundant garden lands and the forest products that provide effective substitutes for most manufactured goods, one's needs and wants are constrained by the very closure and inwardness of one's orientation. Living on the coast or beside a road, one's 'needs' for outboard motor, truck, metal roof, or hardwood floor rise, seemingly exponentially, as income grows. For the Kwaio, with little coastal land, the temptations of life on the coast are reduced (although construction of a road could change that). If their demands are to remain within bounds they can reach, despite a modest rise in cash income, it will have to be through continuing operation of their past wise restraint and conservative values, on the one hand, and a continuing commitment to living in their demand-dampening forest homeland, on the other. Beyond that I can only speculate.

The dilemmas and prospects of the Kwaio, in a backwater of the modern Pacific, may seem trivial to planners who must deal with the economies of nations and continents. But although theirs is a special case, it is not, I think, irrelevant. In Third World countries, millions have abandoned traditional village life, flocking to urban centres or committing themselves completely to cash cropping, wage labour, or entrepreneurship. Caught on the treadmills of development, even those who are getting what they thought they wanted are increasingly haunted by a realization that the quality of their lives has deteriorated. The same realization is increasingly haunting people in affluent industrial nations as well.

The quality of traditional ways of life lies primarily in balances and harmonies with the environment, continuities between generations, social bonds within the family and community, satisfaction with the fruits of one's work, and a measure of safety, predictability and stability in the course of human and natural events. For millions of Third World peoples, population explosions and environmental degradation have destroyed the possibility of these balances being preserved. For others, as in the Solomons, development has led to, even deliberately created, their breakdown—substituting uncertain and shallow satisfactions for sustained and deep ones. It is a hazardous trade-off in which even winners lose a great deal. The Kwaio, proudly and even defiantly following the ways of their ancestors in the last quarter of this century, teach us that the temptations to jettison the values of the old life in search
of western-style prosperity can be resisted. And they may yet be able to teach us, and peoples in Pacific communities trying to rebuild a good life, that selectively exploring new economic paths need not cause the old social order to disintegrate, the old values to lose their meaning.
Section D
Studies of other regions of the world
Chapter 13

Root crops and their utilization in West Africa

D.G. Coursey

The process of urbanization has gone much farther in West Africa than in the Pacific, and at the same time the marketing infrastructures to supply these urban centres with food have reached a proportionally more sophisticated level of development.

There are, of course, many contrasts. West Africa is a compact geographical unit, albeit covering an area of some 6 million square kilometres, but as a single land mass. Internal communications, traditionally by river canoe or by trekking, are provided in modern times mainly by rail and more particularly by road (lorry) transport. The countries of the Pacific are spread over nearly a quarter of the surface of the planet, but with an actual land area of only about 1/2 million square kilometres: communication by sea (and recently by air) has thus been of greater importance. West Africa has a total population of approximately 127 million as against only 4 million in the Pacific Basin (excluding Hawaii), and indeed, several West African countries have larger populations than the whole of the Pacific, and many African cities are substantially more populous than some Pacific countries. West Africa retained somewhat tenuous cultural contacts with the Mediterranean world throughout ancient and medieval times, and since about 500 Before Present (BP) has rapidly become fairly closely integrated with the mainstream of world cultural development: the people of the Pacific Basin on the other hand have developed their cultures very largely in isolation, until only about 200 years ago, while some groups have remained in isolation even within living memory.

The similarity between West African root crop agricultural systems and those of the Pacific, especially Melanesia, is striking, and it is reasonable therefore to hope that some consideration of the West African experience may be of interest and value here. As has been indicated elsewhere
(Coursey 1972), the similarities are most marked with the yam-oriented cultures, and are sufficiently great to suggest that, at an early stage of human history, there was some form of cultural continuum stretching across the tropical/equatorial belt of the Old World from West Africa to Melanesia (Coursey 1976b; Coursey in press). Indeed, Lomax and Berkowitz (1972) have postulated the former existence of 'a continuous ring of gardening cultures' (which would have depended very largely on root crops) around the Indian Ocean. The areas of West Africa and the Pacific where yams and other root crops are still major, culturally important, staples, could be regarded as the two extremities of this ring where, owing to their relative geographical remoteness, the intrusions of more highly organized, grain-based cultures have not destroyed the earlier pattern as they have done in most of the intervening areas.

West Africa - the geographical basis

West Africa is usually defined as that part of the continent bounded by the Sahara Desert to the north, by the Atlantic Ocean to the west, southwest and south, and by the Cameroon mountains to the east. The coastline is mostly at around 5°N, while the northern limit of cultivation, apart from riverain districts and oases, between 15°N and 18°N. The greater part of the area, apart from the Jos and the Futa Jallon Highlands, is below 1000 metres altitude. Climate is generally tropical, with temperatures commonly between 25° and 35°C, the highest temperatures being reached in the dry season. With some local variations there is a steady graduation of rainfall and consequently of vegetation from rainforest and mangrove swamp at the coast to desert at above about 15°N latitude. Rainfall at the coast may be 2500 mm or locally even higher, but even at the coast there is an appreciable dry season, which becomes progressively longer with increasing north latitude; near the coast the rainfall pattern is bimodal, but it becomes unimodal further inland.

In the drier, more northerly parts, sorghums are the traditional staple food crop, with millets being grown in the driest areas. Rice is the staple in the more westerly parts of the southern forest zone (from central Ivory Coast westward) while the greatest concentration of root crop cultivation occurs eastwards from there to the Cameroon mountains, and to some extent beyond (Miège 1954). Plantain bananas are also important staples in this latter area, while maize is grown almost throughout the forest zone, and the (southern) parts of the savanna.
The major urban centres of West Africa tend to occur in two main concentrations: firstly, along the coast, as ports or creek ports, or in the forest zone within about 150 km of the sea; secondly, in the more northerly parts of the savanna along the southern fringe of the Sahara, at what were once the southern termini of the trans-Saharan caravans. Most of the best yam-growing country lies in the comparatively sparsely populated 'Middle Belt', intermediate between the two bands of population density and of urbanization. Cassava is grown more ubiquitously throughout both the 'Middle Belt' and the southern rainforest zone. The northern urban centres being located in regions where sorghums and millets are traditional staple foods, their demand for root crop products is comparatively limited, arising mainly from immigrants of forest zone origin. There is thus an overall southward movement of yams out of the Middle Belt primarily to the southern urban centres, while movement of cassava products tends to be more within the forest zone, and over shorter distances. Cocoyams are products of the forest zone, and appear but little in trade.

Agriculture in Africa is still strongly oriented towards the subsistence economy, apart from the often exploitative production of cash crops for export. It has been estimated (Abercrombie 1967) that more than half the agricultural production of sub-Saharan Africa is in the subsistence sector.

The pattern of root crop production in West Africa

Detailed analyses of the distribution of the various food crops in West Africa have been given by Johnston (1958), while the overall pattern has recently been reviewed by Coursey and Booth (1977): a brief survey of West African root crop agriculture may be useful here.

The only truly indigenous root crops of major importance are the yams, *Dioscorea*, a situation which contrasts sharply with the Indo-Pacific region where the aroids, *Colocasia*, *Alocasia* and *Cyrtosperma* are as old as, or even older than, yams in cultivation (Barrau 1965; Coursey in press). The yams are crops of tropical climates, with contrasting rainy and dry seasons, which gives rise to a sharply defined period of dormancy of the tuber, whereas the aroids are typically plants of the wetter areas, and of equatorial forest ecologies (Barrau 1965), and their cormous storage organs do not exhibit any very marked degree of dormancy. A number of aroids (*Anchomanes* and *Amorphophallus* spp.) and the rather
similar *Tacca* are very minor semi-wild food plants in Africa, which may once have been rather more important than they are today, but they have never been significant items of trade.

West African yam cultivation is based very largely on two indigenous species, *D. rotundata* Poir. and *D. cayenensis* Lam. together with a number of minor species (Ayensu and Coursey 1972; Coursey 1967, 1976a, 1976c). Of the two Asiatic species that form the basis of yam cultivation in the Indo-Pacific region, *D. alata* L. is also grown in Africa, but only as an introduction of the last few centuries, while *D. esculenta* (Lour.) Burk. is only cultivated to an extremely limited extent, in a few districts, and is a recent introduction. The first-named, *D. rotundata*, usually known in West Africa as the White Yam or White Guinea Yam, is by far the most important. It is generally very similar to *D. alata*, except for its spiny, rather than alate stem; the more viscous starch of its tubers; and the fact that it has not lost its sexual fertility quite so completely. Similarly to *D. alata*, this species exists in a plurality of clonal cultivars (Ayensu and Coursey 1972), occupies a generally similar place in the economy, and has a social and ritual importance comparable with that of the Asian species in Melanesia (Coursey 1976a). The Yellow Yam (*D. cayenensis*) is generally similar, but with yellow flesched tubers which usually have a shorter period of dormancy. Yam cultivation in West Africa is extremely ancient, dating back several thousand years (Coursey 1976a, 1976c) and yams are in most districts the most highly regarded, traditional, staple foods. Their cultivation is, however, very largely confined to the 'yam zone' (Miège 1954; Coursey 1967). This area is bounded by the northern ecological limit of effective yam cultivation and to the south by the sea and coastal swamps, but the eastern limits in central Ivory Coast and the western, about the Nigerian/Cameroon border, are ethnic rather than ecological. These limits coincide remarkably closely with the boundaries of the eastern Kwa linguistic group of the Niger-Congo languages, and are marked by fairly abrupt transitions, both qualitative and quantitative, in the degree of organization of traditional societies.

The aroids *Colocasia esculenta* (L.) Schott (the taro of the Pacific area) and *Xanthosoma sagittifolium* (L.) Schott, which in Africa are both generally referred to as cocoyams, are grown in most of the more humid parts of West Africa, although only in a few limited districts, notably the forest areas of Ghana, and in Cameroon do they equal the yam in
their contribution to diets. *Colocasia* was known in West Africa before the first European contacts c. 500 BP, but is not native and its introduction is probably not older than 1000 BP. It may have come via the Sabaean Lane and across the continent from the East African littoral (Murdock 1959) or more probably via the eastern Mediterranean and the Nile Valley (Burkill 1938). It is generally known as 'old' cocoyam, to distinguish it from 'new' cocoyam, *Xanthosoma*, which is of tropical American origin. Although the latter has been cultivated in West Africa for little more than a century, it is often more popular than *Colocasia*, for dietary reasons, on account of its hardiness and freedom from disease, and, because of its widespread use as a shade crop for young cacao (Doku 1967), it is displacing *Colocasia* to a considerable extent. Trade in cocoyams is, however, extremely limited, and consumption remains largely in the subsistence sector.

*Cassava* (*Manihot esculenta* Cranz) is also of American origin, and was introduced to West Africa only subsequent to early European trading contacts, around 300-350 BP. It is now, however, the most widely grown of the root crops, and makes the largest contribution to food production. The greater part of its expansion took place in the last 150 years, subsequent to the introduction of Amerindian processing techniques from Brazil, and to a considerable extent, even, in the last few decades (Jones 1959). In the Zaire basin, and further south in Africa, the spread of the crop occurred rather more rapidly, and was based on the use of less toxic cultivars that do not need processing. *Cassava* has been almost universally accepted in Africa, and unlike the traditional yam, its cultivation is not restricted to any particular ethnic or linguistic group; it is widely grown in those parts of West Africa where the yam is virtually unknown (Morgan and Pugh 1969). It is perhaps the subsistence farmers' crop *par excellence*: it is adaptable to marginal conditions and degraded soils; is not greatly affected by pests and diseases (though more so than is commonly supposed); requires no highly specialized cultivation techniques and, unlike the yam, requires no input from the harvested crop for the next season's planting material. Above all, it is probably the highest yielder of food per unit labour input of any crop.

The sweet potato (*Ipomoea batatas* (L.) Lam.), although grown in much of West Africa since its introduction from America at about the same time as cassava, is a very minor
crop. Although the practices of its cultivation relate more closely to those of the indigenous yams than do those of cassava, and it can be as rewarding a crop in terms of production, with the advantage of a very short growing season, it has never been widely acceptable in West African dietaries, being regarded as too sweet for a staple food for most palates. Nowhere in West Africa is there any cultivation of sweet potato comparable to that in the Papua New Guinea highlands, or recently, since the decline of taro, in other parts of Melanesia, and the small production that there is does not appear to any substantial extent in trade, except at the most local levels.

The white or Irish potato (*Solanum tuberosum* L.) is grown in very limited amounts, mainly in the plateau areas of Nigeria at altitudes of around 1000 m, primarily as a cash crop for sale to expatriate urban elites.

**Market technology**

The two major root crops of West Africa, yams and cassava, are extremely different, not only in history, ecological requirements and production economics, but also in their basic biology. These differences, through their effects on the cropping behaviour of the plant, and on the post-harvest properties and behaviour of the edible organs, give rise to fundamental differences in the possibilities for post-harvest technological inputs, which in turn affect the manner in which they can be marketed.

Yam tubers are organs of dormancy, into which virtually the entire biomass of the plant is translocated at the end of the growing (i.e. rainy) season. They are thus seasonally produced, the new crop first becoming available only in the latter part of the growing season (about August in most of West Africa) and the major part of the crop coming in only at the end of the rains (about November). In the natural state the tubers survive in the ground for up to several months through the inclement (i.e. dry) part of the year. They are thus inherently adapted to independent survival, and so to storage when employed as food: yams do, in fact, store better than almost any other type of non-grain staple food. There is much variation between cultivars in their endogenous dormancy behaviour, and thence in their suitability for long-term storage. Of the two main species, *D. rotundata* stores far better than *D. cayenensis*, those cultivars which are adapted to drier climates with longer dry seasons.
generally storing the best. All yams nevertheless are subject to fairly heavy storage losses, of physiological and phytopathological origins. Larger scale trade in yams is largely confined to the better-keeping cultivars. Yams are normally marketed in the fresh state, as whole tubers, and there are considerable variations in availability of supply through the year, which is only partially alleviated by storage. Limited quantities are processed into yam flour by sun-drying of parboiled slices and subsequent milling, but this accounts for only a small part of the total crop and is primarily a means of utilizing damaged tubers that would not store well (Coursey 1967; Adesuyi 1964).

Cassava, on the other hand, is not a seasonal crop, although in some of the drier districts the hardness of the soil during the dry season may make lifting so difficult that production may be temporarily halted. Normally, however, cassava is available throughout the year. The swollen root tubers do not exhibit dormancy, but represent merely water and energy reserves for the plant held against short-term periods of stress. They cannot normally survive as detached organs for more than a few days, although recent studies (Booth 1977) have demonstrated that it is possible to preserve the fresh roots of cassava for periods of up to several months. Their extreme perishability has been a major constraint on the utilization of cassava in modern agro-industry. Most subsistence farmers leave cassava in the ground, for harvest in small quantities only as needed: this practice has been estimated (Ingram and Humphries 1972) to occupy unnecessarily three-quarters of a million hectares of land across the tropical world. The extremely perishable cassava root is an unsuitable commodity for long-distance trade (although it should be noted that in many parts of tropical America there is a very considerable trade in fresh cassava and limited quantities appear in some West African markets), and nearly all trade in cassava in West Africa is in processed products. Techniques for the conversion of cassava into relatively stable, dry processed foods were originally developed by the Amerindians of tropical America long before European contact: some of these techniques were transferred to West Africa, with modifications in some instances, while other methods were developed locally, possibly by modification of the traditional methods used for the preparation of wild, bitter or toxic, yams (Jones 1959). The development of these food products made trade practicable, while reciprocally the beginnings of urbanization in the early 1900s brought about a demand for 'convenience foods'
and so stimulated the manufacture of processed cassava products. (It has been suggested (Lathrap 1973) that rather similar interactions between trade in, and processing of, manioc products in early tropical America provided a major stimulus to the development of Amerindian cultures.)

The toxicity of cassava, caused by the presence of hydrogen cyanide in the form of cyanogenic glycosides, has provided an additional stimulus to the development of processing methods. 'Sweet' cultivars of low HCN content can be eaten raw, or simply as cooked vegetables, but processing of the 'bitter' cultivars is necessary to reduce the quantities of toxin to acceptable levels (Coursey 1973a).

The most important processed cassava product in West Africa is *gari*, a coarse granular product, made by fermenting, dewatering and roasting mashed or grated peeled cassava roots: its technology is based on that of the Brazilian *farinha de mandioca*. Ideally, good quality gari can be stored for several months, but often it is insufficiently dried, and so keeps only for a month or two before becoming mouldy. Cassava flour, made by milling sub-dried root slices, and doughs, variously known as *fufu*, *atieke* or *dumboi* in different countries, are also items of trade which become more important in certain localities (Jones 1959). These products are made at the artisanal level, very often on the farm where the cassava is grown, in individually very small quantities. Currently a considerable amount of innovation is taking place in introducing partial mechanization in gari production, and some larger-scale plants of capacities of 10 tons/day or more have been built (Jones and Akinrele 1976). Smaller-scale operations are often, however, more effective and economic under West African conditions (Ngoddy 1977).

Many other types of cassava-based foods are made at the domestic level but do not appear to any significant degree in trade. Even after allowing for the cost of processing, cassava is a vastly cheaper staple than yam. On an equicaloric basis, the ratio of yam price to gari price in West African markets is usually between 3.5/1 and 4.5/1 though ratios as low as 2.4/1 or as high as 5.2/1 have been reported (Jones 1959; Johnston 1958). This reflects mainly the low labour input of cassava production, although the lower transport costs (per unit food value) of the dried product may also contribute. Cassava is usually the cheapest staple food available: where available, sundried root fragments or flour milled from them are even cheaper than gari.
The yam trade

Long-distance trade in yams is of considerably greater antiquity than is generally realized. One of the earliest Iberian travellers, Duarte Pacheco Pereira, who visited West Africa in the late 1400s, encountered yams at Bonny in the eastern Niger Delta that had come from 'a hundred leagues or more up the river' in quantities sufficient to need canoes 'large enough to hold eighty men': at that time, they were being traded primarily for salt and dried fish (Coursey 1967). This riverain trade was still in existence in recent years, and comparable trade to coastal centres existed along other major rivers such as the Cross, Niger, Ogun and Volta, that were navigable by canoe to yam-growing hinterlands.

The internal trade is thus an essentially indigenous development, and has remained so throughout subsequent history. Official purchasing companies and marketing boards, like the large expatriate-owned trading firms, have concentrated on cash crop products for export, mainly oilseeds, palm oil, cocoa and coffee, rubber and forest products, while the marketing of local foods has remained almost exclusively in the hands of small-scale local entrepreneurs. A Food Marketing Board has existed in Ghana for several years, but has had little involvement with yam marketing. Nigeria has very recently set up a Tuber and Root Crops Board, and an officially-owned National Root Crops Production Company, but it is too early for these to have had any major impact on the infrastructure of the yam trade.

Not only are yams produced mainly in the rural areas, but the greater part of the storage function is also carried out on the producer farms even where, as is often the case, the yams have already been purchased by traders. Yams are purchased either directly from farmers, or in small rural markets, by wholesale traders, often with the assistance of purchasing agents (who are local men: the wholesalers often are not) who may often work at times for many different wholesalers, on a commission basis. Usually by combining the production of many small farmers, lorry-loads of up to 2000 tubers are made up for transport (Nyangteng 1973) and individual wholesalers may handle several lorry-loads in a week. These wholesale traders may be men or women (the proportion varying greatly between different ethnic groups) and are often 'strangers' - not native to the market towns in which they operate or to the areas where they purchase yams (e.g. Malians in Ghana). The breaking of bulk and retailing
in the central markets, however, is very largely conducted by women, who are indeed highly active in most aspects of the retail commodity trade in West Africa (Lawson 1976; Onyemelukwe 1970). However, the women retailers are facing increasing competition from 'contractors', mostly men, who purchase yams from wholesalers and combine them with other foods to supply schools, hospitals, prisons and similar institutions.

The distribution of costs, profits, etc. in this marketing chain has been analysed by Nyantent (1973) for Kumasi market, the largest yam marketing centre in Ghana, and his observations may be summarized as follows:

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return to producer</td>
<td>55.9 per cent</td>
</tr>
<tr>
<td>Transportation and porterage</td>
<td>18.6 per cent</td>
</tr>
<tr>
<td>Market and stall taxes and similar expenses</td>
<td>5.4 per cent</td>
</tr>
<tr>
<td>Wholesaler's profit</td>
<td>4.4 per cent</td>
</tr>
<tr>
<td>Retailer's profit</td>
<td>14.9 per cent</td>
</tr>
<tr>
<td>Marketing agent's commission</td>
<td>0.8 per cent</td>
</tr>
</tbody>
</table>

This breakdown allows for a parcel, nominally of 100 tubers, but traditionally consisting of 110, to diminish from the 116 originally bought (to allow for wastage) to 104 at the retail end of the chain. In western Nigeria, Anthonio (1967) has reported producer prices ranging between 59 and 82 per cent of wholesaler selling prices in various districts supplying the Ibadan market complex, and wholesaler's profit margins of 10 and 28 per cent.

Yam prices vary considerably through the year. For the last month or two before the early harvest of the new crop becomes available, in July or August, yams may be extremely scarce, and the highest prices occur. The lowest prices are at the main harvest, usually around October or November. Seasonal indices of price (i.e. ratios of price to 12-month averages) between 39 and 93 per cent have been reported in various Nigerian and Ghanian yam markets (Jones 1972). Price fluctuation in the main urban markets may be 'damped' to some extent by the transport cost element, and the fact that the incomes of the urban consumers are not seasonally variable. This gives rise to the anomalous situation that yams in large urban markets can at times be cheaper than in rural producer districts (Udo 1969), which effect can be enhanced by the competitiveness of yam wholesale traders.
There appears to be little correlation in prices between major centres of yam marketing, at least in Nigeria, suggesting that there is little interaction between the hinterlands of the different marketing centres. Bivariate coefficients of correlation between retail prices in yam markets in Nigeria were always below 0.8, and most below 0.5 (Jones 1972). This may be in part a reflection of differences in preference for different types of yam (traditionally the strongly preferred staple) between ethnic groups.

Overall, the marketing of yams and their supply to urban markets appears to be adequate, although the rapid increases in the rate of urbanization in the last few years, coupled with inflationary pressures, are imposing new stresses on the system. Improved communications and education are leading to enhanced aspirations in rural communities, which, together with the drift away from agricultural employment is forcing up the producer price of the highly labour-intensive yam to a greater extent than many other crops. The decline in yam production in West Africa, which has repeatedly been predicted over the last two decades, does not appear to have commenced as yet, although there has been little or no expansion, as there has been with other crops, especially cassava.

The cassava trade

Trade in cassava products, of which gari is the most important, is well developed in the more easterly parts of West Africa, that is the traditional root crop zone. Further west, although cassava is now widely grown, trade in its products is much less extensive. In Sierra Leone, Liberia, Ivory Coast and Senegal, where rice is the traditional major staple food, large quantities of rice are now imported, to supplement local production, and consumption of cassava tends to remain very largely in the subsistence sector. Marketings of cassava products in Sierra Leone are less than a tenth of those of imported and local rice combined (Jones 1972), although the price of fufu is usually less than half that of rice on an equicaloric basis. Such marketing as is done is very largely oriented towards the Creole population of Freetown, whose ethnic origins are mainly from the more easterly parts of West Africa. Fufu is the main product, and this, unlike gari, has a storage life of only days. During the recent droughts in the Sahel zone, which created severe shortages of sorghum and millet, substantial quantities of fresh cassava and of cassava flour appeared in Dakar.
markets, coming from as far away as the Gambia, 200 km or more, but this was a response to abnormal conditions.

Within Ghana, and to an even greater extent in Nigeria, an extensive trade in cassava products exists. The technology of gari production was introduced to West Africa primarily through Lagos, Lomé and other coastal towns between, and has diffused inland from there, most rapidly in the western parts of Nigeria (Jones 1959). Cassava has replaced most other staples to a substantial degree largely through its cheapness, and because of its value as a convenience food. It is seldom, however, a preferred food, and in most West African countries income elasticity of demand for cassava is negative (Phillips 1974):

<table>
<thead>
<tr>
<th>Country</th>
<th>Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nigeria</td>
<td>-0.2</td>
</tr>
<tr>
<td>Benin</td>
<td>0.2</td>
</tr>
<tr>
<td>Togo</td>
<td>-0.1</td>
</tr>
<tr>
<td>Ghana</td>
<td>-0.1</td>
</tr>
<tr>
<td>Ivory Coast</td>
<td>-0.4</td>
</tr>
<tr>
<td>Liberia</td>
<td>0.2</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>0.3</td>
</tr>
<tr>
<td>Guinea</td>
<td>-0.1</td>
</tr>
<tr>
<td>Senegal</td>
<td>-0.2</td>
</tr>
<tr>
<td>Gambia</td>
<td>-0.3</td>
</tr>
<tr>
<td>Upper Volta</td>
<td>0.2</td>
</tr>
</tbody>
</table>

It has, however, been pointed out (Jones and Akinrele 1976) that it is difficult to calculate such elasticity coefficients with any accuracy.

It is in Nigeria that the most extensive marketing of cassava products occurs, and the major product in trade is gari, although fufu and some other products appear to a minor degree. Gari is mostly manufactured on the farm, or at least within the extended family of the cassava farmer, and so its sale price at the point of entry to the marketing chain can be regarded as a farm-gate price for cassava. There is, however, a growing tendency for gari to be made by co-operative groups, or even in rural factories (Ngoddy 1977). From the producer, or the small rural market, gari moves through a marketing chain not unlike that described above for yams, and in which the margins of profit appear to be rather similar (Jones 1972).

Although cassava is not a seasonal crop, except that it may be difficult to harvest in the dry season in regions where the soil becomes hardened, the price of gari shows some seasonal fluctuation, with the highest prices between April and July, owing to an interaction with yam prices. Seasonal indices of price of gari in Ghanaian and Nigerian markets lie between 15 and 39 per cent, very much less than
for yams. There is a much higher degree of interaction among gari markets, at least in southern Nigeria, than there is among yam markets, most of the major urban centres being linked by price correlations of 0.8 or greater (Jones 1972). This is consistent with the observed fact that there is much more trade in gari between eastern and western markets in this much more transportable product: transport costs of gari are less than half those of yam. Day-to-day fluctuations in price in main markets also tend to be less.

Some general conclusions

Very substantial trade networks have built up in West Africa whose primary function is to supply the main root crop products — fresh yams and processed cassava — to the rapidly growing urban centres. They are best developed in the eastern parts of West Africa, the area where yams are the traditional staple food, even although cassava is now much more widely grown. These marketing systems are essentially local developments. They have been built up by indigenous entrepreneurs, mostly operating individually at modest or even very small scale, and with very limited capital which is raised by various ingenious and unconventional means. They are highly labour intensive and yield only modest returns to the middlemen involved, but provide a reasonably high return to the primary producer. As has been pointed out by Lawson (1967), these complex distribution systems make an effective, rational use of available economic resources, and provide part-time or full employment for large numbers of men and women, many of whom are in the rural areas and are of low educational attainments. She has also indicated some of the problems, such as motivation, pricing policy, and location and collection of produce, that could arise where official policy leads to the establishment of Marketing Board or similar organizations to participate in trade in root crop (and other local food) products.

Although these traditional networks appear to have served both farmer and urban consumer well for a substantial period of history, new stresses have developed in very recent years, which may eventually lead to a breakdown of the system. Inflation is serious in most West African countries; rapidly increasing populations, whether urban or rural, are making ever-increasing demands on food supplies; improved communications and education are leading to higher economic aspirations among rural populations; the simple, manual production techniques of the subsistence sector have not been upgraded
sufficiently with the result that imported staple foods are often cheaper than those locally produced. It is difficult fully to predict the overall effects these factors may exert on the future availability of root crop products in the urban centres, but there is little doubt that the very active extension of improved production 'packages' suitable for small-farmer use, and of improved techniques for storage and processing at rural technology level, can make major contributions.
Chapter 14

Options for Latin American countries in the development of integrated cassava production programs

John K. Lynam*

Although cassava was first domesticated in Brazil, it has consistently remained a low priority in agricultural development policies in most Latin American countries. Only with the recent establishment of cassava research programs at CIAT in Colombia and IITA in Nigeria, with the rapid increase of imports of cassava pellets into the European feed market and with the recently inaugurated Brazilian program to replace petroleum imports with domestically produced alcohol derived from cassava starch, has cassava been viewed as a viable alternative in agricultural development strategies in Latin American countries.

The development of new cassava technologies at CIAT and IITA and the implementation of cassava programs in Latin American countries aims at three primary objectives:

(a) an increase in the productivity of cassava producers and, therefore, farm incomes, particularly at the level of the small to medium-size producer;

(b) increasing food supplies, thereby either maintaining or reducing the price to the consumer; and

(c) generating foreign exchange, either by reducing food (or petroleum) imports or by increasing exports.

These objectives would not be dissimilar in a tropical root program developed for the Pacific region. However, where the objectives are the same, the strategy will be completely different because of the differences in socio-economic

* The views expressed in this paper are the author's own, and not necessarily those of Centro Internacional de Agricultura Tropical.
characteristics of the target areas. Where the strategy in the Pacific is to adapt traditional agricultural systems to the food needs of a quickly diversifying economy, the intent in Latin America is to increase production and provide productive employment in the agricultural sectors so as to moderate the rapid rise in rural-urban migration as well as provide for the food needs of the urban sector. Agricultural systems in Latin America are already well integrated into the market and producers tend to be responsive to market incentives. The problem is to increase agricultural production in order to keep pace with increasing demand in the urban markets while at the same time helping to relieve the problems in the farm sector by increasing employment and incomes and improving income distribution. One purpose here, therefore, is to present a study of cassava production systems that are already market oriented, focusing on issues surrounding the production, distribution and consumption of cassava in a market economy. As both the Pacific region and Latin America are large producers of cassava, it is hoped that identifying the problem areas in cassava production in Latin American will be helpful in the development of cassava programs in other tropical areas.

The chief purpose of this paper is to explore the factors that either limit or enhance cassava as a crop alternative in meeting such development objectives in Latin America. I wish to stress the need for technological change in cassava production and utilization and will briefly analyse the inter-relationships between technology design and the achievement of development objectives in Latin American countries.

Cassava production in Latin America

The fundamental characteristic of cassava which determines its importance as a crop is its ability to produce a very high calorie yield under a wide range of environmental conditions, especially under marginal soil conditions. This wide adaptability makes economic considerations the fundamental determinant of where cassava is produced in the tropical zone. The price of cassava, the costs of production, and the returns to alternative crops influence both the location and the scale of cassava production. This section explores the interrelationships between the inherent characteristics of cassava as a crop and the economics of cassava production.

The wide ecological adaptability of cassava is reflected in the widespread distribution of cassava production throughout
Fig. 1. Production zones and area planted to cassava (1000 ha) in Latin American countries, 1974.

Source: Diaz 1977.
<table>
<thead>
<tr>
<th>Country</th>
<th>1973-75</th>
<th>1963-65</th>
<th>% of total</th>
<th>Total production</th>
<th>% of total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Per capita production</td>
<td>Total production</td>
<td></td>
<td>% of total</td>
<td>Total production</td>
</tr>
<tr>
<td>Paraguay</td>
<td>446.3</td>
<td>1,320</td>
<td>4.8</td>
<td>1,117</td>
<td>3.6</td>
</tr>
<tr>
<td>Brazil</td>
<td>245.4</td>
<td>23,866</td>
<td>85.6</td>
<td>25,986</td>
<td>84.2</td>
</tr>
<tr>
<td>French Guiana</td>
<td>69.0</td>
<td>6</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Ecuador</td>
<td>56.8</td>
<td>215</td>
<td>0.8</td>
<td>396</td>
<td>1.3</td>
</tr>
<tr>
<td>Colombia</td>
<td>54.3</td>
<td>733</td>
<td>2.6</td>
<td>1,353</td>
<td>4.4</td>
</tr>
<tr>
<td>Bolivia</td>
<td>45.2</td>
<td>143</td>
<td>0.5</td>
<td>233</td>
<td>0.8</td>
</tr>
<tr>
<td>Dominican Republic</td>
<td>35.0</td>
<td>153</td>
<td>0.5</td>
<td>169</td>
<td>0.5</td>
</tr>
<tr>
<td>Peru</td>
<td>31.6</td>
<td>461</td>
<td>1.7</td>
<td>479</td>
<td>1.6</td>
</tr>
<tr>
<td>Haiti</td>
<td>28.7</td>
<td>111</td>
<td>0.4</td>
<td>144</td>
<td>0.5</td>
</tr>
<tr>
<td>Cuba</td>
<td>25.2</td>
<td>180</td>
<td>0.6</td>
<td>234</td>
<td>0.8</td>
</tr>
<tr>
<td>Panama</td>
<td>24.7</td>
<td>19</td>
<td>0.1</td>
<td>40</td>
<td>0.1</td>
</tr>
<tr>
<td>Venezuela</td>
<td>24.5</td>
<td>318</td>
<td>1.1</td>
<td>301</td>
<td>1.0</td>
</tr>
<tr>
<td>Guyana</td>
<td>17.7</td>
<td>10</td>
<td>0</td>
<td>14</td>
<td>0</td>
</tr>
<tr>
<td>Honduras</td>
<td>14.2</td>
<td>24</td>
<td>0.1</td>
<td>44</td>
<td>0.1</td>
</tr>
<tr>
<td>Argentina</td>
<td>10.2</td>
<td>244</td>
<td>0.9</td>
<td>261</td>
<td>0.8</td>
</tr>
<tr>
<td>Jamaica</td>
<td>9.4</td>
<td>9</td>
<td>0</td>
<td>19</td>
<td>0.1</td>
</tr>
<tr>
<td>Guadalupe</td>
<td>8.6</td>
<td>5</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Martinique</td>
<td>8.4</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Nicaragua</td>
<td>8.2</td>
<td>13</td>
<td>0</td>
<td>18</td>
<td>0</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>5.2</td>
<td>10</td>
<td>0</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Trinidad and Tobago</td>
<td>5.2</td>
<td>4</td>
<td>0</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Suriname</td>
<td>4.9</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Barbados</td>
<td>4.1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>El Salvador</td>
<td>3.7</td>
<td>9</td>
<td>0</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>Puerto Rico</td>
<td>1.7</td>
<td>6</td>
<td>0</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Guatemala</td>
<td>1.2</td>
<td>5</td>
<td>0</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>126.4</strong></td>
<td><strong>27,870</strong></td>
<td><strong>100.0</strong></td>
<td><strong>30,863</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

*Source: FAO (1973 and 1976).*
the frost-free areas of Latin America, as is shown in Fig. 1. On the other hand, there is a wide variance in the importance of cassava in the food economies of individual countries in Latin America (see Table 1). The concentration of cassava production in Paraguay and Brazil as compared to the rest of Latin America is striking. Together these two countries account for 88 per cent of total cassava production in Latin America and per capita production levels are two to three times greater than the average for the region as a whole. It is very difficult to specify all the reasons for this differential between Latin American countries. In this section factors that appear to constrain production on the supply side will be identified. The analysis will consider the interaction between cassava yields and environmental factors and farm-level factors that affect cassava production. This analysis will be followed in the next section by consideration of demand factors that may affect the differential in per capita consumption levels.

Ecological adaptation. According to Jennings (1976:81), cassava (Manihot esculenta) 'is a cultigen, unknown in the wild state. The genus occurs naturally only in the western hemisphere, between the southwest USA (33°N) and Argentina (33°S)'. Man thus played a primary role in the evolution of the crop to its current form. Man's role was instrumental particularly in giving cassava the genetic diversity which makes it so widely adaptable. Especially important in the evolutionary process was the apparent hybridization process between cultivated and wild forms. As Jennings states:

It seems likely that the variability of cultivated forms has been enhanced by hybridization with several wild forms ... Gene exchange produced hybrid swarms from which both new cultivated and new wild forms were derived. Selection in one direction by man and in the other by nature would have provided the kind of disruptive selection which would have provided diversity both between and within the cultivated and wild forms. (Jennings 1976:81-2).

