Farming systems and food production in North Coast regions of Papua New Guinea

This report was originally done as a part of a consultancy by the United Nations Food and Agriculture Organisation for a possible World Bank funded development project on the north coast of Papua New Guinea.

Some photos have been included of some of the less well-known food plants

The original report was done in 1995
and has been modified and made available as a pdf document in 2006

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FAO preappraisal for World Bank project Momase region. Food crops component. Bruce R French Agrosociological consultant.

On the basis of need the disadvantaged areas in Momase were identified as Morobe Province - Kabwum District and Menyamya District. Madang Province - Middle Ramu District and Rai Coast District. East Sepik Province - Ambunti District. West Sepik Province - Amanab District and Telefomin District.

DAL/DPI staff seem keen to include the Maprik District and Upper Ramu due to the accessibility and possibility for cash developing enterprises. The isolation of the districts specified as needing assistance seems a positive deterrent for Government staff but these areas are well served by Christian mission and church organisations and staff, except that these people often are not provided with guidelines or assistance on how to approach agricultural development.

Numbers for farming systems are from the Agricultural Systems of Papua New Guinea working papers by Allen, Hide and Bourke et al, Land Management Project, Department of Human Geography, Research School of Pacific and Asian Studies, Australian National University, Canberra ACT 0200 Australia. Food consumption pie charts are adapted from nutrition data from the 1983 nutrition survey as reported in Allen, Bourke, Hide et al. Ranking codes are from the CSIRO Geomorphology, Vegetation, Land Use maps of PNG.

Whereas the CSIRO PNGRIS system tries to describe climate, geomorphology, soils, etc towards a system of planning for what could be, the system by Allen, Bourke and Hide et al describes what are the current farming systems. What is finally needed is a synthesis of them both attempting to determine what are agroecologically similar zones where similar production methodologies and constraints would allow transfer of information. Then some agriculturally significant information needs to be considered against that base line. For example, after describing that people shift location after one crop, it would be useful to determine why and what constraints restrict further utilisation on the same site for a short time with several crops, or a long time with a restricted fallow. Is it nutrients, weed occurrence, pH or pH cation related release, nematodes, ease of garden clearing, lower insect and pest incidence, or other factors such as soil condition?

The following descriptions of the farming systems are mostly brief summaries from the study by Allen, Bourke, Hide et al. Their report for the Morobe Province is not yet available. Discussion of possible strategies for improvement are included at the end of each region and are preliminary suggestions or possibilities only. For each area detailed consideration should initially be given to all available information and discussion of potential strategies for improvement. Then packages need to be developed to make existing information available to those involved in

these areas while further research is undertaken. At present agricultural extension staff in Papua New Guinea have very little information and very few strategies or packages to guide their activities in development for food crop production.

Given the **seven districts** potentially identified in the pre-preparation social assessment the cropping systems are:

Madang

Middle Ramu

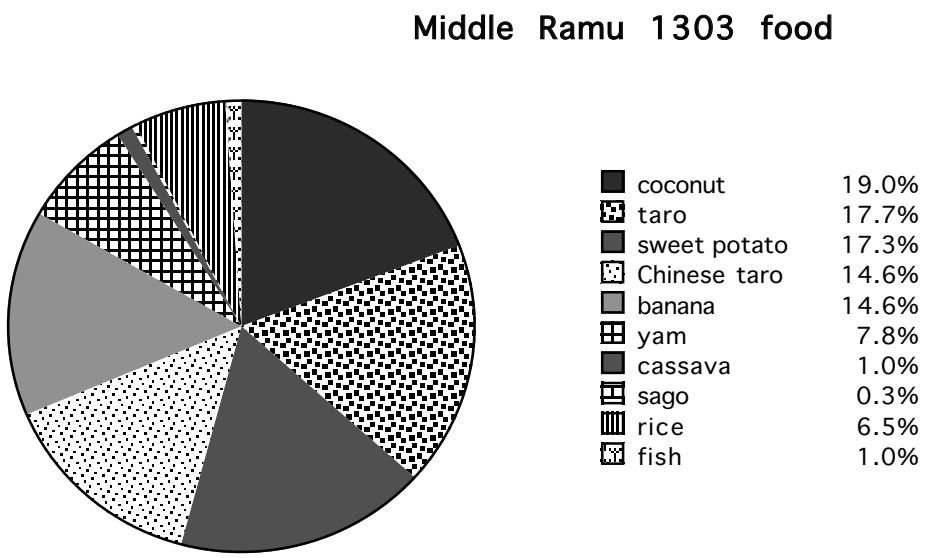
Agricultural systems 1303, 1307, 1308, 1315,1316, 1317, 1318

System No.	Area (Sq km)	Population
1303	6226	19077
1307	567	8457
1308	1002	7583
1315	503	6292
1316	318	8801
1317	192	4600
1318	178	1548 (Cf System 0909)
1319	64	250

Madang

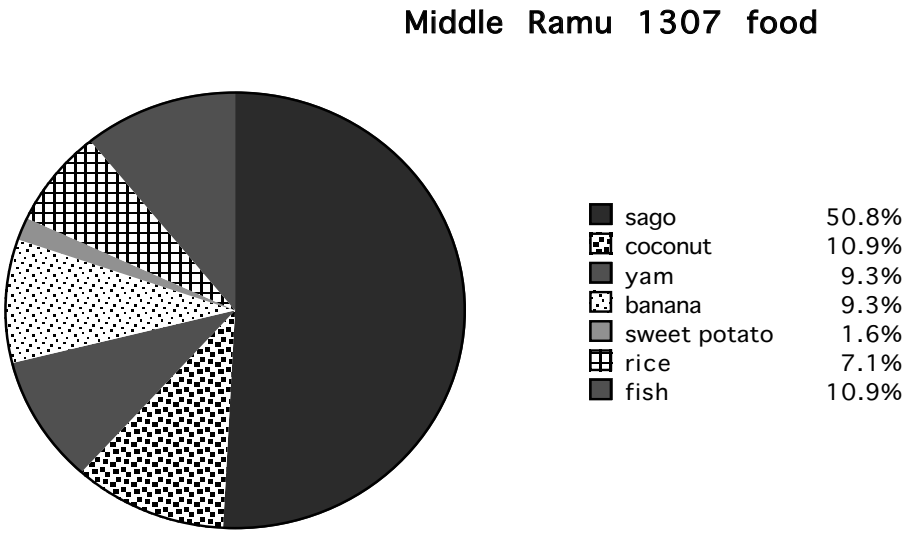
Middle Ramu

Mostly less than 600 m but on the eastern side including Simbai altitudes range from 600 m to 2800 m. This latter area has high slopes that are subject to high incidence of erosion, high rainfall (> 4000 mm) and "homoclinal ridge and ravine land forms and strike ridges and hogback ridges" (CSIRO Geomorphology). On the Allen, Hide, Bourke Land Use system the predominant crops are sweet potato/taro

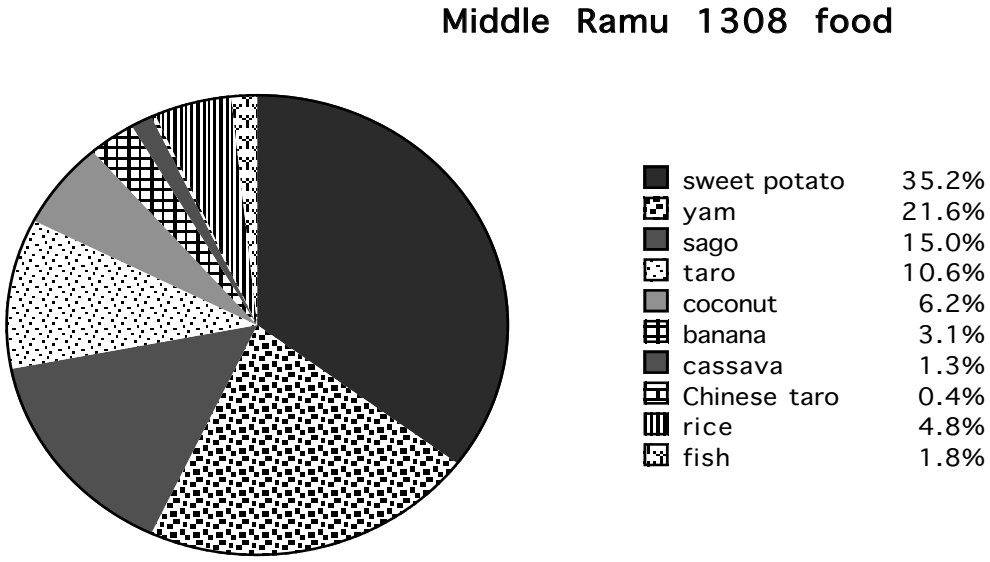


This lowland farming system 1303 is based in woody fallows with long fallow periods. The re-growth that is over 10 m tall is cleared and

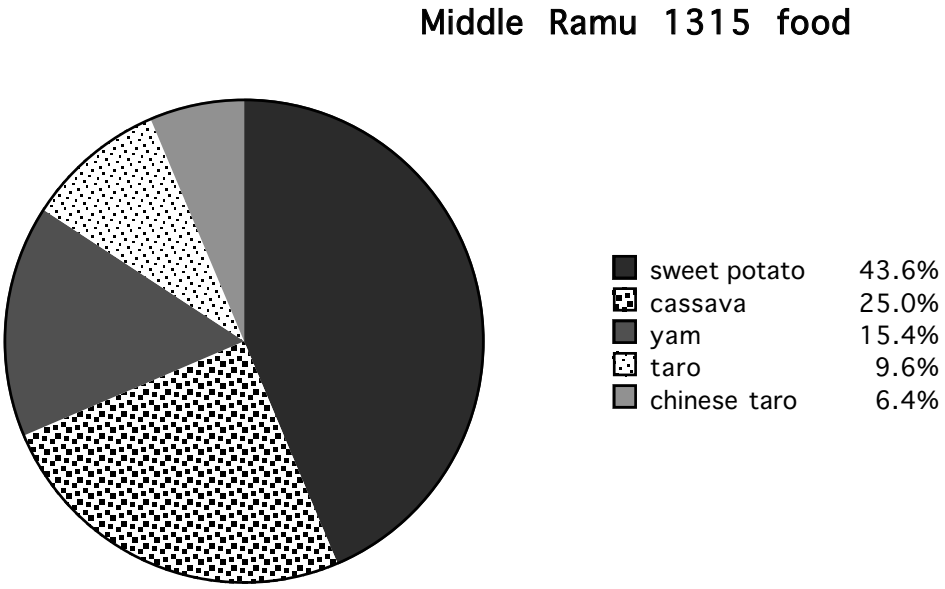
burnt. Sweet potato and taro are the most important crops although a range of other crops are grown. Only one crop is grown before reverting to fallow. Population density is low and villages can relocate when a further cropping/ fallow sequence is begun in older bush. Mixed cropping is practiced. Gardens are planted between July and December. While crops are growing during January to March, food is short. This system covers much of the Madang Province.



