UNESCO/UNFPA PROJECT ON POPULATION AND ENVIRONMENT
IN THE EASTERN ISLANDS OF FIJI
(Man-and-the Biosphere Programme)

PROJECT WORKING PAPERS Nos. 4, 5 and 6

PAPERS ON CROPS, FARMERS AND MARKETING
P.H. Haynes; H.C. Brookfield; J.B. Hardaker

4. Patrick Haynes: SOME ASPECTS OF AGRICULTURE IN TAVEUNI AND LAKEBA
5. Harold Brookfield: THE TAVEUNI FARMERS
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Appendices:
1. Data on the main smallholder crops (Hardaker)
2. Notes on estate copra production (Brookfield)
3. Some technical considerations on rehabilitation of coconuts (Haynes)
4. Further notes on crop density and diversity (Bayliss-Smith)

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THE UNESCO/UNFPA POPULATION AND ENVIRONMENT PROJECT IN THE EASTERN ISLANDS OF FIJI: A DESCRIPTION

The UNESCO/UNFPA Project was conceived within the framework of the Man-and-the Biosphere Programme of UNESCO, and forms part of Project 7, 'The Ecology and Rational Use of Island Ecosystems'. It was designed as an international project, to be one of a series in different regions of the world, both to feed into, and to provide a measure of design for, national programmes of research into man/biosphere relations. After the agreement of the Government of Fiji was obtained in 1973, the project was funded in 1974, and research began later in the same year. Fieldwork ran through 1975 until mid-1976.

The project has had two objectives. On the one hand its purpose is to explore the scientific study of human activity in and on specifically defined environments. On the other hand it has also had the objective of providing researched guidelines for policy aimed at optimizing, within the limits of possibility, the satisfactions of life for the people concerned, within the context of rational use of environment. The objectives are not seen as in conflict; the same research programme feeds both aims, and we have sought to demonstrate that scientific research into population and environment can equally serve both 'pure' and 'pragmatic' ends, each being the better for the incorporation of the other. The two general reports of the project, to be published in the MAB Technical Notes Series, will reflect these two faces of our work.

The research team has represented the disciplines of human and physical geography, demography, soil science, marine biology, nutrition, agronomy and agricultural economics. Topics under review have ranged from the fields of soil and vegetation ecology and the impact of natural hazards, through studies of land use and land holding, detailed community studies and the economics of farm-decision making, to regionally-comprehensive studies of production and communication, historical demography and migration. This list is not exhaustive. The emphasis given to different topics, and hence different specialisms, reflects the problems identified in the particular area. The method of research has varied; community studies are best carried out by an individual researcher, but often several specialists have lived and worked together in the field, each pursuing his own line of interest, but constantly interacting, so that almost all members of the project have become aware not only of the work of their colleagues, but also of the methods used and the problems raised.

This project has had a smaller local component than we wished or had planned. In common with many developing countries, Fiji has only a limited pool of skilled specialists, and we were not able to secure the collaboration of certain persons from
whom the project would have gained much. However, we have collaborated very extensively with the field and headquarters staff of three Ministries and have also collaborated, in a real sense, with the populations of the islands in which we have worked.

The design of the project has been governed by the resource available to us. We have carried out some general studies over the whole eastern island area, and several members of the project have been able to tour quite large areas of an oceanic region. However, we have concentrated our efforts principally on two islands, and have worked less intensively on three others. These five islands, respectively Taveuni, Lakeba, Kabara, Koro and Batiki, were chosen to reflect a range of physical types and also of economic development, and of distance - measured in the real terms of access - from the national centres.

For the most part the full evidence of integration of our work will appear only in the general reports. However, a great body of data and discussion cannot be presented in these reports and we are thus also publishing a series of Project Working Papers, which will contain from one to three reports by individual specialists, or, in a few instances, the collaborative and integrated work of more than one. This series has limited distribution, and its primary purpose is to make our work available quickly in Fiji itself. All Project Working Papers are 'cleared' only with the Chief Technical Adviser; they therefore do not necessarily represent the views of UNESCO or UNFPA, or even of the project as a whole. Responsibility for all statements made and views expressed rests with the author.

Harold Brookfield
Chief Technical Adviser

EDITORIAL INTRODUCTION

This collection of papers and appendices concerning different aspects of the agricultural economy of Taveuni, and to a lesser degree also of Lakeba, has considerable potential interest for those concerned with agricultural development in Fiji and elsewhere in the Pacific. In terms of the project, it represents also a stage in evolution from independent work to the integration of a research team, since the three of us represented here have worked in close interrelation in the field. The whole could, of course, have been woven together editorially into a single statement, but these Working Papers are intended to present our results in a less finished form than would be required by such presentation; they also exhibit, as no integrated general report can do, the individual points of view of different project members.

Haynes was in Fiji long before the rest of us, as agronomist in charge of a small but important project on root-crop cultivation organized by FAO with UNDP support. When we came into close contact with him he had already completed a large programme of experimental work and was ready to put his results and wide knowledge into application -- he never had the opportunity to do this in Fiji. His work with us began as simple association; he needed to examine agricultural systems, and our growing knowledge of the Taveuni farmers made possible complete useful collaboration. Partly still with FAO, and partly with us after his FAO contract came to an end, this work went on to the systematic measurement of crop yields in the field, by very rigorous methods, and with the cooperation of the Ministry of Agriculture. This is the core of the work he reports here. Beyond this, however, he provided us all with guidance in a complex field, and a pair of eyes that saw much that the rest of us missed.

Hardaker had profound experience in a neighbouring country, Tonga, where he had both reported to Government on agricultural policy as a whole, and also had sought to adapt the methods of linear programming well-known in farm-decision modelling in western economies, to the problems of the Tongan farmer. I first met him at the Institute of Development Studies in Brighton, England, where we began a lively (but I must confess rather one-sided) exchange on some of my ideas about Fiji and this project. He brought to us rigour and technical expertise, together with the rather severe data requirements of the l.p. modeller. In his paper here he reports only on one aspect of his work with us; as he says himself, he relies on the rest of us for much of his data, but the viewpoint which he brings is illuminating, and strongly underpins views which we shall have to express in the general report on the project.
There was a measure of overlap between these papers, which I have sought editorially to eliminate by cutting pieces of each paper, and constructing two of the three appendices from material provided. But there was also an inevitable omission, that of depth of local background which only prolonged field work can provide. I have sought to fill this gap both by provision of a very qualitative paper on the background of the farming system mainly discussed, and also by an attempt -- in an appendix -- to link the quantitative results of a limited survey of estate costs to more qualitative evidence.

I hope that the result of this compilation will be viewed as a rather more complete presentation of data and knowledge about agriculture in Taveuni, and its farmers and planters, than could be provided by the simple presentation of unedited papers. It is not a wholly complete presentation, for it does not discuss other aspects of Taveuni society and economy that are highly relevant. For Lakeba it reports little but the results of taro yield measurements. None the less, it represents a useful stage forward in our efforts to condense and analyse our data, and achieve understanding.

Certain obvious conclusions emerge. We all stress the contrast between the productivity of modern smallholder farming growing field crops and the declining productivity of the estate-organized copra industry on which the economy of Taveuni has been based for most of a century. We suggest, however, that this grafting-on of commercialized farming onto a system using subsistence technology has serious limitations, and that new approaches are needed if it is to progress further. But we go beyond this. We foreshadow a discussion of land distribution that will arise later in this series (certain comments were edited out because the data remain fully to be presented). We offer some comment on the present crisis in the copra industry. Perhaps most particularly we focus attention on the peripheral situation of Taveuni within Fiji, so that the results of a very solid local initiative have largely been reaped by places closer to the centre.

Here we lead, as in Bedford's paper (Project Working Report No.3), into two of the central problems of the eastern island region: dependency and scale. The dependency of the Taveuni rural economy on overseas markets and the Suva market emerges strikingly, as do also the costs of remoteness from both. But the scale question also arises. Taveuni is the largest of the islands with which we deal, yet it is too small. Some time ago I met two experts in Taveuni, who were enquiring into the technical and economic feasibility of setting up a desiccated coconut factory somewhere in the copra-producing districts of Fiji. Taveuni, they thought, was too small and a-central to be a candidate for location of such a factory. They then asked me what our project was revealing, and I replied that they had just stated the most central problem themselves: even the largest and most developed of the islands with which we are dealing is too peripheral and too small to support a major investment.

But this is a situation which can feed on itself, as a reading of these pages will demonstrate. We do not discuss this larger problem here, but it is the context of the whole development problem of the eastern islands. These islands are not poor in natural resources; what they are paupers in is two creations of modern development -- location and scale. We make certain proposals in this issue, but the fundamental issue underlies them: it is not aired here, but it is always present.

Finally, I should thank my two colleagues for their willingness to allow me to edit their papers freely, and to decide on their form of presentation. I hope they are content with the result, but I can offer them only my apologies if they are unhappy. I should also thank my secretary, Mrs Colleen Morton, who has swept through the production of this issue immediately after a diet of soils and molluscs (Project Working Papers Nos 1 & 2), with what has looked almost like enthusiasm. Such skill in deception is the hallmark of any good secretary.

H.C. Brookfield
UNESCO/UNFPA PROJECT ON POPULATION AND ENVIRONMENT
IN THE EASTERN ISLANDS OF FIJI
(Men-and-the Biosphere Programme)

PROJECT WORKING PAPER No.4

SOME ASPECTS OF AGRICULTURE
IN TAVEUNI AND LAKEBA

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I - DESCRIPTION OF CROP PRODUCTION

INTRODUCTION

This report describes the crop production phase of Taveuni and Lakeba as part of a more comprehensive appreciation of island communities in Eastern Fiji. The study grew out of my earlier investigations on production systems and yield variation of root crops, which were made as part of an FAO project on root crop production in Fiji, directed by the writer. These studies were extended to include estimates of taro productivity on farmers' fields in Taveuni and Lakeba as part of the UNESCO Population and Environment Project. The association with this latter project provided opportunity to extend my earlier study of indigenous crop production technology.

The present discussion draws on information collected in the earlier FAO project supplemented by field work during February. Since the information presented is intended for use in a multidisciplinary project, descriptions of the components of the agricultural systems in Taveuni and Lakeba are given. These are followed by an account of the cropping systems and practices with some discussion of the various levels of production technology that they reflect.

Later in the report, the yields of tropical root crops are presented and discussed. Information on root crop yields from farmers' fields is sparse. Because of this, taro yields are treated in some detail, since taro is the most important root crop in both islands studied. Time and resources did not permit equal attention to be given to cassava (Manihot esculenta Crantz) and yqona (Piper methysticum Forst).

In the final section, some possible technical changes in the systems are discussed. Evaluation of economic feasibility and the social implications of the proposed technical changes would be required before making positive recommendations. The comments made on alternative technologies may however be of some use in arriving at conclusions about the future development of the agricultural resources on the islands. The concluding comments are not however made as positive recommendations for change.

Acknowledgements

The author wishes to acknowledge the logistic support provided by the Ministry of Agriculture, Fisheries and Forests. In particular he thanks Shankar Prasad for his help with the field work in Taveuni and Lakeba and Miss Prem Cour Singh.
for her help with computations. The willing support, cooperation and hospitality of the agricultural field staff and farmers in both islands will be remembered with pleasure and gratitude. Field measurements in Taveuni were made in collaboration with Harold Brookfield, and in Lakeba with John Campbell and Brian Hardaker.

COMPONENTS IN THE AGRICULTURAL SYSTEMS IN TAVEUNI AND LAKEBA

Crops

While emphasis may vary between individuals and families, crops in the islands are produced either for food, as a source of income or for fabric. The food crops are mainly coconut, taro - dalo in Fijian - and cassava - tavioka in Fijian. Some production of supplementary foods occurs, mainly as grain legumes among Indo-Fijians and leafy vegetables among Melanesian Fijians. The production of fine vegetables is sparse. Coconuts, yamona or kava, and recently taro in Taveuni, are the main commercial crops. In both islands, voivoi (Pasania odoratissimus L.f.) is grown and made into mats, which are highly regarded as items for presentation to fulfill social obligations. Their production utilises a fair proportion of the labour resource, particularly that of females. Masi - bark cloth - (Broussonetia papyrifera (L) Vent) production occurs sporadically in Taveuni, but has not been seen in Lakeba. Where bark cloth is made it also utilises a high proportion of the female labour resource.

Taro - (Colocasia esculenta (L.) Schott) var esculenta. Taro or dalo, as it is known in Fiji, is highly adapted for growth under conditions of low moisture stress (Haynes 1974). In Fiji, three situations for taro production, all with low moisture stress, are recognised. These are (a) high rainfall areas like Taveuni where transpiration loss seldom exceeds rainfall income, (b) high water table areas like the swamps in the lower valleys of Lakeba, where raised beds are constructed with frequent cross drains (tuki tuki) and finally (c) rainy cultivation, where taro is grown on terraced soil with water flowing continuously over its surface fed by diverted streams. The seasonality of taro supply in Fiji is a reflection of its high water requirement. The bulk of the commercial supply is grown as a rain-fed crop and supplies fluctuate with the season. The majority of the crop is planted at the start of the rainy season with little planting in the dry season.

Taro grows well under conditions of high mineral nutrition, frequently being planted as first crop in newly cleared land. Where mineral status is high, three or more successive crops of taro may be grown in the same soil. In less fertile conditions taro may be grown for one season only. Alternatively chemical fertilizers, principally nitrogen, may be applied.

There is wide variation in taro occurring in Fiji. Over seventy named cultivars have been collected (Annual Research Report, MAFF 1974). These are characterised by petiole colour, corm shape, flesh colour and texture, length of rhizome, and number of suckers (suli suli) and various stem characteristics. Many farmers grow stands of mixed cultivars providing some protection against adversity, since it is unlikely that they will all have the same levels of susceptibility to unfavourable conditions (Haynes 1976). For commercial purposes, the cultivar 'Samoa' is most popular. This cultivar has good horticultural and market characteristics. Among Melanesian Fijians the 'kava' or 'basaga' group are preferred. It is interesting to note that this latter group has a higher dry matter content than others. The growth pattern of taro at Korovia Research Station confirms the generally accepted view that taro corms mature after nine months of growth. The possibility of harvesting taro from seven months appear good where growth is rapid, as would be the case with taro yielding in excess of 25 mt/ha after only nine months of growth.

Taro is traditionally planted in holes dug with a pointed and flattened stick, the ai doko or ai sau, but may be planted on ridges or in shallow furrows and subsequently ridged up. The most frequently used planting material is the side suckers or suli suli which are prepared by trimming the leaves and removing in excess of one half of the corn. Experiments at Korovia Research Station show yields to be related to diameter of the suli suli corn (Haynes and Sivan, in press).

Taro has been cultivated in Fiji for a long time. The evidence of old irrigation terraces in Gau, Nadroga, Ra, Taveuni and elsewhere suggest early introduction of this crop to Fiji. The use of the crop for ceremonial purposes also indicates a long association with Fiji.

Yam - (Dioscorea species) Several species of Dioscorea are used as food in Fiji. Of these, D. alata L - uvi - is the most frequent. D. esculenta (Lour) Burkill - 'Kauai' occurs through Fiji, but is grown in smaller quantity than the better known uvi. D. numularia L - Tivoli - is gathered from uncultivated patches and rarely cultivated but occurs widely, and patches of bush rich in Tivoli may be preserved from clearing. D. pentaphylla L - Kale - also wild, is used only under conditions of considerable food shortage. Among the uvi over 100 cultivars are grown locally. These vary in tuber shape, colour of tuber tissues, as well as in foliage characteristics. This yam is one of the most prestigious crops in Fiji, being preferred for ceremonial presentation. Although the nutritive value of the Fijian cultivars has not been established, work elsewhere (Martin and Thompson 1971) has shown some types to have high protein content.
Yam has a cyclic growth pattern in which an active growth phase alternates with dormancy. The duration of dormancy varies between species within the yam family. This is an important factor since it enables cultivars of species like yuvi, with long dormancy, to be grown in climates where severe dry seasons alternate with periods of good rainfall. Dormancy also permits tubers to be stored, an asset of importance to the trading potential of remote areas.

Cassava - (Manihot esculenta Crantz). The name 'tavioka' used in Fiji is an adaptation from 'tapioca' used by some writers to describe both the plant and a starch derivative. Cassava is not indigenous to the South Pacific. This crop grows in a wide range of rainfall conditions enabling it to be planted in any region of Fiji, at all times of the year. Cassava has the ability to produce a crop on soils too poor in nutrients to support other crops. The crop also requires less labour than taro or yam. These three factors, (a) seasonal flexibility of planting, (b) undemanding soil nutrient status and (c) low labour inputs, have contributed to the increasing popularity of cassava. The cultivars used in Fiji are presumed to have a low limamarin content - the glucoside associated with cyanide toxicity, since processing to detoxify the product is not practiced. After peeling, the roots are usually boiled and eaten without other precaution.

Apart from carbohydrates, there is an almost complete absence of food nutrients in cassava. This has been the cause of concern among nutritionists, particularly where its production results in the replacement of the more nutritious yams and taro in diets. In view of the agronomic advantages of cassava, an appropriate strategy to overcome the problem of nutrition could be the education of potential users in the acceptance and use of suitable food supplements to a cassava based diet.

A major constraint to cassava production in Taveuni is the widespread occurrence of rats, as in any coconut-growing area. Damage by this pest is not important in taro and yam due to the presence of other root and rhizome pests. In these species these rhizohides cause irritation in the mouth and throat thereby protecting the species from rodents. The susceptibility of cultivars in Fiji to rat damage may be related to their low HCN content.

Yaqona -(Piper methysticum Forst). The dried roots and stems are used to make kava, the drinking of which is central to ceremonial and social life in Fiji. The development of trade in this commodity could well parallel the growth of urbanisation and the transition from a subsistence to a commercial economy. It would be of interest to measure the extent to which urbanisation has influenced market demand but unfortunately no data exist on yaqona sales. If such a relationship exists then long term market demand and consequently price levels, could be predicted.

Yaqona is usually established as three or four node cuttings. (fig.1). Cuttings with as few as two or as many as six nodes of apical stem material may be used. The crop is usually grown in mixed cultivations with taro and coconuts. Several qualities of yaqona are produced from the same plant (fig.2). The best quality material comes from the roots which are dried to make yaqona current value of which is $3.25kg. Basil stems may be barked, cut into small pieces and dried to make lawena, current value $1.08kg; the scrapings or ciriciru may be dried and used for household purposes. The mid-stems material (kasa) may be prepared like the lawena, commercial value per kg. 33-44 cents per kg. Fig. 3 shows a general view of yaqona preparation. Yields estimates are sparse as the crop is seldom weighed. Farmers in Taueuni claim that 25 plants produce c.195-220kg Lawena and c.175kg Vaka (air dry).

Several cultivars are grown in Fiji, of which the following were recognised in Taueuni:

MATANITABA - characterised by a pale green stem.
YAQONA VULA - characterised by a pale green stem with prominent lenticles.
YAQONA LOA - has a dark stem with short intermodes. Said to be high yielding; appears to be widely grown.
DIKOBANA - has a dark stem with long intermodes.
YAQONA DAMU - has a dark stem with reddish citrus.

Masi -(Broussonetia papyrifera (L) Vent). Masi is usually grown in small patches near the homestead. It may be planted 0.6 x 0.6m, but it quickly spreads. Well drained soil is preferred and masi may even be grown on stony ground. A good patch about 4000m² (1 sq.chain) in size may be established from as few as ten suckers.

It takes up to one year before the first crop is mature, when stem and bark are thick enough to give good fibres. The plant may be cut about 1.25cm above the ground. The bark is split and removed in one piece and then rolled on both sides. A small incision is made from the outer surface and the epidermal tissues removed. This operation is completed by scraping. In traditional practice a cone shell - iKari ni masi - is used. While being scraped, the strip is moistened and placed over a length of bamboo. The clean strip is then rolled and kept moist by immersion in water. The strips are next placed with the outer surface downwards over a wooden base or dyana and the inner surface is beaten with a mallet or ake. The strip is beaten length ways and as beating continues, the strip is folded on itself. When folding is complete the strip is long and narrow; one observed measured 6cm x 25.5cm.

A strip 3.5cm wide was beaten until it became 25.5cm. Three strips were joined by beating together. Strips to be joined are trimmed and beaten to match each other. Since the top tends to be thinner, the strips are joined 'top and tail'. Six or more pieces may be joined by beating the edges together. The joined material may be cleaned by washing. After unfolding, the masi is sun dried, at which stage it is ready for application of designs.
Voivoi - (Pandanus odoratissimus L.f.). The cultivation of voivoi, harvesting of leaves and preparation for mat making is generally the concern of women. Men may help but the crop is largely planted and tended by women. Before planting, bush is cleared and the area forked. Suckers are planted, usually at a spacing of 0.9 x 0.9m (3 x 3ft). The first crop of leaves is taken after two years of growth. Usually four or five leaves per plant are removed at each harvest; some informants claim more. As many as 100 leaves may be collected in one operation. The thorns are removed from the leaf margins and from the back of the midrib. Ten leaves are put together, folded and made into a bundle (fig.4). The cells of the leaves are then killed by immersing in boiling water for a short time (fig.5), usually until the colour changes. The bundles are then untied and hung in the sun to dry. These operations may be completed in one week if weather is fine. The sudden killing of the cells helps to keep the leaves flexible, preventing them becoming brittle when dry. When dry the leaves are rolled and reverse rolled and may be smoothed by rubbing with a shell. Up to 500 may be prepared this way in one day.

<table>
<thead>
<tr>
<th>Informant</th>
<th>No of leaves</th>
<th>Size of mats (cm)</th>
<th>Time taken</th>
</tr>
</thead>
<tbody>
<tr>
<td>Katarina</td>
<td>80</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Anon</td>
<td>100</td>
<td>202 x 140</td>
<td>1 - 2 days</td>
</tr>
<tr>
<td>Mou</td>
<td>60</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sulio Solita</td>
<td>100</td>
<td>220 x 128</td>
<td>1 - 2 days</td>
</tr>
</tbody>
</table>

Mats are important items for presentation, which may be souvenirs to guests, or more formally, may be presented at funerals and to bride and groom in ceremonies - i tevutevu - following a wedding. In 1975 one family made 40 mats which were disposed of as follows:
- 4 were presented at funerals
- 33 as part of their son's i tevutevu
- 3 were used domestically.

Coconuts - (Cocos nucifera L.). Since times of antiquity coconuts have held a central role in cooking in Fiji. Not only is the oil used but also an extract from the grated flesh termed lolo. Non-culinary uses include cosmetics - where the oil is scented with flowers of makosev and with pieces of sandalwood.

In modern times copra and coconut oil have become important items of trade, the volume of which gives them a significant place in the export economy of Fiji. The price of copra is, however, subject to marked fluctuations which cause similar fluctuations in supply, since with low prices the collection of nuts declines. This possibility is not lost on the island farmers. In the south of Taveuni taro and yaqona are intercropped with coconuts after the taro matures in eight to ten months. The yaqona is allowed to grow to maturity taking three or more years.

Cropping Systems and Practices

In Taveuni and Lakoba, as mentioned earlier, a variety of food and fabric crops are grown in addition to coconuts. These are used either for subsistence or sold for cash in the commercial market. The main food crops are carbohydrate, namely Cassava, taro and yam. These are supplemented with foliage of bece, (Hibiscus manihot L.) some ferns and taro. Among Fijian supplemental foods included some fine vegetables and grain legumes. Yaqona, extensively used as a beverage, has become an important commercial crop.

Since the above are grown either as subsistence or commercial crops, the levels of production technology vary. The cropping systems may be categorised in a variety of ways. The following has been found useful by this author:
- Coconuts and complementary cropping
- Taro, yaqona inter-cropping
- Domestic food production including supplemental foods
- Production of fabric crops.