The widest morphological diversity in clones is found in the Paraguay-South Brazil area and Northeast Brazil, areas that account for most of the cassava production in Latin America.

This wide genetic diversity in cassava is supported by research at CIAT on the genetic nature of the plant.
Evaluation of the approximately 2000 clones in the germplasm collection showed a very high genetic variability in almost every characteristic evaluated.¹

This genetic diversity has given cassava its adaptability to a wide range of agro-climatic conditions, including its adaptation to minimal soil fertility conditions and resistance to diseases and insect pests.²

This adaptation to diverse ecological conditions is reflected in the low between year variability in yield levels (see Fig. 2). Average yield levels vary by no more than

![Yield (tons/ha)](chart.png)

**Fig. 2** Average cassava yields in Latin America and the three major producing countries, 1963-1975.

_Sources: FAO 1974 and 1976._

¹ CIAT (1975: 74-5). Characteristics evaluated include such factors as root yield, branching characteristics, harvest index, leaf area index, starch content of root, and leaf area retention, among others.

² Robinson has suggested that crops such as cassava, which are not season bound and are grown as clone population, have by necessity evolved some level of horizontal resistance. That resistance is multigenic and, while not giving immunity, nevertheless gives a stable medium-level resistance to a range of diseases and pests. This theoretical proposition is partially supported by the fact that no cases of vertical resistance in cassava have been reported while a number of cases of multigenic resistance has (see Robinson, in press).
about 25 per cent. Cassava contrasts quite strikingly with a crop like beans, where between any two years yield levels may vary as much as 50 to 100 per cent (Sanders and Lynam 1977). However, the more important question is why there should be such a large inter-country variation in yield levels as shown in Table 2. Part of this variation may be due to differences in ecological conditions under which cassava is produced in different countries and part may be due to differences in farm-level technical factors.

<table>
<thead>
<tr>
<th>Country</th>
<th>Average yield 1963-65 (tons/ha)</th>
<th>Average yield 1973-75 (tons/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paraguay</td>
<td>14.0</td>
<td>13.9</td>
</tr>
<tr>
<td>Brazil</td>
<td>14.1</td>
<td>12.5</td>
</tr>
<tr>
<td>French Guiana</td>
<td>6.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Ecuador</td>
<td>8.6</td>
<td>9.0</td>
</tr>
<tr>
<td>Colombia</td>
<td>6.4</td>
<td>8.2</td>
</tr>
<tr>
<td>Bolivia</td>
<td>11.0</td>
<td>11.6</td>
</tr>
<tr>
<td>Dominican Republic</td>
<td>10.2</td>
<td>8.9</td>
</tr>
<tr>
<td>Peru</td>
<td>10.2</td>
<td>12.6</td>
</tr>
<tr>
<td>Haiti</td>
<td>3.7</td>
<td>4.2</td>
</tr>
<tr>
<td>Cuba</td>
<td>6.9</td>
<td>6.7</td>
</tr>
<tr>
<td>Panama</td>
<td>9.5</td>
<td>8.0</td>
</tr>
<tr>
<td>Venezuela</td>
<td>12.7</td>
<td>7.7</td>
</tr>
<tr>
<td>Guyana</td>
<td>10.0</td>
<td>14.0</td>
</tr>
<tr>
<td>Honduras</td>
<td>6.0</td>
<td>7.3</td>
</tr>
<tr>
<td>Argentina</td>
<td>11.6</td>
<td>11.8</td>
</tr>
<tr>
<td>Jamaica</td>
<td>3.0</td>
<td>9.5</td>
</tr>
<tr>
<td>Nicaragua</td>
<td>4.3</td>
<td>4.5</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>3.3</td>
<td>5.0</td>
</tr>
<tr>
<td>El Salvador</td>
<td>9.0</td>
<td>15.0</td>
</tr>
<tr>
<td>Puerto Rico</td>
<td>3.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Guatemala</td>
<td>2.5</td>
<td>2.3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>13.1</strong></td>
<td><strong>11.9</strong></td>
</tr>
</tbody>
</table>

*Source: FAO (1973 and 1976a).*
There are insufficient data to derive a quantifiable estimate of each factor's contribution to explaining the variation in inter-country yield levels. However, some idea of the variation due to differences in ecological factors can be seen in the yield distribution by ecological zone within individual countries as shown in Table 3. The distribution of cassava production in these Andean countries highlights cassava's wide adaptability. However, the variability of average yield levels between zones implies some yield response to ecological factors. Particularly, yields in the coastal areas tend to be consistently higher than the mountain areas, indicating that temperature has some impact on yields. On the other hand, yields tend to be low in the eastern savanna and rainforest areas in Colombia and Ecuador, but inexplicably high in the Peruvian 'selva' region. By contrast, in Brazil cassava exhibits striking yield stability across production areas, possibly indicating that cassava in Brazil is planted in similar agroclimatic areas (Sanders and Lynam 1977).

Cassava's genetic diversity has made it adaptable to a wide range of environments, though there is some yield response to climatic factors and temperature. The crop gives a respectable yield on highly acidic, infertile tropical soils. Also, cassava in general has a relatively high tolerance to most insect and disease damage, and as well is expected to have some level of horizontal resistance to these same pathogens. These factors make cassava a low risk crop, highly adapted to more marginal agricultural areas. This factor when combined with the low price of cassava relative to other crops causes cassava production to be concentrated in these marginal areas as it is usually not profitable relative to other crops in better soil areas.

3 In yield trials undertaken by CIAT a clear interaction has been shown to exist between temperature and yields of different genotypes (see CIAT 1977:B6-B8). This conclusion does not preclude the probability that other factors as well may be responsible for this difference.

4 Tolerance in cassava varieties is principally based on 'surplus' leaf production, as most diseases and pests attack the leaves. This tolerance mechanism is supplemented by genetic resistances. However, cassava research in pathology and entomology at CIAT has shown resistance to any one disease or pest is dependent on the variety. No one variety has shown resistance to the whole range of major diseases and pests.
### Table 3

Percentage of total area and yield of cassava by ecological zone in selected Andean countries

<table>
<thead>
<tr>
<th>Zone</th>
<th>Colombia</th>
<th>Ecuador</th>
<th>Peru</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% of area in cassava</td>
<td>Yield (kg/ha)</td>
<td>% of area in cassava</td>
</tr>
<tr>
<td>Coastal</td>
<td>32.8</td>
<td>8.5</td>
<td>65.0</td>
</tr>
<tr>
<td>Sierra or Mountain</td>
<td>54.1</td>
<td>6.5</td>
<td>11.9</td>
</tr>
<tr>
<td>Amazon Basin</td>
<td>13.1</td>
<td>5.9</td>
<td>23.1</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
<td>7.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

**Sources:** Troches (1972); Ministerio de Agricultura y Ganadería (undated); Convenio de Cooperación Técnica (undated).
Cassava farming systems. Another factor which determines cassava yields and where cassava is grown is the character of cassava farming systems. What available information there is on the distribution of cassava by farm size suggests that cassava production is dominated by the smallholder producer, as portrayed in Table 4 for the three largest cassava producing countries. Given that these three countries account for 92 per cent of cassava production in Latin America, the table would suggest that nearly half of the area planted to cassava in Latin America is located on farms of less than 10 hectares in size, and almost two-thirds on farms of less than 20 hectares in size.

Table 4

<table>
<thead>
<tr>
<th>Country</th>
<th>Less than 10 %</th>
<th>10-19 ha %</th>
<th>20-49 ha %</th>
<th>50-99 ha %</th>
<th>100 ha %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>45.7</td>
<td>14.9</td>
<td>18.4</td>
<td>8.0</td>
<td>13.0</td>
</tr>
<tr>
<td>Paraguay</td>
<td>52.3</td>
<td>19.6</td>
<td>13.0</td>
<td>15.1</td>
<td></td>
</tr>
<tr>
<td>Colombia</td>
<td>41.2</td>
<td>44.2</td>
<td></td>
<td></td>
<td>14.6</td>
</tr>
</tbody>
</table>

Sources: Fundação Instituto Brasileiro de Geografia e Estatística (1973); International Bank for Reconstruction and Development (1976); DANE (1970).

Note: Owing to differences in definition of strata between sources, some farm-size groupings are aggregated by means of the brackets.

The smallholder locus of cassava production raises a number of issues concerning the development of cassava improvement programs in Latin America countries. On the one hand, owing to the size limitations of their farm operation, smallholders in general tend to be risk averse, have severe constraints on capital availability, must usually depend solely on family labour, generally consume a substantial portion of production, and have access only to underdeveloped
input and output markets. Because cassava production is dominated by smallholder producers, markets for cassava in Latin America are in general rudimentary.

These factors make cassava development programs costly for national governments as compared to large farmer crops such as cereal grains. That is, extension becomes a major component in raising farmer productivity as well as investment in input and output market infrastructure. Furthermore, in developing industrialization schemes for cassava, that is for animal feed, starch or alcohol, dependence on smallholder production increases the risk of under capacity utilization of factories. For these reasons national agencies often view larger scale production schemes, especially when linked to industrial development, as a less costly and less risky investment. This solution, however, undermines any attempts to deal with the broader-based problems of rural-urban migration, rural employment and rural nutrition, that is the improvement of the welfare of the segment of the population with limited resources. Because cassava is already widely grown by smallholders, cassava development programs based on small-scale production units offer a potential solution to these problems. At the minimum, cassava programs should not neglect the requirements of smallholder producers. The development of such programs, however, requires better knowledge of cassava production systems.

A sample of 300 farmers were interviewed in five different agricultural regions in Colombia in 1973-75 (Diaz y Pinstrup-Andersen 1977). The sample (see Table 5) represented the diversity in agro-climatic conditions which prevails in Colombia and includes two mountainous areas (zones I and III), a lowland coastal area (zone V), a 'new land' expansion area in the acid-soil savanna region (zone IV), and a rolling commercial farming area (zone II). The sample furthermore divides into three predominantly small-farm areas (zones I, III, and V, which account for 79 per cent of total cassava production) and two predominantly medium-to-large farm size regions (zones II and IV, which account for 21 per cent of Colombian production).

The sample confirmed that cassava production in Colombia was primarily dependent on farmer-owned resources, land and labour. Purchased inputs were negligible, amounting to only 8 per cent of total variable costs, and labour input
Table 5
Characteristics of cassava production systems in Colombia, 1973-75

<table>
<thead>
<tr>
<th></th>
<th>Unit</th>
<th>Zones</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>I</td>
<td>II</td>
</tr>
<tr>
<td>Farm size</td>
<td>ha</td>
<td>6.1</td>
<td>39.1</td>
</tr>
<tr>
<td>Utilizable land</td>
<td>ha</td>
<td>4.1</td>
<td>38.1</td>
</tr>
<tr>
<td>Area in crops</td>
<td>ha</td>
<td>3.4</td>
<td>24.7</td>
</tr>
<tr>
<td>Area in yuca</td>
<td>ha</td>
<td>2.8</td>
<td>6.9</td>
</tr>
<tr>
<td>Area in pasture</td>
<td>ha</td>
<td>.7</td>
<td>13.4</td>
</tr>
<tr>
<td>Total labour utilization</td>
<td>man-days</td>
<td>105.4</td>
<td>81.2</td>
</tr>
<tr>
<td>Per cent of farmers using mechanized land preparation</td>
<td>%</td>
<td>0</td>
<td>76.6</td>
</tr>
<tr>
<td>Variable cost</td>
<td>Col. pesos</td>
<td>3068</td>
<td>5019</td>
</tr>
<tr>
<td>Purchased inputs as per cent of variable cost</td>
<td>%</td>
<td>10</td>
<td>12</td>
</tr>
</tbody>
</table>

Source: Calculated from R.O. Diaz y Pistrup-Andersen (1977:B12).
accounted for the remainder.⁵

In none of the zones was cassava grown on a large scale, even though average farm size in zones II and IV was relatively large. Cassava dominated the cropping pattern in the small-farm zones and in zone IV, whereas in the commercial farming area (zone II), the cropping pattern was weighted more toward coffee and plantains, implying that cassava was a secondary crop. Also, in all zones except the small-farm area in zone I, pasture made up a substantial component of utilizable land. Hence, land did not appear to be a constraint to on-farm expansion of cassava cultivation.⁶

The largest cost component in the cassava production system is labour. Weeding is the principal activity and the most costly operation. Of the labour utilized in cassava production 63 per cent is devoted to weeding as compared to 29 per cent for land preparation and planting, and 8 per cent for harvesting. Given the adequate available land in most regions, seasonal labour for weeding may be a constraint on cassava output expansion. However, only 3 per cent of the farmers used herbicides and as expected these were the larger farmers in zone II. In weed experiment trials at CIAT selected herbicides have been shown to be effective in cassava systems, but three hand weedicings were shown to give the highest yields at the lowest unit cost (CIAT 1975:97). These results would confirm the fact that herbicide applications are effective only where seasonal labour availability constrains the area under cultivation. In the case of a

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⁵The labour component of variable costs was computed by applying a standard market wage to the physical labour input. This market wage may not represent the labour valuation of family labour in such small-farm economies, where perfectly functioning labour markets do not exist. In such systems the opportunity cost of family labour will be defined in terms of alternative on-farm activities, which in turn will be seasonal in nature. Thus in some periods where these alternatives are almost nil the 'shadow' wage may be practically zero. In many cases these labour costs are overestimated.

⁶This conclusion rests on the assumptions that livestock activities are not competitive with cropping activities and that this pasture component was not a necessary part of a fallowing and crop rotation scheme.
Table 6

<table>
<thead>
<tr>
<th>Selected soil characteristics on the cassava sampled (average by zone)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td>Organic matter (%)</td>
</tr>
<tr>
<td>Less than 4%*</td>
</tr>
<tr>
<td>Phosphorus (ppm)</td>
</tr>
<tr>
<td>Less than 15 ppm*</td>
</tr>
<tr>
<td>Potassium (meg/100g)</td>
</tr>
<tr>
<td>Less than 0.30 meg/100g*</td>
</tr>
<tr>
<td>Aluminium (meg/100g) pH</td>
</tr>
<tr>
<td>Less than 5.5*</td>
</tr>
<tr>
<td>Sodium saturation (%)</td>
</tr>
<tr>
<td>Calcium/magnesium</td>
</tr>
<tr>
<td>Exchange capacity (meg/100g)</td>
</tr>
</tbody>
</table>

* Percentage of farms.

Source: CIAT (1976:B-5).
seasonal labour constraint, extension services and more efficient input markets may aid in expanding area under production by relieving what appears to be a constraint at weeding.

Soil analyses of the farm sample showed that cassava is primarily grown on acidic, infertile soils (see Table 6). As the soils in zone V are typically sandy, only the soils in the large commercial farming areas of zone II can be considered to be fertile soils with good soil structure and proper pH.

Nevertheless, only 20 per cent of the farmers in the sample used fertilizer and then only at very low rates of application. Fertilizer utilization was encountered primarily in the fertile soil areas of zone II and to a lesser extent among the larger farmers in zone IV. When there is adequate land for rotation, high fertilizer prices, and an unknown response to fertilizer, non-utilization of fertilizer by smallholder farmers would be expected. Given no apparent land constraint, maintenance of productivity would be achieved by shifting land use. A rotational system was confirmed by the sample as only 15 per cent of the farmers planted cassava on land that had previously been in this crop and 55 per cent of the farmers planted cassava on land that had formerly been in pasture.

Average yield levels in the sample were 6.2 tons per hectare (fresh weight), a level relatively low when compared to an average yield level of 12 tons per hectare in Latin America as a whole and to average yields in the CIAT regional trials of between 20 and 30 tons per hectare (CIAT 1977). The variation around this mean was large (a standard deviation of 6.5 tons), which primarily reflected the yield differences between producing regions (see Table 7). Furthermore, the small-farmer areas uniformly had low yields, three to four tons, while the large-farm zones had average yields two to three times that level. The reason for this yield difference between regions would appear to be differences in soil fertility and differences in technology between large and small farmers.

The impact of soil fertility is partially confirmed by a multiple regression analysis in which yield limiting factors were regressed on cassava yields (see Table 8). The analysis found that zone II was significantly different from the other zones and that soil factors caused the principal
losses in cassava yields, especially low levels of phosphorus. As only 8 per cent of cassava area in Colombia is in Zone II, the analysis would suggest that cassava production, because of its higher relative yielding ability on infertile soils, has been pushed into poor agricultural regions and these in general correspond to smallholder areas.

Because cassava is grown principally by small-scale farmers, cassava has commonly been considered a subsistence crop. However, the farm sample found that 99 per cent of the cassava was marketed (see Table 9). In the small-scale areas of zone III, where subsistence consumption would be expected to be high, farmers retained only 6 per cent of their production for use on the farm. In all other zones the percentage retained was negligible. Cassava has a relatively long storage life in the ground but minimal post-harvest durability, a maximum of 48 hours for most varieties.

A cassava marketing study in the Pernambuco area of Northeast Brazil found that 11.2 per cent of production was consumed on-farm (see Michigan State University 1969). As the northeast of Brazil is the largest cassava production zone in Latin America, this finding would tend to support the conclusion that a high percentage of cassava is marketed.
<table>
<thead>
<tr>
<th>Factors</th>
<th>Average losses* (ton/ha)</th>
<th>Per cent of area affected</th>
<th>Per ha losses</th>
<th>Estimate of total losses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>ton/ha</td>
<td>%**</td>
</tr>
<tr>
<td>Superelongation</td>
<td>3.45</td>
<td>4</td>
<td>0.13</td>
<td>2.2</td>
</tr>
<tr>
<td>Leaf spot</td>
<td>3.41</td>
<td>4</td>
<td>0.13</td>
<td>2.1</td>
</tr>
<tr>
<td>Lack of phosphorus</td>
<td>2.21</td>
<td>63</td>
<td>1.39</td>
<td>13.2</td>
</tr>
<tr>
<td>Planting system in association</td>
<td>1.89</td>
<td>31</td>
<td>0.59</td>
<td>8.6</td>
</tr>
<tr>
<td>Soil acidity</td>
<td>1.74</td>
<td>58</td>
<td>1.01</td>
<td>13.9</td>
</tr>
<tr>
<td>Ants</td>
<td>1.20</td>
<td>2</td>
<td>0.02</td>
<td>0.4</td>
</tr>
<tr>
<td>Bacterial blight</td>
<td>0.75</td>
<td>5</td>
<td>0.04</td>
<td>0.6</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>3.31</td>
<td>34.8</td>
</tr>
<tr>
<td>Soil texture</td>
<td>1.46</td>
<td>75</td>
<td>1.09</td>
<td>14.9</td>
</tr>
<tr>
<td>Excess rainfall</td>
<td>0.77</td>
<td>48</td>
<td>0.37</td>
<td>5.6</td>
</tr>
</tbody>
</table>

* Average losses for farmers with the problem.

** This percentage was based upon the average yield plus losses due to the particular factor. The average yield for Colombia in this period was 6.2 tons/ha.

*** This estimate was based upon the 165,000 ha of cassava planted in Colombia in 1974.

# This estimate was based upon an exchange rate of Col.$25/dollar.

Source: Diaz y Pinstrup-Andersen (1977:J-5).
Table 9

On-farm consumption v. sales of cassava, by zone and farm size, Colombia, 1974-75

<table>
<thead>
<tr>
<th>Percentage of production utilized for:</th>
<th>Home consumption</th>
<th>Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Human</td>
<td>Animal</td>
</tr>
<tr>
<td>Zones: I</td>
<td>0.4</td>
<td>0.1</td>
</tr>
<tr>
<td>II</td>
<td>0.1</td>
<td>0</td>
</tr>
<tr>
<td>III</td>
<td>5.0</td>
<td>0.9</td>
</tr>
<tr>
<td>IV</td>
<td>0.8</td>
<td>0.3</td>
</tr>
<tr>
<td>V</td>
<td>1.6</td>
<td>0</td>
</tr>
<tr>
<td>Farm size: Small</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small</td>
<td>1.1</td>
<td>0.2</td>
</tr>
<tr>
<td>Medium</td>
<td>0.4</td>
<td>0.1</td>
</tr>
<tr>
<td>Large</td>
<td>0.4</td>
<td>0.1</td>
</tr>
<tr>
<td>Total</td>
<td>0.5</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Delayed harvest is therefore the only present means of supply control or storage. Hence, the farmer apparently waits until he has a market and sufficient labour to harvest the crop. However, because of the opportunity cost of the land, the farmer cannot wait too long for favourable market prices, especially if there are distinct rainy and dry seasons, and the farmer must be concerned about the time-of-planting effect on yields of cassava.

For reasons of price riskiness, labour availability at harvest, optimum planting time and the risks involved in minimal storage life, there are a range of marketing arrangements in moving the cassava to market (see Table 10). The least risk method to the farmer is to sell the cassava field to a middleman who arranges the marketing outlet and harvests the crop when that outlet exists. Over 30 per cent of the farm sample marketed their crop in this way, a major portion of whom were the commercial farmers in zone II. Another one-third harvested their crop and sold to middlemen directly out of the field. The other third of the farm sample transported their crop directly to market, but it was only in the expansion areas of zone IV that a sizeable proportion of farmers transported their crop long distances to a major market (Bogota). Because there is a lack of marketing infrastructure in these expansion areas and farmers, in general, have to fund their own marketing of the product, cassava production takes place there on larger farms. Commercial cassava production in expansion areas is therefore naturally biased to higher-capital operations.

As the farm-level data suggested, cassava productivity is low compared to its potential. This fact would suggest that there are potentially large benefits in developing an improved cassava technology. Also, cassava is a crop where there are particular equity benefits to technical change in production. As shown in Table 11, a larger proportion of cassava is produced on smaller scale farms than are annual crops as a whole. Furthermore, the vast majority of the rural population in Colombia (which is reflective of much of Latin America) is located on farms of ten hectares or less. As cassava production is also widely distributed,

8 For a comparison of the land distribution of Asian countries with Brazil and Colombia see Johnston and P. Kilbey (1975:16). For land distribution in Latin America see Barraclough and Collarte (1973:331-2).
Table 10

Marketing patterns for cassava in Colombia: percentage of farmers, by zones, according to type of selling place and end utilization of cassava

<table>
<thead>
<tr>
<th>Selling place</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>In the field before harvest</td>
<td>41</td>
<td>76</td>
<td>0</td>
<td>27</td>
<td>0</td>
</tr>
<tr>
<td>In the field after harvest</td>
<td>28</td>
<td>9</td>
<td>53</td>
<td>2</td>
<td>89</td>
</tr>
<tr>
<td>Local market</td>
<td>20</td>
<td>2</td>
<td>39</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>Major urban market</td>
<td>8</td>
<td>13</td>
<td>3</td>
<td>60</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>End utilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales for:</td>
</tr>
<tr>
<td>Human consumption</td>
</tr>
<tr>
<td>Processing</td>
</tr>
<tr>
<td>No sales</td>
</tr>
</tbody>
</table>

Source: Diaz y Pinstrup-Andersen (1977:K3).
<table>
<thead>
<tr>
<th>Farm size</th>
<th>Number of farmers in farm size group</th>
<th>Farm area in farm size group</th>
<th>Area planted to annual crops</th>
<th>Area planted to cassava</th>
</tr>
</thead>
<tbody>
<tr>
<td>ha</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>ha</td>
</tr>
<tr>
<td>Less than 10</td>
<td>81.0</td>
<td>10.5</td>
<td>37</td>
<td>89,517</td>
</tr>
<tr>
<td>10-99</td>
<td>16.0</td>
<td>30.0</td>
<td>39</td>
<td>96,120</td>
</tr>
<tr>
<td>100-499</td>
<td>2.5</td>
<td>30.5</td>
<td>16</td>
<td>24,305</td>
</tr>
<tr>
<td>500-999</td>
<td>0.3</td>
<td>10.0</td>
<td>4</td>
<td>3,918</td>
</tr>
<tr>
<td>1000 or more</td>
<td>0.2</td>
<td>20.0</td>
<td>4</td>
<td>3,485</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
<td>100.0</td>
<td>100</td>
<td>217,315</td>
</tr>
</tbody>
</table>

improved cassava technology could potentially have large growth and equity benefits in Latin American countries. However, the achievement of these benefits will depend on market absorption of the increases in supply, which is reflected in the magnitude of decline in the level of the market-clearing price. The next section therefore discusses the demand for cassava.

Demand for cassava in Latin America

Cassava is utilized in four separate markets: as food for human consumption, as an animal feed, as an industrial starch, and for the production of ethyl alcohol. In each market cassava has particular quality characteristics and different sets of substitutable products against which it competes. The price level at which cassava remains competitive depends on the price relationship in each of these four markets. The demand for cassava is thus an aggregate of the individual markets for cassava and cassava products.

Virtually all cassava products in Latin America are consumed domestically. However, there are few accurate estimates of the distribution of cassava supplies between competing uses in Latin American countries. Using what few data were available and their own estimates, the 1964-66 FAO Food Balance Sheets (FAO 1971) estimated the following distribution of cassava production for Latin America:

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human consumption</td>
<td>38%</td>
</tr>
<tr>
<td>Animal feed</td>
<td>26%</td>
</tr>
<tr>
<td>Waste</td>
<td>20%</td>
</tr>
<tr>
<td>Industrial uses</td>
<td>16%</td>
</tr>
</tbody>
</table>

These estimates suggest that a significant proportion of cassava production is consumed as human food, but not as much as is commonly considered to be the case.

Cassava for human consumption. The importance of cassava in the Latin American diet is minor when compared to grains, making up only about 7 per cent of the calorie requirements of the population. However, the skewed distribution of cassava production between countries in Latin America causes the statistics not to reflect the importance

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9 Brazil occasionally exports some cassava starch, but these exports are highly irregular and minimal when compared to total consumption or the world export market.
of cassava in individual food economies, as highlighted in Table 12. Only in Paraguay and Brazil can cassava be considered a staple in the diet. In Brazil cassava on average makes up 12 per cent of the daily calorie requirement. In the northeast of Brazil, which is the major consuming area, cassava makes up almost 20 per cent of total calorie consumption. In Paraguay cassava consumption makes up almost a quarter of the calorie intake. In the rest of Latin America cassava serves more as vegetable in the diet.

Even within countries there are substantial differences between areas in the importance of cassava in the diet. The most striking difference is between rural and urban consumption levels, as is indicated for Brazil in Table 13. Consumption levels in the urban areas are approximately a third of levels in the rural areas. This trend is confirmed by a study in Peru which estimated that nearly 75 per cent of the cassava crop was consumed in the rural areas (as compared to 53 per cent of the population residing in the rural areas; see Convenio de Cooperación Técnica, Peru (undated)). This differential between urban and rural consumption levels would suggest that in the longer term, as the economy becomes increasingly urbanized, there will be a progressive decline in per capita consumption of cassava. Atkinson (1969:7) has hypothesized that this change in tastes is almost immediate, as he suggests that 'as farmers migrated to urban areas where they had to purchase all their food they switched from cassava to rice and wheat'. However, the reason may be more than merely a change in tastes, possibly reflecting higher relative prices for cassava in urban markets - given the bulkiness of fresh cassava and its high transport costs relative to grains.10

The inevitable urbanization of the Latin American population appears likely to cause a fall in per capita consumption levels for human food. This decline might perhaps be partially offset by the increases in income and the fall in relative prices which are assumed to coincide with the introduction of new cassava technology. But the impact of

10 This could be true for all Latin American countries except Brazil, which converts cassava to cassava flour, 'farinha' and 'farofa'. This conversion minimizes transport costs and is the principal form of urban consumption of cassava (see Table 13). Therefore, in Brazil there would not be any basis for a change in relative prices between rural and urban markets.
<table>
<thead>
<tr>
<th>Country</th>
<th>Production per capita kg/year</th>
<th>Consumption * per capita kg/year</th>
<th>Calorie/day</th>
<th>Cassava as % of minimum calorie requirement***</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paraguay</td>
<td>722.2</td>
<td>180.8</td>
<td>540</td>
<td>23.4</td>
</tr>
<tr>
<td>Brazil</td>
<td>298.3</td>
<td>104.9</td>
<td>274</td>
<td>11.5</td>
</tr>
<tr>
<td>Ecuador</td>
<td>22.5</td>
<td>14.6</td>
<td>41</td>
<td>1.8</td>
</tr>
<tr>
<td>Colombia</td>
<td>43.2</td>
<td>25.9</td>
<td>74</td>
<td>3.2</td>
</tr>
<tr>
<td>Bolivia</td>
<td>39.9</td>
<td>25.9</td>
<td>74</td>
<td>3.1</td>
</tr>
<tr>
<td>Dominican Republic</td>
<td>43.2</td>
<td>28.0</td>
<td>82</td>
<td>3.6</td>
</tr>
<tr>
<td>Peru</td>
<td>41.0</td>
<td>29.6</td>
<td>88</td>
<td>3.7</td>
</tr>
<tr>
<td>Haiti</td>
<td>26.6</td>
<td>23.2</td>
<td>69</td>
<td>3.1</td>
</tr>
<tr>
<td>Cuba</td>
<td>26.3</td>
<td>21.8</td>
<td>65</td>
<td>2.8</td>
</tr>
<tr>
<td>Panama</td>
<td>16.0</td>
<td>11.1</td>
<td>35</td>
<td>1.5</td>
</tr>
<tr>
<td>Venezuela</td>
<td>33.9</td>
<td>25.4</td>
<td>68</td>
<td>2.8</td>
</tr>
<tr>
<td>Guyana</td>
<td>15.8</td>
<td>14.2</td>
<td>41</td>
<td>1.8</td>
</tr>
<tr>
<td>Honduras</td>
<td>11.2</td>
<td>10.6</td>
<td>31</td>
<td>1.4</td>
</tr>
<tr>
<td>Argentina</td>
<td>11.0</td>
<td>4.6</td>
<td>12</td>
<td>0.5</td>
</tr>
<tr>
<td>Jamaica</td>
<td>5.0</td>
<td>3.3</td>
<td>11</td>
<td>0.5</td>
</tr>
<tr>
<td>Nicaragua</td>
<td>8.5</td>
<td>8.1</td>
<td>21</td>
<td>0.9</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>6.9</td>
<td>6.2</td>
<td>17</td>
<td>0.9</td>
</tr>
<tr>
<td>El Salvador</td>
<td>3.3</td>
<td>3.0</td>
<td>8</td>
<td>0.3</td>
</tr>
<tr>
<td>Puerto Rico</td>
<td>2.2</td>
<td>1.9</td>
<td>6</td>
<td>0.3</td>
</tr>
<tr>
<td>Guatemala</td>
<td>1.2</td>
<td>1.1</td>
<td>3</td>
<td>0.1</td>
</tr>
<tr>
<td>Latin America**</td>
<td>139.4</td>
<td>53.2</td>
<td>158</td>
<td>6.6</td>
</tr>
</tbody>
</table>

* Direct human consumption. The discrepancy between per capita production and consumption is due to differences in wastage and utilization as animal feed, and in industrial uses.

** Also includes Mexico, Uruguay, Chile, and Trinidad and Tobago.


Source: FAO (1971).
Table 13

Per capita production of cassava in Brazil by area in 1960 (kg per head per year)*

<table>
<thead>
<tr>
<th></th>
<th>Fresh manioc</th>
<th>Manioc flour</th>
<th>Total on a fresh basis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northeast</td>
<td>6.9</td>
<td>53.9</td>
<td>168.6</td>
</tr>
<tr>
<td>Rural</td>
<td>10.3</td>
<td>69.7</td>
<td>219.4</td>
</tr>
<tr>
<td>Urban</td>
<td>0.6</td>
<td>24.1</td>
<td>72.9</td>
</tr>
<tr>
<td>East</td>
<td>12.7</td>
<td>20.7</td>
<td>74.8</td>
</tr>
<tr>
<td>Rural</td>
<td>20.2</td>
<td>29.0</td>
<td>107.2</td>
</tr>
<tr>
<td>Urban</td>
<td>3.9</td>
<td>11.8</td>
<td>39.3</td>
</tr>
<tr>
<td>South</td>
<td>24.1</td>
<td>7.7</td>
<td>47.2</td>
</tr>
<tr>
<td>Rural</td>
<td>46.0</td>
<td>12.1</td>
<td>82.3</td>
</tr>
<tr>
<td>Urban</td>
<td>2.9</td>
<td>3.4</td>
<td>13.1</td>
</tr>
<tr>
<td>Brazil</td>
<td>14.9</td>
<td>26.3</td>
<td>93.8</td>
</tr>
<tr>
<td>Rural</td>
<td>24.7</td>
<td>38.3</td>
<td>112.4</td>
</tr>
<tr>
<td>Urban</td>
<td>3.0</td>
<td>11.6</td>
<td>37.8</td>
</tr>
</tbody>
</table>

* For human consumption

Source: Getulio Vargas Foundation (1970-6).
<table>
<thead>
<tr>
<th>Region</th>
<th>Column 1 (1)</th>
<th>Column 2 (2)</th>
<th>Column 3 (3)</th>
<th>Column 4 (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central America</td>
<td>-0.04</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Costa Rica</td>
<td>-0.20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>El Salvador</td>
<td>0.20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caribbean Islands</td>
<td>0.23</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cuba</td>
<td>0.20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dominican Republic</td>
<td>0.20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Haiti</td>
<td>0.30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South America</td>
<td>-0.16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Argentina</td>
<td>-0.02</td>
<td>-0.26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bolivia</td>
<td>-0.02</td>
<td>0.08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brazil</td>
<td>-0.02</td>
<td>-0.22</td>
<td>-0.45 Urban</td>
<td>-0.003 Rural</td>
</tr>
<tr>
<td>Paraguay</td>
<td>-0.04</td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surinam</td>
<td>0.30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Venezuela</td>
<td>0.10</td>
<td>0.12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peru</td>
<td>0.10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ecuador</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colombia</td>
<td>0.00</td>
<td>.115</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Sources:**

1. Phillips (1973:13), quoting data developed by Commodities and Trade Division, FAO, Rome.
2. FAO (1972).
4. Pinstrup-Andersen, Londoño and Hoover, unpublished data for Cali, Colombia.
rising incomes and falling price levels on increases in per capita consumption of cassava will depend on the demand elasticities, and such estimates as are available show that both income and price elasticities for cassava for human consumption are low, suggesting that there will be little impact on consumption levels from falling prices. It is possible that declining per capita consumption levels will follow income growth or income redistribution; that is if the income elasticities presented in Table 14 are reasonable estimates for Latin America as a whole.

These demand factors would indicate that the growth potential of cassava as a human food is not large, and relies predominately on population growth in the lower income brackets. FAO has estimated the growth potential in demand for cassava in South America to 1980 and finds a 2.3 per cent growth rate over the 1970-80 period but a decline in per capita consumption levels (see Table 15). The FAO model balance an overall positive effect from population growth against a negative effect from income growth and/or redistribution. The negative impact of demand factors on per capita consumption levels is further supported by FAO estimates of national average caloric intake (see Table 16). In three-quarters of the countries in South America per capita consumption of roots and tubers had declined over the 1961-74 period. Those countries in which consumption had increased were primarily those where per capita income was lower than average.

The main question in the context of this paper is at what level will the price stabilize upon introduction of new cassava technologies. Since there is little information on supply side factors for cassava under improved technology, the more appropriate question here is what is the market absorption capacity for cassava for human consumption at certain price levels. Table 17 gives some idea of the price spread between countries and emphasizes that there are wide differences in domestic prices for cassava, the lowest prices being in the high consumption countries of Brazil and Paraguay.