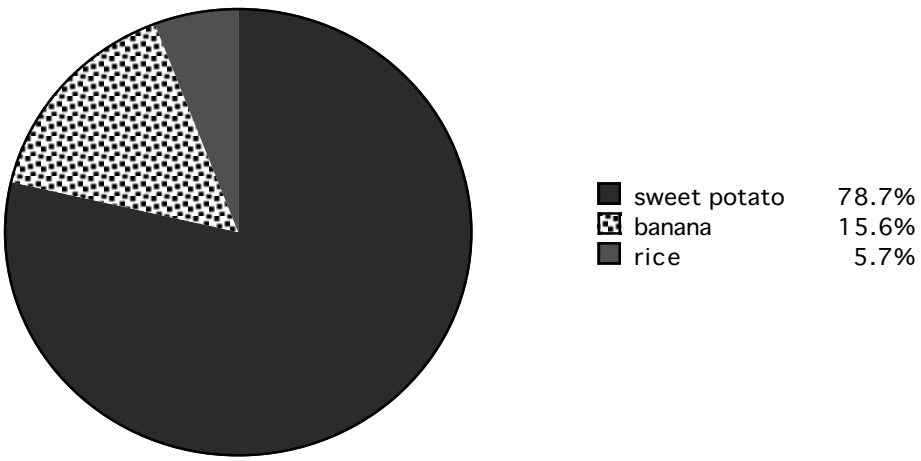
This sago producing system 1307 is on the Ramu River flood plain. Gardens are flooded between January and April and this limits gardening. Garden crops include banana, cassava, Chinese taro, sweet potato, taro, and Greater yam. The fallow vegetation is woody re-growth and is burnt at clearing.



This system 1308 is on the Ramu plain above the flood level. Sago is basic with taro, banana and sweet potato being important. Yams, Chinese taro and cassava also occur.

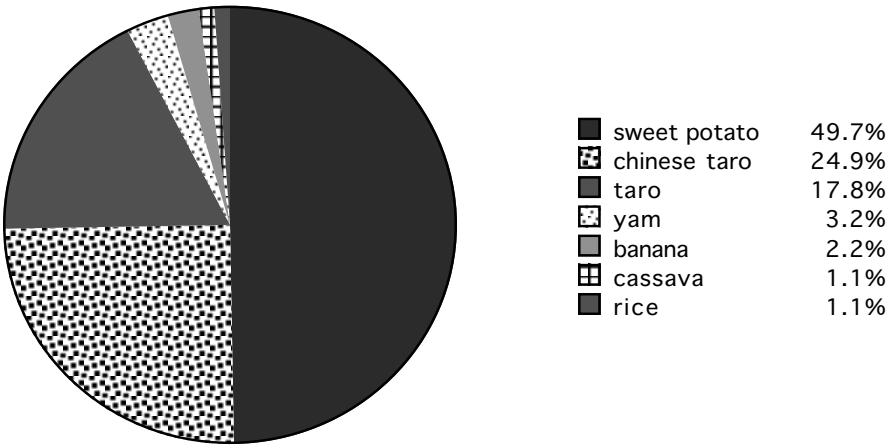


This system 1315 in woody re-growth is based on sweet potato with taro, banana and Chinese taro as other important crops. It covers an altitudinal range from less than 600 m to over 2800 m. This gives the scope to include lowland crops such as coconut to high altitude nuts such as "wild" karuka. The fallow is burnt and both crops and gardens are segregated. Gardens are fenced. Sweet potato is more important above 1200 m while taro, greater and lesser yam and banana are intercropped in lower gardens. Perennial crops of marita, tulip, breadfruit and Ficus are important. The gardens in this area have been described in considerable detail by anthropologists, geographers and nutrition workers. A range of minor crops have also been listed.



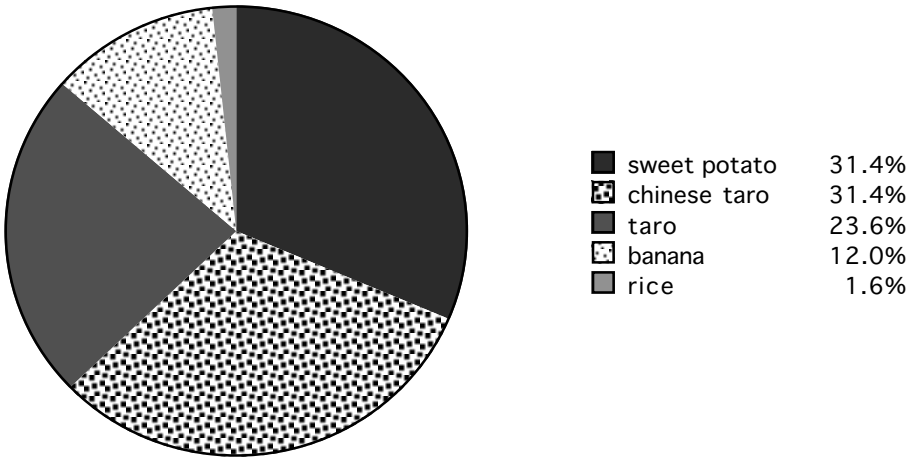
This system 1316 in the Schrader range also has taro although the timing of the dietary intake during taro production season that is presented in the pie diagram above, means its consumption was not recorded. Chinese taro, cassava and Greater yam are also grown. It is a low intensity production system with two crops before a long woody fallow. Household gardens are important and crops are segregated in gardens. Gardens are fenced. Fallow is burnt and ground is cultivated. The altitude is sufficient for cultivated karuka nuts.

Middle Ramu 1317 food



This is a system 1317 in tall woody re-growth with one crop before a long fallow. The fallow vegetation is burnt. Sweet potato is predominant. The altitudinal range is 1600 to 2100 m.

Middle Ramu 1318



System 1318 is a mid altitudinal area with low farming intensity. Tall woody fallow is burnt and sweet potato gardens are made continuously, while taro gardens are made seasonally.

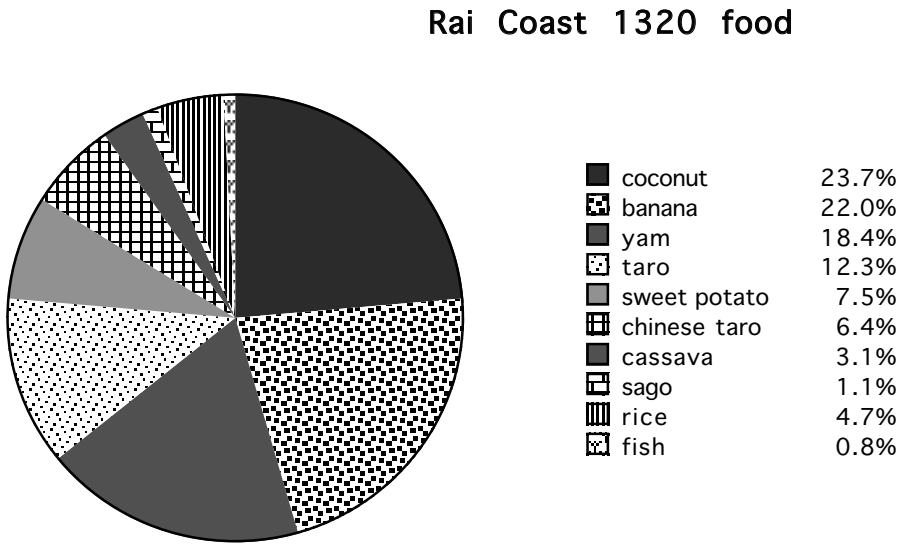
System 1319 is a small group of isolated people practicing gardening in old forest. They maintain sweet potato and taro plus a range of other starchy staples and vegetables. They have access to both lowland and high altitude crops.

Rai Coast

Agricultural systems 1320, 1327, 1328, 1329

System No.	Area (Sq km)	Population
1320	579	8498
1327	11	555
1328	1094	11341 Also 12**
1329	147	3097

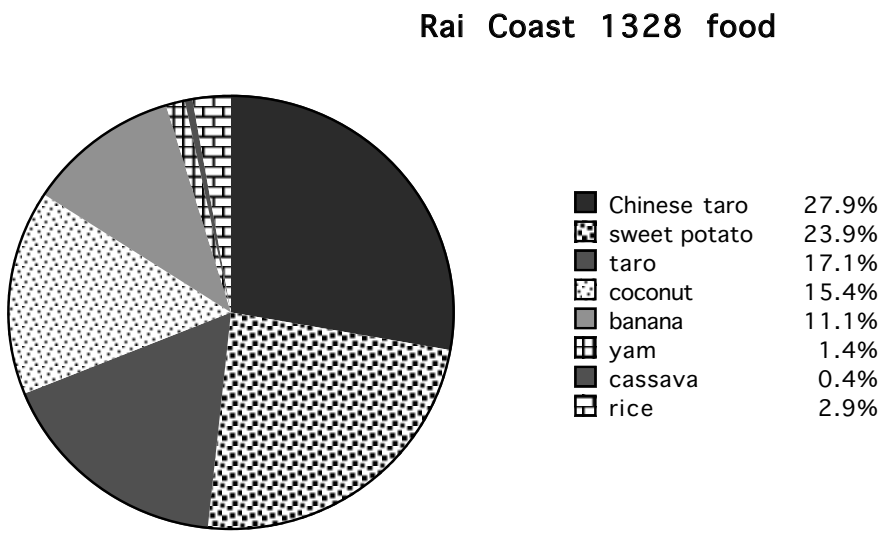
The system 1320 is a grass fallow system involving lesser yam but also with a range of other starchy staples including taro, banana, coconut, sweet potato, greater yam, cassava, Chinese taro and sago. It is a lowland coastal system below 300 m altitude. There are a range of vegetables used including aibika, amaranthus, lablab bean, winged bean, corn, cucumber, lowland pitpit, pumpkin tips, tulip and snake bean. The fruits include mango, marita pandanus, pawpaw, pineapple, sugar-cane, ton (*Pometia pinnata*), *Pouteria maclayana,* mon (*Dracontomelon dao*), and nuts of breadfruit, galip, Java almond and Sis (*Pangium edule*).



System 1327 is a very high altitude system in the Finisterre Mountains near Teptep. The altitudinal range is 2000 to 2600 metres but the slope is moderate. The gardening is in cane grass fallows with sweet potato as the staple and potato becoming more significant. Undoubtedly this trend will continue due to the greater productivity of potato over sweet potato at this altitude. The key ingredients for increased adoption of potatoes as a subsistence staple is for thick skinned high dry matter varieties to be grown in a dispersed planting fashion to restrict the spread

of bacterial wilt from plant contact. Banana and Chinese taro also occur but will be productively inefficient at this altitude and therefore only make a marginal contribution. The vegetables include common bean, cabbage, choko tips, corn, highlands pitpit (*Setaria palmifolia*), Waterdropwort (*Oenanthe javanica*), Pumpkin tips, Bamboo shoots (*Nastus elatus ?*) and spring onion. Fruit include avocado, orange, yellow passionfruit and sugar-cane. Karuka nut is planted.