Coconuts and complementary cropping. This system is usual in the south of Taveuni where much of the lower, more gently sloping land is planted with coconuts. The coconuts are variably spaced. Where these are tall, sufficient light penetrates to permit crops or weeds to grow. The crops include grass which is grazed by livestock (fig.6), or more frequently taro and yaqona as commercial enterprises and occasionally with subsistence food crops (fig.7). The coconuts are grown with little or no inputs apart from those required to extract the copra. Where bush grows under the canopy attempts at control by weeding appear less than successful. Many planters, and most smallholder farmers seem unable to mobilise sufficient labour to clear and keep the groves clean of weeds. Greater success with weed control is achieved with grazing or cropping. Some groves, planted with Malayan Dwarf nuts, allow the passage of insufficient light to permit successful inter-cropping or competitive weed growth. However, in the words of one planter: "Nothing but mass grows under them and the land is useless".

A major deterrent to improving coconut agronomy is the delay of about three years before the effects of such improvement is reflected in yield increase. The intercropping of taro and...
Yaqa could provide income during this lag period, thereby overcoming some of the resistance to investing in these food gardens. These intercrops are complementary and may be planted in any sequence. Most farmers appear to plant taro first and follow this with yaqa. Two or occasionally three crops of taro may be taken simultaneously with varying success. Three year old yaqa. Variants of this basic pattern include rotating the taro with yams or cassava.

Taro - yaqa inter-cropping. The growing of taro and yaqa in intercrop association is usual in the central and northern districts of Taveuni, at elevations beyond the range for coconuts. In cases where the land is being cultivated for the first time, bush is cleared and taro planted in holes in the cleared soil. Such taro is intended for sale and mainly commercially acceptable. After harvest the taro suckers, suil suil, may be left to develop and the more mature suil suil planted between the sites of the original crop. Occasionally a raton crop - vage - may be taken, by permitting suckers present at time of harvest to reach maturity.

On these higher lands, taro is grown entirely by hand. The only operation which is partially mechanized is weed control, where the herbicide 'Gramoxone' is applied as a spray from knapsacks. Some farmers make use of communal labour in taro/yaqa production. In one case, at Qelei Road, 14 farmers spend one day per month on each other's farm. This system effectively mobilizes labour without recourse to the use of wages, a practice representing an interesting survival of subsistence practice into commercial production.

Production of supplementary foods. Although taro is primarily grown for the corns as a source of carbohydrate, this crop also provides substantial food supplements. The leaves may be used to make yu yu or palusami and the stalks, lightly boiled, are eaten as an occasional vegetable. Other food supplements may be gathered from uncultivated patches as in the case of three species of fern, the young fronds of which are boiled and served as a lolo-based. Other leaves used as food include species of Amaranthus which may have been adopted from the eating habits of Indo-Fijians. A frequently cultivated edible leaf is hele. Although cultivated, it is seldom grown in pure stand but occurs as an intercrop or a hedge plant. The plant grows easily from stem cuttings and may be cropped over several years. Apart from edible bananas (Musa spp.), some papaya (Carica papaya) and a variety of nuts, Melanesian Fijians appear to use few additional supplementary food crops. The variety is much greater amongst Indo-Fijians who grow a range of condiments, grain and vegetable legumes, cereal grains and a number of cool and hot season fine vegetables. On one holding at Qila Road in Taveuni as many as 29 different vegetable crops were observed. This may be exceptional, but it illustrates the variety known and available to Indo-Fijian farmers.

The solution to the problem of providing supplemental food takes many forms. Some growers use the leaves and stalks of taro as by-products to basic carbohydrate production. Others resort to gathering edible herbs, some grow complementary crops and many have special food gardens, usually near the homestead village, where domestic requirements are produced.

The Production of Fabric Crops. The main fabric crops produced are ma in Taveuni. Very little ma is now manufactured in Lakeba although it is important in other parts of the Lau group. The apparent amount of time devoted to the production of these fabrics, particularly by women in villages, makes them worthy of study.

Ma is usually grown near villages or homesteads, in small but dense stands, the best fibres of which are made into bark cloth. Its production is onerous and appears to be declining. Its manufacture was only seen at Dreketi (Somosomo) in Taveuni where production is occasional, and the organisation communal. The product is generally used for special presentations or on such occasions as weddings.

Mat making from voivoi, in contrast, is a continuing occupation. There is evidence in most villages of voivoi at all stages of preparation, from fresh green leaves to nearly completed mats. The writer even encountered a party who had crossed to Taveuni from Vuna Levu for the sole purpose of preparing a stock of voivoi for mat making. Apparently a trade is developing in leaves, with increasing demand from urban areas.

II - YIELDS OF TARIO IN TAVEUNI AND LAKEBA

INTRODUCTION

In Taveuni, substantial amounts of taro are now grown in response to the demand from the National Marketing Authority (NMA). Although much of this production is based on the technology of subsistence production, the circumstances of the commercial market have stimulated some changes in production practice. Some of the recent expansion of taro production has occurred on newly cleared land with high levels of mineral and physical fertility. These levels are so high that up to three successive crops of taro may be taken. A substantial proportion of taro production occurs as an intercrop with coconuts, either in rotation with yaqa and food crops or on soils which have been under grass or bush. A range of taro cultivars are grown in Taveuni. Table 2 shows the cultivar frequency in the Taveuni samples. The cultivar Samo is frequent, and may reflect NMA preference. Other cultivars are also acceptable to NMA, may be grown more in deference to its high yield potential with high rainfall than as a response to NMA preferences. The high rainfall in Taveuni - 3,000 - 6,000 mm per year (Brookfield and Hart 1966) is an important factor in the production of this crop.
Lakeba is in marked contrast. Here the crop is grown on marshy soils of the lower river valleys. The system of cultivation - tuki tuki - consists of a series of frequent cross drains between slightly raised beds (Fig. 8). The taro are planted in holes which reach down to the water table, and along the sides of the drains. The rainfall is somewhat lower than Taveuni, 2123 mm/year at Tubou (Brookfield and Hart 1966), but the high water table enables a low soil moisture stress to be maintained.

### TABLE 2. Frequency of Cultivars in Taro sampled in Taveuni:

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1*</td>
</tr>
<tr>
<td>Samoa</td>
<td>70</td>
</tr>
<tr>
<td>Samoa Oriiari</td>
<td>36</td>
</tr>
<tr>
<td>Tausala Ni Samoa</td>
<td>36</td>
</tr>
<tr>
<td>Dale Tagane</td>
<td>5</td>
</tr>
<tr>
<td>Vavai Lona</td>
<td>3</td>
</tr>
<tr>
<td>Vavai Dina</td>
<td>-</td>
</tr>
<tr>
<td>Missing</td>
<td>-</td>
</tr>
</tbody>
</table>

* At site 1 five plots of 30 plants were sampled. At other sites four plots of the same size were sampled.

In Lakeba, the crop is grown for subsistence purposes with occasional sales of relatively small quantities to visiting ships or resident civil servants. The cultivar range is smaller than that in Taveuni. This is believed to be due to a comparatively recent disease epidemic. The original cultivars have been replaced by Gave ni Urau, a vigorous but not necessarily the highest yielding type.

### ESTIMATES OF TARO YIELDS

#### Method

The evaluation of agricultural yields is frequently complicated by the harvesting of crops in different forms. This is particularly true of taro in Fiji where harvested material may be in any of three forms. The traditional form includes the corms with about 80 cm of petiole attached arranged in groups of two to ten corms, depending on size, and presented as a single unit for sale (Fig. 9). In contrast, the accepted form for purchase by the NMA consists of corms with only 10 cm of petiole attached. A third method is used in the Research Division of the Ministry of Agriculture Fisheries and Forests at Korovis, Viti Levu.

Where yields are measured from corms with all of the petioles removed.

Since yield estimates of taro in Fiji are sparse, yields in all these forms were recorded, added to which estimates of corn dry weights were made from oven dried samples (dried for 24 hours at 80°C). Finally, total plant fresh weight was also measured. All observations were made on individual plants in plots. The cultivar name was noted, together with the area occupied by the plant. From these data, yields per hectare were calculated. To avoid variations due to age differentials, attempts were made to record only ten month old material. It should however be noted that farmers may harvest taro from seven to 11 months after planting.

Size of sample plots varied between Taveuni and Lakeba. In the former, holdings were of sufficient size to permit plots of 30 plants to be taken. These were replicated four times and five in one instance. In contrast, taro for yield estimates was less readily available in Lakeba, where the crop is grown almost entirely to meet domestic requirements. Sample plots on that island were accordingly reduced to 20 plants and replications made within a single ecological unit rather than within holdings. The sites in Taveuni were chosen to represent low and high elevation in the north and south of the islands, as well as a high elevation on a new land development in the central region. In all these areas the crops were cultivated on well-drained soils. In Lakeba the sites were all representative of low-lying hydromorphic soils on a layer of peat on valley or sub-coastal swamp. The cultivation was typical tuki tuki with high water table. Areas of apparent vucu plots (wholly under water) visible in 1970 air photographs were in fact rice paddies; all or almost all have now been re-converted to tuki tuki.

### Results and discussion of taro yield estimates

Taveuni. Taro yields were everywhere highly variable. Table 3 shows the site means, ranges within sites and standard deviations for sites. Mean yields of corm fresh weight varied between sites from 9.34 to 26.01 mt/ha. Within-site variation was similarly marked, with standard deviations from the mean of 1.568 to 9.229 at the extremes. The corresponding mean corn-dryweights varied from 3.06 to 8.93 mt/ha. Reasons for such variation are not easily adduced. Attempts at relating variation in plant spacing and yield by regression analysis proved negative. Other management practices, such as variation in size of planting material may be contributory, but such differences were difficult to establish at harvest. Soil heterogeneity together with micro-level variation in topography appear likely sources of variation. In the absence of critical measurements of soil parameters this is, however, only speculation.

Of some interest is the amount of stalk contained in the farmer’s yield i.e. fresh weight of corn, with about 80 cms of stalk. (Table 3 [c]). While some of these petioles may be used for food, not all cultivars are appropriate for culinary purposes.
TABLE 3. Yields of Taro in Taveuni In Mt/ha.

(a) Corm fresh weight yields

<table>
<thead>
<tr>
<th>Farmer</th>
<th>Mean</th>
<th>Range</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (A)</td>
<td>9.20</td>
<td>7.50 - 11.10</td>
<td>1.568</td>
</tr>
<tr>
<td>2</td>
<td>22.02</td>
<td>16.74 - 26.22</td>
<td>4.753</td>
</tr>
<tr>
<td>3 (C)</td>
<td>13.78</td>
<td>7.55 - 18.19</td>
<td>4.440</td>
</tr>
<tr>
<td>4 (h)</td>
<td>15.78</td>
<td>8.18 - 20.19</td>
<td>9.239</td>
</tr>
<tr>
<td>5</td>
<td>26.01</td>
<td>18.18 - 35.87</td>
<td>7.186</td>
</tr>
</tbody>
</table>

(b) Corm dry weight yields

<table>
<thead>
<tr>
<th>Farmer</th>
<th>Mean</th>
<th>Range</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.006</td>
<td>2.50 - 3.79</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>6.98</td>
<td>5.88 - 8.31</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>4.59</td>
<td>2.71 - 5.75</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>5.95</td>
<td>2.70 - 11.78</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>8.73</td>
<td>6.29 - 12.18</td>
<td></td>
</tr>
</tbody>
</table>

(c) W.H.A. Yields, fresh weight (corms + 10 cms of petioles)

<table>
<thead>
<tr>
<th>Farmer</th>
<th>Mean</th>
<th>Range</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12.1</td>
<td>10.31 - 14.73</td>
<td>1.623</td>
</tr>
<tr>
<td>2</td>
<td>35.2</td>
<td>17.05 - 29.78</td>
<td>5.947</td>
</tr>
<tr>
<td>3</td>
<td>17.3</td>
<td>17.37 - 25.75</td>
<td>6.364</td>
</tr>
<tr>
<td>4</td>
<td>15.7</td>
<td>10.63 - 25.57</td>
<td>10.784</td>
</tr>
<tr>
<td>5</td>
<td>16.8</td>
<td>15.31 - 16.13</td>
<td>10.124</td>
</tr>
</tbody>
</table>

(d) Farmer's yields, fresh weight (corms + long petioles)

<table>
<thead>
<tr>
<th>Farmer</th>
<th>Mean</th>
<th>Range</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9.1</td>
<td>8.97 - 19.47</td>
<td>1.456</td>
</tr>
<tr>
<td>2</td>
<td>28.8</td>
<td>17.23 - 35.15</td>
<td>1.400</td>
</tr>
<tr>
<td>3</td>
<td>27.5</td>
<td>18.07 - 31.03</td>
<td>10.152</td>
</tr>
<tr>
<td>4</td>
<td>28.8</td>
<td>17.23 - 41.43</td>
<td>14.253</td>
</tr>
<tr>
<td>5</td>
<td>59.4</td>
<td>44.73 - 85.53</td>
<td>17.396</td>
</tr>
</tbody>
</table>

(e) Yield of stalk, (Farmer's yield - corm yield) fresh weight Mt/ha.

<table>
<thead>
<tr>
<th>Farmer</th>
<th>Mean</th>
<th>Range</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11.7</td>
<td>9.80 - 13.43</td>
<td>2.0968</td>
</tr>
<tr>
<td>2</td>
<td>1.8</td>
<td>1.59 - 9.03</td>
<td>3.7029</td>
</tr>
<tr>
<td>3</td>
<td>16.8</td>
<td>7.11 - 23.94</td>
<td>9.0858</td>
</tr>
<tr>
<td>4</td>
<td>12.9</td>
<td>7.03 - 20.43</td>
<td>5.4179</td>
</tr>
<tr>
<td>5</td>
<td>23.4</td>
<td>20.09 - 49.07</td>
<td>7.7791</td>
</tr>
</tbody>
</table>

(f) Whole plant yield, fresh weight Mt/ha.

<table>
<thead>
<tr>
<th>Farmer</th>
<th>Mean</th>
<th>Range</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>26.2</td>
<td>17.7 - 29.4</td>
<td>4.8288</td>
</tr>
<tr>
<td>2</td>
<td>39.1</td>
<td>24.7 - 48.4</td>
<td>10.1412</td>
</tr>
<tr>
<td>3</td>
<td>40.6</td>
<td>37.0 - 49.8</td>
<td>17.9571</td>
</tr>
<tr>
<td>4</td>
<td>33.7</td>
<td>20.0 - 69.2</td>
<td>12.2097</td>
</tr>
<tr>
<td>5</td>
<td>87.4</td>
<td>66.3 - 127.1</td>
<td>27.1593</td>
</tr>
</tbody>
</table>

Using site means as a reference for weights of stalks removed in this way, gives Taveuni values varying between 6.9 and 10.82 Mt/ha. In one extreme instance, the equivalent of 40.1 Mt/ha of stalks were removed. In contrast, at the lower extreme the amount was only 1.6 Mt/ha. The higher stalk weights constitute the removal of considerable quantities of organic matter and some nutrients. These are factors which could become of some consequence as pressure of population on the land increases. Of immediate importance however, is the physical difficulty of removing such large masses over the difficult terrain on which much of this crop is grown: stalks are kept to facilitate carrying the corms in bundles, but the penalty paid in extra weight carried is considerable.

The possibility of some physiological advantage in the maintenance of a length of stalk should not be overlooked. There is however no quantitative data known to the author to justify this possibility. Such physiological advantage, if it exists, would result from transfer of carbohydrates and other materials from the stalk to the corm. The relatively small quantities of taro harvested in a subsistence setting could possibly justify the harvest of long stalks since the total mass removed from a field at any one harvest is small. Where commercial quantities are involved however, the value of this practice is very dubious. Doubts are also cast on the practical advantage of harvesting long stalks by the practice in the West Indies of exporting taro for the United Kingdom market with stalks completely trimmed.

Lakeba. Tar yields from ten samples grown by eight farmers in Nasagalau, Waitabu and Tubou were measured. They are presented in Table 4 as site means, yield ranges and standard deviation values. For reasons discussed earlier, the mean values for taro production were taken from 20 plants. In these samples, corm fresh weights varied from 10.30 to 29.42 Mt/ha with corresponding oven dry weights of 1.70 and 8.20 Mt/ha respectively. Stalk weights varied between 7.14 - 28.11 Mt/ha in weights with mean site values of 10.59 to 24.11. The relatively low SD for sites may reflect more uniform growing conditions on pegasse soils, which may be related to more even water supply.

GENERAL DISCUSSION

Taro sample yields for both Taveuni and Lakeba indicate levels of taro productivity considerably higher than those normally accepted for Fiji. The range of provincial averages given by Casey (Census of Agriculture 1969), are 0.19 - 3.17 Mt/acre. These data are not comparable with the sample yields, since some represent taro produced in areas where moisture stress during the growth period of the crop is likely.

This points to the importance of selection of ecologically suitable situations for taro production. If only transport and marketing considerations are taken into account, the result may be the use of unsuitable ecological sites for taro production, with considerable loss of total productivity from the country's soils. Both Taveuni and the well watered valley soils of Lakeba
TABLE 4. Yields of taro in Lakeba in Mt/ha.

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Range</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Corm Fresh Weight</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nasaqalau</td>
<td>17.21</td>
<td>10.30 - 29.42</td>
<td>7.26</td>
</tr>
<tr>
<td>Waitabu</td>
<td>17.45</td>
<td>10.44 - 26.47</td>
<td>7.01</td>
</tr>
<tr>
<td>Tubou</td>
<td>13.75</td>
<td>10.94 - 19.57</td>
<td>3.43</td>
</tr>
<tr>
<td>(b) Corm Dry Weight</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nasaqalau</td>
<td>4.44</td>
<td>1.70 - 7.33</td>
<td>1.99</td>
</tr>
<tr>
<td>Waitabu</td>
<td>5.69</td>
<td>3.19 - 8.20</td>
<td>2.50</td>
</tr>
<tr>
<td>Tubou</td>
<td>4.10</td>
<td>3.00 - 5.78</td>
<td>1.08</td>
</tr>
<tr>
<td>(c) NNA Yields</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nasaqalau</td>
<td>23.22</td>
<td>16.28 - 37.60</td>
<td>8.41</td>
</tr>
<tr>
<td>Waitabu</td>
<td>22.45</td>
<td>13.19 - 31.71</td>
<td>9.26</td>
</tr>
<tr>
<td>Tubou</td>
<td>17.87</td>
<td>13.32 - 23.88</td>
<td>3.81</td>
</tr>
<tr>
<td>(d) Farmer's Yield</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nasaqalau</td>
<td>35.46</td>
<td>29.88 - 53.53</td>
<td>10.34</td>
</tr>
<tr>
<td>Waitabu</td>
<td>30.30</td>
<td>17.58 - 44.02</td>
<td>13.22</td>
</tr>
<tr>
<td>Tubou</td>
<td>24.34</td>
<td>18.28 - 33.34</td>
<td>5.87</td>
</tr>
<tr>
<td>(e) Yield of stalk - fresh weight</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nasaqalau</td>
<td>24.11</td>
<td>13.66 - 28.11</td>
<td>4.02</td>
</tr>
<tr>
<td>Waitabu</td>
<td>13.34</td>
<td>7.14 - 19.55</td>
<td>6.00</td>
</tr>
<tr>
<td>Tubou</td>
<td>10.59</td>
<td>7.18 - 14.01</td>
<td>3.29</td>
</tr>
<tr>
<td>(f) Whole plant yield</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nasaqalau</td>
<td>42.11</td>
<td>33.02 - 63.85</td>
<td>12.59</td>
</tr>
<tr>
<td>Waitabu</td>
<td>34.97</td>
<td>26.03 - 49.91</td>
<td>16.94</td>
</tr>
<tr>
<td>Tubou</td>
<td>29.75</td>
<td>19.97 - 38.33</td>
<td>6.32</td>
</tr>
</tbody>
</table>

The high levels of variability of yield points to the need for more intensive yield measurements to obtain realistic data for crop projections. It would also appear worthwhile to determine the sources of yield variation. Parallel measurements of soil fertility and plant moisture deficit could be useful in the identification of variability. The relatively high yields on the better plots imply that conditions are occasionally available for high productivity. A precise understanding of these conditions could be useful in the determination of improved taro production systems.

III - THE CHOICE OF APPROPRIATE TECHNOLOGY

Experimental results

Experimental work at Koronivia under the UNDP/FAO Root Crop Project showed a comparison between different methods of taro cultivation that underlines the problems of introducing commercial root crop production into an essentially peasant system of agriculture. Four blocks of land, approximately 0.6 ha each, were planted with taro (cultivar Samoa) in September 1973. Each block was prepared for planting using hand, animal, walking- and 4-wheeled tractors respectively. The manual block was split into two sections. One was cleared of weeds with a cane knife, the same technique being employed for subsequent weed growth. The other was weeded by spraying with gramoxone, a practice which is becoming increasingly common among Taveuni farmers — who tend to adopt gramoxone as soon as they can afford the necessary outlay. In both instances, positions for holes were marked 60 x 90 cm apart, and holes were dug using the traditional digging stick.

All work inputs were carefully timed, separated under land preparation, establishment, maintenance and harvesting. Details of this experiment are being reported elsewhere, and only summary figures are presented in Table 5.

Yields were not constant in each part of the experiment, and this affected the harvesting inputs required. If yields in the manual section of the experiment had been the equivalent of those in other parts of the experiment, or those measured in the field.

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1 This section is re-written by the editor, using material provided by Haynes, and also other data collected by himself and Haynes in Taveuni.
in Taveuni and Lakeba, the man-hour and energy inputs in the manual section would have been higher. But it is in any case evident that the use of imported energy sources has a dramatic effect on the man/hours required. Reasons for the Taveuni farmers revealed preference for gramoxone are strikingly underlined. None the less, the most favourable solution in terms of minimizing both human and energy inputs is clearly to plough and ridge the land with the use of animals.

**TABLE 5. Comparison of Taro production systems (Summary table)**

<table>
<thead>
<tr>
<th>Man hour</th>
<th>All energy inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total per ha</td>
</tr>
<tr>
<td>per ha</td>
<td>Per kg taro</td>
</tr>
</tbody>
</table>

**Manual:**

- Cane knife: 3146 1.39 418 184
- Gramoxone: 1298 0.57 905 398
- Animal: 1326 0.33 386 97
- Walking tractor: 1206 0.17 922 128
- Wheeled tractor: 748 0.16 1197 250

Source: Experimental results, FAO/UNDP project.

**Subsistence technology and commercial production**

The choice between technologies available for crop production in Taveuni and Lakeba presents problems. The trend towards commercialism (at the moment stronger in Taveuni) puts techniques capable of increasing individual productivity at a premium. So far, this has been evident in the use of chemical herbicides - notably gramoxone - to control weeds. The hiring of taxis and vans, in Taveuni, to transport small quantities of taro to market is based on doubtful economics. At the other extreme, hand clearing of weeds and planting of taro have too low a work rate and give too small a return on inputs to make commercial production feasible once a quota limited scale of operation is exceeded.

Given the availability of labour in the islands, together with their remoteness, consequent high shipping charges, and the shortage of capital, the use of expensive machines requiring petrochemical fuels would be unrealistic. The case for animal drawn machines appears better. These are notably cheaper than tractors, with greater mobility over the terrain in the islands and in addition natural sources of fodder are readily available.

By suitable management, such as the keeping of animals in compounds, a source of manure could be assured. This could alleviate the problem of declining soil fertility in those areas where soils have been used for long periods without rest, or where more intensive cultivation was required.

A system using animals, which could be easily adapted for taro production, is given below. This is based on the opening of shallow furrows with horse drawn ploughs into which taro suli suli may be planted by hand with subsequent ridging using a single mould board plough. Rough estimates indicate that one hectare of land could be planted in about 3.5 less time than by hand. By repeated ridging at say 6 and 12 weeks after planting not only will the taro be covered to the appropriate depth, but a measure of weed control could be effected. Such weed control has advantages over the use of gramoxone, the cost of which is high and represents a loss of foreign exchange in its importation. Animal drawn transport would also appear to be a more appropriate form of transport for use away from existing roaded areas, but preference is for roads, not only because of the larger loads that can be carried, but also because motor transport has an appeal that, in the present cultural context, no horse can equal.
Fig. 1. Yaqona planting material. Rooted j node cutting.