It may be generally stated that the higher the price level, the more scope there is for increasing consumption.

11 P. Pinstrup-Andersen, N. de Londoño and E. Hoover estimate a price elasticity of -.19 for Cali, Colombia (unpublished data).
### Table 15
Domestic demand (total and per capita) for cassava for human consumption in South America, 1970, and projections to 1980*

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>133 (5.5)</td>
<td>142 (5.1)</td>
<td>138 (5.0)</td>
<td>138 (5.0)</td>
</tr>
<tr>
<td>Bolivia</td>
<td>150 (30.4)</td>
<td>197 (31.0)</td>
<td>201 (31.7)</td>
<td>203 (32.1)</td>
</tr>
<tr>
<td>Brazil</td>
<td>10,980 (117.3)</td>
<td>13,637 (109.5)</td>
<td>12,460 (100.0)</td>
<td>12,106 (97.2)</td>
</tr>
<tr>
<td>Colombia</td>
<td>720 (34.1)</td>
<td>982 (34.1)</td>
<td>982 (34.1)</td>
<td>982 (34.1)</td>
</tr>
<tr>
<td>Ecuador</td>
<td>266 (43.7)</td>
<td>371 (43.7)</td>
<td>371 (43.7)</td>
<td>371 (43.7)</td>
</tr>
<tr>
<td>Paraguay</td>
<td>476 (200.3)</td>
<td>662 (200.3)</td>
<td>662 (200.3)</td>
<td>662 (200.3)</td>
</tr>
<tr>
<td>Peru</td>
<td>403 (29.8)</td>
<td>536 (29.1)</td>
<td>584 (31.7)</td>
<td>611 (33.1)</td>
</tr>
<tr>
<td>Venezuela</td>
<td>229 (20.8)</td>
<td>322 (21.1)</td>
<td>383 (25.1)</td>
<td>414 (27.1)</td>
</tr>
<tr>
<td>South America</td>
<td>13,357 (70.4)</td>
<td>16,849 (67.8)</td>
<td>15,781 (63.5)</td>
<td>15,487 (62.3)</td>
</tr>
</tbody>
</table>

* In 1000 m.t. with kg per capita in brackets

** The 1980 projections are based on the following assumptions:

<table>
<thead>
<tr>
<th>Alternatives</th>
<th>Economic growth</th>
<th>Income redistribution</th>
<th>Export trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Low</td>
<td>No change</td>
<td>Pessimistic</td>
</tr>
<tr>
<td>Medium</td>
<td>High</td>
<td>Moderate change</td>
<td>Optimistic</td>
</tr>
<tr>
<td>High</td>
<td>High</td>
<td>Drastic change</td>
<td>Optimistic</td>
</tr>
</tbody>
</table>

Source: FAO (1972).
Table 16
Per capita daily calorie consumption by food group in South America, 1961-74

<table>
<thead>
<tr>
<th>Country</th>
<th>Total</th>
<th>Cereals</th>
<th>Roots and tubers</th>
<th>Total vegetable products</th>
<th>Total animal products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>3247</td>
<td>3280</td>
<td>1062</td>
<td>997</td>
<td>178</td>
</tr>
<tr>
<td>Bolivia</td>
<td>1638</td>
<td>1860</td>
<td>750</td>
<td>798</td>
<td>246</td>
</tr>
<tr>
<td>Brazil</td>
<td>2420</td>
<td>2541</td>
<td>866</td>
<td>903</td>
<td>285</td>
</tr>
<tr>
<td>Colombia</td>
<td>2142</td>
<td>2164</td>
<td>696</td>
<td>681</td>
<td>150</td>
</tr>
<tr>
<td>Chile</td>
<td>2578</td>
<td>2738</td>
<td>1217</td>
<td>1336</td>
<td>118</td>
</tr>
<tr>
<td>Ecuador</td>
<td>1895</td>
<td>2087</td>
<td>575</td>
<td>680</td>
<td>154</td>
</tr>
<tr>
<td>Paraguay</td>
<td>2521</td>
<td>2723</td>
<td>742</td>
<td>875</td>
<td>519</td>
</tr>
<tr>
<td>Peru</td>
<td>2255</td>
<td>2328</td>
<td>900</td>
<td>915</td>
<td>318</td>
</tr>
<tr>
<td>Uruguay</td>
<td>2938</td>
<td>2978</td>
<td>859</td>
<td>1064</td>
<td>133</td>
</tr>
<tr>
<td>Venezuela</td>
<td>2225</td>
<td>2399</td>
<td>770</td>
<td>881</td>
<td>128</td>
</tr>
<tr>
<td>Guyana</td>
<td>2375</td>
<td>2346</td>
<td>1095</td>
<td>1094</td>
<td>124</td>
</tr>
<tr>
<td>Surinam</td>
<td>2117</td>
<td>2381</td>
<td>1107</td>
<td>1272</td>
<td>33</td>
</tr>
</tbody>
</table>

Source: FAO (1976b).
### Table 17

**Prices received by South American producers of cassava and price indices for selected crops, 1969**

<table>
<thead>
<tr>
<th>Country</th>
<th>Price of cassava $US/m.t.</th>
<th>Price indices*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Potatoes</td>
<td>Paddy rice</td>
</tr>
<tr>
<td>Argentina</td>
<td>24.3</td>
<td>95</td>
</tr>
<tr>
<td>Bolivia</td>
<td>36.6</td>
<td>175</td>
</tr>
<tr>
<td>Brazil</td>
<td>9.5</td>
<td>555</td>
</tr>
<tr>
<td>Colombia</td>
<td>49.7</td>
<td>141</td>
</tr>
<tr>
<td>Ecuador</td>
<td>36.0</td>
<td>172</td>
</tr>
<tr>
<td>Paraguay</td>
<td>21.4</td>
<td>445</td>
</tr>
<tr>
<td>Peru</td>
<td>31.8</td>
<td>194</td>
</tr>
<tr>
<td>Venezuela</td>
<td>55.3</td>
<td>210</td>
</tr>
<tr>
<td>South America**</td>
<td>12.7</td>
<td>380</td>
</tr>
</tbody>
</table>

* Price indices based on cassava price in each country equal to 100.

** Prices weighted by production.

**Source:** FAO (1972:II-94).
However, given a price elasticity of -.2, an 80 per cent drop in price— for example, the price in Venezuela dropping to the Brazilian price level— would only result in a 16 per cent increase in per capita consumption. It may be noted that such supply increases are well within the capacity of new cassava technology developed at CIAT. These factors suggest that there are constraints on production increases of cassava owing to a limited human market, which is reflected in quickly falling market-clearing prices. However, these lower price levels would also potentially make cassava competitive in alternative markets.

Cassava as an animal feed. Probably the greatest growth potential for cassava exists as a cheap carbohydrate source in mixed animal feeds. Cassava processed into chips, meal, or pellets could either go into domestic feed markets or be exported as feed components to the large European Economic Community and Japanese markets. The success of cassava in these markets will depend upon its price competitiveness vis-à-vis substitutable feed components. Here, however, only the broad potential for cassava in these two markets will be considered.

The current destination for world exports of feed components is centred in the European Community and, to a lesser extent, Japan. Because of the community's variable levy on cereal imports—in order to maintain high farm prices for domestically produced cereals—feed compounders have been switching to cheaper feed components, principally oilseed meals and cereal by-products. Cassava is also a potentially cheap carbohydrate source, since cassava is not subject to the variable import levies. Cassava imports into the EEC market have markedly expanded since 1960, increasing from 414 thousand tons in 1962 to 2.3 million tons in 1975. Phillips (1973:61) has estimated that the

12 The differences in per capita consumption levels between countries suggests that there is more scope than this for increasing cassava in the diet. As Table 17 suggests, the high consumption levels of cassava in Brazil and Paraguay are induced not only by low prices for cassava but low prices relative to competing foods. A long-term fall in cassava prices relative to grains may in fact result in a change in tastes and therefore increased consumption above levels represented by the price elasticity. However, there are no data to support this hypothesis.
demand potential for cassava in the EEC in the 1980 may be as low as 3.5 million tons and as high as 9.0 million tons. To date, however, only the Asian countries, especially Thailand, have been able to exploit this market effectively. Thus, in 1975 Thailand exported about 2.0 million tons of cassava pellets to the European Community.\footnote{The data on cassava exports and imports are from International Trade Centre (1977).}

Brazil, the only country in Latin America to export cassava products, has a very erratic record of exporting cassava feedstuffs. In the 1960s exports ranged between one and almost 100 thousand tons (see Table 18). In a market where consistent supplies are necessary for market development—owing to changeover costs from one component to another in mixed feed industries—Latin America has yet to respond to the export potential. This lack of response is partly due to lack of infrastructure development—as compared to the case of investment in soybean processing capacity in Southern Brazil—and partly it is due to uncompetitive price relationships.

In order to be competitive, prices for dried cassava c.i.f. European ports need to be in the range of $70-90 per ton. This price level has not recently compared favourably to the domestic price of cassava flour in Brazil—the only Latin American country where internal prices are even close to being competitive on the world market. In order for Latin American countries effectively to exploit the export market for dried cassava, internal price levels must fall drastically and must remain at this level. Phillips estimates that such price levels for fresh cassava must be in the neighbourhood of $16-22 per ton to cover the costs of both roots and processing (1973:63). This figure in turn would represent the floor price for cassava in Latin American countries. For a comparison with Latin American farm level prices see Table 17.

The exploitation of the export market for cassava by Latin American countries depends on domestic market requirements—as the supplies moving into export will be a residual after domestic requirements are met—and the cost efficiency (per ton) of new cassava production technology. Moreover, this export market depends on EEC price policy, as the market for cassava feedstuffs is one created artificially by the
Table 18

Brazilian exports of cassava products, 1960-71 (metric tons)

<table>
<thead>
<tr>
<th>Year</th>
<th>Flour*</th>
<th>Meal*</th>
<th>Starch*</th>
<th>Tapioca*</th>
<th>Chips*</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960</td>
<td>28,333</td>
<td>2,508</td>
<td>35,258</td>
<td>846</td>
<td>-</td>
<td>66,945</td>
</tr>
<tr>
<td>1961</td>
<td>11,429</td>
<td>5,381</td>
<td>16,555</td>
<td>1,217</td>
<td>-</td>
<td>34,582</td>
</tr>
<tr>
<td>1962</td>
<td>527</td>
<td>1,692</td>
<td>8,507</td>
<td>1,197</td>
<td>-</td>
<td>11,923</td>
</tr>
<tr>
<td>1963</td>
<td>524</td>
<td>6,825</td>
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* Headings from left to right: farinha de mandioca, farinha de raspa de mandioca, fecula de mandioca, tapioca, raspa de mandioca.

Common Agricultural Policy. Should cassava imports start to displace EEC grains in feed mixtures, there would be political incentives in restricting cassava utilization. On the other hand, the EEC has committed itself to assisting LDCs, from which all cassava originates. Nevertheless, there is a certain risk to over-exploiting this market.

However, before the cassava price reaches the aforementioned floor price, there would appear to be potential for using cassava in the domestic mixed feed industry in many Latin American countries. Demand for mixed feeds appears to be growing rapidly owing to the increase in intensive poultry and egg production systems and, to a lesser extent, in the intensification of dairy systems around large urban markets. To date this demand has spawned new markets for grain sorghum and oilseeds, especially soybeans. If the price for dried cassava is competitive (because of the introduction of new technology), there would appear to be substantial growth potential for cassava in domestic markets for feed concentrates. Furthermore, if lower cassava prices lower the costs of mixed feeds, this would induce even further expansion in the demand for feedstuffs, especially in the dairy industry.14

In order to exploit this market the price of dried cassava should be about 20 per cent less than the sorghum price.

Cassava as a source of starch and alcohol. Starch makes up practically all the biomass of cassava, making it an excellent raw material for the production of processed starch and alcohol. Little, however, is known about the markets for these two commodities in Latin America.

Industrial starch production forms the principal industrial utilization of cassava in Latin America. All starch production is utilized in domestic markets, except for erratic exports from Brazil. The cassava starch is utilized in a number of end uses, among them in paper sizing, as an additive to prepared foods, in soaps, as a clothing starch, in pastes, and in a whole range of chemical preparations. The demand for cassava starch is, therefore, a

14 It should be further noted that it is extremely doubtful that mixed feeds will be used in beef cattle production in Latin America as nearness to market is not so critical and there are still extensive pasture areas. Furthermore, growth in production of mixed feeds is dependent on a similar expansion in the production of economical protein sources, principally oilseed meals.
derived demand dependent on the demand for these end products. Growth in demand for cassava starch in Latin America is therefore dependent upon its competitiveness with maize and potato starches and on the growth in domestic end product markets. It is difficult, then, to estimate the growth potential in this market. Nevertheless, it is unlikely that Latin America will enter into the starch export market, as it is highly competitive.

Finally, cassava starch may be an excellent raw material for the production of ethyl alcohol. The production of anhydrous alcohol is currently being promoted in Brazil as a substitute for gasoline. A National Alcohol Commission (CNAL), established in November 1975, plans to replace 20 per cent of Brazilian gasoline consumption with alcohol by 1980, a program which will require the production of 4 billion litres of alcohol per year. By the end of 1976, 83 distillery projects with a capacity of 1.9 billion litres had been approved, but only five of these relied on cassava as a raw material, the rest being sugar cane distilleries. Given the limitations on land adequate for sugar cane production, cassava is being considered as the principal future source of alcohol. To meet this 4 billion litre target, an expansion in cassava area of between 1 and 2 million hectares is required or an increase of between 50 and 100 per cent over current planted area (see Hammond 1977:564-6).

The future of alcohol as a fuel source and the future of cassava as a producer of alcohol in Brazil are dependent on government policy. The government determines the relevant price structure for alcohol and gasoline, which in turn determines the relative profitability. Currently the wholesale price for alcohol is fixed US$1.0 per gallon (3.8 litres) v. 1.50 dollars per gallon for gasoline (Hammond 1977:565), a price structure which appears to make alcohol production from cassava profitable. Government action concerning location of distilleries is also important, as opening the cerrado would give the edge to cassava as opposed to developing the high-unemployment areas of the northeast, which would make sorghum the more attractive raw material source. The growth potential for cassava in this market, therefore, depends first

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15 The cerrado is the generic term for the vegetation type found on the undeveloped savanna and bush area of Brazil's interior. These areas are characterized by long dry seasons and highly acid, infertile soils.
on government policy, second on the development of improved cassava technologies, and third on the interplay of economic forces.

Summary. The one conclusion that can be drawn from this brief analysis of demand for cassava is that any large expansion in the utilization of cassava in Latin America is heavily dependent upon a fall in the current price level, which is in turn dependent upon the availability of an improved cassava production technology. The development of a lower-cost production technology is therefore a two-edged sword. On the one hand, new technology is necessary in order to provide the proper price incentives for development of growth markets for cassava products and, on the other hand, the extension of improved technologies without proper market development and market integration could produce a severe price depression with negative effects on producers and on the distribution of farm income, especially if increased supplies are absorbed only into the fresh food market. A post-harvest technology is necessary to insure that new cassava technology is not constrained by a limited market. It is at this point that technology design in cassava becomes even more crucial to the achievement of agricultural development goals in Latin America.

Cassava technology design and development goals

It is now possible to consider how the promotion of cassava can contribute to the achievement of development goals in Latin America. Cassava as a crop is in an unusual position in being able to provide growth with equity in agricultural development. However, the achievement of the equity benefits, particularly in a Latin American context, is dependent upon the design of cassava technology, especially post-harvest technology. The choice depends on government policy and rests principally on national government's perception of the most efficient means of industrializing increased cassava production.

Characteristics of cassava in relation to development goals. The development and extension of improved crop technologies are broadly designed to increase food production, thus contributing to growth in the economy and the provision of food needs for a growing population. However, this growth process should also insure that those with limited resources will be provided with the means of obtaining this increased food availability, either through increased employment or
increased income (production) in the rural sector or lower prices in the urban sector. In labour-surplus economies the cost efficient means of generating increased food production and making sure that that food is available to the segment of the population most in need of it (at least in the rural sector) is through sustained development of smallholder agriculture. Through such a policy the secondary goals of achieving a more equitable distribution of income, improving human nutrition, improving food self-sufficiency, providing productive employment, and reducing rural-urban migration rates to acceptable levels can be integrated into one overall strategy.

Increasing the productivity of cassava production is a means of contributing to such a strategy. As this analysis has shown, cassava is adaptable to a wide range of agro-climatic conditions and produces acceptable yields under poor agricultural conditions, namely badly distributed rainfall, infertile soils, and high disease and insect pressure. Furthermore, cassava is currently produced largely on small to medium-sized farms. To the extent that small farms are located in poorer agricultural areas - as data presented in this study suggest - an improved cassava technology would be especially well suited to achieving the goals outlined above, at least from the point of view of the production side. 16

However, as the demand side analysis has suggested, cassava has a very inelastic demand, at least in the market for human consumption. This inelasticity implies large price variability with small changes in marketed supplies. The impact of an improved cassava production technology is thus potentially limited by a price depression due to this inelastic demand, thereby resulting in changes in the

16 Within Latin America cassava is one of the few remaining crop alternatives where the benefits of a small-farm strategy can still be achieved. Export crops, grains (except maize), and oilseeds are increasingly being produced under large-scale technologies. The efficiency of such operations is in many respects artificial, because of subsidization of mechanization and agricultural inputs, bias in technological research, bias in input and credit markets, and price supports. Owing to this technological bias, the small-scale producer has been priced out of these markets. Cassava at least offers the possibility of balanced growth in both the large and small-farm sectors.
distribution of cassava producers as production is concentrated in the more efficient cassava areas.\footnote{The impact of improved rice varieties on Colombian agriculture has followed such a course; see Scobie and Posada (1977).}

Improved technologies are, therefore, simultaneously required to expand the consumption of cassava. In order to contribute to the development strategy outlined, these post-harvest technologies should meet two objectives:

(a) to provide an inexpensive but acceptable food source for urban consumption; and

(b) to insure that industrial processing of cassava is adaptable to small-farmer supply systems.

Technologies to increase food consumption. Technology design to increase cassava consumption seeks to produce a cheaper but preferable form of cassava, especially in contributing to the calorie intake in the diets of low income consumers. Two means of achieving this objective are considered here:

(a) developing technologies that reduce the marketing cost, especially those that increase the storage life of fresh cassava; and

(b) processing technologies that improve the form, quality, or nutritive value of the cassava.

The marketing margin for fresh cassava is large compared to most other unprocessed foods. In Colombia marketing costs for fresh cassava account for one-half to two-thirds of the consumer price, as is shown in Table 19.

The largest component in the marketing margin is at the wholesale level. The principal costs at this level are transport and those associated with spoilage. Since fresh cassava is bulky, per unit transport costs are high, especially since production zones are well outside urban areas. Also, since cassava has a very short storage life after harvest, there are substantial risks in assuming ownership of the product, thus further raising costs.

Inexpensive technologies to increase shelf-life would be one means of reducing the price to the consumer without
Table 19

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<td>1630</td>
<td>1570</td>
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Marketing margin as percentage of price to consumer

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<tr>
<td></td>
<td>61%</td>
<td>65%</td>
<td>51%</td>
<td>79%</td>
<td>73%</td>
<td>53%</td>
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</table>

affecting the farm-level price. CIAT has done basic research on the causes of post-harvest deterioration of cassava and is continuing with research on the design of inexpensive on-farm and transport storage devices.

Another way of reducing transport costs is by reducing the bulkiness of the cassava by taking out the moisture - which as well reduces deterioration. It is in the form of flour that most of the cassava for human consumption is traded in Brazil. The cassava is either processed into flour on the farm or in small-scale processing units in cassava production areas.

Given the cost advantages of on-farm processing of cassava into flour, the additional question remains about the taste preferences of the urban market for cassava in this form. Phillips (1974:83) found that in Brazil 'there is a positive income demand elasticity for fresh cassava but not for cassava flour in urban areas'. Such a conclusion may not be relevant to other Latin American countries, however, where cassava flour is relatively unknown. Furthermore, this conclusion does not consider the technical possibilities of substituting cassava flour for a certain percentage of wheat flour in bread baking nor fortifying cassava flour with soya protein to improve nutritive value. New technologies to adapt cassava products to the taste preferences and nutrition requirements of the low income urban consumer have only recently been given serious attention.

Also in this vein there is evidence to suggest that there are taste preferences for different types of fresh cassava (independent of HCN content). For example, in Bogota the variety 'chiroza' sells at a significant premium to the variety 'llanera' (in 1976 Colombian pesos 3.56 to 2.59 per kilogram; Federación Nacional de Cafeteros de Colombia (1977:56 and 60)). Thus, in developing new cassava production technologies, high-yielding varieties should as well be compatible with consumer preferences.

Technological design of cassava processing industries. As the demand analysis suggested, the principal growth potential for cassava lies in the market for dried chips and starch. These chips in turn can be used in domestic feed plants or pelletized for export. Starch, on the other hand, can be sold directly into the starch market or used as a raw material in the production of alcohol. Two factors need to be considered in developing cassava agro-industrial systems
that meet the aforementioned objectives of an integrated development program; these are the choice of scale of technology for the industrial processing of cassava and the choice of the source of supply of the raw material.

In developing industrial cassava schemes in Latin America government planning agencies are faced with a significant 'choice of technique' problem. The options are numerous and lie between the two extremes of small-scale (usually on-farm) chipping and drying techniques and traditional starch production techniques, both supplied by small-holder agricultural systems, to a vertically integrated cassava industrialization scheme (such as the 60,000#L/day alcohol project in Minas Gerais, Brazil) in which large-scale processing plants are supplied by mechanized cassava plantations. The choice depends on standard economic, benefit-cost assessments but these assessments depend on a clear delineation of alternatives and correct specification of prices.18

The choice of technique is also determined by - and as well also determines - the source of supply of the raw material. In the case of a crop such as cassava where transport costs are high and timely processing is critical, a key component of the profitability of the processing plant is continuity of supply. Broadly, the higher the capital costs for such a processing plant (i.e. the larger the scale of the activity), the greater the dependence of profitability on continuity of raw material supply, because fixed costs make up a greater proportion of unit production costs. There is, on the one hand, a tendency in small farm production areas to invest in smaller scale processing capacity. On the other hand, there is an inherent tendency of investors in large-scale cassava processing plants to invest also in cassava plantations in order to ensure control over the supply and price of the raw material.

Thailand has been the only country to develop a well integrated cassava industrialization and marketing system. Exports of dried cassava products increased from 44 thousand

18Market distortions will bias a benefit-cost assessment and may lead to an inefficient choice. Shadow prices are used to sort out these problems. For examples of choice of technique evaluation, see Warr (1976:1-24) and Timmer (1972:59-88).
tons in 1953 to 2 million tons in 1975 (Phillips 1974:97 and International Trade Centre 1977:57). This growth in cassava production and export of processed products is based on small-scale technologies. Average size of cassava producing farms is 8.6 hectares, of which 47 per cent of cultivated land is planted to cassava. The average fresh cassava capacity (potential/realized) of the processing plants is: chip plants, 16 tons per day/9 tons per day; pellet plants, 21 tons per day/14 tons per day; and starch plants, 32 tons per day/21 tons per day. A cassava industry based on small-scale production and processing is, therefore, possible; its analogue in Latin America is the 'farinha' production system in Northeast Brazil. However, the interaction of the industrial requirement for a continuous raw material supply and the profit maximizing objective of smallholder agricultural systems creates the need for close marketing and technical integration between the two systems.

It might be suggested that the choice of technique in Thailand was highly dependent on relative factor costs (between labour, land and capital) and the distribution of these factors (especially how land and labour are distributed). The choice of technique is not so clear cut in Latin America, principally because of the very unequal distribution of land. Johnston and Kilby (1975:127) term the development pattern in Latin America 'bimodal', in that it is based on a dualistic size structure of farm units. Barraclough and Collarte (1973:xxv) suggest that this 'bimodal' agricultural development 'impedes the introduction of new technology and economically rational land and labor use'. In the case of crop cultivation the dualistic size structure of the farm units makes a labour intensive (per unit of land) production technology profitable on small farms while on large farms mechanization becomes profitable. In labour surplus economies this would imply that private profitability (on large farms) is not compatible with maximization of social benefits. Thus, the choice of technique for cassava production in Latin America will not necessarily follow the Thailand example unless it is influenced by technology design and government policy, which also determine how the benefits of improved technologies are distributed.

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19 Phillips (1974:101). Potential represents the processing rate of the plant at full capacity; realized is the actual operating capacity of the plant at the time of the survey.
Because of the inadequacy of extension and technical services in smallholder agricultural areas, the development of an integrated cassava production and industrialization program based on smallholder agricultural systems will require initially a higher degree of planning and investment in marketing infrastructure. A commitment to smallholder production schemes will also require the dual development of small-scale chipping and drying technologies, as well as small-scale pelletizing and starch plants. For the Brazilian alcohol projects where there appear to be return to scale benefits in investing in large distilleries, a core plantation may be necessary but this could be supplemented by nearby smallholder production. 20

Summary

The central thesis of this paper has been that cassava offers great potential for the development of smallholder agriculture in Latin America. The need for such crop development programs in Latin America is clear; to generate employment, equity, the control of rural-urban migration, and increases in food production. It has been argued that the key to achieving sustained growth in smallholder production of cassava is through technology design, the role of government in the technology transfer process, the expansion of demand, and in the structuring of cassava industrialization schemes.

Cassava is in many ways a perfect crop (and one of the few remaining crops) for generating growth in smallholder agricultural areas. Cassava cultivation is already concentrated in such areas. Cassava is not a very risky crop, being tolerant to moisture extremes, insect and disease damage. Cassava is also adapted to relatively infertile soils, which thereby offers the possibility of raising the incomes of smallholders that farm even poor agricultural lands. Finally, rudimentary cassava marketing systems in smallholder areas already exist and evidence on percentage of production marketed suggests that farmers are well integrated into the market.

20 This type of system has worked exceptionally well for palm oil processing plants in Malaysia and the Ivory Coast. In the case of palm oil there are even more severe constraints on timely processing of the palm bunches after harvest than with cassava.
Sustained growth in cassava production depends likewise on sustained increases in demand. What little evidence exists suggests that the growth potential for cassava as a human food (in its currently known forms) is limited and is primarily dependent on population growth in low-income groups. To achieve the full benefits of technological improvement in cassava production, therefore, also requires growth in industrial processing of cassava. It has been argued that technological design in this area is also crucial to the expansion of smallholder production of cassava. There is an inherent tendency for the industrialization of agricultural crops in Latin America to be linked to large-scale supply sources. Particularly, the larger the investment in processing capacity per plant, the more stringent the need for continuity of supply in order to cover costs - an inherent problem in a crop such as cassava with a minimal storage life - and therefore the greater the tendency to develop plant-owned plantations or contract with large-scale producers. There are, as in the case of Thai and Brazilian flour production, small-scale processing technologies for cassava, many of which can be made even more efficient with research and can be integrated into smallholder production areas.

Because of demand uncertainties, cassava technology design therefore requires emphasis at both the farm level and the processing level. Integrated development at both levels is especially critical if increases in cassava production are to be based on smallholder agricultural systems. It is in achieving this objective that government policy in the choice of technique is especially crucial. The potential benefits to the smallholder sector in the development of cassava technology are not likely to be achieved if the model of the Brazilian alcohol program is a harbinger of government policy in this area.

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21 For a discussion of this linkage see Pastore (1977:217-22).
Chapter 15

Focusing farming systems research on smallholder agriculture: experiences from West Africa

J.C. Flinn

While it is dangerous to extrapolate findings from one region to another, there seem to be principles which apply equally well when designing research related to indigenous agriculture - whether it be in Oceania or Africa. For reasons of familiarity, and possibly to present an alternative approach, the examples used in this paper are drawn from West Africa. Further, because of the differences in peoples, social, economic, political, technical, biotic and physical environments of Africa, an attempt will be made to present principles which, with adaptation, could be modified to fit a specific situation, as opposed to presenting a case study of one region, island or nation.

There are several differences between West Africa and Oceania (apart from geographical) which are worthy of mention. First, 'subsistence affluence' in the sense applied to Oceania is not common in Africa. Second, while transport and distribution are also problems in Africa, large urban centres in the humid and subhumid tropics, coupled with the uncertainty of crop production in the drier zones, result in an enormous potential - if not effective - demand for indigenous food crops. Third, most African farmers, apparently unlike their counterparts in many areas of Oceania, have been exposed to money exchange economies for a considerable period of time.

Agricultural development strategies in West Africa were, until recently, mainly oriented to export crops (e.g. oil palm, cocoa, rubber, groundnuts, cotton). This emphasis is understandable. Traditional systems of food crop production were able to support population increases in land extensive systems of agricultural production; food scarcity, as it was not a major political issue, was of little concern to colonial administrators. But more importantly governments found it convenient to finance public works and services through
export taxes on primary products, for which an effective demand existed in the industrializing nations, and research showed that it was not easy to improve on indigenous systems of food crop production.

In African countries where natural resources do not provide foreign exchange earnings, export crop orientation remains a necessary tenet of agricultural policy - despite the artificially low prices often received by the primary producer. However, rapidly increasing populations and urbanization have resulted in the demand for food crops growing more rapidly than supply in Africa (IFPRI 1976), with part of this food deficit being met through imports. Food imports require expenditures of scarce foreign exchange, so less scope remains for the import of needed capital equipment and consumer goods. Foreign exchange constraints have contributed to limited economic development, which adversely affect the welfare of a majority of the population, and so may lead to political instability. As a result, politicians and planners are becoming more concerned with development strategies which among other things will lead towards self-sufficiency in food crop production.

The vast majority of food crops directly consumed or marketed in tropical Africa are produced in various crop mixtures by subsistence farmers relying on shifting cultivation and bush fallow systems for the maintenance of soil fertility (Okigbo and Greenland 1976; Ruthenberg 1977). While such systems are stable when land is not a limiting factor, they tend to break down when the number of people that the land must support becomes so large that fallow periods are substantially reduced (Prothero 1972; Lagemann et al. 1976). This is the emerging situation in many parts of humid and subhumid Africa. Moreover, the predominant systems of land tenure result in fragmentation of holdings and reduced farm sizes, thereby minimizing the relevance of bringing more land into cultivation as the means of increasing food crop production. Thus, if the marketed surplus of food crops is to be increased in tropical Africa, new systems of crop production and land use must be developed which will first increase and then sustain agricultural productivity as population and economic pressures accelerate the transition to more intensified systems of land use.

While there is a growing literature related to the allocation of resources to agricultural research (e.g. Fishel 1971; Arndt et al. 1977) planners and policy makers faced
with the task of identifying priorities for food crop research in developing countries have a more difficult task than their colleagues in the developed world. A number of reasons have been advanced for this. First, in the indigenous sector, land and labour normally belong to the household and may not have market values which reflect their true scarcity. Second, because of a limited effective demand, private enterprise is not often encouraged to develop new innovations or market inputs tailored to the needs of the smallholder. That is, the 'inducement mechanism' to research as defined by Hayami and Ruttan (1971) is not a common feature of the food crop sector of developing countries. Third, smallholders are not usually active, articulate innovation seekers with an organized voice to influence the research and development priorities of governments. Fourth, and what will be a focus of this study, agricultural research priorities are often set without a clear understanding of the effective constraints to agricultural production at the farm level.

Some basic assumptions

Before focusing on agro-economic research from a production viewpoint, it is important that several assumptions are made explicit. These assumptions highlight the need for micro- and macro-economic research and planning to be carried out as complementary activities with agricultural research as integrated components of the agricultural development process. The assumptions are that:

(a) there is an effective demand for the crops of interest at the farm level and that market prospects for the crops are such that increasing supply will not result in drastic reductions in the farm price of the crops;

(b) planners and policy makers have realistically assessed the performance (constraints) of support services (markets, processing, input supplies, credit, etc.) and the designers of agricultural research projects have taken these into account; and

(c) the distributional consequences\(^1\) (both among producers and between producers and consumers), foreign exchange requirements, employment considerations, etc., of increasing the production of

\(^1\)In this context see Scobie and Posada (1977).
alternative crops by alternative means, have been considered and are acceptable to government given its development objectives.

Unfortunately, the assumption that the above classes of analyses have been undertaken, digested, and used to help guide agricultural research priorities is often a naive one.

**Strategy for farming systems research**

One possible framework in which farming systems research may be viewed is shown in Fig. 1. In summary, to ensure that applied research is effectively directed at the binding constraints of agricultural production, it is necessary to identify and quantify the economic and bio-technical problems faced by farmers in the real world. For this reason, field level studies are necessary to describe and analyse existing farming systems. Through analysis of these systems, the causes, effects and interactions of the major physical, biotic and socio-economic factors and their related constraints faced by farmers are identified and described.

Inferences drawn from studies of farming systems are used as inputs to help guide the formulation of research programs directed towards the alleviation of the real constraints to increased agricultural production. Specific research projects will usually relate to one, or a limited number of problems (e.g. soil management, weed control, pest management, plant nutrition, storage) and will normally be discipline oriented. The subsequent integration and testing of the research findings of individual scientists should be approached within a multi-disciplinary framework. Finally, before any 'improved' method of crop, livestock production or land management is considered to be ready for

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2 As this paper focuses on bio-technical research for increased food crop production, questions of constraints due to marketing, input supplies, uncertainty of prices, government policies, etc. are not considered. These exogenous constraints of course are of equal importance to those discussed here.

3 While I am a strong advocate of multi-disciplinary research for problem identification, setting research priorities and evaluating the products of research, I am of the opinion that researchers must be able to pursue discipline-oriented research to ensure that innovative and significant technological advances are made.
Fig. 1. Farming systems research and development strategy involves a problem-oriented integrated research effort and on-farm testing and feedback from the farm to the scientist at various stages.
extension, it is critical that the proposed methods are evaluated by the researchers in a farm environment and adapted to meet the 'real world' circumstances of the farmer as dictated by the specific conditions of the locality.

**Studies of farmers' systems of production**

Three parallel areas of research provide useful foci for studying and developing descriptive and quantitative inventories of farming systems in use, and in identifying the limiting factors and resource potentials of a given region. They are:

(a) agronomic and economic studies of agricultural production;
(b) soil, land use, and land capability surveys;
(c) agro-climatological analysis of the region.

**Studies of systems of agricultural production.** Agricultural technology which requires non-market 'persuasion' by authorities before farmers will implement it is rarely viable. Hence it is important that new systems of production are designed in a manner which the farmer perceives as contributing to his goals ('meeting his felt needs'), which are consistent with his financial and managerial capacity, and which can be met with the limited assets at his disposal (de Wilde 1967).

As there is a paucity of data related to these factors and their interrelationships it is often necessary to conduct farm level studies to describe and quantify them. Because actual farming systems are a result of the interaction between human, technical and the natural resource factors (Fig. 2), studies of smallholder farming systems should be designed to provide information on:

(a) the attitudes, values and objectives of the farmer and his family;\(^4\)

(b) existing levels of technology and resource use (resource combinations and productivities) and the rationale for the farmer's management of his resources; and

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\(^4\)Theoretical and empirical studies of decision making by low resource farmers are reviewed in Anderson, Dillon and Hardaker (1977).
Fig. 2. Integrating components of the farmers bio-physical, technical and socio-economic environments on which farming systems research must be based when generating appropriate foodcrop technology.
(c) factors (bio-physical, technological and socio-economic) which define the constraint set in which the farmer must make and implement his decisions.

Procedures and problems involved in undertaking various types of farm management surveys - from the agricultural economist's viewpoint at least - are well documented (e.g. Collinson, 1972; Kearl 1976). Collinson (1972), Cleave (1974) and Helleiner (1975) provide excellent reviews of farm-level survey work undertaken in Africa. The results of the farm management studies provide a means of ensuring that human as well as ecological factors are taken into account when designing problem oriented agricultural research projects.