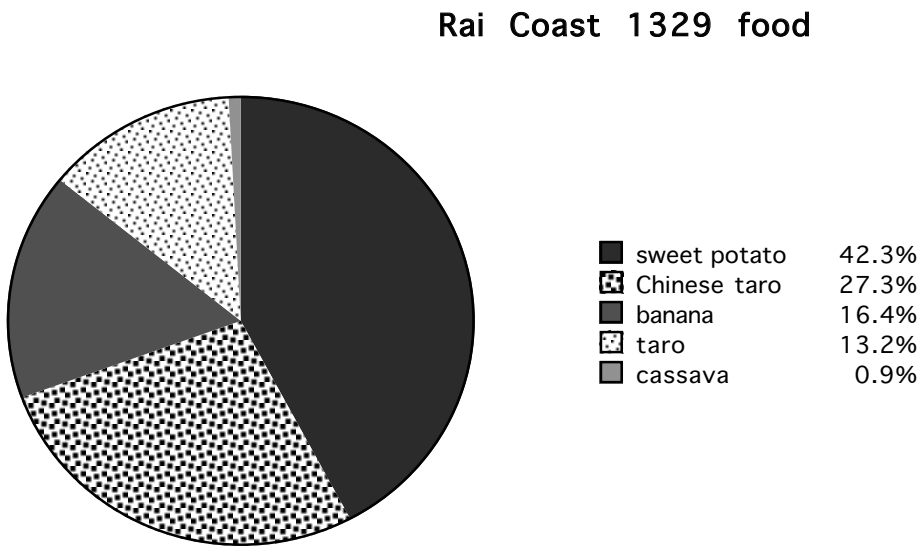
A range of other introductions could be considered into this system. Once an area is fenced, crop production continues within this barrier for 6 to 14 subsequent crops although short fallows occur within this barrier and fallows of 5 to 15 years occur between garden shifts.



The system 1328 is based on sweet potato production in woody re-growth. It also has Chinese taro, and taro then bananas and both lesser and greater yams. It is a system used in an altitude zone between 300 and 1600 metres and where slopes are gentle. Edible greens include aibika, amaranthus, cabbage, choko tips, corn, lowland pitpit, peanuts, pumpkin tips, snake bean and karakap (*Solanum nigrum*). The fruits are mango, marita pandanus, orange, pawpaw and sugar-cane. Nuts include breadfruit, coconut and sis (*Pangium edule*). The fallow vegetation is burnt and often two crops are grown before land reverts to bush. Gardens are fenced and several crops are distinctly seasonal. This system also extends into the Madang District and into the Morobe Province.

System 1329 is a higher altitude system at between 1600 and 2000 m. The main crop is sweet potato, with Chinese taro being important and banana, potato and taro also being grown. There is a long woody fallow of over 15 years and after clearing, 3 to 5 crops are successively grown before the land is allowed to revert to bush. Some composting is used in the small sweet potato mounds. For the initial crop, little cultivation is done but fallow vegetation is burnt. In subsequent crop sequences, the soil is cultivated. Gardens are fenced. These areas have common bean,

cabbage, winged bean, choko tips, corn, ferns, highland pitpit (*Setaria palmifolia*), lowland pitpit (*Saccharum edule*), pumpkin tips and spring onions. The fruits include marita pandanus, orange, yellow passionfruit, sugar-cane and tree tomato. Karuka pandanus nut trees are planted. Karuka nuts often yield biennially in larger amounts but during these good seasons karuka nuts can make up 80% of food consumed for one or two months and therefore are very significant. Being highly storable adds to their worth.



Comments on Rai coast

Winged bean is one of the most nutritious plants available in the world and its production in PNG has been declining instead of being strongly promoted and increased. It is subject to a range of normal production problems that should be a challenge to agricultural officers in an area. Nematode problems that impact on it along with a range of other crops especially in coastal areas are not an insoluble problem and should be addressed. Improved varieties of seed need to be continually dispersed throughout the country and great emphasis given to this crop.

Upper Ramu

Upper Ramu was not one of the selected districts but DAL/DPI staff already have a SMASPF project in this area and are committed to its inclusion because they consider the road infrastructure allows access and therefore potentially greater cash crop possibilities.

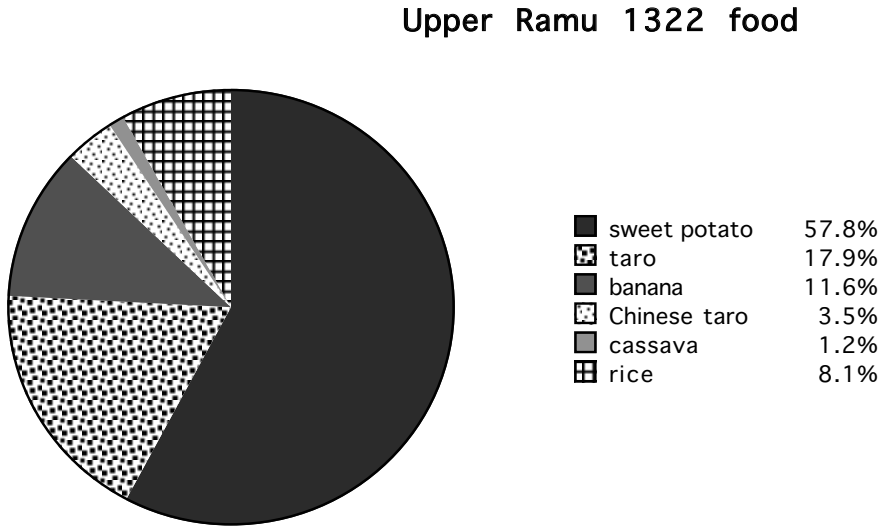
Upper Ramu

Agricultural Systems 1321, 1322, 1323, 1326, 1330, 1331, 1332

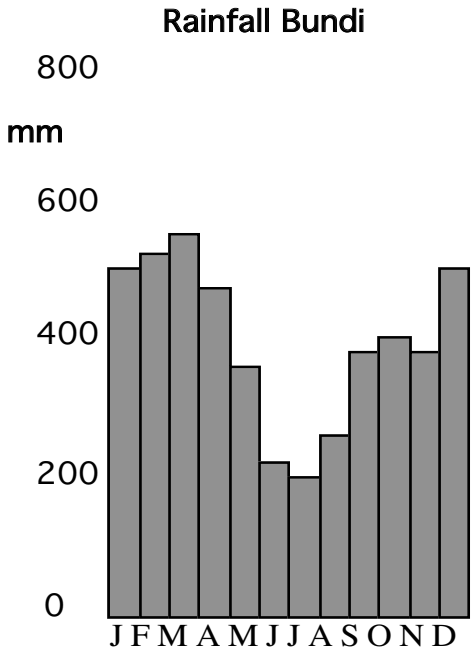
System No.	Area (Sq km)	Population	Similar systems
1321	237	1383	
1322	140	3844	
1323	87	566	
1326	320	4599	Cf 1303
1330	15	0	Cf 1109
1331	46	776	Cf 1201
1332	33	0	Cf 0906

Two of these gardening systems involve small areas of gardening by people within other Provinces on land that extends into the Upper Ramu district. ie 1330 and 1332.

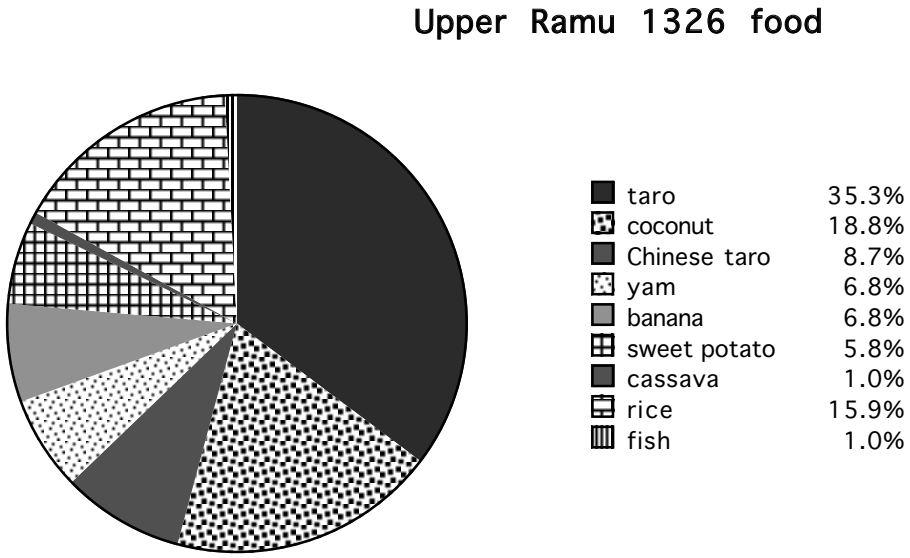
System 1321 is a mid altitudinal zone predominantly with sweet potato as staple. It is in woody fallow with low intensity land use and one crop before a long fallow. Fallow is burnt, gardens are fenced and people also have access to higher land in system 1322.



System 1322 is a higher altitude zone between 1400 and 2200 m. The people have links with highland Provinces and sweet potato is the main crop. Several cropping and nutritional studies have been done in this area. Rainfall is high.



The largest system 1326 has Chinese taro and taro as the main foods with banana, cassava and sweet potato as subsidiary starchy staple crops. It is a lowland area between 150 m and 650 m altitude. There are also some yams and sago. The vegetables include aibika, amaranthus, lablab bean, corn, cucumber and lowland pitpit. Fruits include mango, marita pandanus, pawpaw, pineapple, sugar-cane, watermelon, guava and mon (*Dracontomelon dao*). Nuts include breadfruit, coconut and galip. The gardens are only grown for one season before being allowed to revert to tall woody regrowth. This fallow period is between 5 and 15 years. Gardens are fenced and fallow vegetation is burnt prior to gardening. Some of the crop production is seasonal.



System 1331 is a small area extending into Morobe Province.

Comments on Upper Ramu systems

The Rapid Rural Appraisal (RRA) of the Upper Ramu District Madang Province by Caven R., & Gitai J., 1990 mentions a few crop production details. These include comments about sweet potato plant densities of 30,000 plants per ha and taro plant densities of 16,000-28,000 plants per ha. In land only partly cleared from bush these are not necessarily the most useful measures. Pests and diseases mentioned include - taro leaf blight (*Phytophthora colocasiae*), taro beetle (*Papuana spp.*) and sweet potato scab (*Elsinoe batatas*). A K10,000 taro blight research programme, (unless it is village level seedling selection programme for horizontal resistance) seems inappropriate with such a well known and studied disease. Instead a village taro leaf blight control programme seems more appropriate. Removing early sources of inoculum; controlling disease "hot spots" during production; thinking about spacing, aspect etc; are easily applicable technologies appropriate at the level of technology currently used. Sweet potato scab has significant levels of horizontal resistance available within the multitude of cultivars, and the disease becomes more significant in old sites as fertility declines. This most often becomes a phenomenon when gardens are fenced, (rather than pigs being fenced in, or tethered) as people try and extract the maximum production from the plot before the labour intensive work of new fence construction is undertaken. Controlling the disease gives yield advantages but not as a substitute for understanding why the disease has become significant in this particular situation. This disease is widely spread throughout sweet potato production areas and only in certain situations becomes significant as a production constraint. As this disease becomes noticeable to village farmers it has a useful role in educating farmers about the nature of disease, the causes and methods of disease management by good crop production technologies and similar educative functions. Taro beetle is a major constraint for taro production. At present the only recommendations for control involve lindane, which is restricted worldwide. In the interim, some advantages can be recognised at village level due to factors such as aspect, barrier crops (the insect migrates at night) and flooding may have some applicability in some taro production areas. With an insect with such a long reproductive cycle, any means of decreasing numbers has some feasibility. The larvae although quite edible by people, could also be utilised for protein for small livestock. With such long established pests as the 18 species of taro beetle which are well known throughout the country, including an understanding of the whole life cycle by most observant villagers, better farmers have undoubtedly developed some methodologies for control which have some validity and could be disseminated in the interim. The inter-farmer variation in production levels even within one area is a mechanism for doing simple appropriate extension. DAL/DPI staff have the unique privilege in this country to actually do this dissemination between farmers while farmers are far more preoccupied with maintaining their own production. (None of this interactive observation and extension can be done from an office, a