Fig. 2. Family group preparing the yaqona plant before drying.
Fig. 2. Line drawing of Yaqona - *Piper methysticum* showing the parts used for kava.
Fig. 4. Preparation of voivoi - Pandanus odoratissimus L. leaves for mat making.

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THE TAVEUNI FARMERS

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The five Taveuni farmers whose mature taro was harvested for the yield measurements discussed in Part II of Haynes' report are well-known to the Project. With help from the Field Assistants and Fieldmen of the Agriculture Department, they were selected from among a 'short list' of farmers living in land-settlement areas who have lately made taro production a principal cash enterprise. They are among a larger population of some 450 individuals who hold blocks of from two to as much as 40 hectares, in freehold or leasehold title, or as tenants-at-will in de facto settlement schemes. The population is heterogenous both in origin and in racial composition, and its emergence is the most significant innovation in Taveuni agriculture and society of the present generation. The recent specialism by some of them on taro production is perhaps surprising, in view of the distance of Taveuni from the urban markets which it supplies. Since the following paper discusses, inter alia, the economics of this recent development, it will be useful here to discuss the background of these farmers, to place their activities in context, and also to provide some ancillary detail on the individuals whose yields we measured.

The people we discuss here do not live in villages. They are individuals who live, for the most part, on their own blocks of land. Other blockholders do still reside in villages, and some move backward and forward between village and block. But others have never lived in villages. They include the mixed-blood descendants of early European planters whose estates have been subdivided over and over again to accommodate growing families. They also include Indo-Fijians who have succeeded in acquiring generally very small areas in subdivided sections of estates. But the largest group are now Fijians, who have been established on blocks of subdivided matagali land, mostly since 1951. The movement toward further subdivision, and residence on individual holdings, is still continuing, and is important to an understanding of Taveuni agriculture that it be placed in context.
I. THE BACKGROUND OF LAND SUBDIVISION

A turbulent history

This is not the place to provide a documented discussion of the whole settlement and subdivision of colonial and post-colonial Taveuni, which will form a principal topic in another Project Working Paper. However, a few simple facts may be stated. During the mid-nineteenth century a series of destructive wars, involving especially the forces of the Tui Cakau and the Tongan, Ma'afu, terminated the older pattern of settlement and resource allocation, brought about massive relocation of people, and led indirectly to the alienation of very large areas to Europeans. By the time of Cession to Great Britain in 1874 much of the greater part of the seaboards was in alien hands, and while only five percent of the total area claimed by aliens in all Fiji was in Taveuni, 20 percent of the area cultivated by them was on this island. The Fijian population, much reduced, was deprived of the larger part of its ancestral lands, and even after the rectification of some of the worst anomalies by the Lands Commission, village lands were greatly circumscribed and for the most part separated from each other by estate land.

Many of the early estates were very small, the commonest form of demarcation being the allocation of long parallel strips running at right angles to the shore. Over time, most of these became consolidated into larger holdings, but a minority were instead further subdivided. In the north of the island, and in an area on the central-west coast, are two clusters of such fragmented estates, now divided among the numerous descendants of a small number of early settlers.

Establishment of Indians on the Land. The estates needed to import most of their labour. Considerable numbers of Solomons Islanders were brought to Taveuni, where some of their descendants remain. But after about 1905 the main labour force became indentured Indian workers, housed in labour lines many of which still stand, and are in use. But after the termination of indentures in 1920 a large number of Indians and their Indo-Fijian children left Taveuni for the relative affluence awaiting them in the sugar cane country of Viti Levu and Vanua Levu, and planters suffered not only from chronic low prices for copra, but also from a worsening labour shortage.

1 In Lau Province to the southeast were situated only two percent of the claimed alienated land, but no less than 28 percent of the cultivated area at this date. Together, 48 percent of the area cultivated by settlers in 1874 was in Taveuni and Lau (de Ricci, 1875, p.191-2)
As one strategy to hold a labour force, many planters allocated small areas of land for the use of their resident workers, and two went further and established settlements of Indians on part of the back-lands of their estates. These two, at Qila Road and at Qarawale on Waimaqera Estate, ultimately became freehold settlements, and for a time they were joined by a third subdivision on the small Dawadikadrika block of leased land, near Velagi village. Such small subdivisions were not intended to provide whole subsistence for the occupiers, who would thus continue to work on the estates to supplement their livelihood. A small number of Indians and Indo-Fijians were also able, through trade, enterprise or gambling, to acquire sufficient capital to set themselves up in business, or to buy strips and parcels of land in other subdivided estates where their descendants now live intermingled with part-European neighbours. Still others, women, received land allegedly for services rendered to the planter. The total area was not large, and the majority of Indo-Fijians continued to be simply estate workers, but the foundation of an Indo-Fijian peasantry was laid.

Beginnings of Fijian land settlement. During the inter-war period almost all Fijians continued to reside in villages, and to cultivate portions of mataqali land in which, whether as co-owner or as borrower, they held only usufructuary rights. At Somosomo village, however, most of the nearby land was divided up in 1926 among leading men, with rights held inalienably in the male line. Other individuals acquired land through the custom of kovukovu, a form of dowry given to the wives of prominent men; many of these titles, latterly almost all, persisted through the male descendants of the original grantee and became, in effect, freehold. Some blocks were quite large; one kovukovu near Lovoni village, for example, has come to be operated as a small estate by its Fijian holders, and has tenant settlers.

After World War II, the nation-wide galala movement began to take increasing numbers of Fijians out of the villages onto blocks of land which they operated independently. Some of these men, exempted from certain communal obligations on payment of a commutation fee, moved into houses on their blocks. Most such blocks later became incorporated into the settlement schemes. Then at the end of the 1950s, the balance of the long-neglected backlands of Waimaqera estate were offered for sale, and a block of 413 ha was bought by a collective group of Fijians, through the agency of the Fijian Affairs Board. A total of 147 contributors, group and individual, were involved in this purchase, but among these almost 60 percent were residents of places outside Taveuni, mainly in Vunu Levu. No clear plans were drawn up for the use of this land, known as Delaivuma, and although there were proposals for a 'cooperative' cocoa estate, these aborted and nothing was done for several years. We shall come back to Delaivuma below.

One group of Fijians was not, however, included in all this. By the end of World War II most estate workers in Taveuni were Fijians, drawn mainly from among land-poor in Lau, Lomaiwiti, and remote parts of the two main islands. Whereas before the war...
most Fijian estate workers were still recruited on contract, which included free repatriation, this virtually ceased before 1950, and thereafter a majority of Fijian estate workers had little expectation of ever returning 'home'; in our 1975 survey some were unable even to name their own mataqali. Yet the desire for land among many members of this group is strong. Some individuals were able to borrow money from their fellow Indo-Fijian estate workers, had money saved, and moved to the major- 

land in many areas of Fiji still sold by the government, these individuals did not meet approval for the major- 

Land development in the 1960s

At the national level fears of the effect of rising population numbers, coupled with new approaches to the whole field of colonis- 

The reports of Spate (1959) and Burns (1960) arguing for greater individual- 

By the end of 1964 over a thousand new farms had been set up by the Land Development Authority, and the whole programme was still in its infancy. Regional development teams were set up at Divisional and District levels to coordinate land-development planning, and took the opportunity to advance the trend toward individualization of Fijian land tenure. This trend received an important boost with the publication of a report on coconut planting and replanting subsides following the Silao (1963) report on the coconut industry.

Land development in Taveuni. On Taveuni, two subdivision schemes were quickly set up, at Vuna-Nakavuva in the south, and at Qeleqefi in the northeast. They were soon followed by a third, including the whole group of villages in the area known as Bowne-Lavena. As it happens, these were not the earliest such scheme to be set up in Fiji, but have also proved to be among the more durable products of this phase in Fiji development history.

Subdivision plans had first to be approved, then blocks were allocated initially on tenancies-at-will; after a two or three year 'trial period', the applicants were to be given 30-year leases. Blocks were to be quite large, initially 8 ha to support a sugar-cane economy farm by tree crops, or 40 ha for grazing. Sector officers were appointed to supervise detailed planting programmes, and were to be supported by Agricultural Field Assistants and nurserymen. In Taveuni the objective was to establish coconut and cocoa plantations. Marketing channels were to be developed with the aid of the Co-operatives Department. Speed was the essence of the matter: research was minimal, and staffing and organization problems appeared almost from the outset.

By about 1965-67 the three initial schemes were all in 

The existing soil survey (Twyford and Wright 1965) proved inadequate as a guide, being on too small a scale; too often schemes were initiated with no research or pilot stage. There had been some signal and rather dramatic failures, and more generally the plans to double agricultural production were clearly getting nowhere. After about 1966 the organization began to run down, and by the time of Independence in 1970 its higher levels were absorbed into the District Administration structure, while the Agriculture Department took over the lower levels. A national Central Planning Office was perhaps the most important single product of this period, which quickly involved itself in planning of a different kind.

In Taveuni, a District Development Committee continued to exist, but latterly has concerned itself mainly with minor issues such as water supply and sewerage. Two of the three sector stations have become outstations of the Agriculture Department; the third is no longer separately staffed. The main work of the Fieldmen and Fieldmen at these outstations has, however, continued to be with the farmers on the subdivisions.

A large proportion of the discussion is based on files in the National Archives of Fiji, Taveuni District Office, and in the National Archives of Fiji. Material has been collected by myself, and also by John Campbell and Richard Bedford. We gratefully acknowledge the help given by Government officers in locating files and also the permission given us to use them freely. Because of the nature of the material, full copies of files are given in text, and not in a list of references.
The signal failure in Taveuni was cocoa. By 1969 there were 132 cocoa growers, of whom 93 were on the schemes, official and by decree. In addition the Morris Hedstrom estates had undertaken to grow 162 ha of cocoa with cocoons. Morris Hedstrom had a centrally-located fermentary, and a second had been built under Agriculture Department management at Bouma, in the humid north-east at the most central location possible. Plans to build a second at Yuma in the south never materialized. Then canker struck the cocoa groves, prices remained poor, and when in 1973 a decision was taken to buy only wet beans rather than pods, thus thrusting the industry into the processing stage onto the market, it came to a virtual halt. Already it had been decided that the wrong variety of cocoa had been planted, and that the windward side of the island (i.e. the area around Bouma fermentary) is too wet for cocoa.

Nor had coconut planting been an unqualified success. A major element in the early enthusiasm was to gain access to the coconut planting subsidy, but once the trees were planted they often became neglected and overgrown. While a minority of settlers went to live on their blocks, most continued to reside in the villages and found the blocks too distant. This was especially so as only a small part of the proposed network of feeder roads was ever constructed; most blocks lying at any distance from the roads lay untouched, or with less than a hectare cleared and planted, and then neglected. Viewed around 1970, the prospects for the settlements in Taveuni did not look rosy. But new sources of income were already beginning to emerge.

The shift to field crops

Antecedents. Local marketing opportunities were being exploited by Indo-Fijian settlers on estate back-lands as early as 1930, when there was already a shift from the Indian-type subsistence crops to roots and vegetables more widely acceptable on the local market. Commercial growing of yagona had also begun (Taveuni District file 3/7, Indian Affairs). There is reference to Saturday marketing as early as 1938 when a hawker visited 'places far remote from the District headquarters for the purpose of meeting their ambitious ends' (ibid.). Some enterprising Fijians also became involved in marketing. The Taveuni District Annual Report 1940 recorded that a Yuna man had recently sent ten bags of yagona to Suva, and received £117. The same man went on trying to sell his field crops in Suva for many years, consigning tomatoes, peanuts and taro, as well as yagona. However, he was 'consistently beaten down' so that by the time his stock was sold in Suva he had spent almost all his profits on subsistence and travelling expenses' (Labasa file CND 2/31, National Marketing Authority, 1971).

Taro. By the mid-1960s quite a number of farmers in the south of Taveuni were growing taro for sale to the urban markets. The District Annual Report for 1967 records that the bloomeders at Yuma-Nakawau had sold 200 tons in Suva, and had obtained some temporary easement of the permanent transport problem through a (doubtless short-lived) scheduled sailing of one of the ships.

Serving the island. While this commercial taro production had nothing to do with the plans drawn up for Taveuni schemes it quickly proved useful. When bananas failed at the showplace Land Development scheme at Lomaivuna in Viti Levu, and the settlers had declined to return home to Lau, the scheme was turned over to taro production for VatuKoula and Suva; the planting material for this change was obtained in Taveuni.

Marketing and transport were the critical problems. During the later 1960s the Department of Fijian Affairs itself set up a marketing scheme, until this was superseded by the establishment of the National Marketing Authority in 1971. But not all farmers were included. The Labasa file on this topic (loc.cit.) records that farmers in the Qeleni Road scheme had hired a launch to market five tons of taro and one ton of yams in Labasa, in 1968-69.

Once the National Marketing Authority (NMA) was established, Taveuni quickly became a main area of operation. In 1971 it was claimed that 86 percent of their limited buying of taro had thus far been on Taveuni (loc.cit.). However, this did not satisfy local complaints: the quantity bought was 'peanuts', the buying was irregular, and the difference between a local buying price of 3 cents/lb and a Suva selling price of 8-10 cents/lb gave rise to strong feeling against the NMA.

Yagona. The market for yagona has grown more quietly. Sporadic references only to this crop appear in the files. Nor did purchase yagona from Taveuni occur for a short period in the early 1970s, but the business was developed mainly by a small number of Indo-Fijian middlemen; buyers also came from Suva on the inter-island ships. The price of yagona has continued to improve, and even between the beginning and the end of our own field work in Taveuni, a period of 16 months, there has been a quite perceptible increase in enthusiasm for the crop. The effective combination of taro and yagona on the same land, described by Haynes, makes this a most suitable form of intensive smallholder production.

Revival of the land settlements.

The consequence of the improved market for field crops has been something of a new surge of activity in the land settlement blocks. Men who had lost interest have returned to their blocks to resume clearing and planting, perhaps establishing houses on their blocks for the first time. In the Vuna area, at Qeleni Road, above Velagi, and in the Lavona area, new settlement blocks have been occupied by farmers. Agricultural land has begun to arise under local leadership, creating an effect new semi-independent foci of rural settlement, separate from the parent villages. Additional blocks have been demarcated in the subdivisions at Vuna and Qeleni, and the Delaivaua area has at last begun to be developed -- though not in anything like the manner originally envisaged. And at the official level, attempts are being made to salvage the almost-lost records of the settlement schemes with a view to planning the future.
There has been one other change of some significance. All the early subdivisions on Fijian land were confined to Taveuni Fijians and their relatives or clients, a rough order of priority being: first the members of the land-holding mataqali; second other co-villagers; third relatives or clients from elsewhere. More recently, it has become possible for a few Fijian estate workers without local connexions to obtain blocks in some of the de facto schemes, or de facto extensions, making formal pretension, and sometimes in effect working for the landholder. The population of the scheme is thus becoming little more diversified. This does not, however, extend to Indo-Fijians except on Delaivuna, which is freehold land. Some Indo-Fijians who had planted yaqona and taro as tenants-at-will of Fijian landholders, mainly in the south, found themselves unexpectedly evicted in 1975 and their crops confiscated. In one or two instances they were able to share the proceeds of their crops with the landholders.

II - THE FIVE FARMERS

Four of the five farmers whose crops were harvested for yield measurements are Fijian block-holders on settlement schemes, three of them in official schemes, one in an unregistered scheme. Together, they represent a fair range of types among the settlement farmers. The fourth farmer is an Indo-Fijian whose activities range outside farming: his father settled many years ago on a small piece of estate back-land, and the family has recently been able to acquire the freehold of a formerly Fijian block in Delaivuna. In what follows, they will be described in the context of the area in which they reside, but while the areas are identified, the farmers themselves will be known only by the initial letters A to E, representing farmers one to five respectively in Haynes' paper.

FARMER A: VUNA

Farmer A holds three blocks in the Vuna settlement scheme in the south of the island, totalling 37.6 ha; in addition he has an inoperative block at Delaivuna (6 ha) and another 61 ha in the forests north of the allocated land that separates Vuna from its large inland holdings to the north. This latter is of little use under present conditions, but none the less Farmer A represents well those whose position has been very greatly improved by the subdivision distribution; as with others who have been advantaged, he is a prominent man. His father was a man of independent spirit, not only a long-time galala but also one who reputedly would have nothing to do with communal activities, even at real social cost to himself. Farmer A inherited from his father a well-developed holding which is one of his present blocks.

Including additions since the original scheme was drawn up, there is a total of 69 blocks in the Vuna subdivision, and in addition 19 kovukovu blocks most of which are operated in the same way. Some smaller mataqali blocks are also operated only by single families, even though there may be many members of mataqali without land to use. Most of the subdivisions are on land of the dominant mataqali Yasaratu, which held the whole area surrounding the quite intensely subdivided land close to and east of the village. The village itself is in reality two villages; it includes also Kanacea, which is a settlement of people evicted from Kanacea island in northern Lau, when the island was sold from their ancestors to a European in the third quarter of the 19th century. Though each Kanacea man mataqali may be allocated a block at an early date, and the whole rivuva has since been allocated some additional land, Kanacea as a whole has far less land than Vuna (Korovou) proper. Some Kanacea men received blocks on Yasaratu land in the distribution, which was finalized in 1967 though in operation on a de facto basis several years earlier. But several families in the combined village have no land to use of their own, and must borrow patches from others for food crops.

The Vuna scheme is among the most successful products of the land development period. Partly because of the strong personality of its leaders, and the enterprise already exhibited by some Vuna men, the implementation of this scheme was given high priority by Government in the early 1960s. It was to have been a coconut/cocoa scheme, and the original planning document, drawn up in 1964, states that some 12,000 ha of coconut was already in the Vuna-Navakavau settlement area, some having been planted as early as 1957. A survey in 1969, however, recorded only 9800 coconut trees at Vuna and Navakavau, grown by 32 men. In fact, cocoa has never secured a firm footing at Vuna partly because of the distance from the fermentaries, but also because of the pioneering development of field crops; this latter goes unremarked in the scheme progress reports of the 1960s, but it is none the less the reason for the strong relative position held by Vuna today. Much the largest share of the MMA buying of taro is at Vuna, and this is also a major area of both copra and yaqona production.

It is also important that a good feeder road running into the subdivision area was constructed at an early date, though it was not extended as far as was planned. Additions to the road network are currently being urged by the Du Vuna, who was sector officer in the early years of the scheme. An agricultural field assistant was also appointed early, and he was later joined by a fieldman. The quality of the two men holding these jobs in the 1970s may have much to do with the success of the scheme in recent years; earlier there were some problems.

One of Farmer A's blocks was already planted at the time of subdivision. He cleared the second and larger block, which is adjacent to the feeder road, very quickly. It was still mainly bush in 1964, but was half-planted in 1967, and is now cleared and planted right down to the sea. This is not unusual; many blocks at Vuna are completely developed. Farmer A built his own copra drier, a solid construction, and built himself a house nearby.
The Vuna area slopes gently to the sea, though five cinder cones break the continuity of the smooth topography, and there is an extremely bouldery area close to the sea at the southern and and Humic Andosols, coarse textured, on and, and on Humic Andosols, fine textured, deep phase, on and basaltic flows. Except for stoniness in the first, both are excellent soils, without serious limitation for arable cultivation and of high mineral fertility. There is, however, a suggestion of exhaustion of this fertility under continuous cultivation without fertilizers.

The feeder road passes the top of Farmer A's larger block. It is here, close to his copra drier, that he grows most of his field crops, and has kept the land in continuous use for a decade. The plot harvested, he has grown taro, peanuts, yamona intercropped twice with taro, and taro again on this land in recent years; the farmer believes this to be an incomplete list. Farmer A regularly employs five to six casual workers, derived from among the land-poor in Vuna-Kanacea, paying them now $2.00 per day which is the going agricultural wage in Taveuni, though much below the 'official' rate paid by Government, and UNESCO.

His workers are engaged in cutting and collecting copra, planting, weeding and harvesting taro and yamona, and in cutting and drying yamona for sale. He tends his copra drier himself, and joins in all activities. Labour is not a constraint on the relatively labour-intensive copra is used. In this, too, he is probably not unique, as the whole road of border is well used under cocomats and field crops. The Tui Vuna's present move towards an extensive feeder road system is probably the most effective means available of obtaining a more rational land rotation in this sophisticated and prosperous community.

**Farmer B: QARAVALU/DELATUNA**

Farmer B is an Indo-Fijian. His grandfather was an immigrant worker on Waimaera estate, and received a small plot of land at Qaravalu, on the backlands of the estate, when this was subdivided in the 1920s. This area, rather more than a hectare, has been planted with coconuts, and carries some yamona bushes and food crops. But many years it served as little more than a base for his family. Farmer B's father worked as a copra cutter most of his life, and his sons have also worked as copra cutters, walking several kilometres to work at either the cocomats or Salalevu on the other. Like several of their neighbours, however, the family gradually built up capital and undertook other enterprises. In the late 1950s one Qaravalu man began to provide a taxi service to connect Salalevu and Qaravalu with the main road at Waimaera, and its bus service. Now several taxis, legal and 'pirate', operate from Qaravalu.

Despite their unfavourable location in the midst of estate land, several of the Qaravalu people, including Farmer B's family, entered into the business of buying 'green' (wet) copra and drying it in their own drier for sale. This business, which has also been taken up (sometimes illegally without licence) by some Fijians at Vuna and elsewhere, is unpopular with the authorities because it curtails the business of the cooperative societies, but it flourishes none the less. It is in line with both the business development by Indo-Fijians elsewhere, seeking small commercial niches in the system and developing them. One, for example, has made a useful business of buying empty bottles and shipping them to Suva: the large liquor supply of the Tevunai people of all and any land they were able to rent on temporary tenancy outside the boundaries of Qaravalu. The improvement of the road to Qaravalu in the 1960s gave them an enormous boost; with motor vehicles they were able to range far more widely. None the less, they still desired land.

**Dolaiwuna.** The opportunity came with the failure of many Fijian owners to develop their blocks at Delaiwuna, which is adjacent to Qaravalu settlement, and borders it on two sides. It will be recalled that this remaining area (43 ha) of the Waimaera backlands was sold to an association of Fijian buyers at the end of the 1950s. The area had never been planted with coconuts, but before World War II it all but the cinder cones had been cleared, and were under grass, using for grazing. It was described to us as a 'sea of grass' at this time. But the area was neglected, and became overgrown with a low but dense bush in a few years; this is the state it was in at time of sale.

Delaiwuna posed problems. Many suggestions for its use were made, including sale to the Vuna people; to have subdivided the holding among all the buyers would have given only an average of 2.95 ha per head, and it was then held that the minimum economic holding was one of 5.1 ha. In any case a majority of the subscribers lived outside Taveuni. Ultimately, Delaiwuna was subdivided into 63 blocks, averaging 5.9 ha, and after adjustment with the subscribers, freehold title was granted on all these blocks, in 1967.

Once again, however, only a minority of the holders were Taveuni residents, whether individuals or groups. At least 24 blocks (possibly more -- some of the holders could not be identified by name) were given to Fijian and cooperative societies in Vuna-Levu, and not more than half of these over moved to Taveuni to take up their land. Other land went to Yasawa, Yanuca, Tamusu and Gailevu; to individuals, whole villages, matanui and cooperative societies at the other end of Taveuni, and to men prominent in island affairs. Blocks were, however, both delimited and demarcated on the ground in the most professionally complete subdivision job yet done in Taveuni.

Some development now began, though in several cases it consisted of no more than the planting of coconuts which were then neglected and became overgrown. It seems that Indo-Fijians from
Garavatu cultivated some land as tenants from an early stage: indeed it is possible that the 'negligible development' described in miles before the date of subdivision was done from Garavatu. The only supervision provided has been by the Field Assistant and Fieldman from Vuna, who have no vehicle of their own.