Studies of farming systems by agricultural economists have often been incomplete because they lacked the professional expertise to evaluate adequately the biotic and physical environments of the small farmer. In recognition of the complexity and interaction between the biological, physical and socio-economic components of farming systems, this institute has found it useful to include agronomists, economists and pedologists in their analysis of farmers' systems of production and land use. The desired composition of a multi-disciplinary survey team obviously depends on the situation being studied. For example, in livestock producing areas animal and range management specialists may be key members of a team; similarly questions of marketing and logistics may make marketing, transport engineers and geographers priority members. The actual composition of such teams will of course be largely dictated by the personnel and other resources available.

Soil and land capability surveys. A sound knowledge of the soils, their agricultural potential and limitations is vital if agricultural research is to give priority to the potentially most productive systems of land use within a region (Sanchez and Buol 1975). Similarly, such information is useful for planners when evaluating likely shifts in agricultural production, identifying areas for production campaigns, and in planning for the preferred location of transport routes and other services (e.g. processing facilities).

Baseline soil surveys should be directed to (FAO 1976a):

(a) determining the inherent characteristics of the
soil in relation to land use potential;
(b) classifying the soils into defined and named units;\textsuperscript{5}
(c) establishing and mapping the boundaries on maps of the region;
(d) predicting their response and hazards to defined management systems for adapted crops, forages, trees and livestock production;
(e) predicting their suitability for roads and other structures.

An excellent example of a land resource study is that of Murdoch et al. (1976) for the savanna zone of the western region of Nigeria.

Normally, resources (personnel, time, finances) do not permit detailed soil surveys of a region. However, through aerial photograph interpretation coupled with ground reconnaissance surveys, experienced pedologists are able quickly to map a region into major land forms, areas for adapted crops, and predict potential hazards of various kinds of land use. More detailed follow-up surveys should then be conducted on the ecologically most promising areas.

Agro-climatological analysis. Analysis of weather records (coupled with soil and crop data) for a region go a long way in evaluating the potential and likely productivity of crops and cropping systems for various soil types in a region. Work at the Commonwealth Scientific Industrial Research Organization in Australia has shown how quite simple agro-climatic models may be used with purpose to assess the biologic relevance of various crops and crop management systems in a region (e.g. Slatyer 1960). These models provide a methodology well suited to tackle problems such as (Rose 1975):

(a) for any given area, which crops have the greatest physical and economic advantage?

(b) for any given crop, which areas have the greatest advantage?

(c) for any given crop or area, how might productivity be raised?

\textsuperscript{5}At present the soil taxonomy (Soil Survey Staff 1975) is being extended to make it more precise for the classification of tropical soils.
The relevance of such information when producing 'crop-suitability' mosaics for a region and in planning farming systems research is self-evident.

While long-term official weather records may only be available for a limited number of sites in many developing countries, and it is well recognized that weather (particularly rainfall) patterns may be extremely localized, the possibility often exists for augmenting these 'official' records with those collected by private users, for example by plantations. Also, it is probably not necessary for farming systems scientists to conduct the agro-climatological analysis themselves; it may be preferable to subcontract the work to an institution which has the specialists and facilities (computer, programs, etc.) to undertake the research.

Problems of increasing food crop production

Field and related studies of the types discussed in the previous section, coupled with the findings of other researchers, show that the low yields obtained by subsistence farmers in humid tropical Africa are caused by several groups of factors. They include (Flinn et al. 1975):

(a) biological and physical constraints arising from a lack of improved species, and the nature of pests, soils and climate;

(b) limitations imposed by the structure of farming and the resources available to the smallholder;

and, while not discussed in this paper,

(c) problems associated with policies, institutions, input supplies storage and marketing.

Important bio-physical factors which limit potential gains in food crop yields in tropical Africa include:

(a) a lack of improved, adapted crop varieties which perform well under intensified, improved systems of land use;

(b) the destructive impact of pests (weeds, insects, nematodes, diseases) which is magnified in tropical regions compared to temperate regions because of the generally favourable environment for the existence of pests;
(c) potential crop yields are also restricted because of limited net photosynthetic capacity caused by high night temperatures, and, in the humid tropics, low radiation intensities due to a high incidence of cloud cover (Chang 1968);

(d) low water-holding capacity of many tropical soils (a result of their clay mineralogy and coarse-textured characteristics), coupled with high potential evapo-transpiration, often causes crops to be moisture stressed after as few as ten days without rain. Dry periods of this length are common, even in the wet season. At critical stages of plant development such intervals of moisture stress can cause yield losses (Moormann 1973);

(e) high intensity storms, typical of the tropics, result in substantial nutrient loss through leaching and surface runoff, and in severe erosion unless the soil is protected by a canopy of plant or surface mulch (Lal et al. 1974). Winds, which often accompany rainstorms, also contribute to the lodging of crops;

(f) high soil temperatures, especially at the start of the planting season, inhibit the germination and retard the growth of certain crop seedlings (Lal et al. 1974). They may also contribute to reduce rhizobia activity and nodule formation in legumes such as soya beans;

(g) low or uneconomic response to fertilizer, particularly on highly leached acid soils, and their inability to retain some nutrient because of their low cation exchange capacities, organic matter content and clay fractions, other nutrients being fixed owing to high oxide contents (Kang 1974).

While the dominant biological constraints to food crop production in tropical Africa are fairly general, the dominant physical constraints tend to be related to more specific soil/climate complexes. Hence, to help focus agricultural research it is often useful to relate production constraints to the farmer's natural resource base. As soil formation is largely a function of environmental factors (climate, parent material, living matter, relief, age of

6 Of course, the incidence of specific pests will depend on the locality.
landform) classifying problems in relation to soil types provides a basis on which to stratify a region. For our purpose, we have found it useful to characterize the soils of tropical Africa in relation to their base status (most have low activity clays); the crops which are adapted to the soil/climate can also be defined to indicate the major components of cropping systems in the sub-regions so characterized (Table 1).

Techniques designed to reduce the bio-technical constraints must also be developed with a clear awareness of the objectives, circumstances, and constraints faced by the farmer if they are to have a reasonable chance of being adopted by a significant proportion of them. In this regard, small farmers across humid and subhumid Africa have many features in common which are of particular relevance when designing agricultural technology. These are:

(a) the vast majority of farmers are subsistence farmers in the sense that they produce a substantial proportion of their food requirements. They pursue management practices which result in:
   - an assured source of staple foods;
   - a regular and varied source of food over time;
   - a source of cash income for the purchase of goods and services not available from the farm;

(b) widespread use of slash and burn techniques and a reliance on bush fallow to maintain soil fertility;

(c) farmers distinguish between crops grown principally for family consumption and principally for sale; their priority for resource allocation (labour and land) is first to their food crops, even if

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7 The 'green revolution' in Asia, incidentally, largely took place on high base status soils with high activity clays (e.g. mollisols and vertisols), where water control and fertilization are practised. West African soils have substantial inherent limitations when compared to these soils.

8 Helleiner (1975) provides an excellent summary of the circumstances and characteristics of subsistence farmers in tropical Africa.
Table 1

The dominant cropping systems and problems in increasing crop production in tropical Africa

<table>
<thead>
<tr>
<th>Humid tropics</th>
<th>Subhumid tropics</th>
</tr>
</thead>
<tbody>
<tr>
<td>(&gt;1500 mm rainfall)</td>
<td>(1000 to 1500 mm rainfall)</td>
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<table>
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<tr>
<th>Low base status soil*</th>
<th>Upland</th>
<th>Soil derived from basic rocks**</th>
<th>Hydromorphic</th>
<th>Upland</th>
<th>High base status soil#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principal components of cropping systems</td>
<td>rice</td>
<td>tree crops</td>
<td>rice</td>
<td>maize</td>
<td>&lt;</td>
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<tr>
<td>(yams)</td>
<td>yam/cocoyam</td>
<td>rice</td>
<td>off season</td>
<td>cassava</td>
<td>rice</td>
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<tr>
<td></td>
<td>vegetable-legumes</td>
<td>perennials</td>
<td>depending</td>
<td>seed legumes</td>
<td>fertility management</td>
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<tr>
<td></td>
<td></td>
<td>and annuals</td>
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<td>sole and</td>
<td>weeds</td>
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<td>intercrop</td>
<td></td>
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<tr>
<td>Major constraints to production</td>
<td>water management weeds</td>
<td>Al toxicity nutrient ratios weeds</td>
<td>fertility management weeds</td>
<td>soil physical management weeds</td>
<td>soil physical management weeds</td>
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<td></td>
<td>fertility management (Al, Fe) pests/diseases</td>
<td>pests/diseases</td>
<td>soil physical management pests/diseases</td>
<td>management pests/diseases</td>
<td>management pests/diseases</td>
</tr>
</tbody>
</table>

* Oxisols, ultisols and associated entisols, inceptisols.
** Soils derived from basic rocks important locally but of limited distribution in tropical Africa.
# Alfisols and associated inceptisols.
this will result in lower cash farm incomes;\textsuperscript{9}

d) prevalent land tenure systems often lead to fragmentation of holdings;

e) cultivated area per farm family is small by virtue of the predominant use of manual labour and limited use of animal or mechanical power, and in many areas increasing population density;

(f) serious shortages of labour at seasonal peaks (particularly land preparation and weeding), and high energy demands for operations;

g) highly diversified farming enterprises in terms of the number of crops grown, animals kept and non-farm activities that may be practised by the farm family;

(h) cropping patterns being dictated by the distribution and intensity of rainfall during the year;

(i) seasonal price fluctuations for food crops result in the farmer receiving the lowest price for his produce during seasonal peaks of glut when a majority of farmers are selling soon after harvest, because of their need for cash and effective, low cost, storage techniques;

(j) farmers often having very low cash surpluses to purchase agricultural inputs, when available.

These seasonal labour constraints which limit the potential and realized output of the small farmer indicate that an effective applied research program must also seek ways of increasing the productivity, and lessen the drudgery of agricultural labour in addition to reducing the limitations imposed by bio-technical factors. It is equally important that the research design must take into account the farmer's preferences, his priorities for allocating resources (land, labour, capital) and his financial and managerial capacity.

\textsuperscript{9}A typical example is found in the oil palm region of eastern Nigeria where the major oil palm harvest is at much the same time as food crops are planted (with the start of the rains). Late harvesting of the palm bunches results in income loss because there is a reduced harvest and a lower quality oil (higher VFA).
The situation of the small farmer suggests that if technology is to be effective it should generate substantial, stable and sustained returns over time, be resource-conserving, and, in the first instance at least, the technology should not require drastically new or different ways of managing the environment, nor should it require costly additional resources, or increased demands for labour during critical periods of the year.

**Discipline oriented research**

As the science and training of many agriculturalists have been biased towards conditions found in the western world (e.g. predominance of sole crops, moderate to high input levels, mechanization), the researcher working on food crop technology suited to the smallholder of the tropics must be innovative in adapting his disciplinary skills to the intercrop, low level of technology, limited capital, high labour input situation. Okigbo (1974) has identified useful guidelines for problem-oriented research directed to smallholder farming systems.

**Socio-economic research.** The role of agricultural economists in studies designed to explain, describe and understand the environments and methods of existing agricultural systems has been discussed. Suffice it to mention that for maximum impact these studies should be conducted in collaboration with physical and biological scientists. The value of these studies being collaborative not only ensures that the farming systems are described from a number of interrelated viewpoints, but also, if the results are to influence significantly the priorities for agricultural research, it is important that these scientists are also involved in identifying those areas in the existing systems most amenable to change through improved technology.

Agricultural economists should also contribute to the design and evaluation of technology, and undertake studies to assess the impact of technical recommendations as adopted by farmers in the light of social, market, technical and institutional pressures (see, for example, Gerhart 1976).

**Soils management and land utilization.** The objectives of soil studies in the humid tropics of Africa are:

(a) to develop practical means for farmers to ensure that the soil remains stable after clearing and
under cropping with minimal fallow periods;

(b) to ensure that its physical condition, water regime and pH are maintained in as favourable a state as possible for the crops to be grown; and also

(c) that the supply of plant nutrients is as adequate as possible in a system with minimal added nutrients from outside the system.

Soil chemical, physical and fertility studies will have conventional components (studies of nutrient imbalances, soil conservation, increasing the efficiency of applied nutrients, etc.), but must also be concerned with methods which make best use of nutrients cycled through the tree canopy, and other variations associated with nutrient release at the start of the rains, and through the cropping cycle (Nye and Greenland 1960). Research in soil microbiology should focus on reducing the need for nitrogen fertilizer by emphasizing biological nitrogen fixation as a major source of new nitrogen in the crop system, on increasing the uptake of phosphorus (mycorrhiza) and other elements by plants, and with monitoring the decomposition phase of nutrient cycles.

**Crop improvement and management.** Conventional selection criteria of plant breeders (e.g. breeding for increasing yields, resistance to pests, diseases, adverse environmental conditions, quality, etc.) are appropriate particularly for the low resource farmer who has little access to methods of plant protection. However, the breeder concerned with the smallholder situation will face special problems in breeding for adaptation to the interactions and sequences found in mixed cropping. It is not necessarily true that a selection which performs best in the sole crop environment will do likewise in mixed cropping; breeders must select for lines adapted to a mixed crop situation and length of growing season, so that the crops fit as well as possible given the growth cycles of components of the system.

In addition to giving priority to short-term needs to satisfy rural subsistence requirements, the breeder must also develop lines more suitable for urban markets and for intensified commercial production. It is likely that the priorities for the urban markets will be for processing into convenience, easy to prepare foods and for the reduction of fuel costs through harvesting and processing of the fresh products instead of the usual dry (mature) seeds. Similarly, the increased production of market (cash oriented) food crops,
where the capital intensity and scale of operation increases beyond subsistence oriented systems of production, may well result in food crops being grown in simpler mixtures, using higher input levels than was historically the case. Thus the breeder in his concern for the relevance of his work as related to the subsistence sector should not ignore the development of varieties suitable for an emerging commercially oriented agriculture which indeed may involve simple, if not sole, cropping.

Agronomic practices (tillage, crop sequences and arrangements, applied nutrients and plant protection) must be designed to optimize the output of the system (as opposed to component parts) over time, with minimal non-farm inputs, while conserving the soil resource of the farmer. Particular areas of focus may be zero and mulch-tillage techniques, and increasing the efficiency of the use of non-farm inputs (e.g. fertilizers).

Crop protection. In mixed cropping, pests and pathogens are likely to behave in ways quite different from that predicted from sole crop situations. Mixed crops may of themselves offer a suitable environment for integrated control of pests, particularly if resistant varieties of the component crops are available. New methods of crop protection (against weeds, insects, nematodes, animals, diseases) may therefore be required, possibly very different from those regarded as standard practice in sole cropping. Herbicides, appropriately employed, could release labour at critical points in the cropping cycle, thus increasing the average productivity of labour over time. Similarly, the strategic application of insecticides (possibly using Controlled Droplet Application (CDA) spraying techniques) markedly increases the return from crops at low added cost.

Agricultural engineering. Farmers in the subsistence sector require alternative power sources and improved tools to reduce labour inputs - particularly at peak labour demand periods - and to reduce the drudgery of farm work. It is not automatic that power sources and equipment developed for rice culture in Asia, for example, will be appropriate for upland conditions in the tropics. Alternative sources of power to the internal combustion engine, for example, animal, water, wind and solar power may be harnessed to better serve the needs of the small farmer.
Moreover, it must be recognized that food crop production is but one of the demands on the farm family's time. The task of increasing labour efficiency in the farmer's life system as a whole - transport, pumping and heating water, cooking, crop processing - over the year may require far more human energy than all crop production put together and thus cannot be ignored in agricultural engineering research.

**Evaluating smallholder technology**

Proposed alternative designs for improved technology based upon problem-oriented research must initially be screened and evaluated in a research station environment, with some effort made to duplicate the real world conditions of the farmer. Evaluation should be directed towards identifying those proposed technologies which appear sufficiently relevant for off-site testing, and which will provide a feedback to scientists to enable them to evaluate their past research and help focus their future priorities.

Perrin *et al.* (1976) outline budgeting and related procedures for such analysis. The technologies must be evaluated in relation to the binding constraints faced by the small farmer (return per unit of capital invested, per man-day during labour scarce periods, etc.). Simulating the farm system, for example, using linear programming techniques, has also proved useful in evaluating how well a proposed technology performs in relation to the constraints faced by farmers from a whole-farm viewpoint (Heyer 1971; Low 1974).

Analysis of experiments and models provides useful information for researchers and planners when predicting possible changes in output mixes and necessary resource and infrastructural support, if a suggested technology is adopted by farmers. If it is clear that such support will not be forthcoming, there is no point in evaluating the technology at the farm level, or recommending it to farmers. To minimize infrastructural problems, there is obvious advantage in field testing of new technology to take advantage of any integrated rural development projects that exist. Similarly, projects should also be encouraged which link infrastructural development (input supply and marketing) with the introduction of new technology.

The designs selected as having highest potential (from the research station testing) should then be evaluated on
farmers' fields to select the most appropriate ones for extension purposes. First, these candidates should be compared and evaluated by the collaborating scientist at a number of sites using simply designed field trials. To reduce the risk faced by collaborating farmers on what is an unproven method it may be necessary for the researchers to provide the management and technical inputs, with the farmer supplying the land and labour for operations. The farmer should also be guaranteed that he will not be worse off by co-operating than had he allocated his land and labour to his own production processes; on completion of the trial this may require a payment in cash or kind to the farmer. During this phase the technology should be more sharply focused and adapted to the farm situation.

Second, the most promising technologies so identified should be evaluated in collaboration with the farmers; the farmers being involved in all operations, and their reaction sought to the proposed technology. These sequential phases of research evaluation should be conducted in close collaboration among the researchers, extension officers and farmers. Additional spinoffs from this approach are that the trials provide on-farm demonstrations of the technology, and if new varieties are involved, a means for rapid multiplication in the field of these materials.

Norman (1976) argues that the field evaluation of proposed technology should be assessed in relation to its:

(a) technical feasibility;
(b) level and dependability of profits;
(c) compatibility with the farming system; and
(d) compatibility with infrastructure.

If the technology is judged to be positive on all accounts, it has a fair chance of being adopted by farmers. Norman (1976) and Flinn and Lagemann (1976) provide examples of the field evaluation of technology on the above basis. These examples also demonstrate that the evaluation should be collaborative between the biological, physical and economic researchers, and emphasize the importance from a research planning viewpoint of precisely determining why the technology failed if it did so.

10 The basis of the 'Mini-kit' and 'Production-kit' approaches (Williams 1977).
Getting results to farmers

The urgency of getting results from experiment stations to the farmer necessitates that the on-farm testing, followed by demonstration plots, should be initiated in different locations as soon as a given technology shows promise of being relevant for farmers. While a discussion of extension methodology (i.e. procedures which ensure that (a) research information is taken to the mass of farmers as rapidly, effectively and efficiently as possible and (b) ensuring a feedback of farmers' problems to research scientists for solution) is beyond the scope of this paper, collaboration of scientists with extension workers in the evaluation of technology goes a long way in reducing the gap, and establishing dialogue between these disciplines.

Finally, to return to the original assumptions. Improved technology of itself is not a sufficient condition to guarantee increased agricultural production. Other necessary conditions are reliable input delivery systems and the farmer being confident that he can dispose of his crops at remunerative prices. In consequence, agricultural research leading to improved methods of farming, coupled with extension, assured markets and input supplies for the farmer, should be regarded as interacting and linked components when developing plans and policies for agricultural development strategies.

Conclusion

Farming systems research should be designed with a strategy to produce agricultural technology relevant to a given target group - in this instance, the subsistence farmer of the tropics. For agricultural research to have this focus requires that scientists are in contact with and aware of the binding constraints to increase production faced by low resource farmers. The awareness is best achieved through multi-disciplinary studies of farmers' systems of production, with discipline-oriented research programs being focused on the constraints so identified. Potential advances in science must be critically evaluated and adapted to the real world circumstances of the farmer by research and extension workers before being regarded as technology suitable for extension to users.
Chapter 16

Some reflections on traditional Indian agriculture

Nitish R. De

Faced with the massive scale of their basic needs and poverty problem, the poor nations have no choice but to turn inwards, to the extent made possible by global interdependencies. Whilst vigorously pressing for new international structures and a more equitable world distribution of opportunities, they must pursue genuinely self-reliant styles of development aimed at attacking poverty directly and developing the means to satisfy their own basic needs.

Our politics is based on promises of more consumption. It is based on the assumption that our commercial irrigation system need not earn a profit; that Electricity Boards must run at a loss; that the products of our public sector must be deliberately priced to produce a loss and that mobilisation of resources even from the affluent sections of our farming community is a cardinal sin. And that we can miraculously combine atrociously feudal agrarian relations with hopes of modernisation of agriculture.

Tinbergen et al. (1976:71) Haksar (1977:27)

In the context of the Central and Western Pacific region, where nature has been both bountiful and niggardly, where modernized agro-industrial metropolitan nations continue to dominate the human ecology of old Melanesia and where the traditional societies are seeking national identities in the wake of political independence, the observation of Fisk (1976) that 'considerable rethinking appears to be necessary' to evaluate the role of traditional modes of production in conjunction with the relations of production is indeed timely. Predominantly given to forestry and food-gathering activities, these island people have a rural subsistence life with their tribal traditions, distinctive cultural patterns and linguistic varieties. The picture has, however, been made complex over many
decades. Expatriate settlers came with modernized forms of plantation activities; economies became monetized and export trade turned out to be a major motivation for the non-indigenous entrepreneurs. The bowels of the earth opened up to mechanized mining. The wealth of the sea responded to fishing technology made effective by refrigeration techniques. Thus, two sectors of the economy came to live side by side, but it was not a peaceful co-existence. The engine of modernized agriculture and mining disrupted the rural ecological balance; terms of trade between the traditional farmers and settlers acquired a new dimension via new forms of land tenure and utilization practices and by the unequal exchange of goods and services. In effect, the traditional modes of life and living received an unprecedented challenge.

These developments over decades, if not a century or more, have now forced upon the host countries a necessity to revamp the rural development strategy. Papua New Guinea has pronounced an 8-point development charter. Fisk (1974) and his colleagues believe that there is a strong case to build from the bottom up, exploring the enduring strengths of traditional agriculture - its self-sustaining, self-managing and democratic traditions. At the same time, a balance is to be struck between the traditional form and its adaptation under the compulsion of population pressure, ensuring improved quality of life - quantitative and qualitative - developing organizational designs appropriate to needs and, lastly, ability to survive against the inroads of urbanized, machine-age elitist values and consumerism.

Let us refer to the case of the Solomon Islands. Still a British territory, the Islands will acquire the status of independence and the membership of the Commonwealth about July 1978. Currently with over 196,000 population, nine out of ten families depend on subsistence economy. Some of the best lands are in the freehold occupation of the expatriates. A question arises whether these and other lands should vest in the government or the original owners and their heirs. Historically, the 'civilized' settlements have taken place around the coastline. Christianity has taken root in these areas. The pagans, for example the Kwaio tribe of the Malaita district (Keesing this volume), are left in the hinterland in comparative isolation, are politically weak as a pressure group and deprived of such basic needs as education and health care. Fifteen per cent of the population over the age of 14 years are working for salary or wage. The mainstay of agriculture is copra (50 per cent produced by small holders),
but it is losing its importance to tuna fishing, logging projects and palm oil ventures, in most of which the organized sector is linked with the multi-national corporations. Bauxite mining and alumina projects are looming, which may in future bring major producers across the world. The meat industry is on the verge of a boom - 24,000 head of cattle to reach a target of 45,000 by the mid-1980s. What will be the proportion of internal need fulfilment and export of meat? In the meantime, the population growth rate is 3.4 per cent per annum. This sketchy picture (Eele this volume; Ryan 1977) presents some problems whose implications span the Third World:

(a) the understandable primacy to commercialize and industrialize the economy;

(b) this will entail not only transfer of know-how, but also importation of alien management systems, technicians and management personnel;

(c) collaboration with multi-national corporations whose multiple interests extend beyond technical contracts and host country interests;

(d) rise of an indigenous elite group in the government set up and around the multi-nationals whose orientation to rural development will be technocratic and whose approach will be from the top.

(e) development of a superstructure of 'culture-islands' with modernization of education, urbanization of social overheads and bi- and multi-national exchange programs;

(f) rural populations may become human 'fodder' to the organized commercial-industrial nexus, even though most of them will continue to dream of acquiring urban status.

There is thus a case for exploration of rural development 'walking on two legs'. With few exceptions, China being one, the rural leg has so far been infected by the virus of the impressive, modernized industrial conglomerate which has transformed agriculture into a sophisticated accomplice.

Some dimensions of rural development

Arithmetic of life. In the Third World, this is a most crucial lack in rural development. The arithmetic of life symbolizes the desired amount of food, shelter, drinking
water, nutrition, literacy and leisure essential to the human being. This is an absolute concept and not comparative. The macro-figures are staggering. According to the UN Secretary General, 10,000 persons die every day as a consequence of malnutrition; 120 million in the Third World suffer from 'great distress'. According to UNESCO, between 400 and 500 million children suffered from malnutrition and starvation in 1973 (Mesarovic et al. 1974:115). Waterborne diseases kill an estimated 25,000 people every day. Bilharzia (live worms in water) affects 200 million people in 71 countries. Filariasis (a major cause of blindness) affects 250 million a year and malaria 100 million. A UNICEF survey in eight developing countries has shown that 90 per cent of all child deaths could be avoided by safer water supplies and hygienic sanitation (De 1976).

India, with three decades of independence and five Five-Year Plans behind it, still nourishes over 400 million poor in 550,000 villages. Over 40 per cent of the population are below the poverty line (Selbourne 1977:41-2; NSS 1976:5, 7). According to the same survey (NSS 1976:33-4), 46.07 per cent of the rural population were seeking employment in 1972-73 for one year or more. The per capita consumption of cereals has remained practically static: the same in 1966 as it was in 1955; the same in 1975 as in 1956. Per capita consumption of cloth has had an overall decline of 23 per cent between 1965 and 1975 (Selbourne 1977:4). With wide income disparity, the law of averages without appropriate disaggregation of data can be a misnomer. The official statistics in October 1975 mentioned that average per capita daily income was 2.30 rupees (Selbourne 1977:43). An in-depth study in two villages in West Bengal shows that the corresponding figure was 0.37 rupees per day in 1972 (Bandyopadhyay 1972). In all probability, this level of income can provide food in terms of calories less than what the rodent population can muster from the field and the grain silos. About 18 per cent of the total annual food grains produced are lost through pests, diseases and weeds (Asia Year Book 1976:60). Yet another aspect is the basic needs other than food. Given the net rise in population growth (2.4 per cent net per annum), India needs to build, from 1975 until 1995, 1000 new school rooms per day, 1000 new hospital wards and 10,000 houses (Mesarovic et al. 1974:80).

This picture, however appalling, is representative of the majority of Third World countries, especially in South Asia and tropical Africa. Essentially, this arithmetical
dimension of life in the rural sector should receive priority attention in rural development strategy. It is thus understandable that while deliberating on an approach to rural development, Bardhan (1975:19) puts quantity of life before quality of life, a dichotomy which is perhaps relevant in a schizoid world.

Land and its distribution. Agricultural activities are, without exception, premised on one basic resource—land. There are estimates that the usable arable land—about 2.3 times what was put to use in 1975—can support between 10 and 13 times the present world population. India has more arable lands than the United States (Asia Year Book 1976:60; Selbourne 1977:2). However, 75 per cent of land in India is without irrigation (Selbourne 1977:2). But it is not the only dynamics. Of 160 million hectares of arable land (at least 20 million hectares are fallow), 24 million hectares, under land-ceiling legislation, are surplus and should vest in the state from the landlords. With the first Land Reform Law in 1950 (in Uttar Pradesh), in a period of 25 years, between 0.5 and 0.9 million hectares could be acquired (Selbourne 1977:7-8, 439). At least 40 per cent of rural workers are landless. Indications are that the number is on the increase—both in absolute terms and relative to other economic groups (Bandyopadhyay 1977). Immediately after Independence, 55 to 60 per cent of all cultivable land was with the landlords. The severity of rack-renting through intermediaries can be judged from the fact that the ratio of the land revenue paid by landlords to government to the rents received by them from tenants was 1:23 in pre-partition Bengal and Uttar Pradesh and 1:7 in Bihar (Hiro 1976:93).

The dynamics of land reform (i.e. redistribution) can be seen from the case of Rajasthan. A committee to fix ceilings on land holdings was set up in November 1953. It took four years to submit the report, and another two to push through the legislation. In March 1960 the President's assent was obtained. Another three and a half years went by before the draft rules were framed. On the eve of its implementation in December 1963 the landlords went to the Court of Law. After they lost the case, 1 April 1965 was set as the date of enforcement to be postponed till October 1965. Then came some operational problems raised by the landlords. Came the 1967 general elections and so land reforms had to wait. Meanwhile the mala fide land transfers up to December 1969 were legalized. Thus the saga that began in 1953 came to its climax in 1970, by which time the bulk
of the surplus land had been spirited away (Hiro 1976:95-6). This is by no means an exceptional case.

The need for distributive justice in land has several aspects to it. One major aspect is the alienation from land of the poorest strata either by brute force or through money-lending at usurious rates of interest or through collusion with the law-enforcing agencies. One typical case of land alienation of tribals has been recorded by Baxamusa and Savur (1977). The Warlis in the Thana district of Maharashtra were owners of land during early British rule. But gradually they lost their possessions because of (a) inability to fight the luxuriant weeds in the forest land and (b) the introduction of stiff plough tax on land use by the British making agriculture a depressing occupation. On top of this stagnancy came the demand for timber for ever-growing urban centres. The urban and rich rural landlords could penetrate into the Warli lands. Cheap liquor came as a convenient manipulator. The owners of land became its serfs. Despite legislation to protect tribal land ownership in several states, alienation came through trader-cum-money lenders as in Srikakulam in Andhra Pradesh which in the late 1960s saw guerrilla action by Girijan tribals, or through landlords-traders-money-lenders-liquor vendors as in Dhanbad district in Bihar.

Yet another aspect of a fair land distribution program is the need of the so-called nomads. The Gujjars of Jammu and Kashmir, Himachal Pradesh, Haryana, Punjab and Western Uttar Pradesh are semi-agriculturist and pastorally nomadic. They require land to graze their stock of cattle, buffaloes, sheep and goats. However, migration in search of pasture land partially conditioned by the severity of nature (summer and winter) is to be matched by access to markets. They need land to raise millet and vegetables. And they are gradually becoming appreciative of the need for settlements for steady family life, health care and education for children. But, by and large, they receive inhospitable land, sloping mountain terrain prone to soil erosion, so that they remain in a state of perpetual backwardness, despite their orientation to hard work. The Gujjars' late entry into the queue for land has left them in a vulnerable position as regards land reform efforts (Negi and Raha 1977).

Similarly, Mahapatra (1977) has shown the adverse effect of a low level of land-holding in the tribal economy of Mayurbhanj district of Orissa State. Seventy per cent
of the total number of holdings are below 2 hectares making 42 per cent of the total area. Any innovation in the form of investment outlay is either not possible economically or the facilities do not exist. A study of the types and quality of implements used for agriculture shows continuance of the same between 1902 and 1961. With population pressure and the closure of iron ore mines throwing 10,000 Santhal tribals out of employment, one can appreciate the deteriorating situation. Over 30 per cent of the population are landless. No doubt there is some form of supplemental activity such as rope-making, tasar-cocoon rearing and some kind of cloth weaving.

A point has often been made that the regressive myths ('bound' myths as distinct from 'free' myths) stand in the way of the tribals' adaptation to hybrid maize culture, use of electrical pump-sets for irrigation and increasing economic vulnerability through steadfast loyalty to unproductive rites, ceremonies and festivals. What is often missing from such analysis is the appreciation that in rural areas 'the most important means of production is land and the only way to ensure access to it is to own it' (Griffin 1972:10). There is evidence that the loss of land - the most essential productive capital for the rural poor - not only affects their economic wherewithal but also results in a formless, uncreative and depressed way of life, what Elvin calls the loss of nerve (Panchbhai 1977). It is thus no surprise that sturdy, hardworking Warlis in the Thana district are perceived today as lazy, drink-addicted and crime-prone, in short, disoriented from an attachment to life. The point to note is that historical evidence does not support the thesis, popular among some psychologist elites, that is is personality orientation of the Warlis that has made them indolent. One should examine the dynamics involved in expulsion from their own land.

Yet another aspect is the characteristic of the semi-feudal culture that goes with the land-holding pattern. Bhaduri's (1973:120-37) study in West Bengal shows that share-cropping, perpetual indebtedness of the small tenants, two modes of exploitation (usury and land ownership) and lack of accessibility for the small tenant to the market, all linked with skewed land-ownership patterns, lead to a continuance of feudal values. The landlord may like to persist in the traditional modes of production. This enables him to keep the sharecroppers or small tenants at the brink of economic dependence on him round the year so that his
domination is not only economic but also political and social. Income from usury is often more than what increased investment in modernized technology can bring in. Evidence is available from the rest of eastern India in support of this position that effective land utilization has not been possible. It was found in the Balasore district of Odisha in 1972, that although irrigation facilities were available over an area of 2400 hectares, the sharecroppers were disinclined to go in for two crops (winter crop as the second crop) because their economic vulnerability inclusive of no right over land was a primary cause for lack of initiative (Appu 1975:3). A much more glaring example is provided by the experience of the Kosi project in northeast Bihar (Appu 1975:20-34; Biggs 1976:151-8; Prasad 1972). The project has been aimed at significantly improving the land-land relationship by reducing the ravages of flood, bringing in land under effective irrigation systems and improving the potential use of land along with the appreciation of its value. By March 1972, a sum of Rs.889.4 million was spent, that is about Rs.180 per cultivable hectare in the command area. However, apart from the other aspects, the irrigation objective has not been attained. With a fully developed canal system 580,000 hectares should be irrigated annually. In reality, the achievement at the most has been 130,000 hectares. Technological problems apart, the poor cultivators with insecure right over land (sharecroppers) have had no motivation to accept multiple cropping. Secondly, small farmers with ownership of less than 0.8 hectares of land have utilized water resources effectively for both monsoon and winter crops, but not the farmers with over 8 hectares of land. Appu (1975:29) came to the conclusion after his on-the-spot study that 'the large size of the holding is, without doubt, one of the main reasons for the low utilization of the irrigation potential'.

The reality of inequality of land ownership in India can be gauged from Tables 1-4. Table 3 indicates that while 9.77 per cent rural households own land of 4 hectares and more, 9.34 per cent possess no land at all; 80.89 per cent have land from .005 to 4 hectares. The last line of Table 4 shows that 0.96 per cent of rural households have control over 13.96 per cent of total assets. The skewed distribution pattern is obvious from the fact that 30.37 per cent of the households have total assets amounting to 80.25 per cent while on the other side of the coin 69.62 per cent have control over 19.86 per cent of assets.
Table 1
Land holdings survey, 1961-62

<table>
<thead>
<tr>
<th>Size (in hectares)</th>
<th>Percentage of total holdings</th>
<th>Percentage of area operated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 0.4</td>
<td>17.13</td>
<td>11.40</td>
</tr>
<tr>
<td>0.4- 2.0</td>
<td>44.56</td>
<td>7.90</td>
</tr>
<tr>
<td>2.0- 8.0</td>
<td>33.79</td>
<td>51.60</td>
</tr>
<tr>
<td>8.0-20.0</td>
<td>3.49</td>
<td>17.50</td>
</tr>
<tr>
<td>20 and above</td>
<td>1.03</td>
<td>11.60</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Size (in hectares)</th>
<th>Percentage of total operational holdings</th>
<th>Percentage of area operated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below 0.5</td>
<td>32.88</td>
<td>3.36</td>
</tr>
<tr>
<td>0.5- 1.99</td>
<td>36.79</td>
<td>17.50</td>
</tr>
<tr>
<td>2.0- 9.99</td>
<td>26.41</td>
<td>48.26</td>
</tr>
<tr>
<td>10.0-19.99</td>
<td>3.03</td>
<td>17.59</td>
</tr>
<tr>
<td>20 and above</td>
<td>0.89</td>
<td>13.28</td>
</tr>
</tbody>
</table>

**Note:** The term 'operational holding' is defined as 'the fundamental unit of decision-making' in agriculture; not the same thing as an ownership holding, which was the subject of the 1961-62 survey.