vehicle or a village meeting and must be done on foot in gardens talking to farmers individually without them being overwhelmed by groups of people such as in RRA teams.) In the RRA of this area it was noted that Chinese taro was turning yellow but no further details were given. It is a shame to say Chinese taro leaves are yellow without saying whether this was young or old leaves, or whether it was on the leaf margins, leaf tips or whether it was mottling or general yellowing. To give no indication of whether it was one or a few plants or a general occurrence, or whether it was associated with damp sites, old plots, or low fertility soils, and then to suggest a follow up study is not likely to be a cost effective strategy. A simple basic observation (or photo) by those who had spent all the money to get there would have been both responsible and useful. It is the job of agricultural officers to at least have a set of eyes and preferably some basic agricultural knowledge and skills. If all agricultural workers had good coloured photos of common deficiencies, diseases and pest damage, much more efficient observation could occur. Similarly it is a pity when agriculturalists in an area say corn is planted, without saying whether it is inbred, showing deficiencies, suffering from disease or pest etc. or making any comments that may have any agricultural significance. Taro is grown from March/May till February. How does this correlate with the rainfall pattern and the disease constraint of taro blight? Far more thought needs to be given to garden surveys, than simply recording basics. The gardening pattern against rainfall done by Togiba, Daink and Agodop and redrawn below gives the basis for discussion on potential strategies for improvement than simple observations of what crops occur in an area. As well, the description "other traditional green leafy vegetables" is a fairly unprofessional statement especially as these may well have double the nutritional value and greater yield stability as well as sociocultural acceptance within the local setting. Since when are food plants not worth a name!

Phytophthora colocasiae
Taro blight

Elsinoe batatas
Sweet potato scab

Typical cropping pattern Upper Ramu Sumau Garia Census Division

Rainfall

Drawing a gardening diagram for an area such as that done in the report by Togiba, Daink and Agodop gives a good visual image of how rainfall and planting times determine production. More detail needs to be given to harvesting duration to allow food supply to be assessed. In many cases this is a determining factor on food and nutrition. In many areas especially where gardens are cleared from fallow during dry periods then burnt and planted, there is an abundance of vegetable foods for a short duration of time but little replanting to give regular production. The starchy staples are often not ready for harvest at this stage but a surplus of protein foods accentuates the energy/protein imbalance that characterises so much of the malnutrition within PNG.

Crop production diagrams such as these should be drawn for all production systems and areas so that potential crop introductions to extend the duration of harvest or fill production gaps with suitable crops could be planned. The inputs from seasonally available perennial crops needs to be included, as well as the reserve crops such as sago that can be utilised to fill gaps.

During our visit it was mentioned that there was trouble maintaining aibika planting material in sufficient quantities due to root rots. Root rots with aibika (*Abelmoschus manihot*) seem to be something of a limiting constraint with the multiplication and maintenance of planting material and methods of managing root rot problems need to be promoted along with supply of planting material.

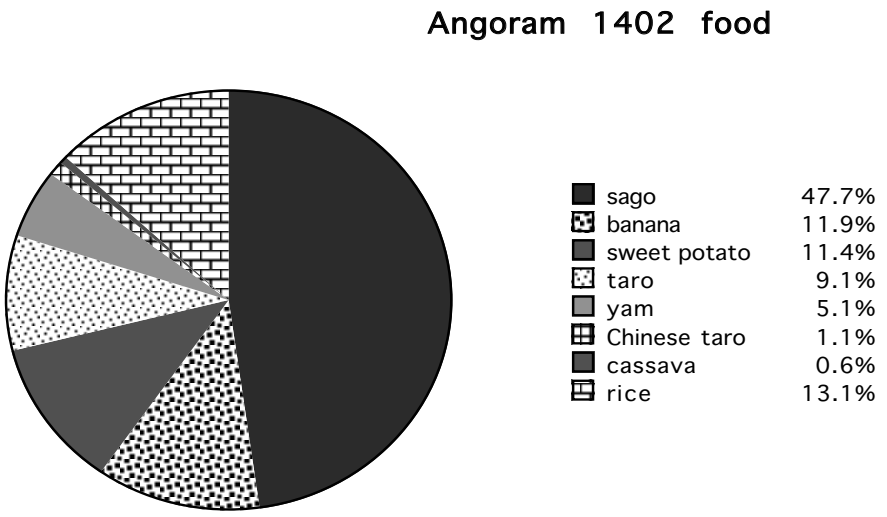
East Sepik

Ambunti

Agricultural systems 1402, 1413, 1417, 1418

System No.	Area (Sq km)	Population
1402	5648	60153 (Only part in Ambunti)
1413	5221	14464
1417	3414	4399
1418	1188	5941

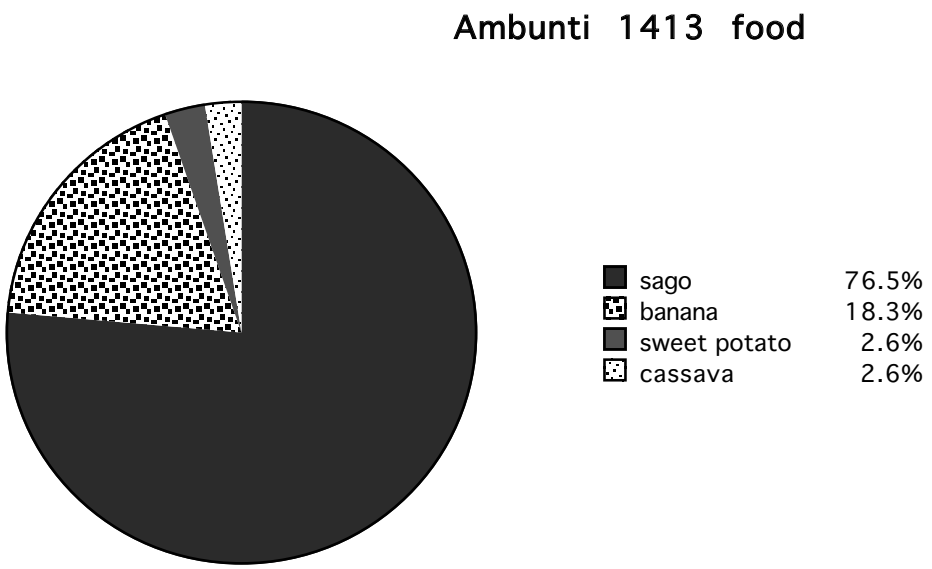
East Sepik Ambunti



System 1402 has sago with ancillary crops including sweet potato, taro and banana. In the CSIRO Geomorphology map the area is defined as AMa - flood plains with ABa - black swamps through the centre. Ridges occur to the South with prominent structural features but subject to fluvial action and mass movement. Most of the area is below 600 m with rainfall increasing to the South from 2000 mm to 7000 mm. A large part of the district is subject to permanent or frequent flooding along the Sepik. Current sago production is mostly along the river margins. The vegetation is medium height (20-30 m) swamp forest of *Campnosperma, Terminalia, Syzygium, Nauclea, Myristica and Melaleuca species.* Of these genera, *Terminalia, Syzygium,* and *Myristica* have edible fruit/nut bearing species and some of these may have potential in the area. A survey and the potential for any utilisation of these edible species should be considered. Current sago production is strictly confined along the river and its tributaries. This is most likely a function of accessibility and human movement along the river navigation system. Access probably controls utilisation of the potential sago sites. Probably the whole of the CSIRO land use potential zone classified Fd could potentially grow sago but little else. This zone occupies 57,000 square kilometres of PNG of which probably half is in the Momase region in the Sepik and Ramu river systems. It therefore justifies greater study and emphasis. Into the next century it could be the energy source for industrial or food supply for the

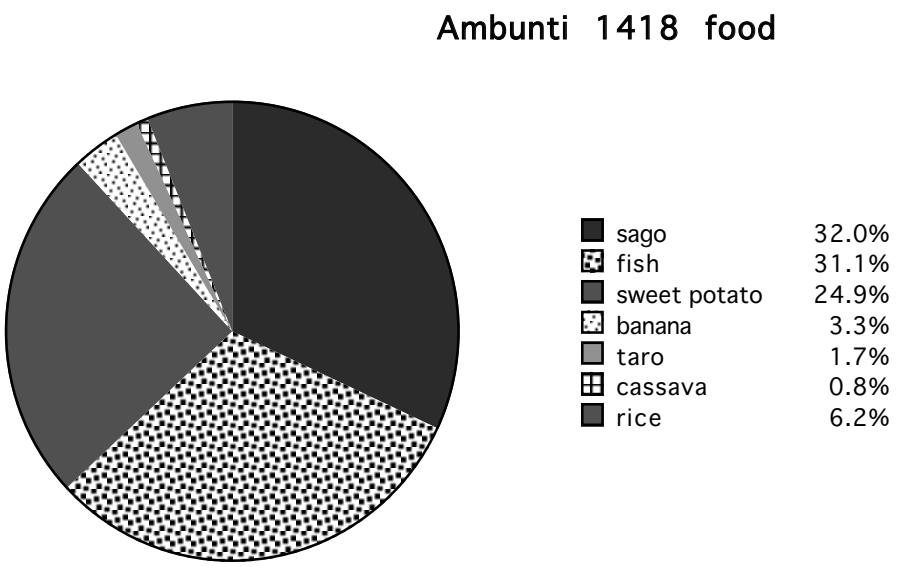
country, but sago has a lag time of 15 years before coming into production.

In Allen, Bourke and Hide et als Agricultural Systems study this intensive sago zone is classified as Farming system 1417 which occupies 3414 square km and where the population is 4399; and system 1413 which occupies 5221 square km with 14464 people. Other crops present include banana, sweet potato, Colocasia taro, aibika, amaranthus, corn, cucumber, ferns, kangkong, Saccharum pitpit, marita pandanus, pumpkin tips and tulip (Gnetum gnemon). Pawpaw, sugar-cane, ton (*Pometia pinnata*), breadfruit (seeded), coconut and Sis (*Pangium edule*). Less than 30% of households have food gardens and these are small. Although in these gardens burning is a feature, it remains desirable to develop longer term strategies which delete this practice. The sudden release of potash or slight cation/pH effect should ultimately be addressed in a more sustainable fashion. Hunting and gathering are important activities otherwise the system is similar to 1402.



System 1413 is along the Sepik, Keram and Yuat Rivers, with sago and fish important. Small gardens are made in either woody or canegrass fallow.

Saccharum edule



In system 1418, these people exchange fish for sago rather than processing much of their own sago. Very small gardens are made on levee banks but gardening is not an important activity. Greater and lesser yams are grown as well as perennial stands of bananas. Where regular flooding is a restriction the shorter duration greater yam crop is grown. Tulip, ton, breadfruit and coconut are other significant perennial crops. Aibika, amaranth, corn and kangkong are grown.