By the early 1970s a very irregular picture emerged. A few blocks, mainly along the road that passes through Delaivuna to Salalauve estate, were well developed. The resident cultivators were as often sons, relatives or clients of the holders as the owners themselves. Some blocks began to change hands. Latterly, this has accelerated, and there are few than ten blocks have by now been sold, all but two by Indo-Fijians and Europeans. One other is quite intensively worked by a Sino-Fijian leaseholder, and one other by a part-European who is married to the sister of the owner. The price of land has escalated. Land sold initially for $500 has recently changed hands at as much as $45,000, and it was reported early in 1976 that one Vuna Levu owner had been seeking buyers among Taveuni Indo-Fijians at more than $10,000.

The effect is currently as follows, on the basis of a cursory land-use survey. About 35 percent of Delaivuna has been cleared and planted to coconuts, but no more than 20 to 25 percent can be said to be proactively planted. Of this about one third is now owned or operated by non-Fijians. Of land in field crops, the proportion owned or operated by non-Fijians is between 50 and 60 percent; about half of this is operated from Qaravatu.

Farmer B and his brothers have land at Delaivuna. Their block includes the slopes of a complex, steep-sided cinder cone and the piedmont area at its foot. Following Denis (1976) Farmer B's land is located on Mollic and Humic Andosols, coarse textured, rolling to hilly, on lapillin. These are well-drained soils, of high water-retention capacity, and are chemically rich. At the time when Farmer B and his brothers occupied the land, some five years ago, the land had lain under bush for as much as 30 years. Clearing was an arduous task, and the first crop was not harvested until 1973. The side of the old volcano, on which the yield measurements were taken, was this the third successive crop, the unchaking land at the foot of the cone was under dense vegetation in 1975, but two crops of taro had been taken before the yagona grew up to provide complete cover. In early 1976 the yagona was still in the ground, but the hillside was bare and not yet replanted; Farmer B had declared his intention to leave the land in fallow for a year. With such high yields one might wonder if this was necessary, as there would be continual renewal of the soil by downhill slope creep, but it must be recalled that farming is not Farmer B's sole activity.

His land is, however, intensively used. Only a small area at the top of the hill remains cleared. He has only a third of the whole block, the balance being held by his two brothers just as is the smaller block at Qaravatu. The total land area held by Farmer B is therefore only 2.7 ha, one third of the total held by the three brothers. His largest business is certainly the buying and selling of yagona, for which he ranges quite widely in Taveuni. Though he is some way from being the largest yagona buyer on the island, this is none the less a substantial business. He also buys taro, and ships it to Suva on his own account, even though his own taro is sometimes sold to the NMA. He also makes copra. Everyone in the family works, and no labour is employed; it is interesting to observe what can be done with very little in Taveuni.

FARMERS C AND D: BOUMA AND QELENI ROAD

Different though they are, Farmers C and D may be taken together as representative of the hard-working farmers of the two northeastern schemes. Farmer C was in the cocoa/coconut scheme at at Booma from the outset; he was among the first recommended for subsidy payment in 1963, when he was described as 'young, single, industrious, lives on block'. Farmer D, on the other hand, is a non-local, working on the block of another man who is prominent in his home community and has responsibilities which prevent him from using his own block to the full.

This is the wetter side of the island. Hilly, broken terrain, deeply trenched by streams emerging from the northern end of the main range rises quickly inland of the coast. Most of this was covered in dense rain forest which, though much of it is evidently secondary, is none the less well established. Much more land was left to the Fijians in the northeastern part of the island than elsewhere. South of the large leasehold block of Nacaguai estate there are only two further estates: the large block of Vunivasa, straddling the spectacular gorge and outfall of Taveuni's largest river, the Naiulula, separates the two schemes, and beyond the Vunivasa the small Vurevure estate occupies a point of land in front of the northern part of the Booma scheme. Surrounding Qeleni village itself is the 366 ha block of the Deputy Prime Minister's estate, freehold land but acquired by his father essentially in the manner of koyukovu since his grandmother was a member of the owning mataqali. While many Qeleni people have gardens on this land, by permission of Ratu Penia, their own land is entirely separated from the village through this grant made by an earlier generation.

At the time when subdivision was mooted, the coastal area of Qeleni and the Booma group of villages (Waiatabu, Vidawa, and Booma) was already well planted with coconuts, and with subsistence gardening. Cocoa planting had already begun in the area in 1957, and this was seen as the main potential area for a cocoa industry in Taveuni.

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Like many, but not all, Indo-Fijians interviewed, Farmer B was a cagey informant. He talked freely, but omitted a good deal that he had to be piece together from other sources, and observations. He was particularly vague on his acquisition of the land, and on the date of first occupation, doubtless because of current feeling in Taveuni on the topic of Indo-Fijian purchases at Delaivuna.

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4 For material on Qeleni up to 1975 I rely mainly on notes provided by Richard Bedford, who worked at Qeleni in September 1975.
Subdivision schemes were agreed quickly, and work was put in hand on two roads: an extension of the existing road southward from the Navula border to Bouma, and a branch road running inland behind Satu Penama's estate at Qeleni to an elevation of 400 m. Allocation was first to members of the owning mataqali, as at Vuna, but absenteees sometimes missed out, and at least 11 items of mataqali property seemed to assist outsiders elsewhere in Kawaudrove by giving them use of land, rather than allow it to lie idle because of absentee owners. Since many titles have never been received, his attempts to transfer title have led to a confusing situation, yet we were told of many cases in which title is in process of being transferred.

Progress on both schemes was rather slow, and the collapse of cocoa had a more serious effect here, where most of the cocoa was grown, that at Vuna. At Qeleni in May 1973, 61 of 67 blocks were not being used at all, and a further 22 were visited only occasionally. Over much of the scheme, a land-use survey made in 1972 is still essentially valid in 1976. The effect of the shift to field crops has been slower here, not taking place on a large scale until after the price of copra began to fall steeply in the second half of 1974. However, once begun, it has transformed the aspect of the schemes even more dramatically than at Vuna.

At the time of our field work the blocks lying within reach of the Bouma road, and the Qeleni branch road, were mostly undergoing rapid development for taro and yagona. It is not only NNA buying that is important here, but a regular market has also opened up at Laucaela estate, out to the east of Qeleni. Some of these carry their crops in hired transport to the landing at Dala, where it is bought at a price which compares favourably with the NNA price. When this failed temporarily early in 1976 because of oversupply, some farmers took instead to carrying their taro around to the small markets at Waiyevo and Somosomo by bus or taxi. Farmer C was among these, and he was to be seen at Waiyevo market two or three times a week in this period.

Two aspects are of particular interest here. First is the manner in which development of blocks is closely related to access by road. Both at Bouma and Qeleni, blocks lying away from the road still lie mainly undeveloped. Even those on the back of the walking track from Qeleni village, whereas a great deal of clearing and cultivation was in progress in most of the blocks close to the road. Access is vitally important where bulky vegetable crops are concerned. There is an outlying group of blocks at Nacaua, which can best be approached by the road leading up through Nasaua-mataqali estate. Blocks here have been developed from the estate, and farmers have been selling vegetables to the estate workers for some time. In 1976 the owner of Nasaua-Nacaua exercised his legal right and closed the road to the blockholders and to Indo-Fijian buyers who came up to them through the estate. The effect of this closure on the blocks in question remains to be seen, as a long, rough walk down to the Qeleni road is the only alternative access.

Second is the growing importance of local leadership in the development of land. Outstanding here is mataqali Nacaua at Qeleni, which has a long strip of land which, coincidentally, is closely followed by the qeleni branch road. Mataqali Nacaua has for long maintained a hamlet on the coast, about 1.5 km north of Qeleni village, and the son of the former turaga ni mataqali, Nanawa Ramasi, has been most active in ensuring the development of the inland holdings of the mataqali along Qeleni road. He has been active in arranging 'transfers of title' of blocks held by absentee owners, and in organising the group clearing of a large area of thick rain forest at the head of the road during 1973-76, a development which has encouraged government officials to open up the road right to the top. Beyond the end of the road, the whole remaining portion of Nacaua land has now been allocated in addition to the registered blocks. Nanawa has also encouraged settlers to live on their blocks, and some of the number of houses has grown up on the middle section of Qeleni road around and above this own house. This includes members of the larger Nacaua mataqali, and some newcomers from Vuna Levu, as well as Nacaua people.

Farmer C is a rather different type from members of the Qeleni road group. He is an individualist, who has succeeded more through hard work than through advantages of location or support. His block lies only about half a kilometre from the road in the narrow valley of a creek north of Bouma, but it can be approached only by fordable stream which has a very irregular regime: from time to time he is cut off by flooding. His block adjoins the settlement scheme, having been developed originally as a galala holding in 1976. It is entirely cleared, and largely planted in coconuts; farmer C also has a large block of coconut on his own. An exception of a few trees this has been cut down. His copra yield is extremely low for young coconuts almost in full bearing; he gets only about 0.15 mt/ha out of his very variably spaced trees; the site is, he says, too wet and cloudy for good copra. He has therefore planted some 20,000 taro plants of varying age, and these together with some yagona are now his main enterprise. His taro yield is also on the low side by Taveuni standards, and this is an average yield from plots which varied greatly in productivity. The hillside taro was not sampled, and all taro harvested for measurement was taken from a bouldery alluvial flat; this lay beyond the area covered by Denist soil survey. What seems to be an ancient diversion channel, now silted up, runs across the back of the plot, and close to this channel yields are much higher than on the undisturbed bouldery alluvium, possibly because of less coarse soil, or possibly because sparse coconuts shade out rather more of the light away from the channel. Farmer C does not have an easy time of it, but he is a consistent trier, as witness his response to the sudden closure of his main market outlet in 1976.

Farmer D is at Qeleni road, operating a block on the road itself, on steeply dissected terrain at an altitude of about 400 m. Almost the whole block is cleared, except for some land below a deeply incised creek. The block belongs to a prominent man in Qeleni village, who has employment which occupies his time very fully. The present occupant is from Lomaviti, but settled at Qeleni road like a group of Waiyevo (Vuna Levu) men who came to Qeleni in 1967 to assist the clearing of land of
relatives, and have remained. Farmer D has lately been active in the group. He is the head of the road, where a large new block has been allocated to him in his own name. His present block has already grown two or three taro crops, and the fair yield may be related to soil creep on the steep slopes. Following Eromedo (1976) the land, and even Andosols, fine textured, in rolling to hilly landscapes, deep phase, on basaltic flows. This is identical to the soil type occupied by Farmer E, whose yields are the highest recorded.

**Farmer E: Vione**

Vione subdivision is one of the unregistered subdivisions in the central-west of Taveuni, but within this group it has an unusual history. According to Ioane Eremodo, the present turaga ni mataqali, Vione was once a very large group occupying a great area of land running far to the north. An old village site on the land defended by two deep ditches and the Dakeniwal creek, is certainly unusually large with several score house platforms still clearly visible, and the land above it is scored by ancient diversion ditches carrying water from the Dakeniwal; one of these has recently been cleaned and reopened to provide water to the settlement. Close by are the remains of stone fences enclosing land in which pigs were kept; in the organization of Taveuni under the Tui Cakau in the early 19th century the one who was to supply pigs, that of Pagal near Qoleni was to provide fish. Vione people believe that the numerous wild pigs in the bush still obey the turaga ni mataqali, and attribute their freedom from crop damage to their obedience to his will.

But Vione mataqali declined in numbers almost to vanishing point in the early colonial period. The lower part of their land was given to the Tui Cakau, who leased it to European planters under the father of the present title-holder resumed control of the land himself in the 1950s, and operated the estate in his own name. The upper part of Vione was not claimed by the Tui Cakau in person, but most of it was also leased; the history of land holding in this area is not clear. It is, however, certain that in the 1950s and early 1960s there remained no resident members of Vione mataqali in Taveuni. Eremodo and his brother were away at work, and when the land development period arrived their land was claimed by the powerful mataqali of Valelevu of Somosomo, the mataqali of the Tui Cakau. It so appears on a map of land ownership in the area, prepared in 1966 at the request of the authorities in Labasa who were concerned at the almost uncontrollable progress of subdivision plans in central-west Taveuni.

There is friction between the survivors of Vione mataqali and Valelevu. Sorcery is claimed as a cause of their decline, sorcery which Eremodo’s father escaped only by leaving Taveuni. When Eremodo himself returned to Taveuni in 1958 he was subordinated by an allocated to Valelevu people and their clients already in existence on the unleased part of Vione land; he protested to the Tui Cakau, established his rights, and the settlers were removed. An adjacent area a little to the south of Vione was also subdivided, but occupied by men recruited quite widely since members of its own mataqali, the Lamini division of Valelevu who claim to be of much older origin in Taveuni than the Somosomo division. But this in a model. Eremodo proceeded to develop the Vione land in the same way. He took up residence himself in Lamini, a hamlet lying immediately to the north of Somosomo and superficially a part of this great village. He then embarked on efforts to recover the lease on the small plantation of the estate for himself above the Tui Cakau’s estate and the uncleared bush above, meanwhile, it seems, already subdividing the latter. He succeeded in the early 1970s, and has since worked this small copra estate, a little over 40 ha himself.

The subdivision is the land above the estate. Except for the limited clearing done by the pre-1968 settlers in the unleased southern portion, it was all in thick secondary forest and primary forest at higher altitudes. Eremodo took over the existing subdivision boundaries at the southern end, where blocks were rather small, but delimited larger blocks on the rest of the land, up to 12 ha in extent, and running in long strips up and down slope.

He had no shortage of takers for the land. They belong to two main groups. First there are four men from Welagi village, and one from Dreketi, a hamlet of Somosomo. The remaining are all from outside Taveuni. The Welagi men were unable to obtain land in their own subdivision at Delaiwolagi; there are claims against the land; and they claim to be its victims. The Dreketi man was one of those with land at Vione before Eremodo’s return; he asked to keep his block. Because he is closely related to Somosomo Valelevu on his mother’s side, he got only 2.5 ha; Eremodo now regrets this because he is one of the best of the farmers. The remaining men are drawn mainly from Vamosa Levu, but two are from Lau and one from Viti Levu. Some of these came to Taveuni to work with relatives, including Eremodo himself; others were estate workers who sought to escape from the estate system. At first they still lived on the estates and worked their blocks only at weekends; later, when they had built houses and sold their first crop, they moved to Vione.

None of these men have title. They complained of this to an agricultural officer in 1971, and they still complain of it today. Eremodo maintains that he is both saving them money and giving them extra time by withholding formal leases until they are fully established. Meanwhile he is able to turn unsatisfactory settlers off Vione — as was intended for all schemes in the 1960s, but seldom done. Two men, who have cleared only small parts of their land, have in fact been turned off in the past year, and their land is likely to be reallocated to Lauan estate workers, who will then occupy all the land at the north end of Vione, most of it no longer in the road. Eremodo himself has been involved in the development of the area closely; his tenants provide him with food so that he need grow none of his own. They do not, however, work on his small estate, for which he has a separate labour force currently of four men.
Conditions are not easy at Vione. Except what is provided by the streams and the re-opened diversion channels, there is no land on which to grow crops, as the land was under heavy forest, all of which had to be cleared by hand or, when money could be found, with chain saws. Houses are rudimentary, and there is no room larger than 300 m. The whole subdivision lies above 300 m, and the highest parts reach 500 m. Slopes are steep. There is no road onto the subdivision, and until 1973 there was no road access at all. Funds had been collected to encourage Government to build a road, and the agreement of the part-European small planters (one freehold, one leasehold) was obtained to build a road into Vione across their land. However, the road was instead provided to the adjacent Namara subdivision of Lamini Velayu land, which was much more fully developed, and only a spur road runs to the top of a hill overlooking the creek which is the southern boundary of the subdivision. It is to this point that all taro must be delivered, either by horseback, or by human carriage. Yet the Vione people are considerable producers of taro, equaling on a per-capita basis the best of the Vuna farmers.

Progress is considerable in the eight years of development. Most blocks have from three to five hectares of land fully cleared. The lower land is planted with coconuts, and there are a few surviving patches of cocoa. Higher up are the current taro and yaqona plots, intensively cultivated. Beyond these are the new clearings, waiting for about two years until the wood has largely rotted into the soil. Beyond this again is the forest edge, still being constantly attacked. Equipment is limited, but not all farmers yet have grummoaxes, and most work is still done with cane knives.

Yet this is Taveuni agriculture at its most productive. Farnslay E, a Kelagi man, has one of the most fully developed blocks. The taro harvested for yield measurements was the first crop, on land cleared two years previously, and its size was as phenomenal as its weight. The uphill movement of cultivation provides the necessary rotation of land, and there is no adherence to the most accessible site for production of a labour-demanding crop. Except for Eresmo himself, who is not wealthy, the only differentiation between farmers lies in the period of occurrence of their own efforts. There is no group work, though its frequency has been reduced from three days in each week to two, so that 12 farmers each get the services of the mutual aid team a little less than twice a month. The remotest Lauans at the northern end of Vione are not yet included in this group, but they have cleared some two hectares by their own efforts in a year. Notwithstanding their complaints about water, land tenure, boundary demarcation, lack of access to schools, shops and health services, the Vione farmers are a self-reliant and confident group. It is interesting that the organization of this subdivision perhaps adheres more closely to the model of the original planters than do any of the schemes set up with abundant Government aid more than a decade ago.

The future of Vione is largely in Eresmo's hands. His plan is visionary, but they also assume that the land, planted with coconuts, will be inherited by his sons. Whether title to blocks will be granted is also in his hands; meanwhile, however, he has allowed some settlers to cultivate closer to the boundary of his land than he thought, and believes necessary. And at least one Vione family has branched out. A block in an incredibly difficult situation behind Somosomo, allocated to a chiefly Somosomo man, is in fact used by a Vuna Levu man who lives at Vione. He walks daily through the forest, across streams, to cultivate taro and yaqona that, unless he climbs down gullies into the gorge of the Somosomo stream and out again, can only be reached by some 20 to 30 minutes of consumption or sale by the same two kilometre journey. Not surprisingly, he intends only the yaqona for sale.

III - DISCUSSION

These five farmers are among the more active and productive; it had to be so, for by no means every taro farmer can afford to have 120 plants harvested at one go, especially when our plot-demarcation requirements necessitated a block of mature taro containing at least 300 plants. Even in Taveuni, it was not easy to find this much mature taro. The majority of farmers are less productive. None the less, the range exhibited by these men and their situations do make possible a discussion of a large part of Taveuni settlement agriculture. Three other areas might, however, be mentioned briefly, before we seek to draw the discussion together.

Qila road is a very different Indo-Fijian settlement from Qaraqaru, though its origin is similar. It would seem that some Indians were cultivating there even in the 1920s, but though the estate owner was contemplating a freehold subdivision of this upland block of 239.5 ha in the early 1930s, formal transfer was not achieved until the mid-1940s. The holdings are larger than at Qaraqaru and some of the settlers here became full-time farmers at an early date. The soil, which following Denis (1976) is Humic Andosol, fine textured, petric phase on basaltic flows, with areas also of the stony phase of the same soil type, is characterized by variable quantities of coarse material in the profile and in the latter case also on the soil surface; this greatly increases the labour of manual cultivation.

The Qila road farmers have planted coconuts and for many years were also quite important producers of vegetables for the local market. This was in spite of the absence of a motor road up to their land until 1970. Latterly, however, a growing number of people at Qila have turned to paid employment, mainly for the Public Works Department, and more than agriculture it is this trend that has been facilitated by the road. Qila road farmers claim that after some 40 years their soils are becoming exhausted; unfortunately time prevented measurements to test...
this statement, which we had hoped to make. But whether this is so or not, manual cultivation clearly has additional problems at Qila road, and given access to employment it is not surprising that many Indo-Fijians have preferred this alternative way of making a living.

Tavuki village inland of the central-west coast was more constrained in the availability of useful land than any other. They lost their coastal area either to the Catholic Mission, to other European estates, or to outlying settlements of people from Somosomo on land ceded to the Tui Cakau. Two large estates could not get close off the remaining upland areas of their land, all above 450 m, and even an adjacent block was leased to the Mission. Tavuki did evolve a subdivision scheme, relating to its upland areas, in the mid-1960s, but it was not implemented. Tavuki people have mostly found work, and often even both husband and wife in a family are in employment.

Two recent developments have changed the situation somewhat. About 1970, the Mission voluntarily relinquished the lease on the Tavuki land lying immediately above the village, and in 1973 work began on a road running up through this wedge, passing over a piece of alienated land to continue through the upland Tavuki land to the top of the range (1190 m) where a VHF Telecommunications station is being constructed. Five Tavuki men have since established houses in the wedge of land above the village, and almost the whole of this land has been cleared and brought into cultivation. Higher up, a number of men have rather optimistically planted coconuts along the inner edge of the alienated land, at 450 to 550 m, and here, at 530 m, is the highest farm land yuqona yet planted in Tavuni. There is a lot of interest in this upland area; one large grazing lease application has been made - even though the whole area is under dense primary forest. Given a means of access to land, however difficult, modern Tavuni farmers will seek to use it.

Somosomo itself is unique in Tavuni in many ways. Not only is it the residence of the Tui Cakau and of the Deputy Prime Minister of Fiji, but a large proportion of its population is of chiefly stock. Yet there are also miserably poor people in Somosomo, especially in the hamlet of Dreketi, south of the creek. Somosomo has quite a large block of land, and some of its mataqali (principally Vakilevu) also have land blocks lying down the coast for several kilometres, but the larger part of the land of most of the Somosomo mataqali is in fact in Vatu Levu, whereas their ancestors came to Tavuni in the late 18th and early 19th centurie. Much of this land is leased; some is used by Somosomo men for copra production, but no food crops come into Somosomo from Vatu Levu.

A peculiarity of the land behind Somosomo village is that it was 'subdivided' in 1926 among some 17 men of chiefly stock, with inalienable rights descending in the male line to mataqali as a whole, so that the men without individual blocks are as effectively separated from the land in which they have collective rights as though an estate were in the way. The reasons for this unusual early subdivision of land closest to the village involve politics of the Tui Cakau, and do not concern us here. But the effect does. Most of the individually-owned land is in coconuts; it carries few food crops. In the mid-1960s proposals were made to subdivide the mataqali land lying behind Somosomo, and beyond a large leasehold estate to the south. As we have seen, these proposals extended also into Viona to the north. A total of 33 men made applications for 35 leases, mostly very small and many very inaccessible. As we have seen, the scheme was opposed by the authorities, and it was never implemented. Many of the blocks allocated have never been cleared, and as we have seen one lying behind the gorge of the Somosomo creek is now being worked on tenancy-at-will by a man living at Viona.

There is, however, one important exception. Five blocks delimited and demarcated south of Morris Hedstrom's leasehold estate have been very well developed. These are larger blocks; the holders live on them and include one very high chief. The area is about a kilometre from the road and access is only by footpath. Plans for 1977 do, at last, include road access to this subdivision, whose participation in commercial tare production is at present constrained.

It is often said of Somosomo village that its people do not work the land. Certainly many are in employment, and there is a rather high incidence of idleness among young people. Many reasons are advanced for this situation but the peculiarities of the land tenure system in Somosomo are scarcely ever among them. Yet here too we find a few farmers, settled on workable blocks of adequate size, who have achieved very full development of the land.

Taveuni has been an innovative area of Fiji in modern times. Land settlement here proceeded faster and went farther than in most parts of the country, and the Taveuni blockholders included the men who pioneered a shift from tree crops to field crops that anticipated the full impact of rising market demand for these crops. But they cannot be said to have achieved all that they had hoped. A great deal of effort put into cocoa was lost, and the acceptance of farmers at Qeleni in the early 1960s, who said they would plant cocoa only because this was what the authorities wished, was well justified.