**Source:** *All India Report on Agricultural Census 1970-71* (Department of Agriculture, Ministry of Agriculture and Irrigation, GOI), Table 1, p.113. Original data in acres.
### Table 3

Estimated number of rural households according to area of land owned, 1971-72

<table>
<thead>
<tr>
<th>Land owned (in hectares)</th>
<th>Percentage of total households</th>
<th>Number of households</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nil</td>
<td>9.34</td>
<td>7,281,000</td>
</tr>
<tr>
<td>0.01 - 0.4</td>
<td>34.89</td>
<td>27,193,000</td>
</tr>
<tr>
<td>0.4 - 2.0</td>
<td>33.78</td>
<td>26,330,000</td>
</tr>
<tr>
<td>2.0 - 4.0</td>
<td>12.22</td>
<td>9,526,000</td>
</tr>
<tr>
<td>4.0 - 8.0</td>
<td>6.49</td>
<td>5,053,000</td>
</tr>
<tr>
<td>8.0 - 20.0</td>
<td>2.89</td>
<td>2,254,000</td>
</tr>
<tr>
<td>20 and above</td>
<td>0.39</td>
<td>302,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100.0</td>
<td>77,939,000</td>
</tr>
</tbody>
</table>

**Source:** Statistical Tables: All India Debt and Investment Survey, 1971-72, Reserve Bank of India, Vol.1, Table 1, p.16 (a survey carried out in collaboration with the National Sample Survey, 26th Round, of the Government of India). Original in acres.
## Table 4

Distribution of assets of rural households on 30 June 1971

<table>
<thead>
<tr>
<th>Asset (in rupees)</th>
<th>Percentage of total households</th>
<th>Percentage of total assets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 500</td>
<td>11.38</td>
<td>0.23</td>
</tr>
<tr>
<td>500-1,000</td>
<td>8.35</td>
<td>0.53</td>
</tr>
<tr>
<td>1,000-2,500</td>
<td>15.49</td>
<td>2.30</td>
</tr>
<tr>
<td>2,500-5,000</td>
<td>16.09</td>
<td>5.17</td>
</tr>
<tr>
<td>5,000-10,000</td>
<td>18.31</td>
<td>11.63</td>
</tr>
<tr>
<td>10,000-15,000</td>
<td>9.71</td>
<td>10.47</td>
</tr>
<tr>
<td>15,000-20,000</td>
<td>5.69</td>
<td>8.65</td>
</tr>
<tr>
<td>20,000-30,000</td>
<td>6.24</td>
<td>13.40</td>
</tr>
<tr>
<td>30,000-50,000</td>
<td>4.83</td>
<td>16.22</td>
</tr>
<tr>
<td>50,000-100,000</td>
<td>2.94</td>
<td>17.55</td>
</tr>
<tr>
<td>100,000 and above</td>
<td>0.96</td>
<td>13.96</td>
</tr>
</tbody>
</table>

**Source:** *Statistical Tables: All India Debt and Investment Survey, 1971-72, Reserve Bank of India, Vol.1, Table 6, p.27.*
At the early stage of land reform measures, Jawaharlal Nehru intended to place the peasant 'in the centre of the place', which, after two decades (1950 to 1971-72), does not seem to have taken place. Raj (Hiro 1976:103), a noted economist, believes that on 1961-62 operational holdings records, 'all rural households can be provided with holdings of not less than 4 acres [1.6 ha.] in the relatively dry zone of north-west, central and west India if a ceiling of 20 acres is enforced; and of at least 2 acres [0.8 ha.] in north, east and south India if a ceiling of 10 acres is enforced'. While such a radical measure seems inconceivable in India's socio-economic context, the fact stands out that, without land reforms, even traditional agriculture will not attain the potential it is capable of. Ladejinsky (1973:383) has expressed it adequately:

Agrarian reform is a combination of a great many things, and not all of them are of equal importance. Important though the other ingredients are, unless those who work the land own it, or at least secure on the land as tenants, all the rest is likely to be writ in water ... It is relatively easy to use science to increase production, but only if the cultivator's relationship to the land and the State's treatment of him and of agriculture create incentives to invest, to improve the land and to raise productivity. Too many of Asia's cultivators are still waiting to find that incentive.

Ladejinsky first published his observations in 1964. Writing twelve years later, Tinbergen and colleagues (1976:72) have said that for the Third World countries, 'land reform is one of the most important prerequisites, with land viewed as an essential social good and not a profit object. Land reform must benefit the small and poor farmer, liberating him from exploitation, discrimination and servitude ...'

Agrarian structure and relations. The continuing tragedy of under-development cannot be separated from the stark reality of its structure and process of functioning in the agrarian sector. A most poignant depiction of such a reality is in *Cambao* by Francisco Juliao (1972), which concerns 'the hidden face of Brazil'. Nearer to home is the Indian situation. The modes of production and the relations of production are enmeshed in such a way that one can not only identify the contradictions but also the socio-cultural
mores that have made the rural structure so stable and enduring over a long time-span. Thorner (1956) perceives a 'common pattern' throughout the country that points out the reality of the heterogeneous, discrete character of rural society. There are landlords (largely absentee), proprietors exercising management and control over cultivation, working peasants (tenants) with varying degree of security over land they cultivate with supplemental activity to support the family and the rural labour who have no right over land they till but work as wage earners or sharecroppers. The dynamic character of the modernization of agriculture has introduced new elements such as appreciation of the value of land, low level of land tax including income from agriculture, and free-trade in commercial crops and food grains with few exceptions by way of control over price. Thus, the rich and middle farmers including erstwhile (a legal fiction) landlords have developed a vested interest in land, particularly where technology has made it possible for land use to be more intensive, and felt it necessary to weaken the bargaining strength of small and marginal farmers as well as the landless labour through a variety of means: money-lending, denying access to the record of rights to land, debt-bondage, violation of the provisions of law that entitle the sharecroppers to a certain share of produce, and so on.

The ceremonial and social obligations have been invoked to make the tillers of land remain not only food-hungry but also debt-prone to meet these obligations. Distress-sale of their share of produce is a common phenomenon. A free labour market in agriculture is a rarity.

This hierarchical structure of interests in the land has required, in effect, that quite a substantial proportion of the produce be reserved for persons who perform no agricultural labour ... In the end, the working Kisan (labourer) was left with no surplus to invest in better implements, improved seed, or fertiliser, and in any case no real incentive to increase his productivity (Thorner 1956).

The complex socio-economic and cultural-legal forces in operation in the rural sector have thus produced a situation which Thorner calls the 'built-in-depressors'.

The rural social stratification has also been mentioned by Patnaik (1971:A191), McEachern (1976:452-3) and others in the context of the mode of production. They have underlined
the exploitative character of this hierarchical arrangement. What is often missing from such analysis is the class-caste nexus of agrarian relations. The case of Sultanpur village will make the picture somewhat clearer (Haque et al. 1977: 3-30). This village with 2500 population in Moradabad district of Uttar Pradesh is a beneficiary of 'green revolution'. Of 800 hectares of land, the Jats (economically the dominant caste and 15 per cent of the population) own 70 per cent of land. They own 11 out of 12 tractors, all privately owned electric tubewells and 27 out of a total of 46 diesel engine sets. Bank finance has been made more easily accessible to them. The lowest caste, Jatava (sweeper group), constitute 40 per cent of population and are predominantly landless labour. They enjoy hardly more than 150 days' work in a year and some of them live in a semi-bonded state. Then, there are caste such as Brahmins (small farmers and white collar workers) and Baniyas who are in trade doing well. There are other middle castes who work as gardeners, black smiths, carpenters, barbers, potters, etc. The gardeners, owning .8 - 1.2 ha. of land, are comparatively better off utilizing family labour. The Muslims (10 per cent of population) are small and medium farmers but socially somewhat closer to the Jatavas.

Two interesting dynamics emerge from the study. First, the Jats who have been steeped in feudal culture with antipathy to 'agricultural work' fairly quickly responded to the land reform measures of 1950. Taking advantage of the debt redemption and 'land to the tiller' provisions, the Jats took direct control over the land so long 'leased out' to the trading community and moved towards capitalist farming techniques. Increased demands for labour inputs which would normally justify higher wage levels were neutralized by rapid population growth. Thus, the landless labour could neither benefit under the land ceiling law nor could they significantly improve their socio-economic status. Secondly, Jatavas failed to appreciate the basic problem that, even if the meagre amount of surplus land wasted in the state were made available to them, it would not change the reality, because they would all crave for land on a family unit basis in the hope of becoming self-sufficient (like the Jats) and there was not enough such land in the village to distribute. There is thus the irony of a situation in which the oppressed are still emulating the values of the oppressors. The idea of a collective or co-operative alternative design of land ownership/utilization still eludes them. In fact, the mythification of reality was such that they failed to realize
that the Jat farmers, rich and powerful, had taken recourse to money-lending to further secure their tight grip over the landless labour. The caste differentiation had helped the rural stratification to stabilize, with occasional minor manageable tension, at a new level of equilibrium. It is also worth noting that the caste-class lines do not follow a clear logic. The Jats as a caste are hierarchically lower than the Brahmins but in terms of economic dominance they are at the top. It is only in respect of the lowest social strata, the Jatavas, that caste and class do coincide.

In Bangladesh, where caste is not a social phenomenon among the Muslims, the agrarian structure has followed similar logic. The well-known Comilla experiment meant to reach the middle and small farmers with a view to freeing them from the stranglehold of the rich farmers-cum-money lenders-cum-traders did not produce the desired results except for a small area where the project was being monitored by the Comilla Academy itself. A.H. Khan, the initiator of the project, did not seek to bring in the landless labour in his scheme of things as his objective was to break the contradictions of modes of production and relations of production between the large farmers and the small farmers. As Haque and his colleagues (1977:43) put it, 'Akhtar Hamid Khan looked at a village as a community forming, as it were, a tiny republic. His vision of the Republic was a self-sufficient community producing everything but salt and oil and guaranteeing "production, protection and distribution". His cooperatives, he regretted later, achieved only production but failed to distribute it equitably and protect the poor'. In fact, in May 1973, Khan addressed the Economic Commission for Africa at Addis Ababa to say that 'At the bottom of the heap struggled those who had neither land or capital, an ever increasing number ... In the busy season the labourers received the lowest possible wages; in the slack season they were laid off. Their survival was a miracle of human endurance' (quoted in Thorner 1956:5).

Yet another aspect of the agrarian reality is the existence of bonded labour, which is a category by itself among landless labour. It is a subtle, modernized version of serfdom of farm-labour existing in a state of relentless debt bondage. Intensive study of the bonded labour phenomenon during 1976-77 among over 300 victims of the system in Bihar, Orissa, Rajasthan, Madhya Pradesh and Andhra Pradesh (Maharaj 1975; Maharaj and Iyer 1976; Bandyopadhyay 1976; Iyer and Das 1976; Maharaj 1976; Iyer 1976; Das 1976; Bandyopadhyay
1977; Maharaj and Iyer 1977; A. Rahman et al. 1977), indicates that the system is widespread despite the persistent denial by authorities in the past. Continued economic and social disabilities from which the landless labourers suffer force them to borrow money or grains at an exhorbitant rate of interest which cannot be liquidated even if the accounts are properly kept (which they never are). An equitable exchange ratio between forced manual labour from dusk to late night (as a way of repaying loans either for medical treatment, to meet the expenditure to defend oneself in the Court of Law, to buy grains to feed the family or to defray marriage expenditure) and the money valuation that is put to inputs of labour is so tilted against the hapless bonded labourer that there is indeed no escape for him. The logic of the system forces him to borrow more for mere subsistence and in the process plunges him into a system of slavery. Two to three generations of bondage are not unusual. Wives and children put to bondage for a loan taken by husbands are also not uncommon. According to official statistics on 28 February 1977, 92,776 bonded labourers have been identified in 10 out of the 22 Indian states. The figure of rehabilitated bonded labour stands at 22,699. That there is neither the determination nor the appropriate machinery to undertake schemes for rehabilitation of freed bonded labour is evident from several studies (e.g. Narayan 1977). What is significant is that on the economic structure of land holdings have been built the superstructure of socio-religious practices which act to facilitate the persistence of bonded labour systems (Pandhe 1976:29-34). Except for Jan Bremen (1974) and the field studies of the Lal Bahadur Shastri National Academy of Administration and the National Labour Institute, this aspect of agrarian structure has been neglected so far by both scholars and administrators concerned with rural development. The studies cited above also indicate that the bonded labourers belong almost exclusively to the lowest castes and tribes. Thus, as with the landless labourers, the caste-class symmetry has been maintained.

For a realistic assessment of the agrarian structure the reader is referred to Das (1977:154) and also to the work of Yugandhar (1976).

**Democratic institutional structures.** Yet another concomitant factor of rural development is the role of democratic institutions at the grassroots level. Lerner (1958) has emphasized the role of 'psychic mobility' (empathy) in the modernization process of which the institutional network
is an important signpost. But in communities where rigid social stratification and cleavages exist, where the weakest sections of rural population are subjected to an unrestrained process of socio-economic and cultural deprivation, conflict resolving approaches cannot be ruled out as a possibility (Tullis 1973:40). Horizontal mobilization may be the only alternative available to landless labour (Huizer 1977).

Surveying the Asian rural scene, Myrdal (1968:Ch.26) has mentioned the proneness to failure of new institutional forms in the agrarian situation. The rationale of this reality can be understood in terms of the lag (or dissonance) that exists between value expectations and value capabilities as formulated by Gurr (1970). Expectations of people, for a variety of reasons with which we are familiar, run ahead of the institutional capabilities that exist at any time. This hiatus, no doubt a cause of frustration, does not necessarily lead to an organized protest or revolt. Davies (1962) has indeed argued that a revolution can occur in a period of comparative betterment and rising hopes blocked by short-term impediments and not during the times of major distress or under affluent conditions; however, there is evidence that a sense of comparative deprivation cannot always predict a rapid change (Wertheim 1974). A unique formulation of the process by which the gap between value expectations and value capabilities is either created or resolved is not an easy task. But what can be presented as an insight into the comparative 'traditionalism' or the lack of 'vitalism' in the organizational system is the dynamics of representative system of democracy in a conflict-ridden, heterogeneous rural community.

India provides some basis for this line of analysis. The parliamentary form of democracy, the basis for which was laid by the British, assumed a variety of national and local forms including Panchayati Raj at district and lower level administrative units. Simultaneously, planned development became the official strategy for economic growth. A wide variety of plans, programs, schemes and projects was conceived and launched. Fruits of imported and indigenously developed science and technology were made available. Thus, a complex delivery system was installed within the government as well as the local democratic institutions. Innumerable studies indicate that the economically privileged groups in the rural areas have captured and dominated the delivery system through control over the elective institutions and use of elective offices as legitimate influence upon the
local administration. In the process, the acquisitive system to reap the benefits of democratic decision-making participation and the material and financial subsidies of the developmental programs remained confined to the rural elites. Neither the small and marginal farmers nor the landless labour could become a decisive force either in the delivery system or in the acquisitive system (Tandon 1977). The concept of homogeneous rural community which provided the rationale for democratizing the local developmental planning processes thus further accentuated the socio-economic cleavage in the agrarian structure. Politics became the legalized midwife for economic exploitation of the rural poor. Then over the decades there has emerged a formidable politico-economic force in India aptly labelled 'dominant peasantism' by D.A. Low (1976). Low's analysis shows that this phenomenon is not confined to India only. Wainer's (Hiro 1976:99) study in the Kaira district of Gujarat and Ramdrug Sub-division in Karnataka shows that the active political cadres and leaders of the ruling party hailed from 5 per cent of the landowners possessing more than 12 hectares of land. Iqbal Narain et al. (1976), in their case study of Rajasthan, find that 'as we move up from lower to higher level positions in the Panchayati Raj set-up, persons of higher strata, by and large, man various posts'. A positive response to the Panchayati Raj institution, having a key role in local developmental efforts, comes from 87.1 per cent of rural elites in Ganganagar and 87.5 per cent in Bharatpur. The corresponding figures in Bhilwara and Nagaur are 80.6 per cent and 69.7 per cent respectively (p.114).

Other democratic institutions in India since the British days are the district co-operative credit bank and the primary societies established in the villages. The rural elites capturing these institutions with a view to utilizing the credit facilities for themselves and their peers have been documented in a study by Nilakant et al. (1977). In Purnea district in Bihar, three village societies of Sarsoni, Jagbani and Rautara have 72.73 per cent of the executive committee membership confined to the upper castes, out of proportion with the composition of local population. No doubt, then, the benefits are flowing to those who are 'credit-worthy'. The district bank is dominated by one influential person (politically as well as economically), so much so that in the locality the bank is known by his name. The bank staff is at the beck and call of the dominant peasants who control it and a major chunk of the administrative expenses is on the directors' travels and related
items. Default in repayment is high and since landless labour is hardly represented in the membership, incapacity to pay is not the primary reason for defaults.

Thus we find that the democratic local institutions are captive agencies of the rural elite. Democracy exists in form, not in content. The work of Haque et al. (1977) describes the same phenomenon in Bangladesh and Thailand.

The dilemma that value capabilities do not measure up to value expectations can now be understood in perspective. The power elite who monopolize the delivery system and the acquisitive system will not easily or voluntarily surrender its hegemony over the institutional superstructure.

Thus the challenge in a new strategy of rural development lies in creating conditions for landless labour to develop acquisitive systems which will make the rural institutions substantially democratic.
Section E
Studies with more economic emphasis
Chapter 17

A note on balance of payments considerations in expanding traditional agriculture

Kym Anderson

Most Pacific countries can be thought of as having up to four distinct economic sectors: (a) a traditional subsistence agricultural sector producing taro, yams, etc. but with little or no market surplus, (b) a commercial agricultural sector—often non-indigenous—producing sugar, meat, etc. for the domestic and perhaps export markets, (c) a large-scale and often foreign-owned agricultural export sector, usually involving plantation production, and (d) a small but rapidly-growing urban service (and perhaps processing) sector. With subsistence farmers providing little in the way of regular surpluses of traditional foods for town markets, the urban sector has necessarily relied heavily on surpluses of locally-produced exotic foods such as rice, and/or on food imports paid for with the foreign exchange proceeds of export sales and tourism. And, as the indigenous people of these countries replace expatriates in the public service, as industry and commerce expand, and as incomes in the towns rise, so the urban demand for food continues to rise. This growing demand can be met in any of four ways: (a) by expanding service and handicraft industries to attract tourists and thereby earn foreign exchange to pay for more food imports, (b) by expanding the large-scale export sector, again to pay for more food imports, (c) by encouraging commercial agricultural producers to supply more non-indigenous foods to urban (and perhaps export) markets and (d) by expanding indigenous root crop production in the traditional sector.

The general question being asked in this book is whether the latter course—that of expanding traditional root crop production—is a feasible alternative to the more usual approach of other developing countries of neglecting root crops and adopting a western mode of commercial farming and a diet based on storable cereal grains. Expanding traditional agriculture may well be viewed by locals as the most desirable strategy, because it involves less dependence on imported
food and on tourism and foreign-owned plantation companies for foreign exchange revenue. It also provides townspeople with their preferred local food. And it preserves the indigenous agricultural system and its associated social and cultural attributes while providing rural people with a cash income to meet their monetary needs and wants (a point which is stressed by Roger Keesing in Chapter 12). But, as pointed out by other contributors, these benefits - like those of other strategies - are not free of costs. This note is particularly concerned with one aspect of the benefit/cost calculus which needs to be taken into account when deciding between strategies, namely, the effects on the balance of payments. Balance of payments considerations are inevitably important in developing countries whose economic growth is heavily reliant on imported skills, capital equipment, and the like. But these considerations are especially important for those developing Pacific countries attaining independence, adopting their own currencies, and being forced to rely less on a colonial government to meet balance of payments deficits.

At first one might think that expanding traditional food production would ease the balance of payments situation, because less food would need to be imported. This would certainly be the case if more local food could be produced without cost. However, even in the Pacific, nature is not that bountiful. Local staple food supplies can only expand if more resources are applied to their production and marketing. At the very least, the government would need to increase its investment in market infrastructure such as roads, and farmers would need to use their land more intensely and work longer hours each day - although public investment in agricultural research and extension might be able to provide more productive techniques and higher-yielding varieties of root crops some time in the future. Each government therefore needs to ask: is it more desirable to spend these resources expanding traditional agriculture, or could these resources be better used in expanding exotic, small-scale agriculture and/or industries which earn foreign exchange with which food imports can be purchased? The question is an extremely complex one to answer, for it depends not just on relative prices and costs of production today but also on future relative prices and production costs, on social and private benefits and costs of expanding in different ways, and in particular on the difference, if any, between collective and individual values attached to maintaining a traditional form of agriculture versus adopting a western
form of agriculture and/or being dependent on more or less reliable foreign markets for urban food needs. Consider each of these factors in turn, starting with today's relative prices and production costs.

**Today's prices and production costs**

Suppose, for argument's sake, that a country is capable agronomically of producing only three crops: copra, sugar and taro. At existing world prices, one region near the port is producing copra, because if the same resources were put into sugar or taro production, less income would be generated. Another region near the port is producing sugar, again because less could be earned if the same resources were used to produce copra or taro. The rest of the country is not serviced by roads and cannot profitably market any surplus and so is used only for subsistence production of taro. At present prices, townspeople will only buy imported rice, even though they would prefer taro if it were cheaper and as regularly available as rice imports.

While the government could insist that taro be produced near the port — for example, by putting a high enough tax on sugar and/or copra production — the country would be made worse off overall in the sense that its resources would not all be employed in their most economically productive use. In our hypothetical country then, we have a situation not unlike that of a number of Pacific countries today: no regular marketable surplus of the traditional staple food, a world price for and availability of cereals relative to that for the staple root crop such that consumers choose the former, and world prices for the export crops which return more to the resources used in their production than those resources could earn from producing the traditional root crop. And as long as present prices, production costs, resources and consumer tastes remain unchanged, so this pattern of production and consumption will continue.

**Future prices and production costs**

Now suppose this country is given foreign aid for the specific purpose of building roads and other infrastructure in the subsistence region, such that the cost of getting products to town markets is no longer prohibitive. The better transport facilities may induce taro growers to sell any surplus to towns at a price competitive with that of imported rice. And these earnings may further induce them
to expand production so that they can supply a regular surplus for the market. On the other hand, however, it may be that sugar production promises to be more profitable than taro in this newly-opened region, perhaps because the world price of rice is declining and so reducing the price growers can expect for taro. If this were so, traditional agriculture would still not supply urban food needs, and while some subsistence farmers may move into the non-traditional, small-scale commercial agriculture sector, others may simply choose to revert to producing only for their subsistence needs.

The above scenario is not meant to be pessimistic about the prospects for expanding traditional agriculture, but rather is provided simply to point out that when world market options are available, the balance of payments situation and the economic welfare of the country as a whole and in particular of some former subsistence producers may actually improve more if export production rather than root crop production expands. But then of course the government needs to take account of more than just the economic welfare of its citizens.

Social benefits from expanding traditional agriculture

Suppose each individual farmer in the former subsistence region is keen to move into the western mode of commercial sugar production only if the traditional culture, etc. of his region remains basically unchanged (which it would not do if many other farmers, each acting in his own interests, also became sugar producers). Then there may be a case for the government intervening to ensure that an expansion of taro production is privately profitable, for example by investing in taro production research to find sufficiently more productive techniques and varieties. Whether there is such a case depends on the government's assessment not only of the expected social versus private returns from such a research investment compared with other investments (such as in developing tourism), but also of how much its citizens intrinsically value (a) the traditional agricultural system and its associated cultural and social life more than the alternative, and (b) the thought of being self-sufficient in traditional food rather than dependent on more or less reliable domestic and imported substitutes.

Only one thing is clear: choosing a development strategy is not a simple task.
The root crops - cassava, taro, yams and sweet potatoes - are probably the most important food crops of the low income, indigenous populations of the tropical world. It was estimated by Coursey and Haynes (1970) that root crops formed the staple diet of 400 million people. On present estimates this figure is 550 million inhabitants. Although most of the root crops produced are consumed as subsistence products, an ever-increasing fraction is produced for commercial sale as the urban populations increase relative to the rural populations. This need to produce increasing amounts of root crops for sale to the urban markets in the developing nations has created problems for the existing infrastructure (Fisk this volume). Root crops, because of the strong dietary preferences by the indigenous urban populations (and rural populations), having a low market price relative to other substitutes, with a high bulk to value ratio and a low storage capability, are prone to substantial marketing problems. Our present concern is to analyse the production and marketing constraints and discuss ways of alleviating some of these problems.

Fiji, which had a total population of 588,000 in 1976, of which 37.2 per cent or 218,495 were urban dwellers, is a microcosm of the root crop production and marketing problems faced by traditional societies in developing nations. Therefore it is possible that the marketing methods tried in Fiji will have implications for many other countries. In this paper the root crop production system, the utilization of land, labour, capital and current expenses, the marketing structure and the consumption pattern in Fiji are described. Most of the statistical data reported in this paper are derived from the Sigatoka Valley where the productive efficiency of the smallholder semi-subsistence farms was recently studied in detail (Chandra 1976).
The semi-subsistence producer

The traditional root crops in Fiji are grown mostly by the indigenous Fijian villagers and some Indian smallholders. Farms are usually small and in the Sigatoka Valley these averaged 2.64 ha for Fijians and 3.54 ha for Indians. Apart from cassava, taro, yam and sweet potatoes, a large number of other crops are grown as shown in Table 1.

<table>
<thead>
<tr>
<th>Crops</th>
<th>Fijians</th>
<th>Indians</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsistence</td>
<td>Major</td>
<td>Minor*</td>
</tr>
<tr>
<td>Cassava</td>
<td>Taro</td>
<td>Rice</td>
</tr>
<tr>
<td>Sweet</td>
<td>Yams</td>
<td>Pulses</td>
</tr>
<tr>
<td>potatoes</td>
<td>Bananas</td>
<td>Egg plant</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Green beans</td>
</tr>
<tr>
<td>Commercial</td>
<td>Maize</td>
<td>Teeth</td>
</tr>
<tr>
<td>Watermelon</td>
<td>Tomatoes</td>
<td>Chinese</td>
</tr>
<tr>
<td></td>
<td>Irish potatoes</td>
<td>cabbage</td>
</tr>
<tr>
<td></td>
<td>English cabbage</td>
<td>Chillies</td>
</tr>
<tr>
<td></td>
<td>Twist tobacco</td>
<td>Broom corn</td>
</tr>
<tr>
<td></td>
<td>Virginia tobacco</td>
<td>Cucumber</td>
</tr>
<tr>
<td></td>
<td>Broom corn</td>
<td>Peanuts</td>
</tr>
<tr>
<td></td>
<td>Passion-fruit</td>
<td>Pumpkin</td>
</tr>
</tbody>
</table>

* Less than 10 per cent of the total cropped area.

The traditional root crops are important on the Fijian farms but unimportant on the Indian farms. Some Indians and fewer Fijians grow Irish potatoes in the Sigatoka Valley but this will not be discussed here. The resource utilization patterns of the semi-subsistence producers are now described.

Land. Most of the land utilized for root crop production is the Native Lease Land or mataqali land (mataqali is the
land-holding clan in the Fijian society). Some Fijian producers farm Native Reserve Land which is also owned by the mataqali but which cannot be sold or leased to a non-Fijian. Most of the Indian farmers farm Native Lease Land which now has a minimum lease period of 30 years as enacted by Parliament in 1976. The rent on Native Land varies between $2.50 - $25.00 per hectare per year. This variability in rental rates is a reflection of historical land administration rather than of resource endowments.

**Labour.** Family labour is almost invariably used for root crop production. The mean size of a Fijian family is about 5.6 persons whereas for Indians it is 7.0 persons. Both groups have very young populations, averaging two or three persons of school-going age. The number of fulltime workers on an average farm is two for Fijians and 2.5 for Indians. Adult females and school children also form an important component of the farm labour supply, especially for the lighter tasks such as weeding and looking after draught animals. About 45 per cent of the labour used in root crop production is utilized for the harvesting task and this reflects the total dependence on hand labour.

**Capital.** Semi-subsistence smallholders are usually characterized by low levels of capital investment. Horses are the important source of power on Fijian farms. The Indians own bullocks and horses and some have tractors. Other important capital items on an average farm are the plough, harrow, scarifier, wooden sledge, hoe, fork and cane knife. Draught animals are seldom hired but sometimes a tractor is hired for the initial ploughing.

**Current expenses.** Cash inputs for root crop production are low, usually less than $50 per farm per year. Most of the planting material for cassava, yams and sweet potatoes is readily available on the farms but taro tops are usually purchased. No fertilizer or agricultural chemicals such as pesticides or herbicides are normally used. Hired labour is sometimes used for the harvesting of crops such as cassava. The most important cash input is the payment for hired tractors.

**Productivity levels.** The farm management survey in the Sigatoka Valley between 1970 and 1972 showed that on the Fijian farms the average gross output (defined as value of all subsistence and commercial crops valued at the farmgate price) was $733 (Chandra 1976). The variability was $176 to
$2374. The root crops generally accounted for over 50 percent of the farm gross outputs. The productivity of land was generally low at $278 per hectare with a range of $54 to $533 per hectare. Returns to labour and farm cash inputs were high, varying from $0.26 to $1.07 per manhour for labour and $1.50 to $35 per dollar for cash investments.

The crop production system

Cassava (*Manihot esculenta*). Cassava is grown on all soils, the main varieties being Beqa, Vuratolu and Merelesita, with a growing season of eight to ten months. Cassava is planted throughout the year. After several ploughings and harrowings the ground is prepared into 15–20 cm high ridges with a row space of 90 cm. The planting material is the stem of the plant which is cut into 30 cm sticks and these are poked into the ridges to a depth of 10 cm, in clusters of three to four around a space 30 cm in diameter. Because the plants often reach heights in excess of 3 m, the planting distance between clusters is about 1 m. Hoeing is done two to three times in the first three months and by this stage the crop forms a sufficiently dense canopy to block out sunlight. The crop is lifted out by forks and the tubers cut from the roots by cane knives. The tubers are large and individual tubers often weigh over one kilogram. For home use a few plants are harvested daily by women. Tubers destined for market are bagged for transport. Cassava has no serious diseases or pests in Fiji. The average annual yield is about 10 mt per hectare. Total annual production in Fiji is probably around 35,000 mt (Casley 1969).

Taro (*Colocasia esculenta*). Taro is grown on the clay and silty clay soils because the crop has high water requirements. Taro is a 10–12 month crop grown throughout the year. The main variety grown is Samoa. After ploughing and harrowing, deep holes are made at a distance of 90 cm with a thick wooden stick. The planting material is taro tops or suckers which are placed in the holes to half their lengths and covered by soil. Taro requires considerable hoeing, this being repeated four to five times during crop growth, especially during the rainy season from December to March when weeds predominate. The crop is harvested using forks and spades. For marketing the tops are left on the tubers, tied and sold in bundles of five to six. The average annual yield is about 9 mt per hectare. Total national production is thought to be around 17,000 mt per year.
Yams (*Dioscorea alata*). Yams are a 9-10 month crop and because they are organs of dormancy planting is only possible in August when the tubers sprout. The crop is harvested in May and June of the following year. Yams are grown on loams and clay loam soils and the main variety is Beqa. Deep holes are also needed for planting and these are made with spades. The planting material is yam tubers which are cut into 0.12-0.25 kg sizes and planted at a distance of 1 m and 15 cm deep. About 2 m long sticks of reed are used as plant supports and this increases the photosynthetic area of the canopy. Yams are lifted using forks. The average annual yield is about 8 mt per hectare and the total national production is about 5000 mt per year.

Sweet potatoes (*Ipomoea batatas*). Like cassava, sweet potatoes are planted and harvested throughout the year and this crop also has a wide range of soil tolerance, although the best soils are the sandy loams. Several varieties are grown, the main one being Vulatolu. The ground is prepared into ridges and furrows with a row spacing of about 75 cm. The planting material is the vine of the plant which is cut into lengths of 30 cm. Planting is done along the ridge tops with half of each cutting covered by soil. No other task is required until harvest as the plants quickly form a thick, impenetrable canopy over the whole ground surface. Four to five months after planting small amounts of the crop are harvested every few days for home use. The average annual yield of sweet potatoes is about 9 mt per hectare and the total annual production could be about 3000 mt per year.

A model of production

Research methods. Recently the allocative efficiency of the Fijian root crop producers in the Sigatoka Valley was measured using estimated elasticities of production and the marginal value products of the four production factors - land, labour, capital and current expenses (Chandra and DeBoer 1977). Two-year farm management data, covering the period November 1970 to October 1972, were utilized for the study. The data base consisted of 26 farms but in the second year this was reduced to 24 farms as data from two farms could not be collected because of a land tenure dispute between the tenants and the mataqali.

In the production function, the input-output data of each farm are treated as an observation as has been done in many other similar studies (Massell and Johnson 1968;
Yotopoulos 1968). The observations for the two years were pooled so as to derive an aggregate production function for the Fijian root crop farm.

The production equation. The use of land, labour, capital and current expenses on a farm can be related to the value of the crops produced on that farm. The function chosen to describe this input-output relationship is the Cobb-Douglas type of production function which, for this study, can be written in logs (to the base e) as:

$$\ln Y_j = \ln K_j + \alpha_1 \ln A_j + \alpha_2 \ln L_j + \alpha_3 \ln C_j + \alpha_4 \ln E_j + U_j$$

where $Y$ = gross output of farm $j$ (value of all crops based on farmgate prices); $K$ = a constant; $A$ = land (farm size, ha); $L$ = labour (manhours); $C$ = capital (capital service flow deflated by crop-time ratio, that is the actual time a crop occupied the ground); $E$ = current expenses (cash costs); $\alpha_1 \ldots \alpha_n$ = elasticity of production of each of the above factors; and $U_j$ = the random error term.

The Cobb-Douglas type of production function was chosen instead of other types of production functions partly because of the ease of computation this function involves and partly because the regression coefficients of real variables are also the elasticities of production. The elasticities of production are used to estimate the marginal value products of the production factors, which are the important parameters for the test of allocative efficiency on the farms. The Cobb-Douglas type of production function is linear in logs and therefore to fit the function to the data in the least-squares regression analysis requires log transformations of all real variables.

Marginal value products and optimum resource allocation. The elasticities of production were used to calculate the marginal value products of each factor of production. The marginal value product of an input factor is the value added to the gross output by the addition of one more unit of that factor. Marginal value products of variables are calculated at the geometric means and a detailed review of the procedure followed is presented in Massell and Johnson (1968).

The concept of optimum resource allocation is based on the ratio between marginal value product (MVP) and marginal cost (MC) of the factor of production. If ($\text{MVP}/\text{MC}$) is
greater than 1, then the use of that resource should be expanded because the cost to the farmer of one unit of that resource is less than what he gains from its use. If (MVP/MC) is less than 1, then the use of that resource should be decreased because the cost to the farmer of one unit of that resource is greater than what he gains from its use.