Comments on East Sepik, Ambunti systems

The people in this farming system have a recognised disinterest in gardening methods involving cultivation. In the sociocultural context this should in the initial development stage be recognised and not become a simple cause for rejection or despair. All agricultural innovations must be related to the sociocultural context and the technological level of those involved. But improvements and innovations can be made if done in a suitable fashion. The introduction of waterdropwort (*Oenanthe javanica*) suits these swamp areas not only because of its floating nature but also because it can remain productive under low maintenance conditions. Increasing food production in site stable household plots through minimally managed cropping systems needs to be considered. If long duration banana varieties such a the AAB and ABB clones "kalapua" and "Jawa" respectively do not already occur, they will suit such production systems on sites near homes. Boundary hedges around villages and homes of Kumu musong (*Ficus copiosa*); "Valanguar' (*Polyscias spp.*) and tulip *(Gnetum gnemon*) introduced by a villager from a region where these plants are already well managed and utilised would enhance any acceptance of them or their improved production and maintenance by pruning etc. It would be equally as unrealistic to expect a hunter/gatherer in a sago production system to change rapidly to more intensive agriculture as it would be irresponsible to ignore the nutrition

needs and do nothing. The intensification of present practices could be utilised. Amaranthus spp makes a very productive, highly nutritious edible green recognised throughout the tropical world and ideally suited to small back door plots. It is highly responsive to potash and nitrogen, both of which are common bi-products around home sites. Ashes from domestic fires are high in potash and urine or compost of green material can readily supply nitrogen. Amaranthus has very small seeds and the common method of simply scattering them normally results in poorly spaced plantings subject to diseases such as wet rot of leaves due to *Choanephora cucurbitarum* and to damping off fungi. Mixing seed with sand enables better spaced plantings and such simple technologies should become a part of the improved methodologies being promoted by agricultural officers. Talinum (*Talinum triangulare*) easily and readily can maintain itself long creek banks and in drains. People are unfamiliar with its use in many areas. It needs promoting.

Given the energy and time demanding task of shredding and washing sago and the national goals for women in PNG of allowing women's involvement in adaptive research on appropriate technology for food production and processing, ongoing efforts should be made in all sago processing areas to improve the extraction and processing component of sago preparation. This is the highest priority need in sago areas and high level appropriate technology type attention and resources should be allocated to improving the processing methods.

Considerable innovation needs to be made in the area of nutritional and creative cooking of sago. As in other countries, changes and improvement in dietary habits never happen without lots of creative promotion and generation of desire through marketing and publicity. Out of this, real changes could be realised in import replacement as people began to have greater appreciation of local products and product enhancement through down stream processing and value adding.

The complementary potential crops for this agroecological zone include waterdropwort (*Oenanthe javanica*), Waterleaf (*Talinum triangulare*), and Climbing swamp fern (*Stenochlaena palustris*).

The collection of wild edible foods is an important activity along with hunting and fishing. The species utilised as wild edible foods should be documented and where appropriate any assistance give to enhance their utilisation. Species occurring in this agrocecological zone are of high significance because they are adaptated to a unique environmental zone. Often simple selection procedures can enhance their domestication and productivity. (eg rooting hormone to allow vegetative propagation of improved selections from trees which are normally only grown from seed with mixed results.) The Golden apple (*Spondias cytherea*) is an example of a species probably occurring in this area that should be subject to significant improvement by this method. Any such process should be demonstrated as effective by an agricultural worker <u>in the field situation</u>

then the process immediately handed over to a local entrepreneur. Such a propagation procedure is not the type of activity agricultural workers should dedicate their time and resources to as this creates an unhealthy dependency.

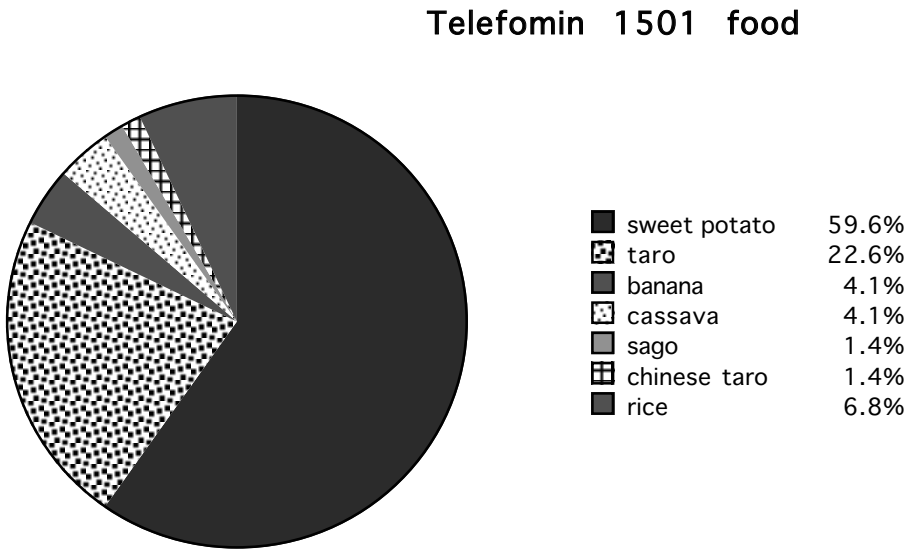
Fruit flies are a problem in for example guava. Fruit flies will be a limiting problem for almost all fruit exports from PNG. Over 200 species of fruit fly are involved and some have not yet been definitively specified.

Telefomin

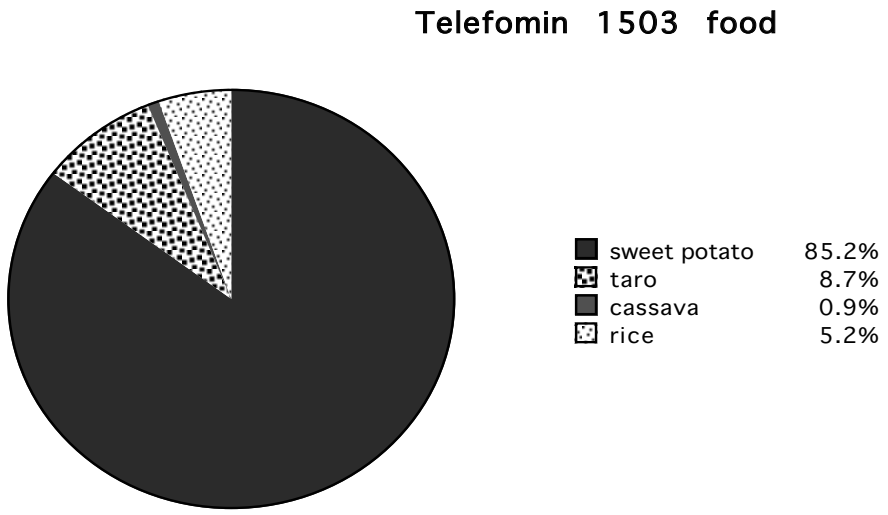
Agricultural systems 1501, 1502, 1503, 1505, 1509, 1510

From the farming systems observed by these geographers, the allocation in terms of land area and population are:

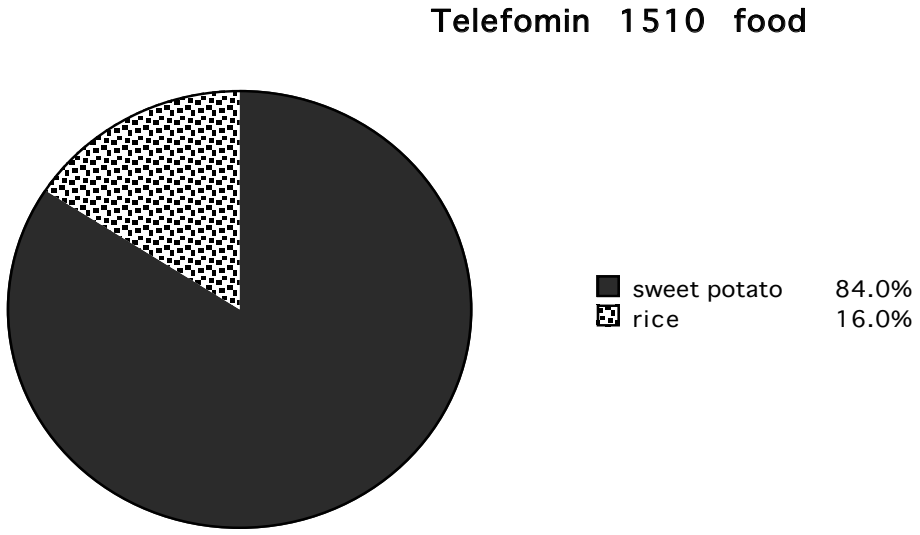
System No.	Area (Sq km)	Population
1501	1304	8561
1502	18	927
1503	217	3395
1505	99	65 Cf. system 0102
1509	24	789
1510	45	3125



System 1501 is based on taro planted under tall re-growth and the trees are thinned and removed subsequently. Chinese taro is planted in separate gardens at lower altitudes. Only one crop is grown on each site before fallowing, but sequential crops are planted across the field. Some soil regenerating yar (*Casuarina*) trees are planted and composting or mulching is practiced to some degree.



The system 1503 has sweet potato dominant below 1900 m and taro above that level. Casuarina trees are now being planted in gardens. The adoption of such new practices is a salutary reminder that farming practices are endlessly adaptable given appropriate technologies and strategies.



Some of these production systems have been in crisis due to unaddressed problems. In system 1510 at Oksapmin in the Tekin valley, a change of staple crop has occurred from taro to sweet potato recently due to serious production problems.

Comments on Telefomin Systems

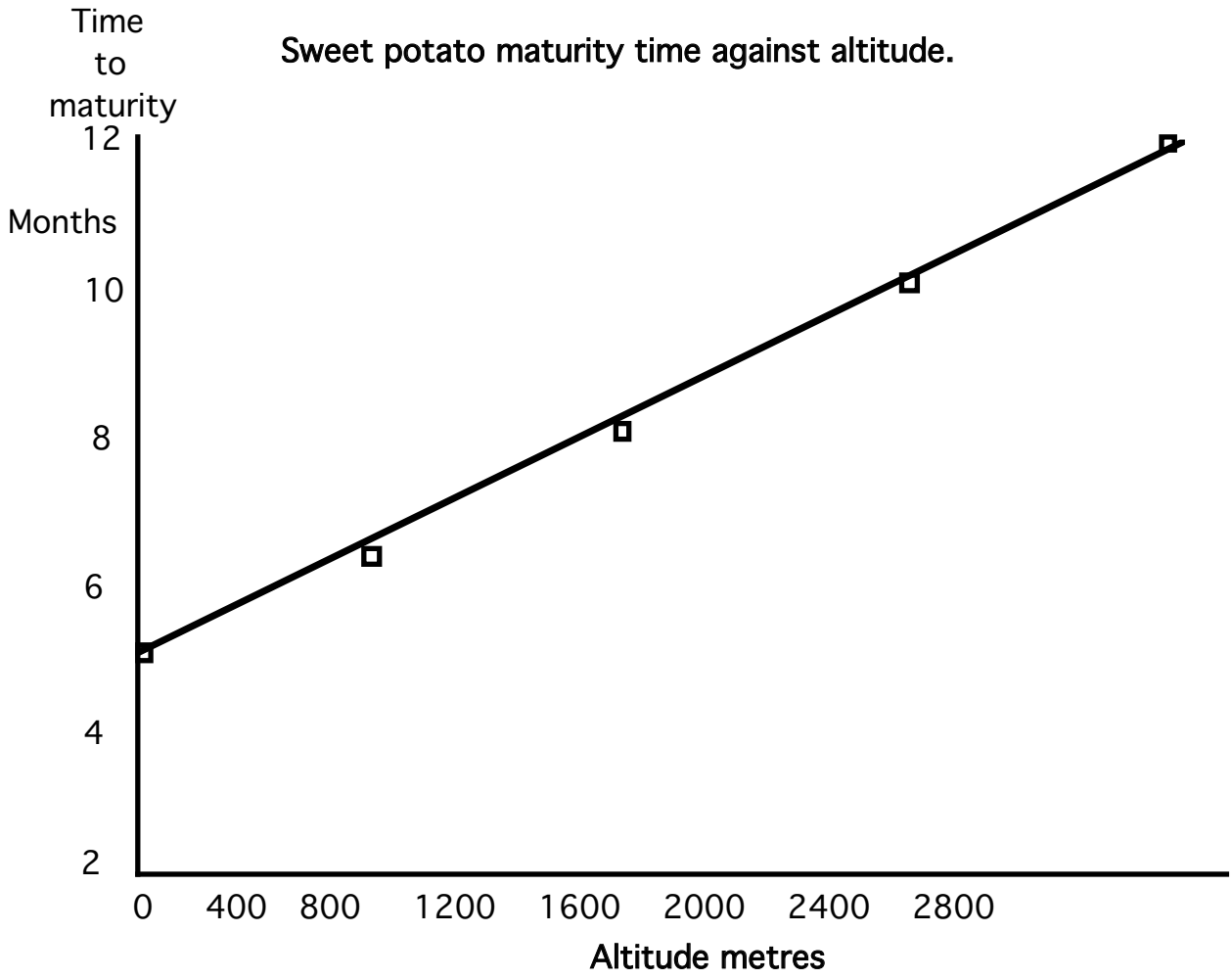
The Telefomin systems are sweet potato and taro farming systems. They also have Xanthosoma taro and bananas. The altitude range is from 400 to 2200 metres. The geomorphology of the area is denudational landforms with prominent structural features and ridge and ravine forms.