More recently, Taveuni farmers have been particularly unfortunate in not reaping the full results of their initiative in developing commercial production of tare for the Suva market. It is their misfortune that the Fijian banana industry collapsed in the late 1960s, and that a variety of reasons among which plant disease was prominent; already restricted to a limited area within reach of Suva, it collapsed first on Kadavu, and then in southeast Vatu Levu. What then happened was that these lands were turned over to tare production, a good part of the planting material in fact coming from Tavuni. Being much closer to the market, they are able to supply it more readily, and their tare does not suffer so severely from deterioration since it can be marketed more
quickly. Nor do they have to rely wholly on the NMA. Boats from Kadavu to Suva are very frequent, as also from Koror at which has become an important producer. The people in southeast Viti Levu can take taro to market by road, and Sino-Fijian buyers also go to the roads very regularly, paying prices higher than those offered by NMA. Taveuni growers are still exhorted to plant taro, but when there is an adequate supply in the Suva market, as in early 1976, NMA buying becomes spasmodic in the extreme.

The greatest achievement of the Taveuni smallholder farmer is to have evolved a production system that makes effective commercial use of the natural advantages of the island in terms of its combination, unusual in Fiji, of soils of high agronomic capacity under medium to high rainfall. The coconut industry is far less discriminating, and even though its energy returns to input may, as Hardaker shows in the following paper, be much higher than taro and yaqona cultivation its cash return both per hectare and per man-hour is enormously smaller. In terms of the aim stated in the present development plan to utilise the maximum the potential of the regions' of Fiji (Central Planning Office 1975, p.6) one would expect this initiative to receive every possible encouragement.

However, the planners seem to take a somewhat different view of agricultural performance in the nation as a whole. We find it stated (loc. cit. p.65) that:

While Government is determined to put even more effort into agriculture, production ultimately depends on the farmer himself and on his response to the opportunities and incentives he is offered. If farmers are unwilling to give their wholehearted co-operation to those who are trying to help them, as has too often been the case during 1971-75, then no amount of effort or investment on Government's part will succeed.

While this may be true of some parts of the rural economy, in Taveuni as elsewhere in Fiji, it seems to imply an order of events which is dissimilar from that described above. Taveuni land settlement was initiated on a basis which led it to the brink of failure, and recovery has been more through the initiative of the farmers themselves than through external inputs. Only now is serious consideration being given to extension of the feeder road system in the settlement areas, where only a fraction of the work originally proposed was every implemented. Yet the importance of road building emerges very strikingly from this brief survey, and from the mapping on which it is partly based and which will be published in a later Working Report. As Hardaker shows in more detail than I offer here, the NMA cannot be said to have solved the marketing problem, and the transport problem remains essentially now as ever.

This is not the place to discuss the land tenure problem in detail, as some analysis of the data gathered still remains to be done. Hardaker makes some comments, which are reinforced by this discussion. But it must be said even at this point that the inequalities in, and maldistribution of, land-holding units in Taveuni have been and remain a serious constraint to optimal land use. No discussion of Taveuni agriculture that pretends to be comprehensive can ignore this aspect.
References


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ECONOMIC ASPECTS OF AGRICULTURE
AND MARKETING IN TAVEUNI

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PREFACE

This report contains a preliminary analysis and discussion of information collected during two visits to Fiji in early 1976, extending in all to seven weeks in the country. During these visits I was able to make three trips to Taveuni, spending in total 24 days there. From such a short period of field study it is difficult to draw firm conclusions. Indeed, I would hesitate to say anything about agriculture in Taveuni were it not for the considerable help, advice and information I received both from other members of the project and from Department of Agriculture staff in Taveuni.

In drafting this report I have drawn heavily on data collected by other members of the project. I have used information on estate costs obtained principally by Harold Brookfield and I have made considerable use of data from the Resource Base Survey (RBS) collected by the Project in association with the Ministry of Fijian Affairs and the Department of Agriculture. Access to these RBS data was facilitated by Richard Bedford. There are obvious dangers in using data collected by others, but I trust that the results I have presented, and the interpretation I have placed on these results, do not do too much violence to the truth.

The report has been written in the belief that an agricultural economist can provide a perspective on the situation in Taveuni that may reveal dimensions not so obvious to others. The observations I make and the conclusions I draw are therefore set down not as confident assertions of fact, but rather in the hope that they will be insightful to others who, although more knowledgeable about the situation than I, view it from a different perspective. It follows of course, that the views expressed in this report are mine, and do not necessarily have the approval of UNESCO.
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I - THE STRUCTURE OF THE AGRICULTURAL INDUSTRY

INTRODUCTION: FARMING SYSTEMS

Agricultural production units in Taveuni can be classified into three main types - estates, settlement holdings and village smallholdings. While the distinctions between the three types are not always sharp, the classification is a convenient one for the purposes of the present discussion; it is the classification employed by the Resource Base Survey in addition to an ethnic classification, and data are hence available in this form.

Estates are generally fairly large in terms of land area. Most are over 40 ha (100 acres) and several extend to more than 1000 ha (2500 acres). A few cover many square kilometres. Most of the larger units are owned by overseas interests, several being in corporate ownership. Other estates belong to Europeans or Part-Europeans who are Fiji residents, while a few estates are owned by Fijians or Indo-Fijians. The land, which is almost always freehold or leasehold, is devoted principally to copra production. Most of the work is done by employed labour, accommodation for the workers usually being provided on the estates.

Settlements. There are several settlement areas in various parts of Taveuni where land has been subdivided to form smallholdings. Over 400 settlement blocks have been established covering about 4000 ha (10,000 acres). The blocks range in size from about 4 ha (10 acres) to about 20 ha (50 acres), averaging about 9 ha (22 acres). They are mostly held in individual tenure by Fijians and a few by Indo-Fijians. However, not all the settlement holdings are being actively cultivated and some have not yet been cleared. Some block holders have not settled on their blocks and it is generally those who live elsewhere (even outside Taveuni) who make little or no use of their land.

Most Fijian villagers operate small farms on communally-owned mataqali land. The availability of such land varies somewhat from village to village. Throughout Taveuni substantial areas of former village land have been alienated or leased to estates and in some places relatively little village land now remains. Nevertheless, many individual Fijian village farmers have been able to establish usufruct over a designated area of mataqali land, usually by clearing it and planting coconuts and other crops. The principle is stated to be that coconuts belong to the planter, who also has rights of control (lawa) over the land beneath the trees, which others may use only with his permission. A few Fijians hold such large areas that they are more properly classified as estate owners.

The type of agriculture practised by settlement smallholders and by village smallholders is very similar. In both cases there is considerable emphasis on subsistence production using mainly
family labour. Cash is earned chiefly by sales of copra, taro and yaqona. The methods of production are practically identical on both types of holding. Hence it will usually be convenient to consider the two groups of units together in the discussion below, while noting the few differences, for example in output patterns, that exist between them.

**METHODS OF PRODUCTION AND ECONOMIC CHARACTERISTICS**

In this section the main methods of agricultural production will be outlined and the available data on economic performance of the three types will be reviewed. The first part of the discussion relates to estates and the second part to smallholdings.

**Estate Production.**

Copra estates occupy nearly two-thirds of the agricultural area of Taveuni and account for about 85% of the total area of coconuts on the island. The results of the Resource Base Survey (RBS) indicate that about 30% of Taveuni households are located on estates and it may be presumed that most of these are dependent on employment on the estates for the main source of household income. It can be deduced from the Quarterly Survey of Employment (Bureau of Statistics, 1976) that over half of the paid employment in Taveuni is on estates. Clearly, estates comprise a very important sector in the economy of the island.

Estate production of copra is essentially a labour-intensive process with few opportunities under present productivity technology for substituting capital for labour through mechanization. Collection of nuts in the coconut groves and cutting the copra are time-consuming jobs, normally done on a "task" or piecework basis. Labour is also required for transport, drying and bagging of the copra and for general estate maintenance. Many estates nowadays use wood and husk-fired dryers and so further labour is needed for collecting fuel. (See Appendix 2).

Some data on costs and other performance measures for 15 estates have been collected by Brookfield. The following discussion is based primarily on a partial analysis of this information. It should be noted, however, that not all the estate owners or managers contacted were able to supply complete and wholly reliable data. Hence the results presented below should be treated circumspectly.

On average about 55% of the total area of the estates surveyed was planted with coconuts. The mean yield of dry copra was found to be 0.68 t/ha (0.27 tons/acre). Labour productivity averaged 8.2 t (8.1 tons) of dry copra per man year (excluding managerial labour). The annual wage cost per man averaged $780, resulting in a labour cost per tonne of copra of $96 ($98/ton). Other costs were rather variable between estates, depending, for example, on whether or not tallow drying was used, but averaged $64/t ($65/ton), giving a total cost of production (excluding management) of $160/t ($163/ton). This is almost exactly equal to the current

(May 1976) Taveuni price for grade 1 copra and exceeds the average price for copra of mixed grades by about $3/t.

In reviewing these results it should be noted that most of the cost data from which the averages have been calculated relate to 1974 when copra prices were very high, averaging over $400/t. The subsequent sharp decline in copra prices is illustrated in Figure 1. In the face of this substantial price fall many estate owners or managers have made such economies as they could. For example, relatively few oil-fired dryers are now in use and the amount of labour devoted to plantation maintenance has been reduced in many cases. It should also be noted that many estates have other sources of income, notably cattle and occasionally other cash crops such as taro or yaqona. Where the data permit, the direct costs of production of these activities have been excluded from the costs given above. While no such adjustments were possible in several cases, it can be stated at current (1976) prices that the value of cattle output, the predominant subsidiary product, averages only about 10% of the income from copra. Cattle production in Taveuni is generally a low-cost operation so that errors arising from the failure to isolate the costs of copra production from the costs of subsidiary activities are likely to be very small.

Despite the above qualifications, the broad picture that emerges from the cost of production data is consistent with the view gained during fieldwork in Taveuni in early 1976. The current level of costs is high relative to current prices and profit margins for estate owners are slim or nonexistent. Because copra production is unavoidably labour-intensive (labour costs comprise about two-thirds of total costs on average), the scope for cost reduction is slight. Producers' difficulties have been exacerbated by recent inflationary pressures on wages and other costs. Moreover, the major economy that has been made (saving back on plantation maintenance) is likely to lead quite quickly to a reduction in harvested yield. Hence it provides no real solution to the cost-price squeeze.

The effects of the depressed economic condition of the estate sector on the economy of Taveuni are manifold but include principally:

a) reduced employment of estate workers, especially reduced use of casual workers;
b) reduced purchases by estates of other goods and services (for both agricultural and domestic uses), affecting turnover and employment in the trade sector;
c) reduced output, in both physical and value terms, reflected in reduced contributions to gross domestic product and balance of payments.

The effect on output is particularly serious since it seems likely that the change may not be readily reversible. A large part of any decline in the production of estates in a period of low prices and profits can be attributed to the discontinuance or maintenance measures, chiefly weeding, especially in
"Marginal" areas of the estates and to non-replacement of senile palms. If the economic slump is severe and prolonged, weeding and replanting may be stopped over the whole estate: many estate owners and managers say that they are doing none now. Weed competition may cause a reduction in the yield of the palms, and luxuriant weed growth certainly makes access to the coconut groves more difficult and costly so that the harvested yield is reduced, and the cost of what is collected rises sharply. If prices subsequently improve, the previous level of production will not be attained again unless estate owners invest in plantation rehabilitation. Such investments will be made only if there is an appropriate economic incentive. In other words, prices must be above the level necessary to cover the costs of routine maintenance and palm replacement. Moreover, after a period of severe economic depression such as they are experiencing at present, few estate owners will have the funds to finance investments in plantation rehabilitation, and their confidence in the future of the copra industry may well have been so undermined that they will be unwilling to borrow money to invest even if credit is available to them. Notwithstanding the operation of a price stabilization scheme which has kept the prices paid to copra producers in Fiji above the very low levels reached on world markets, it is at least doubtful whether Taveuni copra estates will ever fully recover from their present economic decline.

The population of the estate sector. The importance of the conclusion reached above lies in the fact that the welfare of an appreciable proportion of Taveuni households is closely tied to the fortunes of the estate sector. In the RBS some 250 households were enumerated on estates. At the estimated rate of coverage achieved in the survey of 60%, this implies a total of about 400 estate households. The average cash and estimated subsistence incomes of the surveyed estate households, classified by race, are shown in Table 1.

The heavy reliance on wage incomes of these households is clear from the table. For both Indo-Fijian and Fijian households wages comprise more than three-quarters of total income and more than 90% of cash income. Moreover, a substantial part of the imputed subsistence income is in the form of output from plots of estate land made available to their workers by the estates. Clearly, if employment on estates is sharply reduced, many of these households will be thrown into poverty unless alternative provision is made for their livelihood. (See also Appendix 2).

Smallholder Production.

We now turn to a consideration of the methods and economic characteristics of small-scale agricultural producers on settlement areas and on village lands. The potential agricultural area available for small-scale farming in Taveuni amounts to over one-third of the total area of such land on the island. Data on the area actually cultivated are not yet to hand, but from field observations it is clear that an appreciable proportion of this area is currently in productive use, especially when account is taken of the need for restorative fallows between

Table 1
Mean Incomes of Estate Households

<table>
<thead>
<tr>
<th>Item</th>
<th>Indo-Fijian</th>
<th>Fijian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of households</td>
<td>81</td>
<td>137</td>
</tr>
<tr>
<td>Cash income:</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Wages</td>
<td>91</td>
<td>87</td>
</tr>
<tr>
<td>Environmental</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Other</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>Total cash income</td>
<td>862 (490)</td>
<td>88</td>
</tr>
<tr>
<td>Imputed subsistence income</td>
<td>118</td>
<td>189</td>
</tr>
<tr>
<td>Total income:</td>
<td>8.8 (501) 100</td>
<td>1176 (766) 100</td>
</tr>
</tbody>
</table>

Source: Resource Base Survey
Notes:

a Environmental sources include agriculture, fishing, and handicrafts.

b Figures in parentheses are standard deviations.
c Estimated from incomplete information.

Table 2
Aspects of Land Use and Demography

<table>
<thead>
<tr>
<th>Item</th>
<th>Village</th>
<th>Settlement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of households</td>
<td>306</td>
<td>249</td>
</tr>
<tr>
<td>Number of:</td>
<td>mean s.d.</td>
<td>mean s.d.</td>
</tr>
<tr>
<td>Taro plants</td>
<td>1512</td>
<td>2716</td>
</tr>
<tr>
<td>Yaqona plants</td>
<td>396</td>
<td>144</td>
</tr>
<tr>
<td>Cassava plants</td>
<td>377</td>
<td>193</td>
</tr>
<tr>
<td>Area of coconuts (ha)</td>
<td>0.89</td>
<td>0.79</td>
</tr>
<tr>
<td>Number of residents:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult males</td>
<td>1.86</td>
<td>1.06</td>
</tr>
<tr>
<td>Adults</td>
<td>3.68</td>
<td>3.84</td>
</tr>
<tr>
<td>Adults + children</td>
<td>6.88</td>
<td>4.04</td>
</tr>
</tbody>
</table>

Sources: Resource Base Survey
cropping phases under the traditional method of cultivation.

The two sectors of village agriculture and settlement agriculture are of about equal size, both in terms of potential agricultural area and number of households. In the RBS just over 300 village households were enumerated compared with about 250 settlement households. In proportional terms, just over 70% of all households enumerated in Taveuni were found in these two sectors. While by no means all these households are wholly or even mainly dependent on agriculture for their means of livelihood, it is nevertheless evident that small-scale farming makes an important contribution to the welfare of the majority of the households in the island.

This view is supported by the information presented in Tables 2 and 3. These data, obtained from the RBS, summarize some selected physical and economic characteristics of households in the two sectors. Broad similarities in land use and in household size and composition are evident from the data in Table 2. The main difference between the two groups in terms of land use appears to be that village households generally have access to larger areas of coconuts than settlement households. This is understandable since many settlement blocks have only recently been cleared from bush and a proportion of blocks are at too high an altitude for successful coconut production. There is some evidence of increased planting of yaqona on settlement blocks and of increased plantings of cassava on village lands, the latter perhaps reflecting the reduced fertility of these areas as a consequence of prolonged cropping.

Table 3 shows that these differences in land use are also reflected in the patterns of mean household income for the two tenure types. Substantially more of the income of village households is earned from copra whereas settlement households have higher receipts from yaqona and taro. Overall, the mean total incomes from environmental sources of the two groups of households, including imputed subsistence income, are approximately equal. However, the average income of settlement households from wages and other sources is much greater than that for village households. This result is largely attributable to the fact that the settlement group includes a proportion of Indo-Fijians, whereas settlement households from wages and other sources is much greater than that for village households. This result is largely attributable to the fact that the settlement group includes a proportion of Indo-Fijians, whereas village households are composed of iTaukei households.

It is also instructive to compare the pattern of income of Fijian settlement households in Table 4 with that for Fijian village households given in Table 3. There is some indication that the settlement group is slightly better off on average, despite receiving less income from copra. However, the very

<table>
<thead>
<tr>
<th>Item</th>
<th>Village Type</th>
<th>Settlement Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash Income</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Copra</td>
<td>359</td>
<td>26</td>
</tr>
<tr>
<td>Yaqona</td>
<td>110</td>
<td>8</td>
</tr>
<tr>
<td>Taro</td>
<td>28</td>
<td>2</td>
</tr>
<tr>
<td>Other environmental</td>
<td>22</td>
<td>2</td>
</tr>
<tr>
<td>Sub-total</td>
<td>519</td>
<td>37</td>
</tr>
<tr>
<td>Wages</td>
<td>216</td>
<td>16</td>
</tr>
<tr>
<td>Other</td>
<td>56</td>
<td>4</td>
</tr>
<tr>
<td>Imputed subsistence income</td>
<td>611</td>
<td>44</td>
</tr>
<tr>
<td>Total income</td>
<td>1397 (1557)</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 4: Mean Incomes of Fijian Settlement Households Classified by Race

<table>
<thead>
<tr>
<th>Item</th>
<th>Indo-Fijian</th>
<th>Fijian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of households</td>
<td>109</td>
<td>133</td>
</tr>
<tr>
<td>Cash Income</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Copra</td>
<td>71</td>
<td>4</td>
</tr>
<tr>
<td>Yaqona</td>
<td>160</td>
<td>9</td>
</tr>
<tr>
<td>Taro</td>
<td>63</td>
<td>4</td>
</tr>
<tr>
<td>Other environmental</td>
<td>22</td>
<td>1</td>
</tr>
<tr>
<td>Sub-total</td>
<td>317</td>
<td>18</td>
</tr>
<tr>
<td>Wages</td>
<td>673</td>
<td>39</td>
</tr>
<tr>
<td>Other</td>
<td>426</td>
<td>22</td>
</tr>
<tr>
<td>Total cash income</td>
<td>1416 (1458)</td>
<td>82</td>
</tr>
<tr>
<td>Imputed subsistence income</td>
<td>302</td>
<td>18</td>
</tr>
<tr>
<td>Total income</td>
<td>1718 (1645) 100</td>
<td>1908 (1411) 100</td>
</tr>
</tbody>
</table>

Sources: Resources and Base Survey Notes:

a Figures in parentheses are standard deviations.
b Estimated from incomplete information.
considerable variability of incomes for all these groups, as
declared by the corresponding standard deviations, should be
noted. An analysis of the nature and causes of this variability
is being undertaken and will be reported separately.

The methods of production on small holdings are very similar
on both settlements and on village land. Coconuts, taro and
cassava are the main subsistence crops grown while we have
seen, the first two of these, together with yaqona, also provide
the main sources of farm cash income. The typical methods of
production are outlined in Haynes' paper, and additional details
are provided in Appendix 1. These latter notes contain estimates
of typical levels of resource use and of output. Selected
measures of performance of the subsistence crops are provided
in Table 5 and of the cash crops in Table 6. The figures in
these tables should be taken as broad guides to relative perform-
ance only, since there is wide variability in the basic reference
data collected.

The results in Table 5 indicate broadly similar levels of
energy output per hectare per annum from taro and cassava, while
the output from coconuts is more than twice that from the two
root crops when account is taken of the scope for cropping
between the coconut palms. Coconuts also show the best profit
energy output per man-hour, while it appears that taro may be
somewhat superior to cassava in respect of labour productivity.
Taro ranks highest of the three products on the scale of nutri-
tional quality, as measured by the protein to energy ratio. Of
course, patterns of use of subsistence products are determined
not only by the considerations such as those reflected in the
ratios in the table, but also by custom, by the need for diversity
in the diet etc. Nevertheless, in cases where labour is the
principal scarce resource, rather than land, the data in Table
5 suggest that taro and coconuts are superior to cassava as
subsistence crops. The latter crop might find a place where soil
fertility has been depleted to a level regarded as inadequate for
taro production.

The performance of taro, yaqona and coconuts as cash crops
is summarized in Table 6. It can be seen that the latter crop
falls far behind the other two in terms of both land and labour
productivity. The productivities of both land and labour in taro
production are broadly similar to their productivities in the
yaqona enterprise. However, there is some indication at least
under the rather conservative assumption made about yaqona prices
(see Appendix), that taro may be the more profitable crop to
grow in labour-scarce situations while yaqona may be superior
when land is limiting. Such a conclusion is consistent with
patterns of production found in practice. For example, Table 4
shows the greater emphasis on yaqona as a source of cash income
of land-scarce Indo-Fijian settlement households compared with
the pattern of cash crop income of Fijian settlement households.
Of course, the relative profitability of all three cash crops
taro, yaqona and copra - depends upon the prices paid to growers,
and price of yaqona and copra, at least, have been very variable
in the past. Moreover, although taro prices are less variable,
growers face a significant risk of being unable to market their production, as discussed below. Loss of opportunity to sell part of the crop would have disastrous consequences for profit margins.

The overall impression gained from this analysis of data relating to small-holding agriculture in Taveuni and from observation of the system in the field is of considerable economic resilience. Because production is moderately diversified with a semi-subsistence orientation, growers are able to survive through bad times as well as good. For example, the recent slump in copra prices has certainly reduced very considerably the cash incomes of many households, and in many cases this loss of copra income has not been fully offset by higher yqona prices. Nevertheless, these households have been able to retreat into a position of greater reliance on subsistence production, thereby avoiding too serious hardship. In many cases supplementary cash income is received from the wages of one or more members of the household, from remittances from relatives in Suva or elsewhere, etc. By such means, essential cash expenditures can be met and, although the people are by no means well off, serious hardship is avoided.

There are exceptions to the above generalization. The unfortunate situation of estate workers who have no secure access to land has already been noted. Other households with shortage of land face similar difficulties. They include many Indo-Fijians with very small settlement blocks, and some Fijians living in villages where land is scarce. These groups are obviously much more vulnerable to any changes causing a significant decline in their cash incomes.

The resilience of the economy of small holding production to bad times is bought at a cost. Because growers realize that they must preserve the route of retreat into greater emphasis on subsistence production, they cannot afford to move too far into risky commercial production. It is noteworthy that two of the principal cash crops - taro and coconuts - are also important subsistence crops. Clearly, a grower who switched a considerable part of his resources into wholly commercial production, growing such crops as yqona, tomatoes, chillies or cocoa, would place his family at considerable risk. As discussed below, the history of the marketing of agricultural produce Taveuni is not likely to breed confidence in growers' minds in the future of any cash crop. Considerations of this nature clearly have an important bearing on the prospects of, and policies for agricultural development in the island.

II - THE ORGANIZATION OF AGRICULTURAL MARKETING

Introduction

Agricultural marketing in Taveuni presents an interesting study in contrasts. There is a wide range in the official intervention in marketing. At one extreme, the marketing of yqona is in the hands of private traders with little or no regulation of the way this trade is conducted. At the other end of the spectrum, taro marketing (excluding local sales) is mainly organized and conducted by the National Marketing Authority with the co-operation of the Department of Agriculture. Between these two extremes, the marketing of copra is regulated by the Coconut Board, which fixes prices and grades the copra, but the trade is carried out by independent merchants. It is perhaps an unfortunate coincidence that, at least so far as growers are concerned, these three main marketing channels can currently be ranked in terms of performance in inverse order to the extent of intervention.

With the information available it is impossible to provide a comprehensive survey of all agricultural marketing in Taveuni. For example, there is a small but significant local trade in agricultural produce, much of the trade being conducted in a very informal manner. Similarly undocumented is the trade in copra and coconut oil. However, in this report attention is focussed on the marketing of the three main cash crops - yqona, copra, and, especially, taro.