However, such an expansion and reduction in resource use can only be performed by a farmer to the ceiling at which that resource is available. For example, a farm family has fixed capital resources or available labour for farm use. Hence optimum resource allocation on farms can only be discussed in the context of fixed maximum resource levels. Any reallocation of resources can only be done within such constraints. In the Cobb-Douglas type of production function a limited capital assumption implies that the capital should be allocated among the production factors on the basis of the ratios of the respective elasticities of production and such a procedure was followed in this study. In the absence of a developed land market, the value of land was derived by subtraction after the other production factors, which are based on the level of resource use per hectare of land, had been valued. The market price of land is the average land rent paid. The marginal cost of one hour of labour has been taken as $0.1875, which was the standard hired labour wage rate during the study period. The marginal cost of capital and current expenses is $1.00.

**Results and discussion.** The root crop production equation is

\[
Y = 13.36 A^{1.40*} L^{0.336**} C^{0.285**} E^{0.123*}
\]

* Significant at the 10 per cent level. ** Significant at the 5 per cent level. \(R^2 = .7752.\)

Tables 2 and 3 respectively show the marginal value products and the optimum resource allocation on the farms. The production elasticities show that the production factors in their order of decreasing importance are labour, capital, land and current expense. The root crop production system relies heavily on labour input and to a lesser extent on capital inputs. The relative unimportance of land input in the productive system reflects the high biologic yields of the root crops - that is, large amounts of food can be produced per unit area of land. However, root crops demand large labour inputs per unit of output and hence the
importance of labour in the production function. Root crops are also labour demanding because of the agronomy of these crops, especially in the preparation of planting material and in the harvesting task which relies wholly on hand labour. The low importance of cash inputs in the production system reflects the abundance of root crop planting material usually present on the farms. These materials have no direct cash value, except the taro tops.

| Table 2 |
|-----------------|-----------|
| Estimated marginal value products ($) for Fijian root crop farms |
| Land (ha)        | 36.00     |
| Labour (manhour) | 0.286     |
| Capital ($)      | 4.61      |
| Current expenses ($) | 1.92   |

The estimated MVP of a hectare of land producing root crops is low compared to that of other crops and this reflects the relatively low revenue gained from the root crops. The estimated MVP of a manhour of labour is 58 percent higher than the MC of labour and implies that farmers could successfully utilize more labour in root crop production if they were prepared to sacrifice some of their leisure time. One of the reasons for the high MVP of labour could be that the high biologic yields of the root crops do not induce the Fijian farmers to put more labour into farmwork once the subsistence food requirements of the family have been satisfied. Because only some of the root crops are commercially marketed at present there is no great incentive for surplus production. Another reason for the high leisure preferences of the Fijians is in part related to the communal nature of their living patterns and a social obligation to perform non-farm village work.

The farmers could economically increase their capital and current expense inputs because the returns are substantially more than the unit cost, especially in the case of capital. Commercial production of root crops on a larger
### Table 3

**Optimum resource allocation on Fijian root crop farms**

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample mean level per ha ($)</td>
<td>Ratio of marginal value product to marginal cost</td>
<td>Optimum resource allocation with limited capital ($)</td>
<td>Optimum resource allocation with limited capital and land area fixed ($)</td>
<td>Optimum resource allocation with limited capital and labour fixed ($)</td>
<td></td>
</tr>
<tr>
<td>Land</td>
<td>172</td>
<td>7.18</td>
<td>44</td>
<td>172</td>
<td>56</td>
</tr>
<tr>
<td>Labour</td>
<td>59</td>
<td>1.53</td>
<td>106</td>
<td>48</td>
<td>59</td>
</tr>
<tr>
<td>Capital</td>
<td>19</td>
<td>4.61</td>
<td>90</td>
<td>41</td>
<td>115</td>
</tr>
<tr>
<td>Expenses</td>
<td>29</td>
<td>1.92</td>
<td>39</td>
<td>18</td>
<td>49</td>
</tr>
<tr>
<td>Total</td>
<td>279</td>
<td>279</td>
<td>279</td>
<td>279</td>
<td>279</td>
</tr>
</tbody>
</table>
scale, which will be feasible in the near future given the present growth of demand for traditional food crops in the urban areas, should induce farmers to invest more in capital items and equipment.

On the basis of equating the marginal value product and the marginal cost of the resources (column 2 in Table 3), the policy recommendation to attain efficient resource allocation to the root crop producers would be to increase the level of use of all the four resources. Under the conditions of limited capital, which is a situation most likely to be met in the farming community, the policy recommendation would be to increase substantially the labour, capital and expense inputs and decrease land input. However, if the land area cannot be altered in the short term then the recommendation to the farmer would be to increase capital inputs and decrease labour and expense inputs. In the final case, where the availability of farm labour is fixed, the recommendation would be to increase capital and expense inputs and decrease land input.

This study showed that the Fijian root crop producers can make some gains in farm gross output by reallocating existing resources at optimum levels. At present the production elasticities in their order of importance are labour, capital, land and current expenses.

Greater production of root crops for sale to urban markets in the future will require reallocations in resource use at the farm level. The achievement of allocative efficiency in the root crop production system would be the fundamental goal of the farmers and agricultural administrators once more and more crops are marketed for cash sale. This is because the root crops offer the best possibility to meet the demands for low-priced food crops from the urban poor.

The marketing structure

It is unclear exactly what proportion of the national production of root crops is marketed for cash. Actual farm data from the Sigatoka Valley indicates that about 30 per cent of cassava, 75 per cent of taro, 20 per cent of yams and 10 per cent of sweet potatoes are sold in the urban centres of Suva, Lautoka, Nadi and Sigatoka. These figures show that root crops are the most important subsistence component of the Fijian farmer's diet and that commercial
marketing of root crops is still in its infancy. Because of their bulkiness root crops incur high freight costs when transported and for this reason transportation cost is an important production constraint. An added disadvantage is the relatively short storage capability of cassava, taro and sweet potatoes although yams can be stored for long periods if left uncut.

The most important day for root crop sales in the urban markets is Saturday while a less important day is Wednesday. Crops destined for the urban markets are harvested the day before and transported that afternoon or in the night so that the products are on sale early next day. Trucking is the major form of transport although inter-island boats also carry taro and yams from Beqa, Kadavu and Taveuni for the Suva market.

Urban markets. Table 4 shows the urban markets and the populations of the various centres. These populations are for the greater urban areas, comprising the central built-up area and the thinly populated hinterlands. The majority of the Fijians living in the urban areas, who have a strong dietary preference for the root crops, would generally purchase their root crop requirements although it is not uncommon to see urban homes with small plots of cassava and taro.

### Table 4

<table>
<thead>
<tr>
<th>City/Town</th>
<th>Population as at Sept. 1976*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suva</td>
<td>117,827</td>
</tr>
<tr>
<td>Lautoka</td>
<td>28,847</td>
</tr>
<tr>
<td>Nadi</td>
<td>12,995</td>
</tr>
<tr>
<td>Labasa</td>
<td>12,956</td>
</tr>
<tr>
<td>Nausori</td>
<td>12,821</td>
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<tr>
<td>Ba</td>
<td>9,173</td>
</tr>
<tr>
<td>Vatukoula</td>
<td>6,425</td>
</tr>
<tr>
<td>Rakiraki</td>
<td>3,755</td>
</tr>
<tr>
<td>Sigatoka</td>
<td>3,635</td>
</tr>
<tr>
<td>Levuka</td>
<td>2,764</td>
</tr>
<tr>
<td>Navua</td>
<td>2,568</td>
</tr>
<tr>
<td>Savusavu</td>
<td>2,295</td>
</tr>
<tr>
<td>Tavua</td>
<td>2,144</td>
</tr>
<tr>
<td>Korovou</td>
<td>290</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>218,495</strong></td>
</tr>
</tbody>
</table>

* Census by the Bureau of Statistics
The marketing of root crops in Fiji is done via three main systems. These are: (a) farmers, (b) middlemen, and (c) the National Marketing Authority. Each is discussed in turn.

**Farmers.** Farmers living close to the urban areas often sell their produce in the market themselves. The main crop sold this way is taro, although baskets of cassava, yams and sweet potatoes are sometimes sold by this method. There is no pricing by weight but rather a set price of $1-$3 is charged for a bundle of goods, depending on the quality, quantity and variety. The farmers of Waibau, Lomaivuna and the lower Wainibuka Valley, which are all within 50 km of Suva, sell a considerable amount of taro this way in the Suva Market. Some farmers sell close to two metric tons of taro per week during the main production season.

A major problem with this form of marketing is that the farmers can only sell small amounts of goods at a time and the high per unit transportation cost means that the profit margins are severely reduced. Also there is considerable uncertainty about the price expectation as this is determined largely by the supply situation in the market on a particular day. A third problem is that all goods have to be sold by the evening of the market day, sometimes at below cost, because it would be uneconomic in terms of time spent and family obligations for the farmer to remain in the urban centres until all goods were sold. A fourth disadvantage is that stall fees in the market, in relation to amount of crops sold, can be relatively high. For example, the stall fees for a ton of taro, valued at $110 and sold in a day, are about $10. A final problem is the logistics of hiring trucks and the assembly of farm goods into truck loads since individual farm production for sale on a particular day is usually less than a truckload.

**Middlemen.** Middlemen are people who purchase goods from one group and sell them to another at a profit. In Fiji there are two types of middlemen: (a) those who operate in the urban markets and (b) those who operate in the rural areas. The first type can be further subdivided into (i) market vendors and (ii) truck owners. The market vendors buy goods from farmers who are able to transport them from their farms and sell them to other vendors in the markets. The truck owners usually own small vehicles and travel into the rural areas buying root and other crops along the way. These goods are then brought back to the market and sold to
the vendors. The second type of middlemen consists of the farmers. The farmer middlemen are usually wealthier than other farmers and own or are able to hire a truck for their own goods as well as goods of other farmers which they purchase and sell in the urban markets, possibly to vendor middlemen.

Trading by middlemen is an important form of root crop marketing throughout Fiji. The attraction of this system is that the farmers are paid in cash at the farmgate and therefore the problem of farmer transport does not arise. The important root crops marketed this way are cassava and sweet potatoes. A major reason for the sale of crop to middlemen is the very high per unit freight costs incurred by the farmer for transporting small amounts of goods. For this reason distance to markets is an important determinant of the form of marketing as well as influencing the crop choice on the farms. Table 5 shows the percentage value of crops disposed of via various outlets in Fijian villages in the lower and upper Sigatoka Valley. The amount of middlemen participation in marketing increases as the distance to market increases, whereas marketing by farmers decreases substantially.

<table>
<thead>
<tr>
<th>Table 5</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Naduri Village 14 km from Sigatoka Town</th>
<th>Keiyasi Village 56 km from Sigatoka Town</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmers</td>
<td>60</td>
<td>31</td>
</tr>
<tr>
<td>Middlemen</td>
<td>30</td>
<td>38</td>
</tr>
<tr>
<td>National Marketing Authority</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Valley Industrial Co-operative Association</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Tropic Fruits Ltd</td>
<td>-</td>
<td>12</td>
</tr>
<tr>
<td>Buntings (Fiji) Ltd</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
National Marketing Authority. The National Marketing Authority (NMA), which is a statutory body affiliated to the Department of Agriculture, was established in 1971 to help facilitate the marketing of agricultural produce in Fiji. The main objectives of the NMA are: (a) to ensure a guaranteed market for specified agricultural commodities at a predetermined price for the different production zones, (b) to regulate a steady flow of goods to the markets so that the consumer gets a fair return, (c) to help farmers obtain maximum profits by purchasing crops at the farmgate, thereby nullifying the transportation constraint on production as well as ensuring that the middlemen do not take unfair advantage of the producers, (d) to facilitate and develop internal and external markets for Fiji's produce, (e) to assist in planned crop planting programs and to co-ordinate closely with the Extension Services of the Department of Agriculture so that production and marketing are synchronized, (f) to enable quality and grading standards to be established, and (g) to work with other organizations and Ministries involved in rural development so that the overall development plan objectives of the government are realized.

The NMA has three buying centres in Fiji - Suva, Lautoka and Labasa. Altogether NMA deals in over 85 products including marine resources and in 1976 purchased goods worth $494,957. Table 6 shows that the major root crops marketed throughout the year are taro and cassava, with taro accounting for 91.4 per cent of the total root crops purchased in 1976. Yams are purchased during the harvest season between April and August whereas sweet potatoes are marketed in small volumes throughout most of the year.

The NMA buys taro for sale to the urban centres from various places in Fiji, including the islands of Kadavu, Koro, Moala, Rotuma, Taveuni and Vanua Levu. Contracts are maintained with farmers for the supply of a fixed tonnage every month. For example, the Taveuni farmers have a contract for 20 mt of taro per month with the NMA.

The NMA purchase price paid to the farmers and the sale price to the consumers varies according to the supply of the root crops in the urban markets. Table 7 shows the farmgate price variability of taro, cassava, yams and sweet potatoes in 1976. The NMA purchase price is usually about 50 per cent of the retail market price. The NMA sale price in the market is an approximation of the retail price and therefore the other 50 per cent of the revenue contributes
towards running, maintenance and overhead costs of the NMA. If goods are delivered to the buying centres in Suva, Lautoka and Labasa the NMA purchase price is 2.2 cents per kilogram greater than the farmgate price.

Table 6

<table>
<thead>
<tr>
<th>Month</th>
<th>Taro</th>
<th>Cassava</th>
<th>Yams</th>
<th>Sweet potatoes</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>15,246</td>
<td>970</td>
<td>-</td>
<td>248</td>
</tr>
<tr>
<td>February</td>
<td>15,902</td>
<td>937</td>
<td>-</td>
<td>309</td>
</tr>
<tr>
<td>March</td>
<td>24,307</td>
<td>924</td>
<td>69</td>
<td>195</td>
</tr>
<tr>
<td>April</td>
<td>22,748</td>
<td>1,281</td>
<td>365</td>
<td>57</td>
</tr>
<tr>
<td>May</td>
<td>17,092</td>
<td>1,197</td>
<td>1,115</td>
<td>205</td>
</tr>
<tr>
<td>June</td>
<td>17,767</td>
<td>1,275</td>
<td>1,199</td>
<td>125</td>
</tr>
<tr>
<td>July</td>
<td>9,535</td>
<td>1,337</td>
<td>1,862</td>
<td>-</td>
</tr>
<tr>
<td>August</td>
<td>18,943</td>
<td>1,006</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>September</td>
<td>11,932</td>
<td>1,021</td>
<td>-</td>
<td>250</td>
</tr>
<tr>
<td>October</td>
<td>18,352</td>
<td>1,294</td>
<td>49</td>
<td>6</td>
</tr>
<tr>
<td>November</td>
<td>21,240</td>
<td>1,316</td>
<td>282</td>
<td>513</td>
</tr>
<tr>
<td>December</td>
<td>28,021</td>
<td>862</td>
<td>-</td>
<td>357</td>
</tr>
<tr>
<td>Total</td>
<td>221,085</td>
<td>13,420</td>
<td>5,041</td>
<td>2,265</td>
</tr>
</tbody>
</table>

Table 7

The farmgate price variability of root crops purchased by the National Marketing Authority in 1976 (cents per kg)

<table>
<thead>
<tr>
<th>Crop</th>
<th>Taro</th>
<th>Cassava</th>
<th>Yams</th>
<th>Sweet potatoes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>11.0-14.3</td>
<td>4.4-8.8</td>
<td>15.4-24.2</td>
<td>11.0-15.4</td>
</tr>
</tbody>
</table>
Marketing organizations such as the NMA have a considerable number of problems which can be listed as those deriving from: (a) price fixing, (b) organizational infrastructure, (c) economies of scale, (d) incompatibility between the objectives to help both the producers and consumers, and (e) inconsistency in the objectives and the allocation of resources to promote the development of particular commodities, regions and the nation by the various government departments.

The price fixing mechanism is difficult to determine at the best of times because many uncontrollable factors affect the value of a commodity in the market. Some of these factors that affect the supply of crops are the prevailing weather conditions, road transport situation and the inter-island vessel scheduling, social and cultural activities in the villages and the availability of substitute foods due to seasonality of other crops and imported products such as Irish potatoes.

The problems of organizational infrastructure are accentuated by the need to serve the community in an island archipelago. Whereas markets are sufficiently accessible by roads within Viti Levu and Vanua Levu, the inter-island shipping is a major problem that prohibits marketing of agricultural produce. The NMA relies on commercial firms for all its shipping and most of its road transport requirements. Because all ships that are used for the inter-island transport of root crops are also engaged in copra collection, the scheduling of vessels often does not meet the needs of the NMA or the producers.

The economies of scale is one factor that affects many government and commercial enterprises in Fiji because of the relatively small consumer population. What this usually means in terms of the classical theory of production is that the system operates far to the left in the irrational production zone and therefore the per unit costs are very high. The NMA suffers from this problem because the sales generated are small and insignificant in terms of total internal trade in Fiji.

The objectives of helping the farmers with the marketing of their crops and at the same time maintaining a low enough price for the consumers is a commendable one. The NMA has achieved major success in this area by reducing the farmgate price variability offered by the middlemen as well as reducing the sale price variability in the markets. At the same time
the NMA has been able to maintain quality and grading standards to a level not previously possible.

Finally the inconsistency in the objectives and the allocation of resources to promote the development of particular commodities and regions will always be a problem for marketing organizations such as the NMA. There is a need for greater participation by government departments for more cohesive and planned development programs that take into account all aspects of the problems of agricultural development in Fiji.

Information for farmers. Radio is the important medium of communication for the farmers. The Department of Agriculture has a weekly program for the farmers in three languages - English, Fijian and Hindustani. Information on current and expected market price of crops is provided. Other information such as the activities of the Ministry of Agriculture, Fisheries and Forests is also broadcast and any new research recommendation for the farmers is included. The daily newspaper, Fiji Times, carries a two-page rural news feature every Friday and this is aimed at all sections of the community interested in agricultural development work. Specific information, such as recommendations on crop agronomy, are prepared in the form of farmers' leaflets, written in three languages and available from all district offices of the Department of Agriculture.

The consumption pattern

Dietary preferences. Fijians have a strong dietary preference for the traditional root crops. Table 8 shows the average daily requirements of kilojoules (kJ) and protein in the diet of an adult rural Fijian.

In the rural areas root crops form the basis of a high degree of subsistence affluence as defined by Fisk (1962; 1964), Fisk and Shand (1969) and Stent and Webb (1975) and which has been tested empirically in the Sigatoka Valley recently by Chandra (1976). The basis of the subsistence affluence hypothesis is that farmers get pleasure out of the minimum amount of work required to produce the subsistence food needs of the farm family. Therefore it follows that those farmers who can satisfy their daily kJ needs through the least amount of effort in terms of labour and land use would get the greatest satisfaction. The average daily kJ requirement for the adequate subsistence of an adult Fijian
Table 8
Root crop component of Fijian diet
Average daily requirement of kJ and protein by an adult rural Fijian

<table>
<thead>
<tr>
<th>Staple food</th>
<th>Total kJ supplied per adult kJ</th>
<th>kJ produced on farm per adult per day kJ</th>
<th>kJ purchased off farm per adult per day kJ</th>
<th>Protein supplied per adult per day g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cassava</td>
<td>3613</td>
<td>3613</td>
<td>-</td>
<td>5.6</td>
</tr>
<tr>
<td>Sweet potatoes</td>
<td>1553</td>
<td>1553</td>
<td>-</td>
<td>4.5</td>
</tr>
<tr>
<td>Taro (corn + leaves)</td>
<td>448</td>
<td>21</td>
<td>427</td>
<td>2.4</td>
</tr>
<tr>
<td>Yams</td>
<td>343</td>
<td>260</td>
<td>83</td>
<td>1.1</td>
</tr>
<tr>
<td>Total</td>
<td>5957</td>
<td>5447</td>
<td>510</td>
<td>13.6</td>
</tr>
<tr>
<td>% daily total</td>
<td>50.7</td>
<td>46.3</td>
<td>4.3</td>
<td>22.7</td>
</tr>
</tbody>
</table>

Source: Farm Survey data 1970-72.
is 11,750 kJ of which root crops contribute over 50 per cent of the total (Chandra and DeBoer 1975; Langley 1953; Wilkins 1963).

The main reason why the root crops enable farmers to enjoy a high degree of subsistence affluence is because of the energetics of crop production (Chandra et al. 1974, 1976). Root crops have high biologic yields and therefore much food can be grown with little effort. The two measures constructed to show this aspect are efficiency ratio (E) and energy purchasing power (EPP). Efficiency ratio is the edible yield of crops expressed in kJ and divided by kJ of energy expended by man, draught animals and fossil fuels to attain that yield (Black 1971). The definition does not include the photosynthetic energy utilized by crop plants. The higher the E of a crop the more efficient that crop is in the energetic efficiency with which it uses resources to produce food under a cropping system of a given technology. The energy purchasing power of a crop is the kJ of food energy that can be purchased for one cent value of that crop. The EPP values indicate how cheaply the energy requirements of a family can be met from various crops. Table 9 shows the E and EPP of crops of Fijian farms in the Sigatoka Valley and these reflect the importance of root crops as an efficient source of food, both in kJ and monetary terms.

The urban dilemma. The problem for the urban Fijian is that, because dietary habits are difficult to change, they rely heavily on root crops for their daily subsistence as they do in the rural areas. This means that the urban Fijian is subject to a host of problems such as transportation and marketing charges which makes the final cost of purchasing kJ and protein from root crops considerably higher than that of substitute foods. Such substitute foods which have high nutritive values are rice and pulses and these are readily available because they form the staple diet of both the urban and rural Indians. The high price paid for kJ and protein derived from root crops by the urban Fijians means that the problem of malnutrition in low-income families is becoming acute since balanced diets are difficult to attain because of the cost factors involved. This problem of malnutrition and other related social consequences is potentially a major one for the government as urban populations increase through natural growth and urban drift. This also poses problems for the producers because the increasing urban demand affects the production of other high-value crops,
<table>
<thead>
<tr>
<th>Crops</th>
<th>Efficiency ratio (E)</th>
<th>Energy purchasing power (EPP)</th>
<th>Crops</th>
<th>Efficiency ratio (E)</th>
<th>Energy purchasing power (EPP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cassava</td>
<td>52</td>
<td>850</td>
<td>English cabbage</td>
<td>9</td>
<td>113</td>
</tr>
<tr>
<td>Sweet potatoes</td>
<td>60</td>
<td>785</td>
<td>Chinese cabbage</td>
<td>3</td>
<td>66</td>
</tr>
<tr>
<td>Taro</td>
<td>21</td>
<td>340</td>
<td>Tomatoes</td>
<td>5</td>
<td>84</td>
</tr>
<tr>
<td>Irish potatoes</td>
<td>19</td>
<td>203</td>
<td>Chillies</td>
<td>4</td>
<td>40</td>
</tr>
<tr>
<td>Yams</td>
<td>66</td>
<td>305</td>
<td>Watermelon</td>
<td>14</td>
<td>115</td>
</tr>
<tr>
<td>Bananas</td>
<td>24</td>
<td>377</td>
<td>Rockmelon</td>
<td>5</td>
<td>95</td>
</tr>
<tr>
<td>Rice</td>
<td>17</td>
<td>576</td>
<td>Cucumber</td>
<td>4</td>
<td>60</td>
</tr>
<tr>
<td>Maize</td>
<td>39</td>
<td>2710</td>
<td>Peanuts</td>
<td>15</td>
<td>590</td>
</tr>
<tr>
<td>Green beans</td>
<td>5</td>
<td>65</td>
<td>Passion-fruit</td>
<td>17</td>
<td>183</td>
</tr>
<tr>
<td>Egg plant</td>
<td>14</td>
<td>121</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
since the root crops generate low gross margins per hectare, manhour or per dollar capital investment when grown for commercial sale. Indications are that large-scale commercial production of the root crops in the hinterlands of the urban areas, with one organization controlling the production, transportation and marketing, would be a feasible proposition and worth further investigation.
Chapter 19

Grower response to commercial crop production: a theoretical approach with practical policy implications*

Alan Bollard

An approach to agricultural change

The problem of the adaptation of subsistence agriculture to regular cash cropping for the urban market belongs to the more general problem of structural change in crop production. Analysing the decision to produce a new crop in a new monetized market is a problem far beyond the usual scope of the economics of change. As Margaret Mead (1955) has written, commercializing the American Indians' corn and potato growing communities involved a traumatic change from basing a life completely around a value crop to merely earning a living from a utilitarian crop.

How can we analyse the effect of such change on individual grower decision-making? This paper develops a theoretical series of neo-classical partial analyses of the effects of a number of structural characteristics of economic change; it then shows how, although full of unrealistic assumptions and modelling limitations, these results may be used to interpret some important and real reasons for actual producer behaviour in a particular case. This has important implications for the design and administration of a new crop or indeed of any new economic practice in a particular community.

The particular problem examined here is what a grower's reaction is likely to be when a new (marketed) crop is made available to him to plant if he wishes. This is important because of the increasing attempts of governments and aid agencies to introduce 'improved' crops, often without regard for the appropriateness of design for the community. This is illustrated from the mixed experience of Atiu, a small island in the Cook Group.

*Views expressed in this paper are personal ones, and not necessarily those of the South Pacific Commission.
It is convenient to consider a crop technology as being contained in a standard production function relating crop revenue to managed inputs and market price, but taking account also of the timing and risk of crop response, the growers' knowledge of the process, and other structural characteristics. The effect of technical change due to exogenous shifts in each of these production traits is examined in turn.

Producer preferences are presented in the form of a standard neo-classical utility function which expresses the producer's considered trade-offs between work and income. This too contains elements of time, uncertainty, ignorance, and dependence on others. A controversy continues over the validity of such functions as representing personal economic objectives. The writer agrees with Lipton (1968:328): 'That a peasant maximizes utility, i.e. does what he wants to do under the given constraints - is a tedious tautology'.

Atiu is a small (2690 ha) raised coral atoll in the Southern Cook Group, lying 190 km northeast of Rarotonga, the seat of government. The Cook Islands have been administered by New Zealand from the turn of the century, but became internally self-governing in 1965. The church has had a strong influence. The agricultural economy has remained completely in Atiuian hands.

In 1977 the population was about 1400, belonging to three tribes. The people work the village lands in accordance with the Maori Land Court's recent interpretations of traditional land tenure. It appears that the ariki and chiefs of lesser rank hold declining power and influence. The Island Council, church groups, village committees, and bush beer clubs are all important units of social organization.

Until the mid-twentieth century Atiuans spent much of their time on subsistence work: catching fish and crabs, gathering roots and fruits, and growing mainly root crops, taro being the only one to receive intensive cultivation. They earned small amounts of cash for casual needs, mainly by picking the fruit of the hardy uncultivated native orange trees.

In the 1940s these trees became diseased and began to die out. The New Zealand government tried to provide an alternative source of money on Atiu by introducing new varieties of orange trees in 1950. These required a more regular commitment to the market economy. Oranges were
initially shipped fresh to New Zealand, then later juiced at the Raro factory on Ratotonga. In 1965 the Cook Island government took over administration of the project.

For a variety of economic and biological reasons this scheme was not a complete success. Because of this, the Atiu Administration introduced a whole series of new short- and long-term cash crops over 20 years. These included forestry trees, tomatoes, peanuts, coffee, pineapples and other vegetables. Most of these schemes were not properly designed either. But good crop records exist, and can be used to investigate grower reaction to new opportunities.

Some structural characteristics of change

(a) Profitability. The first characteristic that all farmers are usually assumed to look for in a crop is its money profitability. The justification for introducing a new crop is usually its alleged improved profitability. However, one should be wary of this sort of claim, because there can be a large number of structural crop characteristics that may determine whether a grower thinks it 'improved' or not. For example, a very simple static production function will be considered, in which increments of labour produce exponentially decreasing increments of output. Then there will be several profitability parameters: the minimum labour levels necessary to establish the crop, the capacity yield of the crop, and the labour productivity.

What is the attitude of growers likely to be to increased profitability? How much harder they wish to work to earn more money will depend on the slope of their labour-supply curve. On Atiu it appears that extra money can induce extra labour effort up to some target income, after which the farmer becomes increasingly insensitive to further inducements. Put another way, his marginal utility of income is positive though decreasing with extra income, but his marginal disutility of work is positive and increasing with more work.

How does the grower decide how hard to work on this crop? If he is considered as maximizing his utility subject to this simple production function, then one can obtain an equilibrium condition where his optimal participation lies: this is the familiar condition where a grower is assumed to

1I am dealing here with growers whose unpaid family labour is the main input cost.
keep on working until the increasing marginal cost of his labour equals the decreasing marginal revenue product.

From this result sensitivity analysis can be used to predict the grower reaction to small changes in the profitability parameters. It also makes it possible to analyse more closely the impact of various loosely-labelled 'improved' crop varieties frequently offered in aid projects. For example, evidence from the Green Revolution (Mellor 1969) suggests that project crops frequently offered much higher capacity yields (at least under controlled conditions) in return for a much higher initial labour requirement; labour productivity might or might not be higher. This was certainly the case on Atiu: the new citrus tree had a higher capacity yield than the old native orange but it required a lot more work weeding and pruning just to keep it alive. As an Atiuan grower put it:

The [old] Maori orange you just pick. No weeding, manure, spray and taking away the dry branches. You just pick the orange and get the money. But the [new] plot orange you pick and get more money. But hard work. You spray, manure, weed ... Weeding! Weeding! Weeding! Hard work!
(quoted in Menzies 1970:102).

The equilibrium conditions of the model indicate that Atiuan growers should respond insensitively but positively to increased crop profitability. Selective observation such as this experience with old and new oranges would seem to support this. Is it possible to test this hypothesis in a statistically more systematic way?

To do this requires a number of statistical and methodological assumptions. The equilibrium decision-making conditions must be recast to say that the degree of participation of an average grower in a particular crop in a particular year depends on the profitability of that crop at that time (as well as on another of the structural crop characteristics to be developed in the next section). This relation is assumed to be roughly linear, to facilitate estimation.

Estimates of these profitability parameters are also required for each crop. Figures for establishment labour requirements ($l_0$) come mainly from Agriculture Department estimates, modified to more realistic figures where necessary.
### Table 1

Linear regression of grower participation on crop parameters

\( y_1 = \beta_0 + \beta_1 P + \beta_2 10 + \beta_3 a + \beta_4 \sigma^2 + \beta_5 c + \beta_6 G \)

<table>
<thead>
<tr>
<th>Group</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>y55-59</td>
<td>-23,516.7</td>
<td>7.83</td>
<td>27.4***</td>
<td>6.48</td>
<td>-1,716.9***</td>
<td>6.07</td>
<td>-1,276.5***</td>
<td>6.02</td>
<td>115,795.8***</td>
<td>2.86</td>
<td>16,758.5***</td>
<td>6.50</td>
<td>18,906.1***</td>
</tr>
<tr>
<td>y60-64</td>
<td>-386.5</td>
<td>2.16</td>
<td>4.3**</td>
<td>0.96</td>
<td>219.9</td>
<td>0.37</td>
<td>-20.7</td>
<td>0.11</td>
<td>769.6</td>
<td>0.16</td>
<td>8,973.5</td>
<td>0.07</td>
<td>-524.1</td>
</tr>
<tr>
<td>y65-69</td>
<td>3,559.0</td>
<td>1.90</td>
<td>9.2**</td>
<td>0.26</td>
<td>-115.2</td>
<td>1.31</td>
<td>78.8</td>
<td>2.41</td>
<td>-14,928.7**</td>
<td>1.25</td>
<td>57,104.5</td>
<td>0.25</td>
<td>1,851.7</td>
</tr>
<tr>
<td>y70-71</td>
<td>-157.4</td>
<td>1.23</td>
<td>1.4</td>
<td>1.14</td>
<td>18.9</td>
<td>4.69</td>
<td>17.8***</td>
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<td>235.6**</td>
<td>1.68</td>
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</table>

**Note:** *, **, *** implies significantly greater than zero at 90, 95, 99 per cent confidence levels.
The other two parameters are contained in the marginal revenue of labour for the first unit of production (P), which come from my (necessarily crude) estimates for average years. These are used as explanatory parameters.

The dependent variable that best reflects participation is labour time spent on a crop. This is available from a grower survey for one year only (1974) and is unavoidably rough. For this reason average crop revenue (available from historical records) is also used as a proxy for grower participation. Each region uses data grouped from one of several years from 1955 to 1974, long enough to provide sufficient observations but not so long as to allow inter-temporal distortions.

It is now possible to attempt an estimation of grower participation by an ordinary least squares regression. Rather than present the many results of this and a number of subsequent partial regressions, Table 1 presents the multiple regression of participation on profitability and on a number of other project characteristics yet to be developed.

As was anticipated, the coefficients of the productivity parameter are positive and significantly different from zero for all but the latest year, confirming that Atian growers are interested in profitable crops at least while they still have low incomes. Inexplicably, the coefficient of labour requirements is not always positive or significant, against all observations, suggesting that I have not managed to capture an essential behavioural determinant here.

(b) Timing. Another important aspect of all projects, and especially of tree crops, is the timing of the production process. A crop that grows to fruition very quickly will be regarded differently from one that takes a long time to reach maturity. Note that there is no fixed gestation period for a tree crop for it may begin to bear uneconomic quantities of fruit quite soon and then increase these for perhaps a decade before reaching full maturity (for example orange trees).

If the growth pattern can be described by an algebraic function, then it may be possible to use a parameter to characterize the crop timing. Biological evidence shows tree growth is approximately logistic (s-shaped), and as this function is easily estimable the logistic constant can be used to describe crop growth rates.
The importance of this crop characteristic in a particular community depends on the growers' relative rates of time preference: that is, how they regard work and consumption in the present as opposed to the future. On Atiu, as on many Pacific Islands, people display very long-term views of some traditional types of economic activity such as subsistence crop crop management on customary lands, with all its conservationist customs such as the rau'ī. 2

On the other hand, in cash cropping, growers have been relatively short-sighted in preferring fast-maturing crops. One reason for this behaviour, which is characteristic of much of the Third World, is the absence of adequate new capital markets to handle such investment. A classic example on Atiu came at the end of 1964: having grown peanuts that year, apparently no one on the island saved any seeds for the next season.

To investigate the implications of crop timing on grower decision making, it is necessary to use a fixed culturally-determined inter-temporal discount rate and to represent the grower's preferences by a set of additive utility functions. It is assumed that the production process responds to past inputs as well as to present ones as in the static case, and that at the same time natural growth is taking place. This is treated as a dynamic constrained optimization model, and deduces, as a steady static equilibrium solution, that in each period a grower should keep on working until the marginal cost of extra labour in terms of utility equals the marginal revenue product of labour discounted positively by the grower's rate of time preference and the crop rate of growth. Sensitivity analysis on this result makes it possible to predict the effect of varying the crop growth rate; it is hypothesized that Atiuan growers will be very sensitive to this.

Evidence from Atiu suggests that indeed growers tired of waiting the five to ten years necessary for their orange crops to mature. One of the things that most attracted them about the option of working for wages on the Pineapple Incorporation rather than planting their own private pineapples was that they received their first wage payments after only a week, instead of waiting 18 months for the first pineapple crop.

2Rau'ī is a prohibition order placed on a crop for a specified purpose or period.
More systematic testing of this result requires estimation of the logistic growth rate \((a)\) for each of the project crops, generally using experimental or predicted data. The results of a linear regression including this new explanatory variable are shown in Table 1. Except for early periods, the coefficient is positive as anticipated and is significantly different from zero. This seems to have identified an important determinant of grower behaviour.