They are subject to fluvial erosion. The vegetation is FHm classification or medium-crowned lowland hill forest which is very mixed floristically along the northern border of the district grading into FL or Lower montane forest with pockets of FLc or coniferous lower montane forest especially above 2400 m altitude. There are garden clearings based on dispersed village settlements. In terms of the CSIRO Land Use potential the classification for this area is all El, Er, E indicating land subject to erosion. Rainfall is high, and ranges from 2500 mm to > 7000 mm. The distribution is shown in the pre-preparation social assessment map Figure 25 by Levett et al. What is probably more influential than overall rainfall is its seasonal distribution that in general is more determinative of gardening cycles and patterns.

The Baptist Mission is the predominant mission in this area and has an established record or being able to address malnutrition problems in other areas of PNG (eg Baiyer River). Given their infrastructure in health and education throughout this region it would seem reasonable to seek their cooperation in the servicing of some of the development components in the region. The Ausaid appraisal team reviewing health services in PNG at present, highlight the effectiveness of delivery of health messages by the Baptist Mission through their adult literacy program.

Efficient banana production cuts out about 1600 metres so this would exclude the southern half of the region except river valleys. European potato production significantly exceeds sweet potato production above about 2000 metres. Potato (*Solanum*) varieties with high dry matter content and with thick, preferably dark coloured skins are needed for subsistence production or for potential sale to local institutional markets. Production methods need to be modified to ensure non-contact spacing (scattered through subsistence gardens) to prevent spread of bacterial wilt that is the main disease production constraint. Emphasising introduction of disease free planting material from Australia, as seems to be the main strategy for this disease, is only a temporary solution unless the planting techniques are addressed at the same time. This bacterial disease can be controlled by cultural methods. Target spot (*Alternaria*) could be a significant cause of foliar loss and early senescence given the high rainfall and temperature regime.

Potato Bacterial wilt



Sweet potato maturity time against altitude.

With sweet potato maturity times exceeding one year at this altitude, European potatoes with a maturity time of 4 to 5 months has significant advantages.

Taro has been the existing staple in many of these areas. It has been produced in a rigidly controlled, socioreligious framework with "taro cult" leaders exerting significant power over its production including any adaptations to methodology. The people are in transition between animistic frameworks to Christianity but they may not have rethought their production paradigm for taro within a Theistic framework or Christian stewardship context. Often animistic religious control maintains power where "unknown" forces impact on production. It is significant that in this area people have local language names for certain taro disease symptoms which is unusual in a Papua New Guinea context. (In general people are fairly unaware of disease cause or epidemiology.) This suggests these production constraints could more usefully be acknowledged, understood and addressed if people were given an increased understanding of the disease producing organisms, the epidemiology, as well as symptomatic recognition and control principles. Taro blight (*Phytophothora*) will not be limiting above the 800 m line even though it occurs to about twice this altitude. The high rainfall would enhance the disease risk but other foliar leaf spots such a shot hole and other fungal

blights will undoubtedly occur and should not be confused with *Phytophthora* blight. Below the 800 m line taro blight is most likely to become an increasing problem, increasing with rising temperatures and increasing humidity. Instead of any more taro blight research programmes, it is time someone applied the current knowledge in field situations. Fungal sprays to hit blight "hot spots" in a garden could have some applicability but need to be used with great caution where people eat taro leaves and the level of school attendance means 60% of the children spend their daytime in gardens regularly preparing themselves hasty snacks from garden produce. Bacterial rot and dry rot of taro corms are known problems in this area and unlike many diseases have local language names. This would indicate they are long established and recognised production problems. Dasheen mosaic and other virus diseases of taro occur in this region and their containment and management should be a normal part of improving productive efficiency. Given the frequency of taro flowering and the known practice in this area of growing taro from true seed, some genetic progress towards horizontally stable resistance has probably been established within taro production and this should not be thoughtlessly lost by introductions of taro cultivars chosen and selected from outside this pathosystem and area.

Rats are a significant problem with taro and sweet potato production here as in most other regions of PNG and should be addressed.

Amongst the edible greens, aibika, used in some parts of this area, will not be productively efficient above 1600 m as it will be consumed by insects faster than it grows. Amaranthus would have potential except above 2200 m where germination could be restricted due to soil temperatures during the cooler season. New varieties of Rungia (*Rungia klossii*) would be a useful introduction into the area to establish its production as a cultivated crop instead of a wild harvested plant. In many other highland areas in PNG and Irian Jaya it is regularly grown and consumed with highland pitpit (*Setaria palmifolia*) and is a relatively disease and insect free, long yielding option. The production and utilisation of *Dicliptera papuana*, a related plant, could also be considered but some cultural acceptance questions may need to be addressed as wild forms of this plant are present but not utilised. Blackberried nightshade is not recorded as used in this area but performs well as the earliest producing edible green in similar environmental zones and is greatly appreciated in some areas and regularly sold in markets in small amounts. Its productivity and food value should not be overlooked. Taro leaves are eaten in this area and this should be highlighted and enhanced in all nutrition intervention policies. "A taro leaf a day keeps the doctor away!" Because the perception of the value of local edible greens has at this stage been seriously eroded due to the OK Tedi Vegetable buying promotions, much serious thought and publicity will have to be given to restore a viable nutrition policy in the local area. This will require

attractive coloured photos or posters with appropriate nutritional information to enable people to be empowered to make an informed decision. Foods like cabbage if not already banned, should be banned for child consumption in areas like this. The low nutrient density (food value to volume ratio) makes it a disaster food for children even if it stops them complaining of hunger pains! The productivity of “kumu musong” (*Ficus copiosa*) could be both enhanced and also release women's work loads by greater utilisation and management of it as pruned boundary hedges around houses. The same approach could be taken to "tulip" (*Gnetum gnemon*) in the areas below 1200 m. This particularly attractive and nutritious vegetable should be a standard part of every vegetable component of every meal served in every restaurant in the country. People would then get the message that traditional foods of the Asia Pacific phytogeographical region were something of which to be proud. Import replacements would soon be advanced.

Some of the highly acid soils especially in alienated land such as that sold to clinics and schools show extreme aluminium toxicity symptoms and other unusual deficiency symptoms in crops in the Telefomin area. Addressing this problem could increase productive land near the township of Telefomin and could also have an educative role towards improving food production. Attractive colour photos should be supplied and displayed of the deficiency and toxicity symptoms so that people could recognise such problems and be given empowerment over their fear and superstition over why some soils won't grow. The still existing taro cults could then be disempowered and freedom over production increased. (The same applies for disease problems and symptoms.) Change needs to occur within the cultural world view, not simply avoid it by production of introduced vegetables which are by and large sold or wasted and produced in systems demanding high inputs or at the expense of more basic food production on the best quality land. As highly ultrabasic rocks and limestone occur in the district it may be feasible to address the highly acid soils and aluminium toxicity from local resources within the district. This could assist in developing entrepreneurial skills and specialisation within production.

The development and increased production of *Castanopsis* nut trees should be promoted as a suitable response to environmental degradation. Although some people may not be motivated to plant trees that already grow naturally, re-greening PNG will be an important theme over the next decades. So increasing planting through the development of nurseries in projects under school or other local institutions' control would enhance pig production as well as providing a supplementary source of nuts (with normal cautions) for people. Tethering pigs under *Castanopsis* nut trees is an important component of efficient pig production in some other areas of PNG. Pig production can seriously compete with garden food production and hence significantly increase women's workloads.

Karuka planting in the high altitude zones should be recognised as a highly storable food reserve as well as a potentially marketable commodity both in coastal towns and potentially (with appropriate creative marketing) in the foreign exotic nut market. Because of significant problems with biennial bearing, caution should be taken with any marketing strategy not to promise continuity of supply until factors involved in irregular fruiting are understood. Assistance would be needed to establish appropriate quarantine procedures but given the nature of the crop this should not be difficult. The tourist market in Cairns, Australia, would be an appropriate avenue to explore the market but the more professional quarantine regulations into New Zealand may make that an easier market. Because of the "exotic" nature of entire heads, some of these would need to be included with supplies of individual nuts for consumption. Something of the "karuka" story would greatly enhance any marketing strategy. Naturally, with the karuka production, the current insect pest problems should be recognised and addressed not by fundamental research but by adaptive application of principles from similar and understood pest species that occur on coconuts in coastal regions. Karuka are often important socioculturally and sometimes people are hesitant to distribute their select varieties, so these factors would need to be sensitively considered but not allowed to become a limitation. Assistance with karuka propagation and production should be incorporated in any food production programme. Because it is so highly storable it has a valuable role where food security and reserves are important. Most of the karuka is grown in areas potentially susceptible to frost and as only the Brassica crops are frost resistant, reserve crops are very important.

Corn is a significant but minor vegetable in this area. Corn inbreeding is a universal problem throughout PNG but instead of relying on seed purchased from seed companies, local entrepreneurs could set up corn seed production systems growing in excess of 200 plants at one time to prevent inbreeding occurring. Women could easily be involved in this process given suitable guide-lines to ensure success. Any increase in the already heavy demands on women's labour should be considered, but if this option gave some women a valid new source of income, it may assist. Productive corn seed is a highly esteemed commodity in villages. Allowing this to occur in diverse agroecological zones would be a sound longterm practice. Given such a seed production mechanism the current practice of intercropping corn and taro should be both encouraged and enhanced. It is significant for overall productivity as well as pest and disease reduction. The pest and disease concern with corn should be continuously remedied with intervention techniques appropriate to the low intensity production system current in the area. eg fish tins for cutworm control etc. The ease with which corn can be an indicator of nutrient status because of the clarity of the symptoms makes it a useful diagnostic tool at the level of production and technology current in the area. (Setaria pitpit can also be used in this role.)