Yqona

Enquiries in Taveuni revealed that the great majority of the trade in yqona was handled by middlemen. These men, who are mainly Indo-Fijians or Sino-Fijians, buy dried yqona from growers and ship most of it to Suva for resale to Western traders there. There are three or four principal buyers in Taveuni together with a few others who operate on a more limited scale. Also, buyers sometimes come to Taveuni from Suva.

The中有 produce markets at Waiyevo, the Government station, and at Somosomo; these operate principally on Saturday morning, but there is supply on several other days of the week, especially Friday. The project had planned to conduct its own survey of these markets, but dropped this intention when it was learned that another project, directed by R.G. Ward and T.G. McEee of the National University, intended a comparative survey of markets in several Pacific countries, including Fiji; the survey of Waiyevo and Somosomo markets, carried out under the supervision of Michael Baxter, Research Fellow at the University of the South Pacific, was conducted in January 1976. By agreement, data will be available to the project for inclusion in its later writing.
The functions performed by the middlemen are those of assembly, storage and transport of the yaqona, although some occasionally also undertake the harvest, cleaning and drying of the crop.

The conduct of the yaqona market appears to be quite efficient. Marketing costs and margins could not be fully investigated but no evidences of profiteering or exorbitant profits at the expense of the middleman was found. It is true that the fieldwork was carried out during a period of severe shortage of yaqona, so that it is possible that competition between the traders was fiercer than usual. Somewhat in evidence for this view is the response by the Manager of the MNP that the Authority had to step in to buy yaqona in Taveuni in 1971 and 1972 to force up the price. (Hazelman, personal communication). However, it is not clear if the low prices prevailing at that time (51-60c./kg 30-40c./lb) were the result of a situation of abundant supply or a consequence of some form of collusion between buyers. Entry to the trade appears to require no more than a little capital and a modicum of entrepreneurial ability, so it is hard to see how the existing buyers could maintain an effective cartel permitting them to reap substantial abnormal profits. There is evidence that smaller traders move into the market as opportunity arises, and withdraw when competition becomes severe. There appears, therefore, to be little need for Government intervention in this market, although some minor reforms are suggested in the next section.

Changes in the retail price of yaqona since January 1974 (the earliest date for which data are available) are shown in Figure 2. The marked upward trend in prices as the result of the shortage of supplies is apparent. The shortage appears to have come about partly as a result of damage to yaqona plantations in large areas of Fiji caused by hurricane Bebe in October 1972 and partly as a result of increased consumption. The crop is a relatively long-term proposition and a big enough to harvest. Hence any supply response to increased demand and prices is likely to take a few years to be effective. Moreover, there is a tendency for growers to harvest their crops younger and at lower prices than to wait for the periods of high prices thereby reducing the future potential supply. This is clearly the situation prevailing at present (mid 1976). However, it is to be expected that potential supply will eventually catch up with demand as more areas are planted in response to the high prices, and when this happens the reverse of the present situation will occur. Prices will fall and growers will delay harvesting their crops which will continue to grow, thereby enlarging the unmarketed surplus. Thus a prolonged period of lower prices can be expected in the future. Unfortunately, no data are available to permit even an approximate determination of when this reversal in market conditions can be expected.

COPRA

There are three main routes by which producers of copra in Taveuni can market their produce. First, and most usually, producers who dry their own copra will sell it to one of the two authorized merchants in the island (Morris Hodstrom Ltd and Rabi Holdings). The copra is bagged and taken to the Coconuts Board Grading Station at Somosomo (Nadara) where a specified sample of sacks is inspected and graded. The copra is then delivered to the merchant with the grading certificate and the producer is paid the price specified for that grade by the Coconuts Board. This method of selling is employed by most smaller estates and some larger ones also, but is the principal channel for village and settlement producers, especially those with a sufficient area of coconuts to warrant having a dryer.2

Many of the small-scale copra producers sell their copra green, unusually to co-operatives. The co-operatives assemble supplies of green copra from a number of producers (including both members and non-members of the co-operative) and then dry the copra in a co-operatively-owned dryer. The dried copra is then usually sold through the channel described above. The copra co-operatives appear usually to rely on the voluntary labour of their members to undertake the work of drying the copra, collecting fuel, etc., but they nevertheless have certain operating and overhead costs. Hence the prices paid for green copra are generally less than the equivalent price for dry copra.

2 Among other work carried out by the project is an extraction of data on copra sales at Morris Hodstrom's for the whole of 1974 and 1975, and at Burns Philip from June 1974 (earlier records could not be traced) until this company ceased buying copra in March 1975. Rabi Holdings did not begin until the beginning of 1976. This was supplemented by extraction of data for sales at Suva from Taveuni, and also all islands in Lau and Lomalai (in less detail) from records made available by the Coconuts Board. For Somosomo/Waiyeno sales, and for Taveuni District sales at Suva, details of every sale were recorded. This work was done by John Cook, Harold Brookfield, Muriel Brookfield and two local assistants employed in Taveuni: a total of approximately 12,000 sales were recorded. We had earlier intended to extract data for 1973 as well, but the Burns Philip records were not available, and the scale of the task proved beyond our means.

Coping is currently in hand to obtain from this data precise information on production in each locality, by race and type of grower, within specified time periods, and to relate these data to selling price, area under coconuts, and behavioural information. This large task will be reported separately.

3 The business of buying green copra, and drying it for sale as dry copra, is also carried on by a number of individuals, both Indo-Fijian and Fijian. Some of this trading is illegal, as the buyers are unlicensed. Formerly, before the Cooperative Societies were set up, this was a much more significant practice than it is today.
The third method of selling, used chiefly by the larger estates, involves direct shipment to the buying station in Suva. The prices paid in Suva are higher than those in Taveuni and presumably larger-scale producers can ship their copra for less than the margin for transport, other costs and profit allowed by the Coconut Board to the authorized buyers in Taveuni.

Changes in the price paid to producers for Grade I copra in Taveuni are shown in Figure 1 opposite. The price for Grade II copra has generally been between $10 and $15 per tonne less than the Grade I price (in early 1976 it was about $20 per tonne less) and roughly three-quarters of Taveuni copra is of Grade I. (A very small proportion fails to qualify as Grade II, and is bought only at the much lower substandard price).

The figure shows the very marked fluctuations in prices that have occurred recently, with a peak of nearly $500/t in mid-1974 followed by a dramatic fall to less than $100/t within twelve months. A guaranteed price was introduced in June 1975 to prevent the total economic collapse of the copra production industry and this scheme was still in force a year later, although its longer-term future remains in some doubt. The guaranteed price is based on the concept of a stabilization fund which is currently being financed by the Government. However, it is expected that the accumulated deficit will be made good by a levy on copra when prices again recover.

One peculiar feature of copra marketing is that a cess of $19.75/t ($20/t) is levied on all sales by Fijians (including sales by co-operatives). The cess is retained by the Fijian Development Fund Board in the name of the individual producer (or co-operative) but may be withdrawn only on application and for certain approved purposes.

Taro

The main marketing development in Taveuni in recent years has been the introduction of the National Marketing Authority (NMA) taro buying programme. A principal objective of this scheme, which started in 1971, is to extend market opportunities to growers in places like Taveuni, remote from the main domestic market in Suva. More specifically, the first five of the objectives accepted by the authority are:

(i) to provide a guaranteed market for specified primary produce at predetermined prices for different production zones;
(ii) to maintain a steady flow of reasonably priced, high quality produce to markets;
(iii) to assist in Governments' drive to combat inflation by dampening upward spirals in produce prices;
(iv) to work in concert with all organizations and agencies involved in rural development so that overall effectiveness is enhanced;
to co-ordinate closely with extension services to ensure that production and marketing plans are integrated (NMA Report for the years 1971, 1972 and 1973).

While these objectives are most admirable, the execution of the policy in Taveuni has unfortunately left some scope for criticism, as discussed below. In part, defects represent administrative failures so typical of developing countries where administrative skills are scarce. Some of the problems, however, are a consequence of the divided loyalties of the NMA, as revealed by the objectives quoted above. The promotion of rural development (objective iv) through the provision of a guaranteed market for primary produce (objective i) may be incompatible with maintaining reasonable produce prices to consumers and dampening inflation (objectives ii and iii).

If Taveuni farmers are to be encouraged to produce taro for export they need not only a reasonable guaranteed price, but also the assurance that they will be able to sell their crop when it is ready. This means frequent and reasonably regular collections with enough warning on each occasion to permit the mature taro to be harvested and delivered to the loading point. In these respects the recent history of the NMA programme in Taveuni has been far from perfect.

Records kept by the Department of Agriculture show that during 1975 taro in Taveuni was delivered in 79 occasions. The average interval between buying dates was about 19 days, which at first sight seems quite reasonable. However, the interval was very variable with one break of about two months and a number of a month or more. Moreover, the interval between occasions on which individual growers could sell their taro was much longer than these figures suggest, for supplies were not taken from all parts of the island every time. Thus the intervals are too long both in terms of points of maturity of the crop, and more importantly, in terms of growers' immediate cash needs. In this regard, the ideal would be regular buying days once (or even twice) a week in each production area.

It seems clear that only a small minority of Taveuni farmers are supplying taro to the NMA. In other words, the benefits of the programme are not reaching most farmers. To some extent this may reflect the generally rather low level of commercialization of small-scale farming, but it also reflects certain imperfections of the buying scheme. Generally very little warning is given of the arrival of a vessel which is to load taro. The task of contacting farmers to arrange deliveries in time for the loading of the Department of Agriculture. The Department's field staff, who are not normally provided with vehicles, must pass the word to local growers, arrange for the distribution of sacks to growers with taro to harvest and schedule the collection and delivery of the vessel. The time available for all this is usually only one or two days, so it is understandable why only a few farmers are contacted. Furthermore, the present system is very vulnerable to human error. Mistakes can be made in advising growers that taro is to be bought, with unfavourable consequences for the growers.

At present a longish interval may elapse between harvest of the taro in Taveuni and its delivery to the NMA cool stores in Vatuwaga, near Suva. Ideally this interval should be not more than two or three days but it is often as much as a week and sometimes even longer. The primary determinant of vessel itineraries remains the copra trade. A ship might thus remain a week or more on the coast of Taveuni and Qamea, and then call at one or two other places, in Vanua Levu, before returning to Suva. Small wonder then, that the manager of the NMA reports that on delivery up to 25 percent of Taveuni taro is affected with core rot and must be thrown away (Hazelman, personal communication). The problem lies not in the growing methods, but in poor post-harvest handling and in shipping delays. In view of the high cost of the losses, a solution to the problem should be urgently sought. Possibilities include some system of "curing" the taro after harvest to use of cool storage on board the vessel, or increasing the frequency and speed of shipment.

The price paid by the NMA for taro in Taveuni is 110c/kg (50c/lb) or about $1/4/4. The farmer must pay the cost of transport from his farm to the loading point. This usually amounts to about 20 cents per sack or about $3/t. As noted above, the NMA faces a dilemma in price fixing in seeking to provide growers with an attractive marketing opportunity while simultaneously holding down retail prices. It seems clear that the present price does not provide a strong incentive to Taveuni taro growers. Several of whom expressed the view that the present price is unreasonably low, especially as it has not been increased for more than a year at a time when the prices of other goods and services have been rising steeply. Moreover, as Figure 3 shows, there has recently been a marked fall in the market price of taro. The levels of output shown in the figure should be judged against the planned output for Taveuni during 1975 of about 200 tonnes each quarter.

In one particular respect the NMA price policy can be said to be ineffective, judged by the match attained between supply and demand. There is marked seasonality in taro production in most parts of Fiji, notably in the main growing areas of Viti Levu (Fi) and Vanua Levu (Vn). The result is that taro prices tend to be relatively high during the off-season of November, December, January. The manager of the NMA has complained about the reluctance of farmers to produce taro year-round. His concern indicates a failure to recognize the extra crop or unit output that most farmers would incur in producing taro in
the off-season. A sensible solution to the problem of seasonal
supply would be for the NMA to set a seasonal price
differential, paying more for taro during the period of relative
scarcity and less in times of relative surplus. Then those
farmers with a comparative advantage in off-season production,
such as the Vava'u growers, would find it advantageous to con-
centrate their production in the period of higher prices and
total supplies would be more evenly spread through the year.

At present the NMA tries to regulate taro supplies by
allocating quotas to the various producing areas. The quota
system operates on a district basis: the local Department of Agriculture allocates the quotas.

For example, the quota for the Vava'u district is 30.5t (30
tons) per month or about 7.07t (7 tons) per week. The district
quota has been translated into planting recommendations for
individual growers in the main taro production areas of the
island.

The present system of quota allocation has a number of un-
fortunate features. First, as noted above, no account is taken
of Vava'u farmers' comparative advantage in off-season taro
production. Second, the breakdown of the quota on a district
basis appears to have been made partly on "political" grounds
rather than on the basis of assessed capacity to produce. For
example, the A'ana settlement has been allocated a quota of
17 tons per month but few people in the Department appear to expect
this quota to be met. Apparently in anticipation of such a short-
fall in the north, planting recommendations for farmers in the
South were very arbitrarily determined at some 30 percent in
excess of the number of plants required to meet the district quota.

More seriously, the actual recommendations being made to the
Southern growers totalled between five and ten times the local
quota. While it was certain that many growers would fall down on
such an ambitious programme, it might have been wiser to have
advised a more radical change. The whole subsistence production
system is capable of rapid adaptation to an over-supply of market surplus. Nevertheless, the possibility of a considerable excess of taro above the NMA needs,
prompted by the advice given to growers by the Department of
Agriculture, cannot be altogether ruled out.

In the event, these ambitious plans have come to very little.
The NMA has greatly limited its buying in Vava'u in 1976, finding
adequate supplies elsewhere. The Agriculture Department staff
were greatly embarrassed by this development entirely outside their
control. The farmer-by-farmer planting quotas have been withdrawn,
and latterly the Department put its efforts into helping the
farmers to find an alternative market, but at a lower effective
price, in Labasa. None the less, the expansion of taro production
in 1975 was directly related to expectations of a secure market
for taro planted on firm advice: the loss of a proportion of the
crop through over-maturity can only prejudice the farmers
against further advice from the authorities.

III - ISSUES IN AGRICULTURAL POLICY

The aim in this section is to draw attention to some
deficiencies of present policies affecting agriculture in Vava'u,
and where possible to suggest some alternatives that might be
considered. Three aspects of agricultural policy that will be
examined in these terms relate to land tenure, marketing and
extension.

Land Tenure and Distribution.

In an earlier section of this report attention was drawn

to the economic decline of the estate sector in Vava'u. It was

suggested that the decline may not be readily reversible, even

if copra prices recover somewhat in the future. If this view proves
to be correct, there are important implications for the welfare
of those families currently dependent on estate production for
their means of livelihood. This group comprises mainly the fam-
ilies of copra cutters and other estate workers. As output, and
hence employment on estates declines, a proportion of these
people may find themselves without jobs, and even without homes.
Many, especially the Indo-Fijians, have no means of access to land
and could well fall into severe poverty unless alternative oppor-
tunities are created for them.

A programme of expansion of rural employment in Vava'u is
needed. Such a programme might have a number of facets, but, in
an agricultural context, the best opportunity for creating more
productive employment would lie in the subdivision of some of the
areas of land that are currently being poorly utilized, with a
view to establishment of more smallholdings. Smallholding prod-
uction involves roughly one and a half to two times as much
employment per unit area as estate production, and, of course,

vastly more employment than uncleared bush. Smallholdings also
provide a better standard of living for settlers compared with estate
workers. (Contrast the results in Tables 1 and 4, pages
5 and 7).

Marketing Reform.

Of the three main cash crops grown in Vava'u, it is clear
that the need for improvements in marketing is most pressing in
the case of taro. Because taro has a relatively high bulk to
value ratio, the suitability of the crop for production in an area
relatively remote from the main domestic market must be questioned.
On the other hand, taro grows well in Vava'u, giving good yields,
and the farmers of the island are familiar with its cultivation.
Moreover, it is hard to suggest an alternative crop which could
be widely grown in its place.
If taro is to continue to be grown as a principal "export" crop, improvements in marketing are however essential. The present system could be made to work better. The NMA appears to be not sufficiently well aware of the problems of taro production and marketing in Taveuni. Information flows need to be improved. The Taveuni Farmers Association, currently being formed, might help in this regard, but some initiative by the NMA is also needed. A better understanding in the Authority of growers problems would surely result in decisions giving more consideration to growers' circumstances.

While the present system of buying taro could be improved marginally, it might be more realistic to seek a more radical solution to recent difficulties. For example, district buying stations could be established which would be open regularly, say one day a week. Growers would then know that they could deliver taro for sale to the NMA on a specified day and the problem of contacting growers wishing to supply taro would be avoided. Of course, such a proposal raises a new set of problems, notably that of storage of taro between shipments. As noted above, there is already a need to improve taro storage and handling arrangements to minimize post-harvest losses. One solution, albeit a rather expensive one, would be to establish cool stores at the loading points where taro could be held until the ship arrived. Similarly, cool storage facilities on board the vessel might also be needed if the taro is to be delivered to market in best condition. While research and experimentation might suggest some cheaper solution, the provision of cool stores and of chilled shipping spaces could be valuable for marketing of other produce from Taveuni, notably beef.

With regard to the marketing of yaqona, no major reforms appear to be needed at present. The government, through the NMA, should intervene in the present marketing system only as a buyer of last resort, thereby ensuring that any collusive arrangements that might be made between buyers cannot be operated to the too severe disadvantage of yaqona growers.

As freight costs escalate it may in time become worthwhile to establish a small plant in Taveuni to pound yaqona so that it can be exported in less-bulky powder form. Such a plant would need to be supervised by government authorities to prevent the adulteration of the product with cheap fillers.

There are some grounds for believing that the great instability seen in copra prices may be a more or less permanent feature of the market for this commodity in future. If this proves to be so, the recently introduced Price Stabilization Scheme for copra should prove very valuable to growers. The long-term aim in copra marketing must be to provide growers, whether estates or smallholders, with a reasonable economic incentive to maintain and rehabilitate their plantations. It remains to be seen whether world copra prices will be high enough in the long run to make this goal feasible, but in any event, domestic marketing arrangements should be as consistent as possible with this objective.

A relatively long period of favourable copra prices may be needed before grower confidence in the future of their industry is restored to a level such that they are willing and able to invest further. In this regard, there are dangers in the Price Stabilization Scheme. First, there is a risk that, if world prices recover too greatly, a levy may be imposed on producers to recoup the funds spent on price support and to build up a substantial reserve. Clearly, the desirability of building reserves quickly must be balanced against the disincentive of a heavy levy.

In a similar vein, the present cess on copra sales by Fijians is effectively a tax which acts as a disincentive to produce. Moreover, it operates in part, there is a risk that it will be worked more heavily in times of low prices. If, for political or other reasons, it cannot be abolished, it should at least be converted from a flat rate per tonne to a percentage of sales by value.

One way in which copra growers might be provided with an increased incentive would be via economies in the handling and transport of copra. Indeed, the whole process of copra manufacture and marketing would be worthy of careful study. Relative prices of labour and other inputs have changed substantially over the years yet the methods of copra making and transportation have changed hardly at all. Further comments on this topic will be offered later by the project.

Extension Policy and Programmes

If agricultural extension is to succeed there is a need for planned programmes directed towards the achievements of specific goals. It is not easy for an observer to identify many consistently pursued objectives in the recent agricultural extension work in Taveuni, perhaps largely because of the rapid turnover of staff that has occurred.

A large part of the extension effort during the last year or so appears to have been directed towards encouraging and organizing the production of taro for sale to the NMA. In their enthusiasm to promote change there has been a tendency for Department staff to lose sight of the fact that their role is properly one of facilitation rather than of direct involvement in attempts to implement change. The Department of Agriculture is in a difficult position in regard to taro marketing. It acts as agent for the NMA in Taveuni, thereby placing itself in a position of responsibility without authority. If things go wrong, for example, if the NMA elects to take its taro supplies from elsewhere in Fiji so that Taveuni growers are left with an unsold surplus,

At the bottom of the fall in the copra price in 1975, the copra cess amounted to 27.7 percent of the Somosomo price for Grade I copra and 32.7 percent of the price for Grade II copra (and most of the Grade II sales were made by Fijian growers). When the price was at its maximum in 1974 on the other hand copra cess percentages were 3.4 and 3.5. On the stabilized prices, the cess is 12.0 percent of the Grade I price and 13.7 percent of the Grade II price.
growers are likely to blame the Department as much as the NMA. Moreover, following any such failure, the confidence of growers in the Department may be severely shaken, making future extension work very difficult.

More specifically, it seems that the present system of quota distribution within Taveuni needs further consideration. If advice on the extent of planting is to be given to individual farmers, much tighter control of the recommendations made is required. Recommendations should be linked to reasonably accurate data on actual plantings in the main production areas. It is doubtful whether such a system is within the capacity of the Department’s present resources. The alternative might be to accept the risk of over-production but to protect growers from the effects of such a result so far as possible by forming a price pool for Taveuni. Thus, if the growers delivered, say 20 tons of taro in any week, of which the NMA would buy only 15 tons, the balance would be disposed of to best advantage and the soil proceeds would be allocated to growers in proportion to the amount each delivered. Such a scheme would be less vulnerable to administrative error and would impose less strain on the Department’s resources than does the present scheme, leaving the staff with more time for other and very necessary extension activities.

In overview, it can be argued that agricultural extension in Taveuni should be aimed towards the development of a realistic understanding by farmers of their circumstances. They need to appreciate both the opportunities and the constraints they face. Advisers too need to realize that "quick and easy" solutions to the problems of agricultural development are unlikely to be found. In the past too much faith has been placed in solutions based on a single line of development such as a new cash crop. The long history of unsuccessful crop introduction to Taveuni should give ample warning of the dangers of this line of thinking. Agricultural development will succeed only when the farmers of Taveuni themselves face up to their many problems and are motivated to use their initiative, imagination and labours to find solutions adapted to their circumstances.

IV - CONCLUDING COMMENTS

Some of the problems of agricultural production and marketing in Taveuni are typical of many developing countries. Others are more specific to small islands and still others are unique to Taveuni. The problems can be attributed to many causes. In traditional agriculture farmers' lack of capital and knowledge and their limited aspirations inhibit change and development. The estate system of production was developed during colonial days and is not well adapted to the promotion of rural development. Administration in a developing country often leaves scope for improvement and development policies and plans are not always as consistent as they might be, and nor are they always implemented with the vigour and efficiency that might be desired.

All these kinds of problems prevail to some extent in Taveuni in relation to the development of agriculture. In this report no simple remedies are propounded. Indeed, if readily applicable solutions existed they would no doubt have been adopted long ago. Nevertheless, there is scope for progress. The land is fertile and relatively abundant. Transport problems, although important, are less severe than in other more remote parts of Fiji and the island economy itself is large enough to sustain a degree of local diversification. It therefore is not too optimistic to look for real economic and social development. The suggestions made above in this report are offered in the hope that they might be of some value to those charged with the task of trying to build a better future for the people of the island.
Figure 2: Recent Changes in the Retail Price of Yaqona, Central District.

Source: Bureau of Statistics, Suva
Figure 3: Quarterly Sales of Taro to the N.M.A.
Figure 4: Recent Changes in the Retail Price of Taro, Central District.

Source: Bureau of Statistics, Suva
APPENDIX 1.
DATA ON THE MAIN SMALLHOLDER CROPS
(J.B. Hardaker)

Editor's introductory note: This Appendix is condensed from material supplied by Hardaker, and collected by him from various sources in Fiji and elsewhere. One of his principal sources within Fiji was the set of notes provided to other project members by Haynes, and the main purpose of condensation has been to eliminate overlap so far as possible.

The quantitative data are widely culled. Taro yields are means obtained from Haynes' data. Other yield and input data are derived from project notes collected by Hardaker and others, from sources elsewhere in Fiji and even elsewhere in the Pacific; they are necessary data for modelling purposes, and though many can only be described as 'weighted judgements' (Hardaker's term), they probably represent a reasonable approximation which would need much more inquiry to improve. Because of this imprecision, and the very wide scatter of sources, references are not provided.