(c) Risk. The next important part of the production process to affect grower participation is risk. The analysis is limited here to the case of full information objective risk where the grower knows perfectly the probability distribution of outcomes. (The next section extends to the general case.) It is mainly concerned with (biological and market) risk in yields and prices. This is particularly important, for new crops of the type introduced into less developed countries as aid projects generally give their higher yields at the cost of much greater yield variance: because they are bred under laboratory conditions, they are genetically very sensitive to an uncontrolled environment and have no natural immunity to the pests and diseases found there. This is particularly marked when the plants are bred in a temperate country and then subsequently exposed to the extremes of a tropical island climate.

This in-bred riskiness was very pronounced with the orange scheme on Atiu. Native orange trees bearing there in the 1930s and 1940s had an effective yield variance of only 0.09. Experiments on improved orange varieties growing under controlled conditions in Australia at that time had a variance of 0.21 (West and Howard 1938). Similar improved varieties actually growing on Atiu from 1955 to 1974 had a yield variance of 0.35 which could be traced to two hurricanes, a bad drought, biennial bearing, outbreaks of scab disease, white moth infestations, and occasional shipping shortages.

It is generally accepted that farmers in less developed countries dislike risk, because they have low incomes and cannot afford the consequences of bad luck. This may still be consistent with enjoying small gambles. Indeed Atiuan growers are avid small-time betters on horse races; but they avoid risk-taking where the costs of failure are high. For example, general realization that a slight shipping delay could spoil a whole tomato harvest led to the virtual end of the tomato growing project.
How does a producer take account of the existence of risk in a production process? A representation of his decision process may be made by adapting the standard theoretical model of risky choice; a producer is assumed to be involved in a static production process (multi-period production is not markedly different) where risk affects the process independently of the level of inputs and fills several other conditions. Then it is possible to show that to maximize his expected utility, a grower will work at the crop until the marginal real cost of his labour equals the expected marginal revenue product discounted by a (Pratt-Arrow type) premium for risk.

This result suggests in particular that as the riskiness of a crop increases, so the (risk-averse) grower will work less and produce less. This seems to have been the case on Atiu. To test this hypothesis statistically requires a measure of the objective risk of a project. For this the variance of grower returns from each crop over its lifetime is used. In an attempt to compensate for planned variations in inputs the variance is normalized about what appears to be an average labour trend. This is a dubious method at best.

The inclusion of crop risk ($\sigma^2$) into the multiple regression explaining grower participation generally improves the fit. From Table 1 it can be seen that in most cases the coefficient of the risk parameter is highly negative as anticipated, though not generally statistically significant. On this statistical evidence the hypothesis that Atiuan growers dislike risky projects cannot be rejected.

(d) Knowledge. A related structural element in a production function is the state of the user's knowledge about the production process. As has been shown by many studies, the information content of a process determines how efficiently it will be operated. This is clearly important in the introduction of new unknown crops. In the context of less developed agriculture in a closed community, knowledge may be treated as a public good: it is non-tradeable and observed by all.

The broad approach of Arrow (1969) is used: a grower's knowledge of a crop enables him to make some estimate of the likely outcome of a particular planting policy with some degree of confidence. Learning from repeated trials or observations allows him to revise his earlier estimates if
new evidence suggests they are wrong, and also to increase his confidence about them. To relate it to the preceding section, learning progressively changes decisions under subjective uncertainty into decisions under objective risk.

The difficulty in this sort of learning is that most agricultural processes involve highly variable returns due to changing inputs and uncontrollable factors such as the weather; therefore learning may require a long time, many trials, and some skill in isolating the effect of a new technique from that of an exogenous disturbance.

Atiuans, like all subsistence cultivators before European contact, built up an extensive knowledge of horticultural practices for their limited range of crops. This was based on the more easily observed input-output correlations, and was preserved in traditional folklore in such forms as a tidal-lunar planting calendar. Where outcomes could not be easily accounted for, magical belief was strongest.

Introduction of new crops backed by western scientific techniques inevitably challenges much indigenous knowledge. Then farmers must undergo an often painful adjustment process deciding what to accept or reject. Sometimes this is made more difficult for them by change agents failing to relate new processes like artificial fertilizing to age-old traditional ones like mulching. In this situation, peasants are said to resist experimenting with new crops, and to be reluctant to grow crops about which they feel they do not know enough.

Certainly Atuan growers refused to experiment in established areas such as subsistence root crops where they felt their knowledge was sufficient, even in the time of a crippling taro disease. Yet they seemed keen enough to experiment, at least superficially, with new cash cropping techniques.

The model used here confines itself to the case of learning about a single unobservable parameter (for example the variance of a crop). A grower starts with a preconception of the value of that parameter, and then experiments by growing the crop himself or observing other people doing so. Then it can be demonstrated algebraically that at the end of each harvest year he modifies his idea of the parameter by some approximation of the proportion by which his previous year's yield expectation had turned out to be in error:
this is the familiar adaptive expectation rule. Depending on his initial information, prediction will be poor at first and will then get progressively better in a pattern that oscillates about a roughly exponential learning path.

This rule is used, applying a rough approximation to the coefficient of adjustment, and some estimates of the grower's preconceptions of each parameter (usually obtained from records of what the administration advertised about each crop). Then we can calculate the 'expected' or 'learned' value of all the above production parameters at any time. These values change year by year and eventually approximate their true values.

These learned values are calculated and substituted for the true ones in the regression equation. Surprisingly goodness of fit and statistical significance turn out to be worse than in the full information case. One is forced to conclude that the learning process has not been captured empirically here, or else that growers themselves do not consider information content very important with new crops.

Yet it does seem that the role of information and knowledge is significant. And parametric learning, while a simplification of the process, is useful, for it makes it possible to distinguish between different types of ignorance. For example, Atiuan coffee growers were mainly ignorant of the high variability in yields that they must expect, whereas prospective pineapple growers did not realize the high maintenance requirements and they had inflated views of likely maturity returns. Project administrators do not appear to have identified these problems, partly because they share some of the ignorance.

(e) The community effect. A marked characteristic of decision-making in many small tight communities is the social interdependence of action: people copy each other, especially when faced with a new and confusing choice to be made. When a new cash crop is introduced into an area, initial suspicion may be followed by a bandwagon participation effect. Growers may follow their neighbours for a number of reasons: it may be a way to insure against localized risk, an easier way to learn, there may be economies of scale involved, or it may be purely gregarious behaviour.

This interdependence is most pronounced in ethnocentric communities linked through ties of kinship or patronage.
Here any experiment made by a grower is closely and critically observed by others. Of course all growers are not equally influential in swaying others into participation: the rank and personality of some people make them natural leaders in the adoption of new practices.

Atiuan growers exhibit this tight social interdependence. An example is the export of taro: people had grown this staple for generations. In the mid-1960s a few younger more innovative growers seized the new opportunity to send taro to sell on the Atiu Rarotonga market. But there was something in this new practice of selling a subsistence crop to fellow Cook Islanders that disturbed most growers and they would not join in. Then in 1969-70 several respected influential community leaders, title-holders, and government officials took up the idea. Quite suddenly it became respectable: in the next two years half the Atiuan farmers began to export taro too.

To investigate the statistical effect of this phenomenon requires some measure of an individual grower's perception of the value of company in a project, such as the proportional number of growers involved in that project at any time. This assumes that the relative community effort put into this project is approximated by that proportion, and that each grower is equally influential in his participation.

This index of 'communality' (C) is taken as another explanatory variable in the least squares estimation of grower response (and it is assumed that an inherent simultaneity statistical problem is not distorting). Table 1 shows that its coefficient is always highly positive as expected and significant for at least part of the time.

(f) The role of government. So far the analysis has only been concerned with the ex ante design of a new crop. Now the ex post administration of one already in operation is considered. When a new opportunity arises growers will decide whether or not to participate in it by weighing up each of the above points and possibly many others. Left to themselves they may decide for quite rational private economic reasons that it is not worth their while. The government may then decide to intervene to cushion the impact of the new practice and make it more attractive. Indeed it should do this if the public interest of the community diverges sufficiently from the private interests.
The appropriate role of a government in administration depends partly on the attitude of growers. If they are fiercely independent and distrustful of central interference, as are many peasants, then they are unlikely to respond positively to most incentives. On the other hand many traditionally ranked societies such as Atiu are accustomed to working under direction for the public good, and can be expected to respond well. Firth (1965) provides a good example of economic roles of chiefly classes in Tikopia. Here chiefs insured against local risk, encouraged investment for the future, disseminated agricultural knowledge and co-ordinated important communal work.

Some examples follow showing how a government may attempt to modify what it sees to be the constraining elements in the crop design.

**Government as profit increaser.** There are several ways a government may use its superior bargaining power to increase the profitability of a crop for smallholders. It can provide necessary inputs more cheaply by bulk buying of fertilizers and sprays, by providing larger mechanized implements for hire, and by building infrastructure such as roads and wharfs. It can also obtain a better selling price for all growers by acting as a marketing board with selling rights outside the community. All these roles have been adequately filled by the Atiu Administration.

The Administration on Atiu has filled several other roles concerned with the adaptation of traditional agriculture to smallholder cash cropping. One was to legislate that all money proceeds from a plot of customary land should go to one right-holder. Another was quality control legislation giving the Administration power to reject inferior produce. This was found to be necessary because marketing crops in a remote market divorced the grower from the consumer; as a result the former ceased to worry about quality or production quotas to the long-term detriment of all.

**Government as banker sharing credit.** A second major role of government is the provision of credit to help growers participate in new crops where there is a long interval between planting and receiving returns. It may be in the public interest for individual planters to invest in such long-term projects. Indigenous kinship-based lending and sharing arrangements rarely prove adequate for this new situation. So the government may decide to encourage
investment by providing credit to growers. There are various possible methods, such as development banks, cost sharing arrangements, or forward selling agreements.

On Aitutu a basic scheme was devised to provide growers with all non-labour inputs on credit, to be repaid from a fixed percentage of proceeds when the oranges began to fruit. It is not difficult to adapt the foregoing constrained optimization models to show that a grower may be expected to work harder and apply more inputs than he would have done without such a scheme. Just how attractive the scheme is depends on the profits of crop yields and the grower's time preference scheme. This simple payback mechanism is less flexible than a full commercial capital market; however, it is easily administered and requires no additional security.

**Government as insurer, sharing risk.** Again, a government has the resources to cushion the riskiness of crops for smallholders, and there may be good social reasons for it to do this. Commercial institutions will not insure small farmers; informal traditional arrangements within a community are of limited use where new cash crops involve extensive risk; and private moneylenders and share cropping arrangements are generally exploitative. A government may intervene through a price stabilization scheme, a profit sharing arrangement or a farm insurance institution.

On Aitutu the credit scheme mentioned above also provides limited insurance by smoothing out the grower's net return to labour. In a good year when he can afford to, he pays more for his fertilizer than he would on the open market; in a bad year when he is short of money he pays less. Again, it can be demonstrated by model optimization that he will work harder and use more fertilizer with this scheme than without it. The magnitude of its effect will depend on the size of the risk and the grower's risk premium.

**Government as teacher, sharing knowledge.** Emphasis has already been given to the importance of knowledge about a new technical process for effective decision-making. Most peasant cultivators cannot afford neither the time to experiment to gain this knowledge, nor the costs of failure.

The government should help this learning process because there is a difference in private and social optimum levels of learning. Such help can be given in several ways. Government may bear the cost of the earliest most risky series
of experiments even if it means holding back new crop introduction for a few years. It can collect, record and publicize the results of other relevant experiments that growers may not otherwise hear about. It can keep growers informed of continuing technical progress.

At the same time the government should avoid feeding exaggeratedly optimistic information in the hope of encouraging growers, for this can lead to future mistrust. On Atiu the Citrus Replanting Scheme was originally advertised as likely to yield 16,000 lb or $310 net per original plot. In fact the best plot only reached 11,000 lb and $115 (1950 prices).

**Government as co-ordinator.** Because growers in closed communities may not join a project unless others are involved, there is a clear role for the government to act as a group co-ordinator. By artificially encouraging a few growers (typically the most respected community leaders rather than the best growers) it may be able to induce many others to follow in a bandwagon effect.

For example, no Atian growers volunteered to join the Citrus Replanting Scheme for several years. Then in 1951 the Administration planted out eight demonstration plots on the land of some of the more influential men. This encouraged another 16 bolder growers to plant their own trees later that year, and nearly all households followed suit in the next three years.

There are other possible roles for government. The principle is the same: to encourage participation and production by reconciling private and social aims. Casual observation suggests that this has been relatively successful on Atiu.

How can this be statistically tested? The Administration applies several schemes in different projects, so its intervention can be denoted by a dummy explanatory variable. This assumes a different value for projects without Administration support, for projects with one of the schemes outlined above, and for projects which have effectively been taken over by the Administration employing growers on wages and managing production themselves.

As before, this explanatory variable \( G \) has been included in a multiple linear regression. The results are in Table 1. In all but one case the coefficient of the
government parameter is positive, though it is significant only in recent years. It should be noted that there may be some multicollinearity between government involvement and the other explanatory variables.

Assessment and policy implications

This section investigates two questions: how reliable are the results achieved by this type of analysis, and what practical use do they have?

The approach used is frequently considered inappropriate for non-western economies for institutional and cultural reasons. Fully aware of this, I have used it as a turnpike approach, to take advantage of its established methodology. Now is the time to jump off the turnpike and return to a more realistic road.

Some of the most basic assumptions involved are: that grower attitudes may be represented by a utility function, technologies by a production function, and rational behaviour by their interaction; that growers regard participation in each project independently of other projects at any one time; that the subsistence sector may be considered approximately static for short periods; that the results from partial analysis of technological change still hold generally true for simultaneous change; that it is practicable to use the concept of an 'average grower'; and that the explanatory regressions may be roughly cast as linear.

In the testing of hypotheses there is a danger of considering only selective examples. The regressions are intended as a control of this, and also to hint at the extent of statistical explanation. Most of the primary data are relatively reliable; however several explanatory variables are conceptually difficult and the estimates made of them are open to question.

In view of all these assumptions, the testing of the hypothesis is based on the sign rather than the quantity of the response indicated, and the good statistical fits obtained cannot be taken as evidence of a complete understanding of grower behaviour. But within these limitations most of the expectations have been supported; it seems reasonable to accept that grower response to this situation does depend on crop characteristics in the direction hypothesized, though it may not be possible to say anything
very useful about the magnitude of response. Table 2 summarizes these results.

Because the statistical results are based on such an unreal situation, the analysis offers few quantitative implications for project design and evaluation. Nevertheless, the theoretical model does point to some issues that a grower weighing up a new crop must consider; and the empirical work confirms that most of these are important issues in this particular community (though not necessarily in a different one).

This is the point of the analysis: it offers a framework for the study of the interaction of crop and community. The practical-oriented designer, administrator and evaluator all need this knowledge of the important variables of change and their structure, in order to start formulating sensible rules of thumb about project impact. Some of these practical implications for policy making can be illustrated.

Ex ante project design. New aid projects usually arise from some perceived need and some potential production capability of a community. However, they are rarely designed explicitly to marry the two (hence the criticism of the appropriate technology movement voiced by Schumacher (1973)). Following this theoretical approach it becomes possible to suggest practical procedures to design a more sensitive project:

1. Identify those characteristics of a community that are likely to make a difference to the way its people view a commercial opportunity, whether these be cultural attitudes, social organizations, psychological outlooks, or historical experiences.

2. Identify the range of possible new production activities available and, especially, how they are likely to operate in the prevailing physical and economic environment.

3. Select, and if necessary modify, a suitable project to maximize communal welfare subject to all the policy constraints laid down by the recipient country. This analysis does not help distinguish between projects that perform best on different criteria, and here the designer may have to rely on practical experience. A short cut may be to adapt an established project.
<table>
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<th>Crop characteristics</th>
<th>Grower attitudes</th>
<th>Predicted participation effect</th>
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<td>3. Risk</td>
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<td>4. Knowledge</td>
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<td>ignorance premium</td>
<td>?</td>
</tr>
<tr>
<td>5. Community effect</td>
<td>company (C)</td>
<td>attitude to company</td>
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<td>6. Government</td>
<td>govt participation (G)</td>
<td>all of above</td>
<td>+</td>
</tr>
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Table 2
Summary of theoretical conclusions
**Ex post project administration.** Usually a project package is already formulated and may be operating. Then the section on the role of government offers some practical guidelines for the administration of the project in such a way as to induce a better response. This requires identification of these project characteristics which the community find unattractive, then the use of the resources of government to disguise these features. This changes the grower's perception of the project. Constraints on this are usually financial and also derive from the need to avoid loss of grower initiative.

**Ex ante project evaluation with variable labour response.** A criticism of most agricultural cost-benefit analysis is the assumption of total grower participation, especially in communities where there are cultural restraints on cash involvement. Can this theory of grower response do any better?

It has been admitted that it is possible from this only to draw directional and not quantitative conclusions about grower reaction. But this is useful because, when the likelihood of resistance is indicated, sensitivity analysis can be applied to see the range of varying commitment on project profitability.

For example, it appears that administrators in 1946 (anticipating total grower involvement) expected an internal rate of return of 22 per cent from the Citrus Replanting Scheme, a very reasonable reward from a risky project. Yet if grower involvement had been estimated as roughly equivalent to actual participation in the native orange production in the 1930s (admittedly a very different scene), then the rate of return becomes negative. This is about what happened in practice. If the general direction of grower interest can be predicted then it must be taken into account in project evaluation.

On this basis, it is maintained that the conventional theoretical approach used here for the analysis of the impact of cash cropping in a non-western economy can still be interpreted to yield some broadly useful policy implications.
Section F
Major emerging issues
Chapter 20

Traditional agriculture and urbanization: policy and practice*

E.K. Fisk

As is to be expected, bringing together such a wide diversity of experience and approaches gave rise to a lively and profitable exchange of views on practically every subject discussed. These exchanges contributed almost as much to the conference as the formal papers presented to it. Moreover special mention must be made of the contribution made in this way by those participants who did not present papers.

No attempt has been made to reproduce here the actual discussions that followed each paper. Such attempts are always exceedingly difficult, and would in this case have added unacceptably to the length of what is already quite a long book. An attempt was made in the last session of the conference to draw some conclusions on the basis of a general consensus, but time, and the spate of new ideas sparked by the earlier discussions, which were still bubbling up in this final session, precluded the passing of formal conclusions and resolutions by the conference as a whole. On the other hand, a great number of important issues had been carefully discussed, and a number of original and sometimes exciting views formulated. There was also a very substantial measure of agreement, rising virtually to unanimity on a number of matters.

In what follows an attempt has been made to capture those points on which consensus appeared to be greatest, and those many other points that arose in discussion which appeared to me to be of greatest interest, and which have substantially influenced my thinking on the subject since the conference. In this, full use has been made of comments,

*The author is indebted to Professor R.G. Ward and Dr Diana Howlett for reading an earlier draft of this chapter and for many suggestions incorporated in it.

345
some written, some oral, passed to me by participants since
the conference, as well as my own quite detailed notes made
at the time of the discussions. However, time has not
permitted the prior circulation of this final chapter to all
the participants, to canvass their views, though some
assistance has been sought from those most readily accessible
during the writing process. Therefore, whilst it is hoped
that most participants would agree with a large part of what
has been said in this chapter, the view taken is ultimately
my own, and I must, therefore, take personal responsibility
for the selection and mode of presentation of the content.

Some major general issues

There was general agreement that tropical root crops and
the indigenous systems of cultivation and production had a
high, and in some areas neglected, potential for raising food
production in many areas of the humid tropics, particularly
in the Pacific region. The magnitude of the unexploited
potential varies inversely with the degree of population
pressure on land resources, but is still generally large.
Under-exploitation of this potential is particularly high in
the Pacific region, and although there are technical
difficulties of transport, storage and distribution, together
with problems of organization, incentive and co-ordination
of production, there is nothing to suggest that these problems
are not solvable.

Root crop staples and urban food requirements

The concentration of large numbers of people into urban
centres, together with the development of specialization and
division of labour in that population, creates a type of
demand for food supplies which exhibits certain characteristics
that indigenous systems of root crop cultivation and production
at village and family level cannot readily meet. These
characteristics are:

(a) the demand being remote from the producer;
(b) the demand being for very large quantities of the
    staple foods;
(c) availability at frequent intervals, preferably
daily;
(d) absolutely reliable supply; and
(e) availability of supplies at a reasonable and
    steady price.
These characteristics of urban food requirements differ from those which aggregated surpluses from normal indigenous production naturally exhibit over long periods of time, although these systems are capable of producing very large surpluses on specific occasions, planned well ahead, for major festive occasions. Frequency of supply, and reliability, are of course in-built into the system for the consumption at village and family level. They are not, however, in-built into the system in so far as the production of a surplus for sale is concerned. It is this production and supply of substantial surpluses on a continuing and regular basis that presents problems in adapting indigenous root crop agriculture to the needs of urban populations.

Urban food requirements can be met in a number of ways. For urban populations where root crops are the main staples, these options can be classified into five distinct approaches. These are:

(a) the needs can be met by importing storable grains;
(b) local production of storable grains can be introduced on a large-scale (estate) basis, and land provided for this;
(c) local production for storable grains can be introduced on a smallholder basis;
(d) the urban needs can be met from local production of local root crop products on a large-scale or estate basis; and
(e) local production of surplus root crop products by existing small-scale indigenous agricultural productive systems can be organized.

These options are of course not mutually exclusive, and in fact food requirements for most urban areas are met by a combination of at least two or three of these options in practice.

The first two options do not involve the adaptation of traditional systems of agriculture, and fall largely outside the scope of this book. However, as they are a practicable source of urban food supplies, and indeed have certain advantages, it is necessary to mention them briefly. These advantages derive in the main from three factors:
(a) urban needs of storable grains in most root crop producing countries are small compared with total world trade in grains;  
(b) these grains are eminently transportable and storable, and it is relatively simple to order well ahead and to carry reserve stocks without undue expense or wastage; and  
(c) they are convenient for the consumer, easy to cook and relatively cheap in price per calorie.

Therefore the strategy of importing storable grains to meet urban food requirements has the attraction of stability and security, and in most cases prices are foreseeable and relatively steady in the short- and medium-term. If foreign exchange to purchase the overseas supplies is a long-term problem, the alternative strategy of importing the skills and technology to grow storable grains on a large scale retains many of these advantages, provided that the local conditions make it practicable as a commercial venture. The large-scale rice production being undertaken on the island of Guadalcanal in the Solomons illustrates both the advantages and the problems that arise with such a venture.

However, there are substantial disadvantages in these strategies, some of which have been pointed out in Chapter 17 by Dr Kym Anderson. One of these disadvantages, of which more will be said later, affects the rural areas more directly than the urban. This is that the income and employment effects of the urban food consumption are exported, rather than spread amongst the rural population of the country concerned. Even when large-scale local production on an estate basis is substituted for an import strategy, there is often a similar tendency due to imports of high-level management and techniques, and the use of capital-intensive imported plant and fixtures. Widespread local employment effects are rarely present, so that the spread of income growth from the urban areas to the majority of the population is impeded. This can be a serious consideration when few alternative income-producing activities are available in rural areas.

Another strategy which will not greatly concern us here is that of importing the technology of the production of storable grains, and spreading this amongst the small-scale producers of the rural population so as to involve a large number of small-scale producers in the production of large
quantities of storable grains for the local market. This strategy, which has been attempted in many countries, has very seldom been successful in the long term where the indigenous systems are root crop specific. In the Pacific region, rice and other grain production has been moderately successful in Fiji, and was for a period after World War II moderately successful in Southwest Bougainville; in both cases this success was achieved through the involvement of smallholders. However, in Fiji this success was almost entirely confined to non-indigenous smallholders, and the indigenous systems of agriculture and the indigenous rural population were scarcely involved. In Bougainville, and in a few other small patches in mainland Papua New Guinea, there was some village production of rice, but in Bougainville at least, it survived only so long as other methods of earning cash were unavailable to those populations. With the advent of the more profitable alternative of cocoa, and with the development of road communications that made the marketing of root crops practicable, rice as a cash crop rapidly diminished. As most smallholder rice production is commercially viable in the long term only for paddy or wet rice, successful conversion of indigenous systems from non-irrigated root crops to paddy generally involve far more than a change of technology, for continuous paddy production, particularly in the modern two or three crop systems, involves an entirely new, and highly strenuous way of life, to which people used to the more flexible root crop productive system have seldom taken kindly.

In most countries of the Pacific region, the urban populations include a large proportion, and usually a great majority, of Melanesian, Polynesian and Micronesian peoples whose culture is centred around traditional systems of root crop cultivation, and these people have usually a strong preference for the root crop staple foods to which they are accustomed. Although this preference can in time be overcome, and although rice and wheat products have become acceptable alternatives with prolonged use, even to the extent of having some status significance, there remains a substantial natural demand in most such urban centres for the fresh staple root crops where they can be provided. In addition to their cultural significance and the taste preference, fresh staple root crops have in most cases the advantage of being also food of good quality and nutritional value. In most areas where the diet is composed of traditional root crops, supplemented by the other vegetable products normally grown with them, nutrition is of a good standard.
Where this diet can be transferred to the urban situation through an effective delivery and marketing system, the urban nutritional standards are better than those based on more refined exotic foods such as wheat, rice and sugar. The evidence cited by Dr Bathgate in his separately published paper (Development Studies Centre, Occasional Paper No. 11) shows how nutritional problems can arise, particularly for the young, with the substitution of such inferior exotic diets without the normal concomitant vegetable supplements that accompany village diets. There are therefore some substantial advantages, to the urban population as well as the rural, from the encouragement of traditional local product markets in the urban centres of the region.

On the other hand the difficulties of meeting the requirements of frequent supply, reliability of supply, and stability of price, for the very large quantities needed, are substantial. As pointed out in several parts of this book, these difficulties are partly due to the bulky nature of the root crops, and to their relatively poor storage and transport qualities. This makes it very difficult for local product markets to match the reliability and steady supply possible with exotic staples through the carrying of large buffer stocks. To obtain equivalent security with indigenous vegetable supplies necessitates an effective, fast and reliable transport system reaching far into the rural areas, and in addition, if a strategy of dependence on a large number of small surplus suppliers is adopted, there must be an effective system of ensuring that those surpluses are regularly available.

The difficulties involved in meeting these problems have been emphasized by many of the regional case studies included in Section B of this book. They were also emphasized by Mr John Natera of Papua New Guinea in his verbal statement of the problems met within his country. Dr Bathgate's contribution gives special coverage to marketing and transport aspects of these problems. The economic aspects receive considerable emphasis in the first two chapters of Section E.

In these connections also the conference looked particularly at the experience of Africa and Central and South America. In these regions staple foods derived from root crops provide a substantial proportion of the food requirements of some very large urban concentrations. Moreover, this urban reliance on root crop staples, especially in yams
and in cassava products, has been historically of very long standing. Details of these systems and their success and problems have been discussed in some detail in Chapters 13, 14 and 15.

In Africa two factors seem to have played an important part in making possible this reliance on root crops by very large urban populations. Firstly there is the long history of the yam trade, which has grown up over several centuries and has gradually developed a system of production incentives, transportation facilities and marketing organizations that have made full use of the relatively better keeping qualities of the yams produced. In the Pacific region all aspects of these specialized adaptive processes have had to be developed anew. The other major component in West African urban supplies is to be found in cassava products, and is based largely upon the use of processed cassava, as it is the processed forms of cassava that have the storable and transportable qualities which make this dependence possible. Although through long use some element of acquired taste is associated with these developments in Africa, the ability of the processed cassava to compete with other foods appears to depend also upon its relatively very much lower cost when compared with the storable grains.

Comparable development of processed root products for human consumption has not yet taken place in the Pacific region. There is considerable experience in the processing of some root crops for animal feed in Taiwan and in one or two other sections of the region, and some very interesting experiments have taken place in Papua New Guinea in processing sweet potato (see below), but these have not yet been exploited on a large scale. As a potential means of enhancing the security and reliability of root crop staples for urban consumption, these readily storable and transportable forms appear to hold considerable promise.

On the other hand, whereas in Africa the production of the root crops for urban supplies appears to derive largely from an adaptation of indigenous production systems, in Central and South America such crops are derived mainly from large-scale and small-scale commercial farms that are an adaptation of the western pattern. Chapter 14 has discussed this system in some detail, and has explained its inherent difficulties and how the development of technology and of urban markets for cassava products tend substantially to favour the large-scale rural producers, and to disadvantage
the smallholders who form the bulk of the rural population.

The Pacific experience

The studies from the Pacific have also produced some very interesting experience. In the Solomon Islands, for example, in contrast to some other Pacific territories, there was a prolonged and determined effort by the colonial government to develop food supplies to the major towns based on regular supplies of indigenous staples to the urban markets. This has been quite successful in the capital, Honiara, and success has come in the main with the development of effective all-weather road systems reaching out from Honiara to the rural areas east and west of the town. Although efforts have been made, through the use of subsidized shipping, to extend this to more remote villages on Guadalcanal and to other islands, these have been expensive and less successful. From the point of view of the urban population, supplies so obtained tend to have been insufficiently frequent to produce maximum benefit, and from the national point of view have been a relatively costly, and as yet not particularly effective, stimulus to economic development in the remote areas. On the other hand, from the point of view of the remote rural areas so served, these measures have had the benefit of introducing the people to the benefits of production for the market and of providing a small source of cash income. To many of the areas the only alternative sources of cash income have involved migration to uncertain wage labour in other areas.

In Western Samoa on the other hand, where road and ferry communications are highly developed, and extend to virtually all villages, the problems have been of a different kind. There, according to Mr Sam Leung Wai (Chapter 5), land is still available for considerable expansion of the staple root crops, including taro. Road and other communication services are adequate to make the problem of transport from producing areas to the main towns no serious barrier. Market facilities in Apia are now relatively large and adequately sheltered. In recent years urban and industrial development, and in particular the construction industry, have grown very rapidly. This has resulted in a very large increase in the number of Samoans engaged in wage labour. Concomitantly there has been an equally large reduction in the village labour force. Added to this has been the complicating fact that supplies of the principal staple foods, including taro, yams and bananas, have also been an important source of
foreign exchange earnings through exports.

These factors operating together produced a shortage of foods on the market and very high prices. Reaction by government, development institutions and village producers then led to over-supply a growing season later, and to a collapse of prices. This tended to discourage producers and to cause subsequent shortages, so that a type of 'hog cycle' phenomenon was set in motion. In Samoa, therefore, the problem has not been productive capacity, or transport, or marketing, but rather the inability of producers to respond effectively to market signals so as to produce the continuous reliable supplies which an urban market needs.

Of particular interest also was the situation on the isolated island of Niue (Chapter 7). On this island the indigenous systems of production have been effectively adapted to a very extensive series of changes in the social, economic and political life of the country. In Niue the population is relatively small and population pressure on land resources has not been serious. Through the smallness of the country and its population, it has been possible for aid to be provided on a very large scale per head of population. This has made possible the provision of a high level of infrastructure and amenities, to the extent that by 1977 all villages in the island were connected with the main centre by all-weather roads, all families were accommodated in relatively cyclone-proof houses of modern design, mains electricity had been extended to all villages except two, and was due to reach those remaining two in a short period. A high standard of government services covering education, health, agriculture and public works had been provided to all citizens, and a large part of the population had become wage and salary earners on government payrolls. At the time of writing the export component of Niue production is relatively small and the import component of their consumption, including capital and infrastructure improvements, is very high. The result is a very high level of living, still largely aid-dependent.

However, despite the high level of modernization, a unique feature of the Niue adaptation is that each Niue family still produces its own staple foods from its own subsistence gardens and from subsistence fishing. This applies to all levels of Niue society from senior government officials down, and to facilitate it government, followed by other employers of wage labour, has adjusted working hours
to leave all employees free on all week-day afternoons and on Saturdays, to tend their subsistence gardens. The island of Niue, therefore, is unusual in its form of adaptation of indigenous systems of agriculture, in that the whole population receives its basic foods from these systems, but this has been achieved virtually without the development of a market for staple foods and with minimal market dependence.

On the other hand, attempts to reduce aid dependence for the Niue economy by producing specialized export crops such as passionfruit and limes may be expected eventually to exert pressures on labour resources and on the level of living. The present ideal balance depends upon the availability of both wage and subsistence employment for each breadwinner, and with very few exceptions, young men unable to secure wage employment have emigrated rather than engage in full-time commercial farming. Niue has embarked upon an unusual path of adaptation to modern conditions that has many attractions, but some major difficulties have yet to be faced. If land tenure problems can be overcome, a system involving export agriculture based partly on wage employment on state operated farms, retaining the present system of owner-produced staples from individual garden plots, may be attempted. The Niue adaptive process will be worth watching.

The Pacific region also has relevant experience of government intervention in the collection, transport and marketing of traditional agricultural products. In Fiji an extensive organization has been operated for many years, first by the Department of Agriculture, and subsequently by an institution specifically created for that purpose. In Papua New Guinea similar attempts have been made through government institutions to encourage the supply of vegetables to Port Moresby, and research has been undertaken into the processing of indigenous root crops to improve their transport and storage qualities. The Director of Primary Industry of Papua New Guinea, Mr John Natera, reported progress in this direction, and of particular interest was the processing of sweet potatoes into a granulated form which they call sweet potato rice. Although this had not yet become a significant component in the consumption of the average urban household in Papua New Guinea, it has a very satisfactory shelf life, and holds considerable promise. Further steps are necessary to popularize it and to extend the knowledge of how to make it into a palatable and nourishing meal.
Finally, the Pacific experience includes some cases of extreme difficulty, such as the island groups of Tuvalu where the quantity and quality of agricultural land on small atolls is an acute constraint. There the capacity of indigenous productive systems to supply urban centres lies more in marine products than in agriculture. The problems are exacerbated by the smallness of the producing islands and the long ocean journey to reach the nearest urban area.

Population pressure on land resources

Some indigenous systems of root crop production are quite intensive, and very economical in land use. The 'mound' systems still found in parts of the New Guinea highlands, and the taro terraces still cultivated in a few areas of the New Hebrides, are examples. Moreover archaeological evidence shows that such intensive systems were very much more common in the past than they have been during the period of close European contact and observation. The reasons for their original adoption, and for their later widespread abandonment in favour of more extensive systems, are the subject of some debate. One suggestion has been that very much larger populations, later drastically reduced by exotic diseases, were originally responsible. Other suggestions relate the change to reduced raiding and warfare, making larger tracts of country safe to use, or to the introduction of the sweet potato which could be cultivated at higher altitudes than taro or yams. Probably a combination of factors was responsible. Whatever the causes, the phenomenon is of considerable interest in the present context because it shows that intensive systems have not always been foreign to at least some indigenous societies in the Pacific.¹

Nevertheless most existing indigenous systems of producing root crops involve extensive types of land use, employing long fallow rotational cultivation. These systems are a very efficient adaptation to a land surplus situation. This land surplus has naturally proved to be a temporary situation in most parts of the world, and population growth erodes it. Although in many parts of the world, particularly amongst the larger land masses of the Pacific, pressure of population on land resources is still low, and the extensive systems of root crop production are still viable, it seems...

¹I am grateful to R.G. Ward, Professor of Human Geography in the Research School of Pacific Studies, A.N.U., for drawing my attention to this important set of facts. Unfortunately illness prevented him from attending the conference in Honiara.
almost certain that most developing countries in these regions will continue to have a high rate of population growth for some considerable time. Ultimately the indigenous extensive productive systems will be forced to change to more intensive methods. Intensification will involve not only a change in technology, and probably a considerably greater dependence on the market economy for inputs such as fertilizer and pesticides; it will raise also substantial problems of conservation and of social organization. The role of the indigenous root crop gardener as a 'priest of conservation' so emphasized by Mr Coursey, the concept propounded by Dr Huber that agriculture is more social than economic in objective, and the highly developed level of subsistence affluence achieved by Professor Keesing's groups in the island of Malaita, are all, as far as one can see, intimately dependent upon the land surplus situation of the peoples concerned. Intensification, and increased pressure of population on land resources, will inevitably require the development of new systems of conservation as well as structural changes in the socioeconomic organization of the rural peoples involved.