Many features of the present gardening system should be affirmed and maintained or enhanced. The practice of not burning should be reinforced to maintain or assist in reestablishment of tree fallows as well as for longterm nutrient retention. The short duration of the gardening sequence may well be due to the marginal acidity and temporary change in pH due to cation release on clearing, although taro demands high fertility and the high rainfall will induce significant leaching. Perceptive observation and simple screening techniques (rapid pH tests) would be appropriate rather than any extensive or formal research or trials. At this level of production easily observable results from production-oriented adaptations is all that is needed. Gardens in this area have crops in segregated gardens. It is important to ensure that the edible greens component is maintained because of its strategic importance in a root crop based diet. Gardens in this area are not dug and taro is planted with a digging stick. While land pressure continues to allow rotation fallows exceeding 15 years, such a system should be maintained. For those who because of the demands of school, clinic mission work etc must locate near a central site and garden on poorer land, appropriate soil improvement techniques need to be taught. The longer-term educational benefit of this will have wider ramifications. With the present long rotation system that allows the regeneration of woody re-growth, other subsistence requirements for housing materials and firewood can be simultaneously met. (Traditional clothing in this area is phallocrypt gourds for men but these are now rare.) At present cash income opportunities are scarce except for fresh vegetable marketing where people are sufficiently close to airstrips. Taro planting given the rainfall regime is an almost continuous activity.

Supplementary crops especially in the lower valleys include aibika (*Abelmoschus manihot*), Saccharum pitpit (*Saccharum edule*), pumpkin tips, choko tips, cucumber, pineapple, pawpaw and marita pandanus, sugarcane and breadfruit. Saccharum pitpit is an attractive and nutritious but highly seasonal food easily produced as a part of the standard gardening system as it moves towards fallow. Non-seasonal cultivars do occur although they are rare. Such innovative introductions should be considered. Cassava is gaining a little more importance in some of the mixed gardens. Wherever it is grown the very highly nutritious nature of the young leaves should be highlighted and promoted with appropriate cooking procedures. In some of the mid altitude zones around 800 to 1000 m choko can become a naturally established and maintained edible green as people are little interested in the fruit (or the root) but appreciate the young edible shoots. Highlighting edible greens in the diet utilising plants that naturally produce prolifically in the correct agroecological zone can assist diet without increasing the work load of women. Marita pandanus (*Pandanus conoideus*) is a plant often restricted on a gender basis but as it is without significant nutritional importance the need is less to make this a matter of great concern. Normal production concerns with it such a bacterial soft rot of fruit and pest problems should be noted and addressed where

appropriate as a normal component of an agricultural officers servicing of their clients. Subsistence sugarcane here as elsewhere in the country remains the second most significant component in the subsistence production system and is worthy of continuing assistance, even if none has ever been given anywhere, so far! There are appropriate simple technologies and varietal selections that can reduce the significant losses from borers etc. Rat damage to sugarcane, as with many other crops is a concern. The labour demand can restrict the application of some methods of improving productivity and simply planting a few more plants to allow for losses is still the preferred option in many cases.

Many of the details mentioned here are equally applicable to other regions such as for karuka and potato at Teptep in Rai Coast and will not be repeated in each case. A system needs to be developed and marketed through good training and publicity of appropriate strategies and possibilities for crop and farming system improvement and then some discernment and dissemination applied to ensure that those who need the specific information in each region are appropriately serviced with information and resources. It is unlikely that people in field situations will have the opportunities or inclination to search the incredible scattered information to locate what they need. Packaged resources are needed.

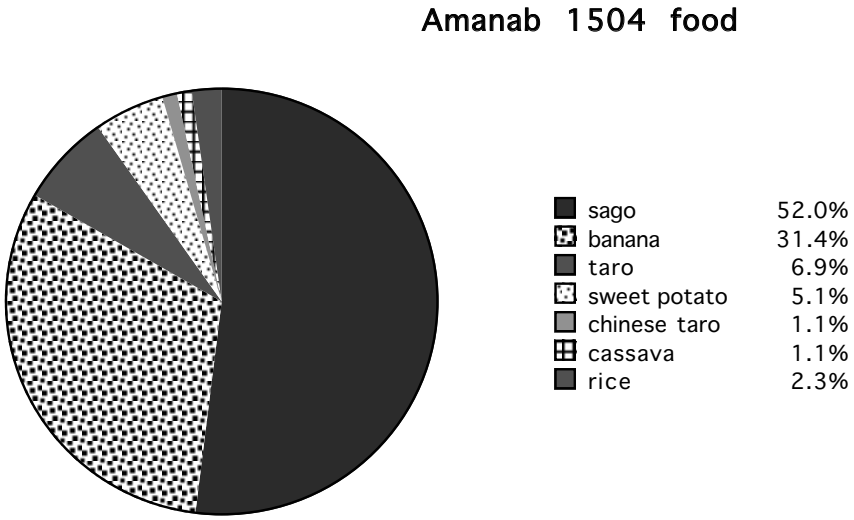
West Sepik

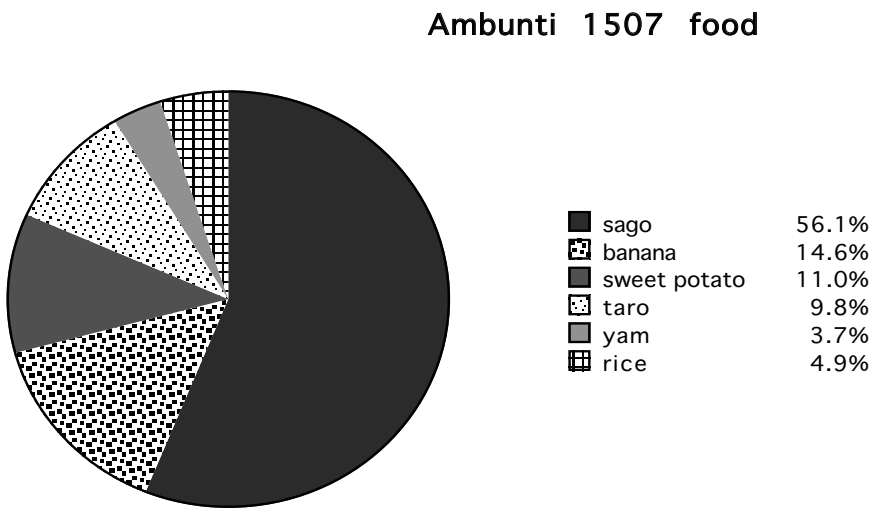
Amanab Agricultural systems 1504, 1507,

Extent of these systems is:

System No.	Area	Population
1504	7822	13851
1507	5432	69580 (Part only in Amanab)

System 1507 also includes parts of Aitape and Vanimo.



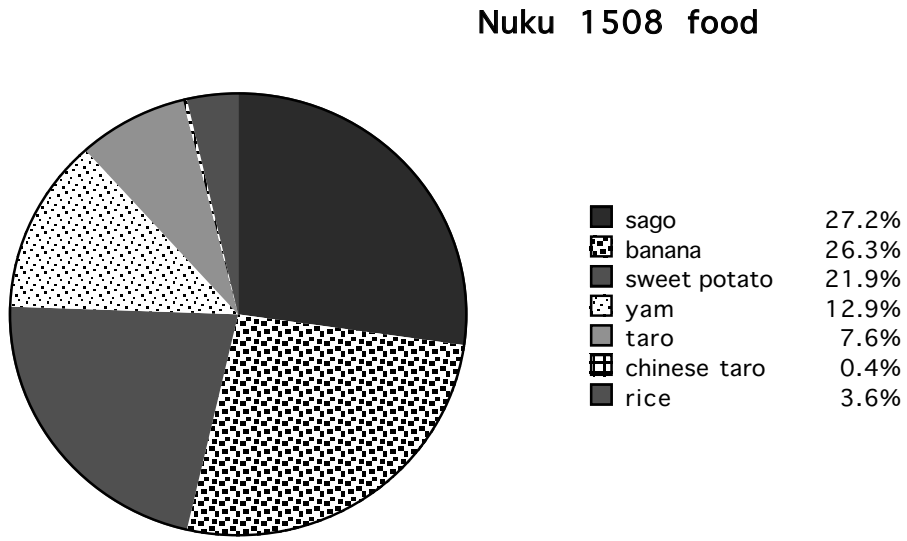


West Sepik

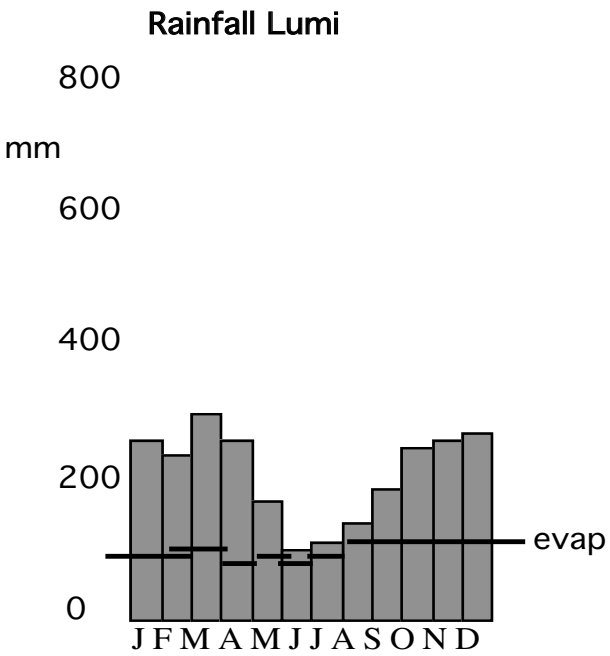
Nuku

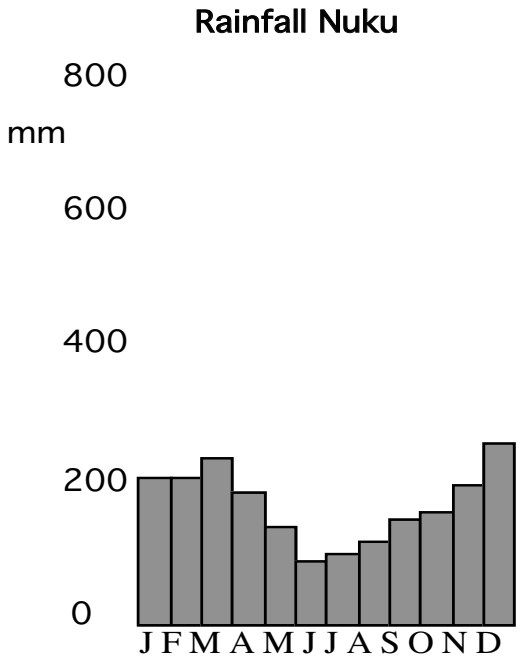
1508

DAL/DPI were keen to include Nuku and Lumi in the areas because of the road access allowing cash crop development to occur more easily.



This system 1508 is a higher population density area in woody regrowth. Vegetation is cleared and burnt and one crop grown before returning to fallow. Lesser yam is the main crop with banana, sago, taro and greater yam being important. Chinese taro and sweet potato are also grown. Perennial crops include mango, marita, pawpaw, pineapple, ton tulip, kumu musong (*Ficus copiosa*), galip, coconut and breadfruit. Vegetables include aibika, amaranthus, winged bean, corn, cucumber, pumpkin tips, snake bean and lowland pitpit.