The concluding table of copra prices was extracted from files at Morris Hedstrom, Ltd., Somosomo, by myself.

A. TARO
1. General Information

The taro grown widely in Fiji and known as dalo is Colocasia esculenta. Other taros grown are Xanthosoma sagittifolium and Alocasia macrorrhiza, known locally as dalo ni tana and vai respectively.

The Xanthosoma and Alocasia spp. are generally regarded as weeds in Taveuni.

2. Seasonality
(a) Planting dates

For the highest yield taro should be planted at the start of the wet season but it seems unlikely that there are any appreciable seasonal yield variations under the high rainfall conditions of Taveuni.
(b) Growing period

The corms mature in about 9 months but in Taveuni may be harvested after about 7 months. The usual growth period is between 8 and 10 months.

(c) In ground storage

The crop can be left in the ground for up to 12 months but there is progressive loss of quality and increasing incidence of corm rot. The loss of quality is less important if the corms are to be baked rather than boiled.

3. Rotational Aspects

(a) Crop sequences

Taro is normally the first crop after a fallow or after clearing bush. It may be replanted on the same area once or even twice, and is usually followed by yaqona, cassava or fallow. A fallow period of one to three years is generally considered necessary before taro is replanted.

(b) Intercropping

Taro can be grown under coconuts provided they are reasonably tall and not too closely planted. It is often grown in association with yaqona. Various sequences are employed but typically the taro is planted first and then soon afterwards yaqona is planted between the taro, usually at about double the spacing of the taro. When the taro is harvested a second crop may be planted, perhaps at a lower density, and a third may be possible if the yaqona is not too tall. Typical plant densities might be:

<table>
<thead>
<tr>
<th>Crop</th>
<th>Density (plants/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yaqona</td>
<td>2500 (1000/ac)</td>
</tr>
<tr>
<td>Taro</td>
<td>1200 (4900/ac)</td>
</tr>
<tr>
<td></td>
<td>8100 (3300/ac)</td>
</tr>
<tr>
<td></td>
<td>4000 (1600/ac)</td>
</tr>
</tbody>
</table>

4. Planting

(a) Spacing

Spacings vary but typically taro in Taveuni is planted at about 0.90 m x 0.90 m (3ft x 3ft) or rather less, i.e. about 12000/ha (4900/ac).

Taro are grown quite close to coconut palms when interplanted in this crop so that the planting density is probably reduced by no more than about 10%.

After harvest suli suli (suckers) may be left for up to 3 or 4 months to develop before being used as planting material.

During this time a new crop can be interplanted. Alternatively, the suli suli may be left as a ratoon crop which matures in about 5 months. Such a ratoon crop will normally be used for domestic purposes as most tubers will be too small to sell.

5. Other Materials Used

Use of fertilizer or sprays to control pests or diseases is rare. Malathion can be used to control leaf hopper (luna).

Gramoxone (paraquat) is widely used to control weeds. Two applications are recommended although three are more usual (sometimes more). Gramoxone costs about $3.50/l ($2.00/pint) and the recommended rate of application is about 150 ml/ha (20-250 oz/acre) although many farmers probably exceed this rate. Thus the average cost per application is probably about $7.00/ha ($3.00/acre) or $22.50/ha for three applications, say $25/ha ($10.00/acre) on average.

6. Labour Requirements

<table>
<thead>
<tr>
<th>Activity</th>
<th>h/100 plants</th>
<th>h/ac</th>
<th>h/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land preparation and planting</td>
<td>6</td>
<td>294</td>
<td>726</td>
</tr>
<tr>
<td>Weeding: 1st time</td>
<td>1</td>
<td>61</td>
<td>151</td>
</tr>
<tr>
<td>2nd time</td>
<td>1</td>
<td>49</td>
<td>121</td>
</tr>
<tr>
<td>3rd time</td>
<td>1</td>
<td>37</td>
<td>91</td>
</tr>
<tr>
<td>Spraying</td>
<td>0.2</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>(Assume 2nd weeding is still necessary if crop is sprayed three times)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harvest (20t/ha NMA net)</td>
<td>2.5</td>
<td>123</td>
<td>303</td>
</tr>
</tbody>
</table>

7. Mechanization

Not usual, except where grown on estates.

8. Yield

<table>
<thead>
<tr>
<th>Category</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmers yield (net)</td>
<td>27.5 t/ha (11.2 t/ac)</td>
</tr>
<tr>
<td>Marketed NMA yield</td>
<td>20.0 t/ha (8.0 t/ac)</td>
</tr>
<tr>
<td>Corm yield (net)</td>
<td>15.5 t/ha (6.3 t/ac)</td>
</tr>
</tbody>
</table>

Yields are net of losses from corm rot.

Assume no effect on net yield of time of harvest within period of 8 to 10 months of planting.

9. Nutritional Aspects

Consumed as a staple, boiled or baked.

Contains about 4.73 M/kg energy (113 Cal/100g) and 2% protein, with about 15% waste based on corm weight.
Cannot be stored for more than a week or two after harvest.

Minimum customary consumption:

Fijians: 0.9 kg (2 lb)/adult equivalent/day, say 30% of energy needs.

Indians: nil.

Maximum consumption might be set at 60% of energy needs to ensure reasonable dietary diversity.

10. Marketing

NMA buys at 11c./kg (5c./lb) or $110/t.
Price for local sales is $1/bundle which, at 10kg/bundle is about 84c./kg NMA yield.
Marketing costs (transport) average about 20c. per sack (50 kg), say $3.50/t for NMA sales and are probably somewhat higher for local sales. Thus a net price of $105/t might be reasonable.
NMA quota for Taveuni was 15 tons/week (15.2 t). This appears to have been discontinued for 1976.

For the individual farmers, sales to the NMA may be curtailed by harvesting capacity. Assuming one shipment approximately every three weeks in a given locality, maximum NMA sales per three months would be:

<table>
<thead>
<tr>
<th>Number of Workers</th>
<th>Bags</th>
<th>Tonnes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 man farm</td>
<td>20</td>
<td>1.2</td>
</tr>
<tr>
<td>2 man farm</td>
<td>40</td>
<td>2.4</td>
</tr>
<tr>
<td>etc.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Of course, labour might be hired to assist in harvesting at a cost of say $3/day, or $10/t, but there would be limits on the availability of such casual labour at short notice.

B. YAQONA

1. General Information

Piper methysticum, known as yaqona in Fijian or kava in some Polynesian languages is a shrub the roots and main stems of which are dried and pounded to make the traditional drink of the South Pacific (also called yaqona in Fijian). Yaqona is often called “grog” in Fiji today.

2. Seasonality

(a) Planting dates

Can be planted and harvested at any time of the year.

(b) Growing period

Yaqona is normally harvested after three or four years, although it can be left for 10 years or more. Both yield and quality are improved by leaving the crop longer in the ground. Because of the current high prices, some yaqona is being lifted at two years, but this is said to be too young.

3. Rotational Aspects

(a) Crop sequences

Commonly grown as a first crop after bush or after one or more crops of taro. Sometimes grown towards the end of a rotation which includes legume 'breaks'. Commonly followed by bush fallow or by one or more crops of cassava. Usually yaqona grown in mixed cultivation with taro and coconuts. See item A3(b) for a review of taro-yaqona association.

(b) Soil fertility considerations

Yaqona grows well on most soils in Taveuni. However, there is some suggestion that, although the crop grows well at higher altitudes (in areas of higher rainfall!), the quality of the yaqona from such plantings is not so good as for yaqona grown near the sea. The soil should be well-drained for yaqona as crops grown on wet land are vulnerable to a bacterial wilt.

4. Planting

(a) Spacing

Spacings vary and a rectangular pattern may be adopted with wider gaps between rows than between plants in the rows, presumably to facilitate intercropping. However, typical spacings are about 2 m x 2 m or a little wider (6'9" x 6'9") implying about 2300 plants/ha (1000/ac).

(b) Planting material

Yaqona is grown from cuttings from the upper stem, usually three to four nodes long, although if planting material is scarce single-node cuttings may be used. The cuttings may be sprouted in a nursery bed before they are planted out.

5. Other Materials Used

Fertilizers or chemicals for control of pests and diseases are not generally used. However gramoxone is used for weed control. Typically four sprayings per year are necessary for the first two years with perhaps only two sprays being required in the third year. Intercropping with taro in the first two years tends to reduce the amount of weed control necessary - say to three sprayings per year. See A5 above for cost data.
6. Labour Requirements

<table>
<thead>
<tr>
<th>Activity</th>
<th>h/100 plants</th>
<th>h/ac</th>
<th>h/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear (if first crop)</td>
<td>2.4</td>
<td>24</td>
<td>59</td>
</tr>
<tr>
<td>Prepare materials and plant</td>
<td>1.3</td>
<td>13</td>
<td>33</td>
</tr>
<tr>
<td>Weed</td>
<td>2.7</td>
<td>37</td>
<td>91</td>
</tr>
<tr>
<td>Spray</td>
<td>1</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>Harvest and process (3 year</td>
<td>100</td>
<td>1000</td>
<td>2470</td>
</tr>
<tr>
<td>plants)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Assume only two weedings in the first year and one in the second if Gramoxone is used for weed control.

7. Mechanization

Not usual

8. Yield

Yields appear to be rather variable depending on growing conditions, age of the plants at harvest and on how much of the stems are harvested.

For plants 3-4 years old, which is the normal time of harvesting, an average yield of leuona (basal stem) plus waka (roots) would be about 5t/ha (5 tons/acre).

The yield is said to increase for up to 10 or 15 years but the subsequent rate of growth may be rather slower than during the first five years or so. Plants may be harvested after as little as two years but there is a loss in both yield and quality when the crop is harvested at this immature stage.

9. Nutritional Aspects

Yaqona is of almost no nutritional value.

A typical household might require one or two plants per month for its own use. (Assume 2 kg (4.4 lb) per household per month or about 1 kg per adult male per month.)

Marketing

Prices to growers in Taveuni have risen in recent years from 66-88 c./kg (30-40c./lb) to almost $4.00/kg ($1.80/lb) in May 1976. It is reported that yaqona is being imported into Fiji from Tonga and Hawaii. In the current conditions of shortage large amounts of yaqona are being planted but the potential future supply is being reduced because crops are being harvested in immature condition. However, the current incentive to growers is so great that it is unlikely that the shortage will persist for much longer and a future reduction in prices, perhaps to quite low levels, is to be expected. A future average price of $2.00/kg (90c/lb) is assumed for purposes of calculation.

C. CASSAVA

1. General Information

Manihot esculenta, or cassava, is known in Fiji as Tavioka. Cassava will grow on soils of low fertility and is commonly planted late in a rotation. There are signs of an expansion of the area planted in Taveuni, particularly on more accessible land near villages and settlements where long bush fallowing is no longer practised. Cassava is almost wholly a subsistence crop in Taveuni. It is generally a less preferred food than taro.

2. Seasonality

(a) Planting dates.

Can be planted at any time of the year.

(b) Growth period.

Matures in about 10 months although may be harvested sooner if need be. Can be left in the ground for up to two years or more as famine reserve against the risk of drought. In-ground storage of the crop in Taveuni appears to be unusual presumably because drought is not a significant risk.

3. Rotation Aspects

(a) Crop sequences

Usually grown at the end of a rotation after two or three taro crops or after yaqona. Cassava may be planted a second time in the same area, perhaps at a lower yield. The land is then usually allowed to revert to bush. Cassava is usually grown either as a pure stand or in association with coconuts. A 10% reduction in yield under coconuts will be assumed.

(b) Soil fertility considerations

The crop will grow on most soils including soils of depleted nutrient status.

4. Planting

(a) Spacing

Spacings are rather variable but typically hills might be 1.80 m x 1.80 m (6 ft x 6 ft) with 3 or 4 cuttings per hill. Some closer plantings (1.30 m x 1.30 m) were observed.

(b) Planting material

Tavioka is grown from stem cuttings.
5. Other Inputs

Gramoxone may be used for weed control during the early stages of growth of the crop. See under taro for cost data.

6. Labour Requirements

No local information was collected, and the following estimates are based on data from Tonga.

<table>
<thead>
<tr>
<th>Task</th>
<th>h/ha</th>
<th>h/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepare planting materials and plant</td>
<td>53</td>
<td>131</td>
</tr>
<tr>
<td>Spray (x2) (3 and 6 weeks after planting)</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>One weeding</td>
<td>37</td>
<td>91</td>
</tr>
<tr>
<td>Harvest</td>
<td>215</td>
<td>531</td>
</tr>
</tbody>
</table>

7. Mechanization

Not usual

8. Yield

Yield is said to be very variable but might average about 20 t/ha (8 tons/ac).

9. Nutritional Aspects

Consumed as a staple, usually boiled. Contains about 6.8 MJ/kg energy (153 Cal./100g) and about 1.5% protein with about 15% waste, based on tuber weight. Cannot be stored with present technology for more than a few days after harvest.

Because of its low protein content, diets containing high levels of cassava are not favoured by nutritionists. A safe limit might be 60% of energy needs.

10. Marketing

There is some local trade in cassava but this is very limited. Because of its poor post-harvest storage potential, sales outside Taveuni are rare. Thus marketing can be ignored for this crop.

D. COCONUTS

1. General Information

(a) Scientific and local names.

The coconut palm, *Cocos nucifera*, is known in Fijian as *Niul*. Three main varieties are grown: *Fiji Tall*, *Malayan Dwarf*, and a hybrid of the two.

2. Seasonality

(a) Planting dates

May be planted at any time

(b) Growth period

Palm normally start to bear nuts after six to seven years. They may survive for up to 100 years but 50 to 60 years is normally regarded as the economic life; this, however, varies with climate and soil fertility.

3. Rotational Aspects

(a) Intercropping

Crop production under coconuts is widespread. It is not possible if the palms are closely planted or before they have grown to a reasonable height. For tall varieties planted at about 9 m x 9 m (30 ft x 30 ft), intercropping would normally be impossible during the period from say five to ten years after planting. Cropping under dwarf palms is unusual.

On estates, cattle are commonly grazed under coconuts. Again, because cattle eat the leaves, this is not possible when the palms are less than about ten years old.

(b) Soil fertility considerations

Coconuts grow well on most soils but are seldom planted commercially above about 300 m (1000 ft). Palms are planted up to 450 m (1500 ft) in places in Taveuni, but probably mainly for drinking nuts since the fruit fails to mature at this altitude.

4. Planting

(a) Spacing

Tall and hybrid varieties are usually planted about 9 m x 9 m (30 ft x 30 ft), dwarf varieties closer. Some plantations, especially on village lands, are rather randomly planted and areas may be overcrowded or too sparse.

(b) Planting material

Selected seedlings are available for transplanting from the Department of Agriculture. There is also a subsidy of $7.41/ha/year ($3/acre/year) paid during the establishment phase for properly maintained new plantings. However, the scope of this scheme appears to be limited by shortage of funds.

5. Other Materials Used

Fertilizer use is recommended but is rarely practised. Gramoxone or other sprays are occasionally used for weed control in plantations and on a few estates banding of palms for rat
control is seen.

Tools, such as knives, axes, etc., may have to be purchased from time to time and on estates inputs are required for the transport and drying of copra and for general plantation maintenance. Similarly, oil must be purchased when oil-fired dryers are used.

For smallholder production, the costs of materials are likely to be quite low, averaging say $5/t dry copra. Estate costs are discussed in the text.

6. Labour Requirements

The following estimates relate to smallholder production.

<table>
<thead>
<tr>
<th></th>
<th>h/t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutting and carting green copra</td>
<td>20</td>
</tr>
<tr>
<td>Drying, bagging and marketing</td>
<td>110</td>
</tr>
</tbody>
</table>

The actual time spent in attendance at a dryer may be much more than that indicated above, but full-time work is not involved. No labour is allowed for plantation maintenance in accordance with current normal practice rather than recommended practice. Labour required for collecting nuts for domestic use is estimated at 60 h/t.

7. Mechanization

On smallholdings trucks may be used to cart copra to dryers and for sale, and to cart firewood. Otherwise, use of machinery is rare except on estates.

8. Yield

Yields are rather variable but a reasonable average would be about 700 kg/ha (5.6 cwt/acre) of bearing palms. Under ordinary circumstances nearly 90% of palms would be bearing reducing the yield per unit area planted to about 500 kg/ha (4.8 cwt/acre). At 6000 nuts/t, this yield is equivalent to 3600 nuts/ha (1500/acre).

There is some evidence of seasonality with the following typical seasonal pattern of output (of copra)

<table>
<thead>
<tr>
<th></th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nov - Jan</td>
<td>20</td>
</tr>
<tr>
<td>Feb - Apr</td>
<td>25</td>
</tr>
<tr>
<td>May - Jly</td>
<td>28</td>
</tr>
<tr>
<td>Aug - Oct</td>
<td>27</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100</td>
</tr>
</tbody>
</table>

9. Nutritional Aspects

Green coconuts are used for drinking and the flesh may be eaten raw. However, probably the main consumption is of mature coconuts used in cooking. At typical rates of conversion, one nut should yield about 300 g (10.6 oz) of coconut flesh with a nutritional value of about 17.0 MJ/kg energy (400 Cal./kg) and about 4% protein.

Data on local consumption of nuts are not to hand, but on the basis of Tongan information, domestic use might average about 200 nuts per person per year. A reasonable minimum reflecting an acceptable customary diet might be set at half this level, with a maximum consumption of about twice the average.

10. Marketing

Copra may be sold green or dry. Most green copra is bought by co-operatives who operate communal dryers. Dry copra must be graded at the Grading Station operated by the Coconut Board before it is sold to Morris Hedstroms or Rabi Holdings. Some large estates sell direct to merchants in Suva. The price paid for each grade is fixed by the Coconut Board.

Prices for dry copra in early 1976 in Taveuni were:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Price (t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade I</td>
<td>$164.26</td>
</tr>
<tr>
<td>Grade II</td>
<td>$143.69</td>
</tr>
<tr>
<td>Other</td>
<td>$ 54.74</td>
</tr>
</tbody>
</table>

On the basis of typical grading results, these prices are equivalent to an overall average of about $156.50/t ($159/ton).

Prices of green copra are rather variable but were typically about $5.50/100kg ($2.80/cwt).

In recent years copra prices have varied wildly. For example, between January 1973 and December 1974, the Suva buying price for Grade I copra varied from $83.25/ton to $97.50/ton. Thus it is meaningless to speak of an average price. However, the prices quoted above are guaranteed, at least in the short-term, under a price stabilization scheme and so may be presumed to reflect what the Government considers to be a reasonable minimum.

Marketing costs, when selling dry copra, might be incurred for transport to the Grading Station and on to the point of sale. An average cost would be $3/t.

A statement of prices at Suva and in Somosomo since 1970, derived from records made available to the project by Morris Hedstrom's, concludes this Appendix.
The functions performed by the middlemen are those of assembly, storage and transport of the yaqona, although some occasionally also undertake the harvest, cleaning and drying of the crop.

The conduct of the yaqona market appears to be quite efficient. Marketing costs and margins could not be fully investigated but no evidences of profiteering or of inefficiency on the part of the middlemen was found. It is true that the fieldwork was carried out during a period of severe shortage of yaqona, so that it is possible that competition between the traders was fiercer than usual. Some evidence for this view is provided by the Manager of the NFA who stated that he had to step in to buy yaqona in Taveuni in 1971 and 1972 to force up the price. (Haselman, personal communication). However, it is not clear if the low prices prevailing at this time (65-90c./kg; 30-40c./lb) were the result of a situation of abundant supply or a consequence of some form of collusion between buyers. Entry to the trade appears to require no more than a little capital and a modicum of entrepreneurial ability, so it is hard to say how the existing buyers could maintain an effective cartel permitting them to reap substantial abnormal profits. There is evidence that smaller traders move into the market as opportunity offers, and withdraw when competition becomes severe. There appears, therefore, to be little need for Government intervention in this market, although some minor reforms are suggested in the next section.

Changes in the retail price of yaqona since January 1974 (the earliest date for which data are available) are shown in Figure 2. The marked upward trend in prices as the result of the shortage of supplies is apparent. The shortage appears to have come about partly as a consequence of yaqona plantations in large areas of Fiji caused by hurricane Bebe in October 1972 and partly as a result of increased consumption. The crop is a relatively long-term proposition, taking three or four years to grow big enough to harvest. Hence any supply response to increased demand and prices is likely to take a few years to be effective. Moreover, there is a tendency for growers to harvest their crops younger and at lower yield during periods of high prices, thereby reducing the future potential supply. This is clearly the situation prevailing at present (mid 1976). However, it is to be expected that potential supply will eventually catch up with demand as more areas are planted in response to the high prices, and when this happens the reverse of the present situation will occur. Prices will fall and growers will delay harvesting their crops which will continue to grow, thereby enlarging the unmarketed surplus. Thus a prolonged period of lower prices can be expected in the future. Unfortunately, no data are available to permit even an approximate determination of when this reversal in market conditions can be expected.

COPRA

There are three main routes by which producers of copra in Taveuni can market their produce. First, and most usually, producers who dry their own copra sell it to one of the

APPENDIX 2.

NOTES ON ESTATE COPRA PRODUCTION
(Harold Brookfield)

This appendix draws on a partially successful questionnaire survey of Taveuni planters, on field observation, and on a period of residence on one estate in January 1976, in order to amplify remarks made by Haynes and Hardaker on estate production. I am concerned only with production and not with marketing, beyond the use of estate transport to take copra to grading and buying points, or to loading points. Matters beyond these, and the wider question of restructuring the copra industry, will be dealt with in other publications. I describe estate production in a period of stable but low price, since this inquiry began after 26 June, 1975, the date on which the Price Stabilization Scheme was initiated. However, the effect of the preceding short boom, and prolonged price drop, was still very much with the industry at the time of research.

The Taveuni estates vary enormously in the efficiency with which they are managed, and in the physical conditions which present owners and managers have inherited from the past. Truly clean, well-maintained estates are now a minority, and several estates are so thickly overgrown that it would be a major and costly operation to restore them. Parts of several estates are so densely bushed that they are scarcely penetrated at all by cutters, and the rate of nut loss on several whole properties is estimated as high as 30 percent.

Estate operation is restricted by low labour inputs. It is commonly said that the annual production per worker is ten tons (i.e., approximately 10.0 tonnes). In fact the mean productivity per worker on a sample of Taveuni estates works out at 9.56 tonnes (sd 2.13), with a range from 6.9 to 13.1 tonnes. This corresponds, however, with a somewhat more variable use of labour per hectare of bearing coconuts, having a mean value of 19.07 ha/man (sd 9.50), and a range from as low as 4.05 ha/man to as high as 53.76 ha/man. The corresponding yields for estates at the limits of the range are also the lowest and highest (0.23 t/ha and 1.76 t/ha), but the intermediate situation is less clear and with such small numbers of cases (15) no significant relationship can be established.

In 1955–56 an unpublished report on the copra industry was written by R.G.G. Haselman, and data were obtained on 15 Taveuni estates in connexion with this report. More than half of these

1 These data were recorded from files by R.G. Ward in 1960. We are grateful to Professor Ward for permitting us access to his notes.
estates were also covered in our 1975-76 survey. The mean estate
coconut area in 1955-56 occupied 347.60 ha, producing 309.08 t;
in 1975-76 the corresponding values are 324.35 ha and 195.25 t.
The weighted (by area) and unweighted means of estate yields at
the two dates are as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Weighted Yield t/ha</th>
<th>Unweighted Yield t/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>1955-6</td>
<td>0.89</td>
<td>0.85</td>
</tr>
<tr>
<td>1975-6</td>
<td>0.59</td>
<td>0.65</td>
</tr>
</tbody>
</table>

Mean of yields 0.41 0.34
Std. deviation 0.01 0.09
Std. error 0.01 0.10

However we view it, this is a very substantial decline in yield,
and it is amply corroborated by the qualitative state-
ments of almost all planters of long experience. Many go further,
and remark that in an undated past yields of half-a-ton per acre
(1.25 t/ha) were normal on Taveuni estates, though it is doubtful
if this every applied to more than a minority of estates. From
whatever former level, the decline was to the order of 0.36 ton/
ac in the mid-1950s and 0.24 ton/acre now. Though some estates
for which we were not able to obtain data do much better than
this, they are very much a minority.