Some difficulties

The majority of the people of developing countries, including those whose indigenous staples are root crops, and where subsistence affluence is relatively common, rapidly develop a desire for increased money incomes as well. The adaptation of traditional systems of agriculture to meet urban food needs is clearly one means of enabling rural communities to earn some cash income. However, the difficulties and uncomfortable aspects of the changes involved must be faced and recognized.

One aspect of these changes is sometimes overlooked. Where a rural subsistence group becomes an effective supplier to an urban population, the urban population so supplied is in effect transferred, in terms of population pressure on land resources, to the land available to that group. In this way the land surplus situation of a subsistence rural society can be dramatically changed in a relatively short time to a degree that would be quite impossible through normal population expansion within the group itself. Whilst urban populations are small, and where the general level of population pressure on land remains low, the impact of this problem has tended to be confined mainly to areas close to the urban centres. However, as urban areas increase in size and importance, and as the general level of population pressure on land increases, a more
rapid, and therefore socially and ecologically more disruptive rate of change to intensive cultivation methods will become unavoidable.

One very important point raised by Mr Coursey was that some important advantages of the indigenous self-subsistant root crop systems are threatened by intensification. Coursey considered that ecological conservation systems of the yam producers in West Africa were jeopardized by intensification and monetization. Professor Keesing echoed this concern, drawing attention to the common traditional resistance to such change, which he said was based on an instinctive defence of the balance behind the quality of indigenous rural life. In this respect he described the Malaita people with whom he had been working for the past fifteen years as perhaps the 'most conservative people in the Pacific east of New Guinea'.

Whilst these problems were noted, there was a general consensus in the conference acknowledging the scope for adapting traditional systems of vegetative agriculture to meet urban market requirements, and an agreement that this did present an important potential for development. However, the conference found itself faced, not primarily with the problems of how this should be done, but also very importantly with the problems of why and how fast it should be done, and where the benefits and costs would fall.

Some of the issues were clearly economic in nature, and some were technical, involving the technology of transport, storage, processing and agronomy. However, it was necessary to go much further than these specific aspects of the problem before any adequate policy making could be achieved. Attention needed to be paid equally to the social, moral, political and administrative aspects of the problem.

Adaptive procedures

The first requirement in devising adaptive procedures is to obtain a proper understanding of what it is that has to be adapted. Productive systems in indigenous agriculture include not only agronomic practices, but also a wide range of decisions covering the allocation of resources, the crops to be planted, the timing and modes of productive activity, the harvesting, storage, disposal and consumption of the crops, and the distribution of the crops or their proceeds amongst the members of the group concerned.
Most root crop systems are organized around relatively small productive units ranging from the nuclear family to the small extended family group, whose first productive effort is directed at the consumption needs of the group itself. There are, however, in nearly all these societies institutional provisions for productive effort on a larger scale, in which the resources of larger groups, from village to groups of villages, can be combined to cope with emergencies, or to meet major social obligations of different kinds.

Many such institutions and organizations were described during the course of the conference, particularly by Dr Bonnemaison concerning the New Hebrides, Dr Thaman concerning the Kingdom of Tonga, and Dr Bollard concerning Atiu in the Cook Islands.

In his thoughtful paper Dr Bonnemaison describes with some care the co-operative forms of organization found on the island of Tanna and suggests the role these may play in facilitating the adaptation of the indigenous productive system to the needs of a wider market economy. Dr Thaman describes how similar co-operative efforts have taken place in Tonga and could be made use of in the Tongan environment, whilst Dr Bollard emphasises the preference which the people of Atiu show for group action and team work and the role which island 'drinking schools' can play as an institution for organizing such co-operative work.

The background of traditional institutions

There is a great diversity in social and economic institutions of indigenous societies throughout the world. However, there are also remarkable similarities. This is particularly so in societies where production is directed mainly at the vegetative cultivation of root crop staples. In Chapter 9 Mr Coursey suggested some reasons for these similarities, and Professor Clarke, Dr Huber and Professor Keesing, in Chapters 10, 11 and 12, also emphasized the cultural and ideological features of the societies they have examined. In Chapter 13 Coursey illustrates this further with his examination of root crop societies in Africa, whilst practically the whole of Section B, comprising Chapters 3-8 inclusive, illustrate some of the similarities with examples from different parts of the Pacific.

A particularly good example of some important institutional features commonly found in such societies is described by Dr Bonnemaison in his Chapter 3. Here he discusses the Melanesian economy of abundance and leisure, in which, as he says, 'the traditional economy functions at two levels'.
The first level, which provides the essentials of life, is largely confined to the household and 'forms the unit of production that can be termed "domestic"'. The second he describes as being 'concerned with the production of valuable or ritual wealth' and in this level of production the people associate together and function in a much larger unit of production for specific purposes. The domestic economy is an economy of abundance and leisure, but leisure is at times forgone in pursuit of cultural wealth and status through a process of association which in some parts of Melanesia is described as 'company'.

This division of the traditional productive systems into two levels is found very widely throughout indigenous economies based on root crop staples, and many have well-developed forms of association for co-operative productive work, very similar to the 'company' type of institution described by Bonnemaison. This two-tier organization of socioeconomic activity is the starting point for many adaptive processes directed at meeting the food needs of the novel development of urbanization.

There is perhaps some superficial similarity here with the distinctions, sometimes made in describing sophisticated monetized economies, between the 'household' as a consumer of finished goods and as a supplier of labour on the one hand, and the 'firm' on the other hand as a consumer of factors of production, and a producer of goods. The similarity is only superficial because in the indigenous system the distinction between 'households' and 'companies' is entirely different. The household performs the functions of supplier of labour, and of consumption, but is also the producer of all the essential goods consumed. The indigenous 'company' on the other hand is often concerned more with the achievement of social and cultural ends than economic ends.

Further differences need to be understood before the problems of adaptation to monetary urban market supplies can be appreciated. In particular the distinction between the profit motive in an economic production process, and the socio-cultural motives of the indigenous systems, is quite marked. In the indigenous social-oriented 'company', success is often won not by the most acquisitive, but by the most generous, and to achieve such success, the society will occasionally be prepared to accept enormous demands on its labour resources. On the other hand the successful 'firm' in a modern capitalist society needs to exercise acquisitive-
ness and parsimony in order that its activities may produce a profit. This is a fundamental difference that frequently causes difficulties in the effective adaptation of traditional agricultural systems to the needs of urban monetized markets. Dr Bonnemaison in Chapter 3 gives useful analysis of the difficult workings of such an adaptive process in his case study of the Southern New Hebrides.

In some notes prepared after the conclusion of the conference, Bonnemaison draws some interesting personal conclusions. Speaking of development in societies based on vegetative root crop production, he draws attention to the almost universal failure of two approaches common in the development process. The first is based on the concept of entrepreneurship, and reliance on the response of some potentially dynamic individuals to the profit motive to transform the society. The second involves planning from above of all social and economic aspects of the society concerned.

Although the universality of his conclusion can be questioned, most fair-minded economists and planners with experience of root crop based societies would concede the reality of the difficulties he emphasizes. In particular the social and cultural objectives of associated productive action, and their conflict with the capitalist concept of entrepreneurship, point to the root of many of the difficulties of adaptation that have been experienced. In his notes Bonnemaison says:

The concept of entrepreneurship is in fact a dangerous idea for groups whose community values come before individual ones. In most instances in Melanesia, the success of an entrepreneur in acquiring monetary wealth, and the rise of his economic power, do not bring any changes within the social group, but on the contrary tend to trigger a mechanism of rejection. As he becomes 'different' the entrepreneur often also becomes a 'stranger' to his own group. There are, of course, some exceptions, particularly when the entrepreneur works within the social rules which enable him to become a traditional 'big man'; but most of the time his newly acquired economic power causes disturbance rather than acceptance, and the social group defends itself by turning
its back on him. 2

The problem of objectives and motivation is fundamental to the whole process of adaptation, and has been mentioned with varying emphasis in practically all the case studies of the Pacific in Sections B and C. On the other hand Section D begins with Mr Coursey's Chapter 13 in which is described the successful utilization of root crop staples as food supplies to the very large urban concentrations found in West Africa. In this process indigenous entrepreneurs and indigenous trade systems of considerable antiquity have played a major part. Although this trade in staple foods was confined mainly to yams on the one hand and to processed cassava on the other, it does show quite clearly that adaptation on the basis of commercialization can work very effectively. However, the West African system has been built up by a slow process of adaptation that has taken place over many centuries, but in many other parts of the world large-scale urbanization is a novel but a very rapid process, and the development problems and adaptation required in these countries need to be solved in a decade or two. Also, and this applies particularly to the Pacific region, countries which have never known the levels of poverty, particularly urban, now found in Africa, may be excused for searching hopefully for a better pattern on which to model their own development. Whether such a pattern could be found, and how, became one of the main questions with which the conference concerned itself.

The role of the indigenous systems, and their two tiers, is one of the major factors in the consideration of these problems. This applies to some degree or other whichever path of development is selected. If the indigenous socio-cultural systems of production are to be retained, then it is the capacities of those systems that will limit and control the surpluses available for transmission to the urban populations. If the exotic small commercial farm system is to be selected, then indigenous systems have to be destroyed and replaced with the new. If on the other hand an adaptive path is chosen, aiming to retain some of the better features of both, then it is the indigenous systems that must be the basis for the adaptation. As Dr Howlett pointed out, such adaptation has to be a two-way process. For the successful implementation of any one of these three possible paths of development, a clear and full understanding

2This is a paraphrase, rather than a verbatim quotation of the original, which was in French.
of the operation of the indigenous systems and their decision-making processes is essential: it is to the lack of this understanding and its consequences that Dr Bonnemaison refers. Further mention of this will be made in the section dealing with research.

Production control and farm decision-making

One major problem in providing food for large urban populations is how production is to be matched to the regular daily needs of the urban population. The problem lies not in estimating the total needs of the urban population (usually a reasonably straightforward calculation), but rather in planning production at least a season ahead. As mentioned earlier an imported storable grain usually provides a means of avoiding this problem; ordering well ahead and carrying large reserves in storage is possible with this strategy. Foods that are storable for substantial periods without serious loss greatly facilitate the solution of this problem, whether the supplies are imported or produced within the country itself. They also facilitate distribution and marketing - where shelf life is important. However, the larger the number of producers, and the smaller the scale of the producing unit, the greater the difficulty of meeting these requirements internally. Let us examine how some of the available methods of such production control can be made to work.

First, there is the extension of the market system to the rural indigenous population through the construction of roads and small shipping services, and providing a market for surplus food at village level. This is more or less what has happened naturally over the centuries in West Africa. It has been attempted with varying degrees of government intervention and assistance in many Pacific countries. The success of these attempts in the Pacific has by no means been uniform, and has nowhere been outstanding. The situation in Fiji, which has had extensive experience of such government intervention, has been described in Chapter 18. Dr Chandra, however, points to the high cost of this intervention, and to the fact that adequate supply at a price acceptable to the low income urban population has not yet been generally achieved. He suggests reversion to the large-scale production by the state or co-operative type producing units specifically to meet the urban demand. In Papua New Guinea similar attempts have been made to meet the food demands of the main cities from local suppliers, and although a large measure of success has been achieved
in some of the secondary towns such as Rabaul, Goroka and Panguna, the problem of the largest city, Port Moresby, has proved particularly intractable. More recently Papua New Guinea has set up a special food marketing corporation, the aims of which the Director of Primary Industry, Mr John Natera, explained.

First, it was to operate on a semi-commercial basis. This was prescribed because the previous institutions to meet this need had made a particularly heavy drain on many government resources. Second, the corporation was to reduce fluctuation in supply, one of the main requirements specified early in this chapter for urban provisions. Third, the corporation was to overcome distribution rather than production problems. In Papua New Guinea the problem of production was left largely to the farmer, assisted by the agricultural extension service, and the Development Bank. The corporation has had some success in its early years, but it is too early to be confident that it will solve the problems and Mr Natera specifically referred to many complaints that the prices being paid by the corporation to producers were too low. This of course is a direct result of the requirement that the corporation's activities should be commercial, and of the attempts to provide the foods to the urban populations at an acceptable price.

Western Samoa had a longer history of effective contact between urban and village areas, relatively less intractable transport problems, and quite a high level of government support and encouragement through the Development Bank and the Department of Agriculture. The problems there encountered have already been described. Mr Sam Leong Wai of the Development Bank of Western Samoa considers that the problems caused in his country by the rapid growth in the urban consumer population indicate the need for attention to the efficiency of agencies and institutions concerned in the distribution and marketing process rather than to the grower himself. He is here referring to the relatively fortunate position in Western Samoa where the factors of production are still adequate to meet the urban food requirements, but it is the matching of this supply to the demand that is causing the difficulties.

In earlier years, when bananas were a major export crop from Samoa, there was a somewhat similar problem of matching production, packing, transport and storage of bananas to meet the exigences of a shipping service where ships were
widely spaced and not necessarily regular. This was overcome quite effectively by transferring the decision-making, through a quota system, to a central authority that could accurately forecast the arrival of ships. This information was transferred to the growers through an authoritative system that fitted in well with the traditional social and productive organizational institutions of the Samoan rural people. This is an example of adaptation of the market-level institution to fit the traditional institutions with which the village was familiar. Some similar approach to the provision of urban food supplies would be worth examination not only in Western Samoa but in other countries where similar problems have arisen.

In the Solomon Islands the conference was fortunate in seeing one of the more successful urban supply operations in action at various levels. They saw several types of adaptation, from the basically self-subsistent village with a small surplus at the one extreme, through to indigenous groups whose production involved almost complete specialization for the market. The system has been described in detail in Dr Eele's Chapter 4, and in the paper presented by Dr Bathgate (published separately, Bathgate 1978). Even there, however, the system has been only partially successful, and according to Bathgate has had severe repercussions amongst some of the producing villages, especially those that have specialized, in regard to their own nutritional status.

In the more remote areas and amongst the smaller production units, difficulties are greater. In those cases the primary aim is to foster some minimal participation in the market economy. Distance, cost of transport, irregularity of transport, and the difficulties of information transfer, mitigate severely against the effective participation of such communities. A good example of such problems is to be found in the attempts by the Solomon Islands government to provide market linkages with the isolated communities of Southern Guadalcanal.

In Chapter 19, Dr Bollard has examined some similar problems of isolation, this time with a cash crop, in the very small island of Atiu in the Cook Islands group. Here again we have suggestions involving adapting the market and government level institutions to meet the traditional level outlook. He regards it as necessary for the government to fulfil part of the marketing function, and that for marketing at a distance it is necessary to create a monopsonsitic
government institution in order to get a worthwhile price, although there is some danger of this drifting into a permanent basis for subsidy. He also points out that marketing, with its price variations, introduces a new set of risks with which the traditional agricultural system is unfamiliar. To counter this he recommends that the government should operate as an insurer, through the operation of some price stabilization system. He further suggests that the intervention of government and its institutions is required in some cases to act as quality controller, because of the relative ineffectiveness of the normal market forces in this respect in the traditional situation. Finally he points out that the distribution of the proceeds of production are usually quite clear within the traditional system, but that this system of distribution is often not equally applicable to activities designed to produce for a market. Here again some authoritative institution may be necessary.

One common feature of nearly all these interventive measures is that many of the costs fall on government, especially in the early stages, and it is difficult for the government to recoup those costs directly through semi-commercial procedures. The developing countries around the world are littered with withering government-sponsored institutions, set up with the intention of producing development 'on the cheap' by rapidly becoming commercially self-supporting. With a very few notable exceptions, such institutions either fail to live up to the financial expectations and require long-continued subsidy, or they fail to bring development to those who must need it by having to concentrate on those who are already viable.

Bringing the small isolated self-subsist self-subsistent producers effectively into the market is often a costly business, even where great care is taken to moderate the costs and avoid unnecessary wastage. On the other hand, where the cost reduction is carried to the point where the measures are ineffective, the whole of the expenditure of effort and resources is wasted. This applies as much to acceptance of the social and political costs of development as it does to the financial costs. Accelerated development has costs, and governments have to choose whether to avoid those costs, or at what level to meet them.

In this connection Dr Zoloveke, Minister for Agriculture in the Solomon Islands, pointed out in his opening address that many governments subsidized the development of export
agriculture in various ways, and that to subsidize the development of import-replacing local foods also deserved consideration.

**Infrastructure and processing**

In addition to the purely economic and to the social and motivational problems, quite vital physical problems have to be overcome in order to link potential rural surpluses to urban needs. If a rural surplus is to be used in an urban area the means have to be provided to collect, transport and distribute it in good condition and at an acceptable cost. Without a suitably developed infrastructure capable of doing this, the utilization of that surplus is not possible on any worthwhile scale.

Provision of the infrastructure will normally involve both public and private investment, but the relative importance of these types of investment vary very greatly from one situation to another. In parts of West Africa, and in parts of South and East Asia, quite a substantial level of urbanization, supplied from the local countryside, had developed before any large-scale public investment was undertaken in its support. In West Africa, for example, the yam trade relied heavily on indigenous river transport for several centuries, whilst in parts of Southeast Asia rivers and bullock cart tracks were important sources of communication and supply before railways and roads were constructed. In other areas coastal shipping on a small scale also played a part. However, in the modern world, and with the pace of urban growth so much greater than in preceding centuries, it is in most cases necessary for government to take the lead in such investment. The economics of this investment are often difficult to assess, and can only be properly looked at as a long-term proposition. As one of the Solomon Island participants emphasized to the conference, for governments the long-term view is often difficult to take. Nevertheless, it has been taken, and in many countries around the world, including the Pacific, substantial progress with the development of all-weather roads, landing jetties, coastal shipping, and even aerial landing fields, have played a large part in such local market development.

This is reasonably well recognized, although more research into the long-term benefits and costs of the alternative forms of infrastructure investment is clearly required in many countries. In particular, for countries such as the
Solomon Islands, or Tuvalu, or the Gilberts, the difficulties of bringing the more remote rural producing communities into the market system are very major ones.

An important part of this problem lies in devising procedures for reducing the cost and difficulty of linking the producer with the ultimate consumer without incurring unacceptable losses, or unacceptable cost structures. In this, processing has played an extremely important part in West Africa and in Central America, where processed cassava products have been rendered virtually as storable and as transportable as many of the storable grains. Unfortunately, in West Africa, and perhaps to a lesser extent in Central America, the urban populations dependent on processed cassava are extremely poor, and no effective alternative staple is available to them within their means. Taste preferences and custom present barriers to the adoption of these particular products in most Pacific countries, and elsewhere in the world where such levels of poverty as to compel their acceptance have not yet been reached. It is sincerely to be hoped that such poverty may be avoided by these more fortunate people, but there is nevertheless a need for improvement in the transport and shelf-life qualities of the staple foods of the Pacific. Without such improvement, effective urban supplies of root crop staples will become increasingly difficult as urban populations continue to grow.

Some interesting experiments have already taken place in a number of countries, and the recent development in Papua New Guinea of a granulated form of sweet potato with a long shelf-life holds particular interest. However, these technical developments are not in themselves sufficient. Cooking and home-preparation recipes also have to be devised to make them palatable to the local people, and careful attention paid to vitamin and protein needs. Finally, to make this type of program effective, a substantial government information program, explaining and commending the new foods and processes to the urban population, is essential.

Forces impelling change

Some people deplore the need to change socioeconomic systems which are both socially and ecologically in balance with their environment, and in which food is plentiful, and leisure is only moderately constrained. Some participants in this conference gave at least some support to such
sentiments in their emphasis of the good points in the indigenous socioeconomic systems. However, as Professor Campo and Dr Evans reminded the conference on several occasions, the forces impelling change cannot be wholly countered, nor can they be ignored. Improvements in hygiene and preventive medicine, reduction of local warfare, improvements of communication and alleviation of famine, have greatly accelerated population growth, and it appears that it will be a long time before this trend is eliminated by population control methods. Similarly, and to a large extent through the same channels of communication, the 'revolution of rising expectations' has spread an increasing desire for the specialized goods and services that money can buy. In some cases, as with Professor Keesing's group in Central Malaita, such aspirations are still at a modest level. There, according to Keesing, the ambition of the people is to raise their cash income from a level of about $5 per capita per annum to about $50. However, there seem to be few grounds for thinking that their aspirations will not grow further when $50 is achieved. This trend of aspirations appears likely to be an accelerating rather than a diminishing factor over the years.

Under these circumstances land surplus, upon which the present subsistence affluence of most of these rural communities is based, can be considered only a temporary situation. Population growth is one factor that erodes it. Increased attention to cash incomes also erodes it through the requirement of additional land for cash cropping, which is particularly disruptive where long-bearing tree crops are introduced. Ultimately the present productive agronomic systems will be forced to change to more intensive methods. This will raise not only sociological and organizational problems within the communities affected, but also problems of ecology and conservation. Coursey, Keesing, Huber and Clarke have all strongly emphasized this danger. Even where there is rural-urban emigration, this does little to relieve population pressure on the rural land resources if urban food needs are met from local production. Ultimately the effect is simply to transfer back to the rural communities the food needs of the urban populations so served. Whilst urban populations remain small, as they are still in most of the Pacific, and whilst the land surplus remains substantial, the problems arising from this backward transfer of population pressure are not immediate. However, they are already looming heavily in some areas, for example in the Kingdom of Tonga, and they will inevitably loom larger elsewhere as time goes on. In
selecting the productive systems and in preparing for intensification of agriculture, these factors need to be taken into consideration well in advance. In this connection it is perhaps advisable to heed the warning of Professor Nitish De from India, who reminded the conference that most of the world's people have already proceeded down the slope of material poverty to the edge of the abyss, to the extent that a more equal sharing of the world's resources is for them the only answer. The fact that most countries in the Pacific region, and many root-crop-based societies elsewhere in the world, have not yet reached this level of poverty should not be taken as a ground for complacency, but rather for urgent preparation. The recent change of emphasis reported in international research institutes, from concentration just on yields to concentration on conservationist land and energy use, is significant and comforting.

Further research

In Chapter 15, Dr Flinn of the Institute of Tropical Agriculture, Ibadan, led a very interesting discussion of research requirements and the methods whereby such requirements are best met. He emphasized in particular the need to consider not only agronomic and economic factors, but also social and cultural factors that relate to the productive systems concerned. He pointed out that much past research dealing with agronomic problems of indigenous agriculture has been based on incorrect assumptions about village production systems. The socioeconomic and agronomic aspects of the situation in the villages cannot be separated entirely, and therefore inter-disciplinary teams are needed when such investigations are undertaken. The Institute of Tropical Agriculture is at present advocating and using such teams with some success.

Many other participants, including Dr Salato of the South Pacific Commission and Mr Sam Leong Wai of the Development Bank of Western Samoa, supported this approach, citing cases in which the need for a proper understanding of all aspects of local problems had been demonstrated. Taking this even further, Professor Clarke emphasized that most recommendations regarding the application of innovative productive organizations were necessarily site specific.

Mr Coursey, citing his African experience, emphasized that research involves learning about facts and problems, and how they can be solved; an important part of this
research involves learning from the farmers themselves, and he assured the conference that he himself had learnt more about yams from illiterate farmers than he had ever learnt in the laboratory or from textbooks.

Another aspect of the debate concerning research centred around the work of Bollard and Chandra (Chapters 19 and 18). They demonstrated how quite sophisticated methods of economic analysis could be used to arrive at practical plans for improved farm results even in unsophisticated areas where only a very small part of productive activity was directed at the market.

Another research need emerged from remarks by Mr Coursey, who said that in the forest zone of Africa life is generally easy most of the time, and that leisure is plentiful. He suggested that there, and in other societies where subsistence affluence prevailed, it was difficult to draw the line between work and leisure. The values placed on labour and leisure in subsistence production of this kind were quite different from those in an industrial society, where work became a bore rather than a pleasure. Whilst some participants felt that this was too strong a statement for general application throughout the root crop producing regions of the world, it was widely agreed that the values placed on labour and leisure in these societies were quite different from those in industrial and urban communities, and that failure to recognize this led often to errors. Further research into this aspect of indigenous agricultural productive systems was recommended.

Finally there is a need to understand more about the social, economic and agronomic features of the remnants of indigenous intensive root-crop systems where they still exist. This may be a matter of some urgency, as the remaining examples are relatively few and in many cases difficult of access. A process of reintensification along lines to which the societies concerned had been adapted in the past may well cause less stress and disruption than change devised in ignorance of this background. Research in this field, including that being undertaken by the prehistorians, may thus prove exceptionally valuable.

Conclusions

This book, and the conference from which it arose, is about changes in the way of life of people. Its purpose is
to enable the choices available to the people, whether as persons or as societies, to be made with a greater understanding of the implications and consequences of the changes involved. It is thus a book about problems, and about issues that need to be considered in their solution, rather than a book about the solutions themselves. It is intended to facilitate effective problem solving by policy makers and administrators, but it is not intended to define solutions for them.

What every politician, administrator, and voter hopes for is that a quick and complete solution may be found to the main development problems facing their countries. However, thousands of years of human experience should teach us to be particularly cautious of such answers and of their purveyors. In my view - a view that was widely shared at the conference - there are no easy answers, and possibly no final answers at all. The best that we can hope to do is to throw a clearer light on some vital issues involved in the difficult decisions which have to be made, and to draw attention to components and relationships in the issues which may not otherwise be adequately appreciated.

A notable feature of this book is that not one of the papers has offered, or even mildly suggested, any single solution. This is because the participants were people with long and intimate experience of the problems of development. We have all seen the rise and fall of fashions in cures for underdevelopment. At one time it was the transfer of technology; at another the provision of capital; at another it was the development of co-operative societies; then it was economic planning; then there was a fashion for community development; more recently there has been a fashion for what is called integrated development. If one were to select the current fashion, it would probably be that entitled the 'New International Economic Order'.

One of the very few direct recommendations to governments voiced during the conference was expressed by Mr Charles in his final notes on the last session. He said that governments should not aim at massive and sudden changes to traditional systems. This was not to say that traditional systems could not or should not be changed, but rather that such change should be introduced with caution and without undue haste. In this he was backed up by Dr Salato, who emphasized that rural people live in small family units, and that developers, politicians and missionaries often made the mistake of
treating them as though they were large homogeneous groups. There was a wide measure of general agreement concerning these points.

On the other hand, there was some considerable disagreement as to how practicable such a cautious and necessarily slow process would be in the long run. The pressures behind the need for change are powerful. In a land surplus situation, where communications are tenuous and difficult, the pressures may be easily resisted in the short term. In the long run, however, they appear to be inexorable, and the conclusion of the conference was that these less urgent pressures, where they exist, must be recognized as providing an opportunity to plan and execute adjustment more carefully, rather than an excuse for avoiding or postponing it.

The origins of these pressures are basically two, though in some respects they are directly related. The first is the growth of population, due primarily to a dramatic reduction in the death rate, as a result of improved medical and health facilities. The second is the accelerating and spreading demand for goods and services available only through the monetary sector of the economy.

The urban viewpoint. The combination and interaction of these two general tendencies have given rise to the phenomenon of urbanization, which is one end of the problem with which the conference was mainly concerned. In many developing countries attempts have been made to check the drift of population from rural to urban areas, usually with little success. However, with the exception of a few countries in East Asia, the intention behind such measures has not been to stop urban growth, but rather to check the excessive inflow of people for whom no urban means of support could yet be provided. The increase of urban industry, commerce and employment has generally been a welcomed aspect of economic and social development, and is clearly an integral part of the process in the countries with which the conference was concerned. Even if the unhealthy excess urban drift is checked, rapid economic and social development appears inevitably to imply the rapid growth of urbanization and of urban populations. Adequate provision for the supply of these populations is therefore an essential part of the development process.

The various strategies whereby these supplies might be provided have been discussed in some detail earlier in this
chapter. It is, however, proper to cite two comments made during the conference which emphasized important aspects of the problem. One was voiced by Mr Coursey who said that, while urbanization may be deplored, it cannot be stopped, and that whilst it is true that there is usually little malnutrition in rural areas dependent upon root crops for their staple, widespread malnutrition is observable in large urban areas that have grown up in such societies. The other view was expressed by Dr Zoloveke who pointed out that the urban population deserves equal consideration with the rural population. Urban people depend on money and have little opportunity to grow their own food, so that the provision of a balanced diet at reasonable cost and with complete reliability is a major responsibility of government.

In this, the interests of the urban population and the interests of the rural village population do not necessarily coincide. One obvious field of conflict in this respect lies in price, where from the urban point of view the lowest possible price for staple food is desirable, whilst from the rural village producer's point of view a reasonable return for his additional work in production of the staple may require a relatively high price, especially where high transport costs also have to be met. More complex conflicts of interest can arise from the longer-term effects of population pressure on land resources. Where the urban population can be supplied from overseas by the import of foods, that part of the population pressure on land resources has in effect been exported. This is how the extremely high population densities of Singapore and Hong Kong, for example, can be supported.

Until recently this same trend was present, though for different reasons, and less starkly obvious, in much of the Pacific. McGee (Food Dependency in the Pacific: a Preliminary Statement, Development Studies Centre Occasional Paper No. 2, Canberra, 1975) draws attention to the remarkably high level of food imports to Pacific countries even in recent years, and even to countries where population pressure on land resources is still at a very low level. By thus exporting at least a substantial part of the increasing population pressure on land resources, it is possible to postpone some of the problems deriving from the need for intensification technologies and the social and economic changes which these involves. At best this is only a postponement, however, and it is clear that the desire for modern goods and services, and consequently for the money with which
to buy them, is not confined to the urban population. It is spreading even to the most remote rural areas, and as initial aspirations in this respect are realized, higher aspirations tend to replace them and the pace of increasing demand tends to accelerate. This demand is part of the explanation for the drift of population from rural to urban areas, and from remote villages to points of contact with the external economy.

The village viewpoint. Technically and agronomically, large surpluses can be produced in traditional gardens in many root crop based societies, without reducing rural consumption. The extent to which this can be done partly depends on the population pressure already being exerted on land in the traditional areas. As already mentioned, one effect of feeding cities from traditional agricultural systems will be to increase the effective pressure of population on land resources there without increasing the land or labour supply. This can go on for some distance where the man/land ratio is low, but if continued, it must eventually lead to exhaustion both of land and labour.

The point of exhaustion can be postponed by intensification technologies - for most indigenous groups a complex and difficult change for which much of the technology and most of the socioeconomic adaptive processes have yet to be evolved. Dr Chandra and Dr Bollard have contributed approaches to the latter. Considerable work has recently been undertaken by UN agencies and by international research organizations into the technologies of intensification and into the development of high-yielding varieties of root crops, with special attention to cassava. It seems reasonably clear that physically, and economically, adaptation is perfectly possible, and considerably higher population densities can be sustained. However, in the process of intensification and commercialization, changes are necessitated that reach far beyond the technical. To some extent the whole social, political, ecological and energy systems have to be revolutionized, and to some degree endangered. Many of the good points of the indigenous agricultural systems, so strongly emphasized throughout the conference by many speakers, are jeopardized by this process. The question arises as to how much intensification the traditional systems can stand without breaking down? Mr Coursey emphasized the danger to the ecology from the replacement of the farmer as a 'priest of ecology' by what Professor De called 'miners of the land'. Dr Huber and Professor Clarke emphasized the danger to the
tree coverage of the land by intensification processes. Professor Keesing discussed the dangers to the social system where reciprocity and generosity were replaced by individual profit and greed. Clarke pointed to the alarming increase in energy requirements per unit of output as intensification increases. These and many other dangers were discussed throughout the conference as costs involved in the type of change that seemed to be necessary effectively to adapt traditional agricultural root crop productive systems to the needs of rapidly growing urban markets.

The choices seem to include the possibility of feeding urban populations by imported foods paid for by exports (or in some cases by aid), in which case the opportunity of passing on to the rural population directly a part of the increasing urban monetary incomes, through the satisfaction of its food requirements, is ignored. Another possibility is the adoption of exogenous systems of commercialization, whether based on large-scale or small-scale commercial farms, as has been tried in many areas in the past. In those parts of Central America and of Africa where indigenous systems have been replaced by exotic systems, very substantial food supplies for large urban concentrations have been achieved. The achievement is by no means ideal, however, either from the urban viewpoint, where malnutrition and low-quality processed foods are common, or in the rural areas where the growth of individual commercial farming on a selfish rather than communal orientation has eroded the indigenous safeguards against extreme poverty, malnutrition and exploitation. Thirdly there is the Arcadian type of system so emphasized by Huber, Keesing, and to a less extent by Mr Tafatu, where man is in harmonious balance with his environment, and there is stability both in the ecology and in the social system.

There was a wide measure of agreement that the latter choice, idyllic though it may be from certain points of view, was no longer a real alternative for any practical political decision-maker, though some relief might be found in reversion to some of the more intensive indigenous systems, such as the taro terraces, now almost entirely abandoned, if further research suggests this is possible. There was, however, a perhaps less wide but nevertheless significant consensus that these three should not be accepted as the only options available. Dr Martin Evans put the question succinctly by asking if there were a trade-off between cultural values and material gains. Dr Diana Howlett put much the same thought in asking whether there is a middle
way. Much of what Dr Huber, Professor Keesing, Mr Tafatu, and Dr Salato had been saying seems to come out in the dilemma posed by Professor Clarke. His question was, in effect, whether the Utopia that is unattainable in much of the world because population growth and modern materialism have gone too far, may perhaps be attainable in some root crop societies of the humid tropics. From many points of view such an attainment would be highly desirable, but it is unlikely to be possible without considerable constraint, both upon the rate of population growth, at least in the long run, and upon the rate of growth of economic consumption per head of population. Whilst, as Mr Coursey pointed out, these constraints will eventually have to be accepted by the world, either deliberately or catastrophically, it is clearly far preferable that the catastrophic approach should be avoided by all means available.

Having said this, the conference did not feel able to go very much further. A great variety of experience of development programs around the world was represented at the conference, and the general view was that in most root crop based societies there remained a very large source of high quality foods that technically and economically could be made available to feed increasing populations, given the necessary economic infrastructure and encouragement. The adaptation of traditional systems to meet this requirement was a complex problem, going far beyond technology and economics, into the fields of social systems, the ecology and the use of energy. The costs and potential dangers involved in rapid adjustment could be high, and required research and caution for their mitigation.

In this book a wide range of facts and issues have been discussed that are relevant to the political decision-making required to plan what to do, and how to do it, and how fast. Beyond this the social scientist cannot go. Social, political, agronomic and ecological conditions vary widely from place to place, and in every situation the optimum solution, if there is one, must be site specific. But the problem goes deeper than this, and beyond the reach of the social scientist. For example, having considered all the facts and issues discussed in the book, finally the decision as to whether, and in what manner, and how fast, to bring the Malaita islanders into the cash economy, and to what degree it is proper to allow the sacrifice of their stable social system, their eminently well-conserved ecology, and their economical energy use, to achieve this end is a hard decision that can
only be taken at the political decision-making level. The social scientist can assist the decision-maker by clarifying the issues and determining the facts; but the final judgment itself is not a scientific one, it is a value judgment. Of such judgments one can do no better than to quote F.A. Hayek who, in his *Studies in Philosophy, Politics and Economics*, said:

Reason can only help us to see what are the alternatives before us, which are the values which are in conflict, or which of them are true ultimate values and which are, as is often the case, only mediate values which derive their importance from serving other values. Once this task is accomplished, however, reason cannot help us further. It must accept as given the values which it is made to serve (Hayek, 1967:87).

Thus, having gone as far as reason and our knowledge of indigenous social systems permit, the ultimate judgments must be left to those who are charged with making them on the basis of the values of their own societies. It is to be hoped that this volume may in some way contribute to their making such judgments well.
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