Failure to replace ageing trees at a sufficient rate, or to
replace them at all on most estates, is a major cause of the
progressive decline in yield. In our survey, planters reported
19.5 percent of their coconut acreage of old palms yielding little,
and this is almost certainly a conservative estimate. One manager, more candid than most, estimated ten
percent of his trees as 'smile', and a further 30 percent as ageing
with declining yield. Substantial replanting has been confined
only to a very few estates, and unfortunately the owners of the most
outstanding estates in this respect were unwilling to respond to the
survey.

As a result of lack of maintenance, and failure to replant
on an adequate scale, we are dealing with an industry in which
large areas have now declined to the level of a gathering economy,
collecting nuts from aged palms, and losing more and more under
the invasive bush until the undergrowth finally becomes so dense
as to make further collection uneconomic. There are still well-
maintained estates, but most planters maintain that they cannot
afford the costs of maintenance, while managers complain that
their head offices will allocate no money for this purpose.
Replanting is not only beyond the means, but also beyond the will
of a majority of estate owners. The fact that the industry is
going downhill is almost universally agreed -- indeed it is
physically obvious. None the less the planting community continues
to operate within these somewhat depressing limitations. It will
be useful to examine in more detail how this is done.

I lived for a few days on one Taveuni estate, and was able
to examine a considerable number of documents relating to that
estate. Like several others, this estate was composed of an
aggregate of former smaller holdings, bought at various times
between 1950 and 1965. Just over half the estate is planted,
nearly two-thirds of this with old Fiji Talls', the balance
mainly with new Fiji Talls plus a small area of the unpopular
Malayan Dwarf palms. The present manager, and other informants
all agree that the estate has been run down badly since its early
days, though there is disagreement as to when. The balance of evidence indicates that since World War II there has been very
variable effort to eliminate the heavy guava that smothered the
planted area during the 1930s and 1940s, so that while some areas
are clean pasture under the coconuts, others are so massively
infested that copra cutters do not reach as much as ten percent
of the nuts.

Management of this estate is good, and production is actually
greater than it was 20 years ago. The main labour force of some
20-25 copra cutters assemble soon after 6.30 a.m. and is allo-
cated to a 'paddock' or paddocks according to the manager's plan,
and the weather. They are in the coconuts by 7.30. At this
estate, unlike some others, there is no aider or the men to
allocate specific rows of trees, or blocks of land, to each man,
so the first hour is occupied in mutual allocation, accompanied
by almost constant calling through the trees. Outside 'casual'
cutters come and fit themselves in, and by about 8.30 am is silent
but for the sound of axes and knives on the collected nuts. The
first task is to collect the nuts from the trees among the
guava, and group them into piles of 100-300.

They are then split open, the coconut water being lost
except to the omnipresent mosquitoes, and the cutter extracts the
meat from each half-shell at a rate which can reach four nuts per
minute. A bag later weighed at 51.7 kg was filled by one man,
assisted by a boy in 10 minutes including a short rest; about
12 minutes of this time was occupied in splitting the nuts. When
the bag is full, the cutters fill another bag, and then return home
on foot. Few are left by midday. Soon after midday the tractor
and trailer, with two day-workers, begins its round to collect
the sacks of green copra on rough terrain and in dense guava
this is no easy operation, and the skill of tractor drivers on
deepest slopes in wet weather is enviable. The sacks are then
brought back to a central point where they are weighed, and
recorded, and after this taken to the drier. The work is normally
ended by about 3 p.m., but there may remain maintenance work on
the tractor and trailer, to make ready for the next day. The
cora itself is loaded into the drier for 24 to 36 hours depending
on the method used, or on a few estates is still spread on vatas
to sun-dry over several days.

Cora cutters are expected to fulfill a 'task', and on some
estates their rate of pay depends on whether or not they achieve
this. Normally, a day's task is four full bags, or more precisely
181.4 kg (400 lb). In earlier years it was often 227 kg (500 lb),
involving the longer day that all accounts of work in former times
would seem to require.\(^2\) In fact, however, the performance is often less than the task. At the estate on which I was living, there were on average 21.7 copra cutters engaged each day over 72 working days (sd 3.32), and the average cut per cutter was only 172.4 kg (sd 50.7). Only nine of 16 cutters employed on each of 30 days achieved the 'task' of 181.4 kg on average, but the range is from 240 kg down to 133.6 kg.

There are three sources of variation in the performance of cutters: first is the cutter himself. Indo-Fijian cutters tend to perform better than Fijian cutters; mainly because they take two or three members of their families with them to assist in collecting the nuts and loading the sacks. Second is the weather; third is the richness of the paddock itself. The degree to which these sources of variation are important depends on the manager. A good manager, such as the one I saw at work, will space collection from different paddocks so as to ensure a steady income for his cutters, and will reserve 'easy' paddocks for wet days so that a good cut can be made in a short time. A close examination of the daily records for this estate revealed very little variation with weather, and the only notably light days were those on which the cutters had been sent back a second time to a paddock not cleared the day before. It is not so on all estates, and a very great variation between days is often encountered.

It is none the less evident that different paddocks vary enormously in yield, and that the mean yields for whole estates conceal very great internal variation. On this estate, the following table represents the frequency of cutting, and the mean cut, from different paddocks over a period of 89 working days in 1975:

<table>
<thead>
<tr>
<th>Paddock</th>
<th>Times visited</th>
<th>Mean daily cut per cutter (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>11</td>
<td>186.65</td>
</tr>
<tr>
<td>B</td>
<td>8</td>
<td>177.58</td>
</tr>
<tr>
<td>C</td>
<td>7</td>
<td>160.71</td>
</tr>
<tr>
<td>D</td>
<td>7</td>
<td>176.36</td>
</tr>
<tr>
<td>E</td>
<td>6</td>
<td>182.67</td>
</tr>
<tr>
<td>F</td>
<td>5</td>
<td>143.83</td>
</tr>
<tr>
<td>G</td>
<td>5</td>
<td>174.36</td>
</tr>
<tr>
<td>H</td>
<td>5</td>
<td>161.80</td>
</tr>
<tr>
<td>I</td>
<td>5</td>
<td>191.51</td>
</tr>
<tr>
<td>J</td>
<td>5</td>
<td>173.36</td>
</tr>
<tr>
<td>K</td>
<td>4</td>
<td>191.82</td>
</tr>
<tr>
<td>L</td>
<td>4</td>
<td>205.11</td>
</tr>
<tr>
<td>M</td>
<td>3</td>
<td>165.65</td>
</tr>
</tbody>
</table>

\(^2\) On Mua estate, for example, there are accounts of bargeloads of copra coming around from outlying parts of the estate, in days before there was a road, around dusk or after dark.

There is enormous variation in the frequency of collection between paddocks. It in fact appears that not less than half the production is drawn from not more than about 20 percent of the area of the estate. Even within paddocks there is great variation; most of the filled sacks picked up by the tractor and trailer may be drawn from only one part of the paddock. It is knowledge of these variations, and skill in exploiting them on the part of both the manager and his cutters, that makes possible sustained high production per head for a long period under conditions of decline in the estate as a whole.

Getting the copra in from the field to the drier is a big operation on a large estate, and the critical element is the mechanical equipment which must operate over estate 'roads' often too bad for even a four-wheel-drive vehicle to negotiate without risk of damage. The 'do-it-yourself' methods known to every Taveuni planter and manager greatly reduce maintenance costs, but they are none the less enormous. Spare parts are hard to get, and planters help one another with them. In spite of all efforts, however, the casualities among mechanical equipment are high, and this risk is a very serious element in the cost structure of estates operating on an exiguous profit margin. Together with a fuel cost which can readily reach a dollar per hectare of coconuts per month, they are the principal reason for the reported contrast between small planters, without mechanical equipment, and the larger enterprise; I revert to this below.

But this is only the first stage, though it is by far the most labour-intensive stage of copra making and marketing. The copra then has to be dried, by methods that vary greatly, in driers of very different age and condition, and by operatives who vary greatly in skill. Most small planters operate their driers themselves, or at least supervise them very closely, for this is the stage at which the quality of the product, and hence its grade and price, are mainly determined. Copra driers are also rather too readily combustible; a great many have been burned down together with all the copra within them.

Until 1974, almost all large estates were using oil-fired driers, but there were exceptions. One of the two big companies remains lumbered with sun-drying vatas which are close to gravel roads carrying far more traffic than when the vatas were constructed. Dust, and other sources of spoliation, give the company second-grade copra so frequently that they commonly hire hot-air drier time from other estates. In the 1920s Taveuni had two of the best copra driers in the Pacific, steam-heated, well-designed to
employ gravity in filling and emptying, and producing a very high quality product. These days are long past, and most driers in the island are structures that have been repaired and modified several times. This is perhaps one reason why large planters are able to make increasing use of the Somosomo grading station, foregoing the higher profit obtainable by direct consignment to Suva for the security of being more likely to receive the Grade I price in Taveuni. A second reason is that ships now make fewer 'loading point' calls around the coast than in former times. Whereas in 1964 trading vessels still called at 18 places on the Taveuni coast to collect copra (Couper 1965, p.79), not more than six or seven places are now regularly visited, and for most planters road transport over longer distances has become necessary thus reducing the gain from direct shipment.

After drying, copra is bagged and then taken in the estate transport either to the loading point or to the Somosomo grading station, and thence again to the buyers' sheds at Somosomo and Waiwevo. Large estates employ trucks for this work, but smaller estates use utilities or four-wheel-drive vehicles in which only a small quantity can be transported at a time.

The cost of the intermediate processing and transporting stages is not negligible, though few planters are able to separate their accounts in their accounts. Although of the operating costs of transport alone, including labour, range between $8/t and $33/t, but in some cases the planter is also the driver, in others copra is delivered only to a loading point, and in still others costs of estate road maintenance is included. Depreciation on vehicles is never included. One planter who consigned to Suva from a point close to his plantation gate estimates the total transport cost to Suva at $22/t, against $32/t to collect and out the copra and bring it to the drier.

It is, however, possible to get closer to the actual costs of the intermediate stage with the aid of one unusually detailed analysis prepared in 1974. The estate concerned is large and complex, with separate units, and produces an average of 153 tonnes in each two-week period. Copra is dried both in wood-fired driers and an oil-fired drier, and a top of dry copra demanded the consumption of 7.96 tonnes of firewood, 4.35 tonnes of husks, 76.09 litres of diesel fuel, 5.65 litres of diesel oil and 1.57 litres of kerosene (for lighting). The use of fuel for motor transport is not recorded. Each tonne requires also 2.83 man-days of work in cutting and transporting firewood and 2.34 man-days attending the drier. The work of bagging is contracted out, and not timed. In addition, transport of the green copra from the paddocks to the drier requires on average 2.35 man-days per tonne; the labour requirement here is much greater in wet weather than in dry, and an average 50 percent of dry days is assumed.

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3 For obvious reasons, no specific acknowledgement is offered. Data have been modified to conceal the source.

<table>
<thead>
<tr>
<th>Labour cost</th>
<th>Fuel cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>$/t</td>
<td>$/t</td>
</tr>
<tr>
<td>Cutting of firewood</td>
<td>4.28</td>
</tr>
<tr>
<td>Transport of firewood</td>
<td>3.72</td>
</tr>
<tr>
<td>Diesel fuel for driers</td>
<td>-</td>
</tr>
<tr>
<td>Diesel oil for stationary engine</td>
<td>-</td>
</tr>
<tr>
<td>Kerosene for lighting</td>
<td>-</td>
</tr>
<tr>
<td>Transport of copra, park</td>
<td>4.89</td>
</tr>
<tr>
<td>Filling, emptying, attending drier</td>
<td>7.43</td>
</tr>
<tr>
<td>Bagging of copra (subcontracted)</td>
<td>7.00</td>
</tr>
<tr>
<td>Transport to selling point</td>
<td>-</td>
</tr>
<tr>
<td>Lubricating fuel</td>
<td>-</td>
</tr>
</tbody>
</table>

The total of $36.14/t is not complete, for it ignores vehicle fuel and also the time of the manager and guards in supervising, and in delivery of copra to the sale point. It also takes no account of depreciation on transport and drying equipment, or of vehicle maintenance. None the less the cost of the intermediate stage are evidently substantial, even without these omitted items.

The cost of copra-cutting itself is also difficult to establish, since wage rates rose sharply during the boom in order to attract casual workers away from their own groves; $1.75 to $2.50 per 45 kg (100 lbs), of green copra, or unwrapped bag, presumed to be of this weight, was commonly paid in 1974 and early 1975. There was then a great reduction in wages and in mid-1975 payment systems were very diverse, ranging between 50 cents and $1.00 per bag with or without bonus payments for quantity. Since price stabilization there has been a tendency to converge toward 70 cents/45 kg, but some estates still pay $1.00, or operate a bonus system. Some weigh copra, some pay a flat rate per bag, normally above 45 kg. Depending on estate, and on the estate to which information refers, the cost of copra cutters per tonne of dry copra may therefore range from as low as $18/t to as high as $54/t with random and dubious figures even higher than this. A general level between $30 and $37 per tonne of dry copra seems, however, to becoming established. Total labour costs of the production stage are higher, because there is variable employment of workers paid by the day (now generally at $2.00/day), and sometimes copra cutters are employed on day rates doing maintenance work, while day workers also sometimes cut copra.

It seems clear however that in the boom period, before the inflation of fuel and maintenance costs reached its present dimensions, the cost of the production stage (being almost all labour cost) was greater per tonne than the intermediate costs.
for most estates. More recently, however, the share of intermediate costs in the total budget has risen sharply. More significantly, the costs of labour and capital in the production function have moved in opposite directions, and this has had important consequences for the balance of advantage between large and small estates. Large estates are more heavily capitalized; until lately this has enabled them to reduce average costs per tonne of copra, but now it is the labour-intensive small planter who has the advantage. Many large estates have replaced oil-fired drying by wood-fired drying, but there is little they can do about their transport costs except by ceasing collection of nuts in remote parts of the estates. Large planters and small planters agree that while the latter still enjoy some profit margin, the former have scarcely any profit at all on a per tonne basis, so that the difference between receiving first or second grade on a delivery may be the difference between profit and loss.

But the variables are not simple. Though, as noted above, we were not able to obtain cost data for what are both reputedly and evidently -- the most efficient of Taveuni estates, it can none the less be deduced on prima facie grounds alone that well-maintained estates that have gone in for extensive replanting and new planting during years of modest profit margin, when others spent their incomes, are now better off than others by virtue of higher yields, and lower collection costs per tonne. Estates with only ageing palms, with or without dense undergrowth to impede and reduce nut collection, will inevitably produce less per hectare or per man-hour of collection time; their transport costs per tonne will be increased by the lower density of the harvest, and inflations in the operating and replacement costs of their capital equipment will hit them more severely. To some degree at least, a large part of the industry is now paying the price of past neglect, and failure to reinvest when the resources to do so were available. Given that they are now smitten with diseconomies of scale, especially when associated with low and declining yields, it would seem that the optimal strategy for planters who still see a future on the land in Taveuni is to contract areally, and intensify activities over small units of land. Some planters are in fact doing this, and selling off parts of their land when buyers can be found. The implications of such a trend for the future of land use and land settlement in Taveuni are obvious, and they lend force to the arguments advanced by Hardaker concerning the redistribution of land.

Reference


APPENDIX 3.

SOME TECHNICAL SUGGESTIONS ON REHABILITATION OF COCONUTS

(Patrick Haynes)

The most cursory study of coconut production in Taveuni and Lakeba reveals scope for weed control and the systematic rejuvenation of groves. Much of the rejuvenation that currently occurs results from the haphazard growth of trees from nuts which have been lost in dense weed growth under the trees. It has been stressed in PWP 4 (above) that companion cropping in coconut groves is an effective way of controlling weeds. Management problems arise when weeds are already established. Hand clearing is onerous, making difficult the mobilization of labourers in sufficient quantity for this task. Where the bush is heavy, chainsaws may have to be used. Disposal of the debris then presents problems. One practical solution to this could be the burning of debris across the slopes and allowing its decay in situ. Profitable exploitation of the cleared land may be possible by planting easily grown cash crops, such as pumpkins, on or near the debris. Such crops are likely to aid in weed suppression as well as provide an immediate source of income. As the material decays, more durable cropping systems may be established. There are several possibilities e.g.

- grass may be planted and live stock reared
- taro and yaqona may be interplanted between coconuts
- the unproductive coconuts may be replanted.

The actual circumstances of the holding would determine which of these options, either singly or in combination, should be adopted.

Rehabilitation of old coconuts with grass. Successful replanting of unproductive coconuts on which cattle are grazed depends on the isolation of the new seedlings from the cattle. Cages may be used, but the management of these is labour and material intensive. An alternative approach is the replanting of isolated blocks. Here, seedlings would be interplanted among the original trees with the removal of the latter before they inhibit the new growth. There is a strong emotional resistance to the removal of any coconuts from groves throughout Fiji. This need not present difficulties provided care is taken to demonstrate that replacement of trees can be achieved without serious loss of yield. Work in Trinidad with cocoa (Shepard 1939) has shown that a yield loss from removal of a proportion of senescent trees is small relative to the total yield. More recent works on fruit trees in Australia (Hardaker, pers. comm.) may be of relevance to this problem. With coconuts, the actual proportion which can be removed without serious economic loss could be complicated by
frequent variations in copra prices. The actual condition of the
trees would also be of importance, as would be the duration of
the period between removal of old trees and commencement of
bearing by the replacements. Before arriving at a satisfactory
formula for replacement, critical observations of yield potential
in old groves would be required.

Old coconuts with light bush as weeds. Many coconut groves
on both islands were characterised by the growth of light bush.
This not only represents an unexploited resource but adds to the
cost of collecting nuts, many of which on falling remain hidden.
Such nuts germinate with subsequent crowding of the trees. Hand
weeding and chemical spraying, although technically feasible, are
less valid solutions due to relatively low rates of productivity
and the onerous nature of such work. Improvement in this could
possibly be achieved through use of an implement developed for
similar circumstances in Trinidad. This consists of a heavy roll
with projecting metal flanges, which crushes weeds when pulled
through the coconut groves. The length of the roll could be
adjusted to enable passage through irregularly spaced trees.
These implements could be horse drawn, with consequent advantages
in manoeuvrability and access. Some experimentation would be
required to develop sizes and weights suitable for drawing by
horses but capable of effective weed control.¹ In some circum-
stances, selective thinning of trees may be required to produce
even spacing, but the removal of productive trees for the sake
of accessibility and evenness of stand would not be recommended.

¹ Weed control by rollers was in use, along with other methods,
on Leviers' plantations at Yandina, Solomon Islands, in the
1960s (Ed.).

Reference

Shephard, C.Y. 1969. The Cacao industry of Trinidad: rehabilitation
of an old field: a progress report. J. Tropical Agriculture 14
(11), p. 247-51.
CROP DIVERSITY.

The quadrat samples are too small and, within each island, too localised for firm conclusions to be drawn about variations in crop diversity. Lakeba farmers would appear, however, to place more emphasis on multiple cropping than those on Koro, possibly because of the ease of access on Koro to wild fruits and leaves which can provide variety in the diet instead of cultivated forms. Both Koro and Lakeba would appear to be more diverse than Batiki, which in cash terms is the poorest of the three islands and the most ecologically constrained.

<table>
<thead>
<tr>
<th>Island</th>
<th>Mean number of crop species per 100 sq.m. quadrat</th>
<th>Mean density of minor crop plants (excluding roots and coconuts) per hectare</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lakeba</td>
<td>3.42</td>
<td>364</td>
</tr>
<tr>
<td>Koro</td>
<td>3.39</td>
<td>91</td>
</tr>
<tr>
<td>Batiki</td>
<td>2.23</td>
<td>84</td>
</tr>
</tbody>
</table>

**TABLE A: Density of Major Crops**

<table>
<thead>
<tr>
<th>Island (Village)</th>
<th>Main Land Use</th>
<th>Number of Quadrats</th>
<th>Mean No. Plants or Mounds Per Hectare</th>
<th>Per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lakeba (Yadrana)</td>
<td>Sweet Potato</td>
<td>8</td>
<td>4175</td>
<td>1690</td>
</tr>
<tr>
<td></td>
<td>Xanthosoma</td>
<td>8</td>
<td>8975</td>
<td>3632</td>
</tr>
<tr>
<td></td>
<td>Cassava</td>
<td>8</td>
<td>4175</td>
<td>1690</td>
</tr>
<tr>
<td></td>
<td>Taro (wet land)</td>
<td>8</td>
<td>13313</td>
<td>5388</td>
</tr>
</tbody>
</table>

| Koro (Nacamaki)  | Yam           | 11                 | 3764                                  | 1523     |
|                 | Mixed taro, Xanthosoma and yaqona | 7                  |                                          |          |
|                 | (1. Taro and Xantho) |                     | 5000                                  | 2023     |
|                 | (2. Yaqona)    |                     | 2585                                  | 1046     |
|                 | Yaqona         |                     | 3*                                    | 2333     |
|                 | Taro (dryland) |                     | 2*                                    | 6500     |

| Batiki (Yavu)    | Cassava       | 12                 | 4683                                  | 1895     |
### TABLE B: Density of Minor Crops

<table>
<thead>
<tr>
<th>Minor Crop</th>
<th>Mean No. of Individuals per Hectare&lt;sup&gt;x&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lakeba</td>
</tr>
<tr>
<td><strong>TREES</strong></td>
<td></td>
</tr>
<tr>
<td>Coconut</td>
<td>21</td>
</tr>
<tr>
<td>Breadfruit</td>
<td>-</td>
</tr>
<tr>
<td>Pandanus</td>
<td>-</td>
</tr>
<tr>
<td>Lemon</td>
<td>-</td>
</tr>
<tr>
<td>Masi</td>
<td>4</td>
</tr>
<tr>
<td><strong>SHRUBS</strong></td>
<td></td>
</tr>
<tr>
<td>Banana/Plantain</td>
<td>50</td>
</tr>
<tr>
<td>Papaya</td>
<td>8</td>
</tr>
<tr>
<td>Bele</td>
<td>42</td>
</tr>
<tr>
<td>Yagora*</td>
<td>42</td>
</tr>
<tr>
<td>Sugar Cane</td>
<td>21</td>
</tr>
<tr>
<td>Egg Plant</td>
<td>-</td>
</tr>
<tr>
<td>Chilly</td>
<td>4</td>
</tr>
<tr>
<td><strong>ROOT CROPS</strong></td>
<td></td>
</tr>
<tr>
<td>Xanthosoma*</td>
<td>229</td>
</tr>
<tr>
<td>Cassava*</td>
<td>221</td>
</tr>
<tr>
<td>Sweet Potato*</td>
<td>38</td>
</tr>
<tr>
<td>Taro (dryland)*</td>
<td>-</td>
</tr>
<tr>
<td>Alocasia</td>
<td>46</td>
</tr>
<tr>
<td><strong>OTHERS</strong></td>
<td></td>
</tr>
<tr>
<td>Pineapples</td>
<td>150</td>
</tr>
<tr>
<td>Maize</td>
<td>67</td>
</tr>
<tr>
<td>Cucumber</td>
<td>13</td>
</tr>
<tr>
<td>Tomato</td>
<td>-</td>
</tr>
</tbody>
</table>

**Notes.**
- * Major crops grown in areas predominantly planted with another major crop.
- + Not differentiated from taro as a major root crop.
- <sup>x</sup> Lakeba: mean of all quadrats in Table A excluding the wet taro ones which contained no minor crops.
- Koro: mean of 23 quadrats in Table A.
- Batiki: mean of 13 quadrats, including 1 yam quadrat not shown in Table A.