Comments on West Sepik Angoram area systems

Instead of dismissing sago production and sago production areas as a development problem that needs to be avoided, it would be more constructive to engage the development process and production system with some insight and integrity. I do not understand the specifics of sago in this area but some general observations would, I assume, apply. Sago is a highly productive stable farming system. It is an efficient energy production method for carbohydrates. It is a very appropriate utilisation of the agroecological environment. The constraints and deficiencies of the lifestyles and food production of areas like this need to be clarified and addressed. Inevitably the dietary inadequacies of sago are highlighted. Many of those who speak disparagingly of sago as a food have done little to enhance its value. The environment suits several highly nutritious low maintenance edible greens that can compliment the farming system. Some of these occur and need promoting and some would involve introductions or familiarisation. Kangkong (*Ipomoea aquatica*) because of its floating nature suits such aquatic environments and can survive flooding without detriment. Little has been done within PNG to select preferred cultivars but the variation is sufficient to make this a worthwhile avenue to increase the utilisation of this species. Edible ferns also are adapted to this region. Waterfern and climbing swamp fern are popular and highly nutritious and can be consumed along with sago etc without meat being essential. Little has been done to promote or extend the production or utilisation of these plants and the cultural environment created by "Western" trained agriculturalists creates a barrier. Posters and photos highlighting the value of such foods, needs to be used in schools, clinics and other situations to counteract this

negativity. Waterleaf (*Talinum triangulare*) had an almost fortuitous introduction into the country in association with Japanese settlements during the war and has failed to gain the recognition this uniquely productive plant deserves. It particularly suits damp environments such as sago areas but through lack of information is rarely grown or used. Its C4 pathway makes it productively efficient. Waterleaf (*Oenanthe javanica*) is increasingly being grown in lowland areas and is established and utilised in this areas. Its suitability for the agroecological environment should be highlighted and its increasing popularity favours well for it. Little production information in available from within PNG but suitable information can be gained from other production areas such as Southern China and Vietnam. I personally still have some hesitancy about its large-scale consumption until any potential negative effects of the suspected psychotropic chemical, myristicin, are further investigated. Any endeavours by well meaning field researchers to collect "varieties" should be delayed until the nature of leaf variations due to non-genetic causes are further understood.

Management of sago groves has been highlighted as an area worth pursuing. Sago grubs are not only a highly nutritious complement to sago production but are an important management tool. Sago trunks that are too fibrous for efficient extraction of starch can be utilised for sago grub production. As well allowing the insects entry into superfluous trunks or palms by cutting a small entry hole can be used to thin groves in simple and productive fashion. Rarely do village people thin groves or stands yet prefer the larger more productive trunks that result.

Sago processing remains an area for considerable further adaptation. People should be allowed to decide for themselves the relative productive efficiency of different scrapers and parers by having them introduced and given exposure. Given that sago in this area exceeds demand and is an under-utilised resource, any potential utilisation of this resource should be investigated but done within the constraints that women's workloads must not be allowed to be increased. Motorised scrapers utilising fuel oil prepared at village level from coconut oil, would be an appropriate technological adaptation and should receive consideration and development. The distance of many sago villages from infrastructure mitigates against other fuel options. Hand pumps commonly built in appropriate technology workshops (eg Rus Alit, World Vision Australia) would also be appropriate to the demands for washing water in sago areas. Hand pipe well systems, would allow ground water to be easily extracted near appropriate sago palms which would make greater utilisation possibilities in areas where washing water is a restriction. Whether this level of technology would allow sago for export to be developed would need to be decided by someone with more experience in the sago exporting areas in Indonesia or Malaysia. There remains a demand for sago in local markets in several areas of the country where teachers and other professionals from sago areas create a demand. Transport is a major problem. Sago is a crop that demands long

range planning. From establishment to first harvest takes 15 years or more. In tightly managed groves such as Kutubu, this becomes a major management exercise as palms are traded and exchanged while new planting comes into production. The availability and accessibility of suitable planted cultivars in the Amanab region is unknown to me, but for the development of this resource and the effective utilisation of the large potential sago areas into the 21st century, demands appropriate action now. Carbohydrate food requirements and alternative energy sources from these environments may make sago an essential option into the future. Preliminary documenting and screening of cultivars in the field using experienced sago growers and consumers should be undertaken before extensive planting are undertaken. The amount of variation seems to be larger in some locations such as Kutubu where a more tightly managed resource has probably increased selectivity. Any potentially selected clones should not be established in DAL/DPI land, but in village settings by stable sago growers. Then they can maintain and assess the selections utilising their own resources. Many keen village farmers will willing accept and trial new varieties and selections within their own production system and according to their own criteria.

Because of the significance of sago environments within PNG a more systematic analysis of suitable alternative crops for these agroecological environments needs to be investigated rather than ignored. Given the world-wide fascination with palms, suitable fruiting species for these environments should not be hard to locate. Some of the extensive studies on mangroves should produce something useful in relation to the edible species.

Amanab has banana gardens as secondary staples. Given the unique resource within PNG of several hundred different banana cultivars, better farmers from areas such as this should be assisted to select suitable cultivars from known areas of diversity so that the social and cultural characteristics can be appreciated and utilised at the same time as selections are made. The Gazelle Peninsula and the Nadzab regions (Adzera's) are known centres of diversity. The introduction of "Cavendish" type bananas makes little real contribution to village diet and they have no commercial potential under present PNG production systems. It is not only the higher yielding more resistant clones such as "Kalapua" which may have a role in an areas farming system but often other kinds with specific characteristics such a "Kekiau" for quick snacks in village gardens and kinds which give quick production in new garden sites. Those preferred for baby food should also receive priority attention. A village producer talking to another experienced village banana grower in a real banana garden setting but in a different environment is the best methodology for facilitating any introductions. (Normal nematode elimination practices and banana weevil avoidance should be undertaken with any introductions.) Banana scab moth risk may create an introduction problem from the major centre of the

diversity in the Gazelle, but it seems that other factors cause the serious scab moth problems in the Gazelle.

Tulip (*Gnetum gnemon*) is common in this and similar areas and although all village people are aware that the nuts and shoots are edible as well as the leaves, very little is done in their processing apart from cooking and eating. In Java, attractive snack foods comparable with wafer chips are commonly created from these nuts, in village level technologies. It is most likely that a simple, highly attractive and nutritious, marketable commodity could be produced by women and marketed throughout the country, simply by gaining information and applying it locally. This would give a genuine and feasible production system for these areas.

In the areas of Amanab where yams are more common the normal yam production enhancement technologies should be promoted. Optimising efficient production by spacing, size of planting material, suitable staking, appropriate variety selection, and so on can be continually refined from available data applied to existing production systems. Disease and yams goes together and is almost uniformly ignored within PNG. Prior to any simple screening of varieties an understanding of the dynamics of genetic resistance within the yam cultivars by any well intentioned interventionist needs to be known or crops selected for one criteria such as yam anthracnose will almost inevitably leave the crop susceptible to virus. The disease pathosystem needs to be selected holistically. Many cultural techniques, often applied but not understood, are common in all yam production areas. Because of the lack of understanding apart from socioculutral taboos and religious restrictions many of these techniques are therefore disguised as "yam traditions and taboos" and are often dismissed. There is an on-going educative role in relation to yam diseases to free the production system from unwarranted mythologies and restrictions. Silvering of yam leaves due to the ubiquitous fungus *Botriodiplodia theobromae* can be of significance and especially as it is related to integrated farming systems. A holistic understanding of food crop production systems and their existing constraints should be a fundamental part of the education of every agricultural officer in the country. Given the extremely high level of significance of subsistence production to the viability of the whole country, the level of knowledge in this area must increase dramatically before ad hoc innovations further erode the stability and viability of the production systems.

Morobe

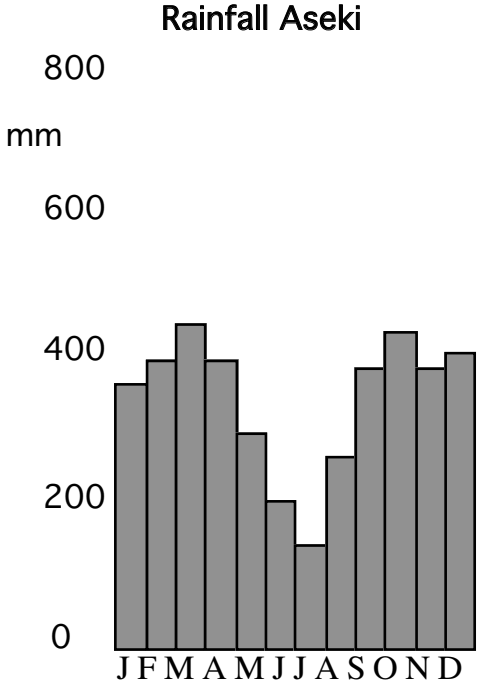
Kabwum

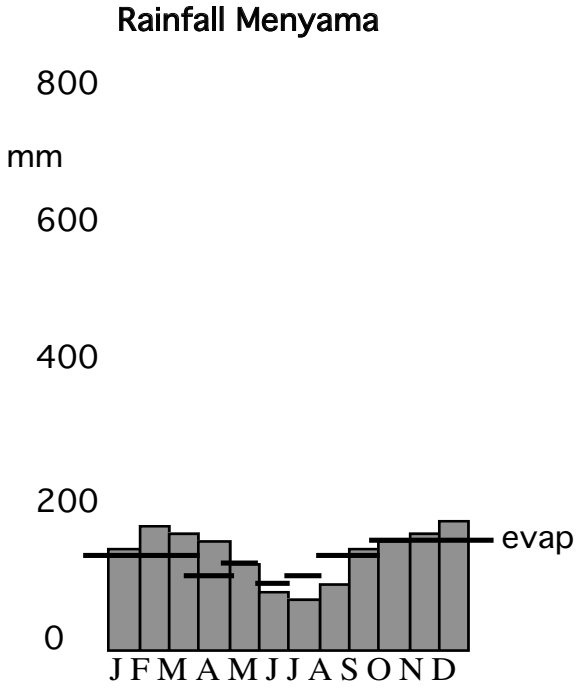
Menyamya

(Farming systems information is currently not readily available but will be published later this year.

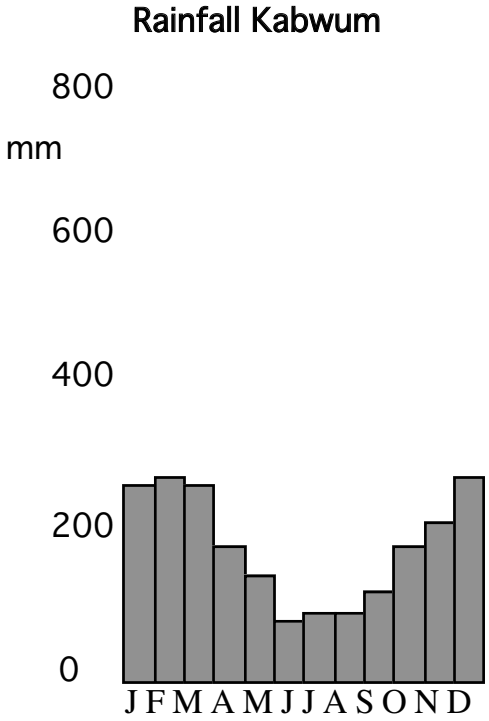
In the Morobe Province the two districts identified are Kabwum, a North Coast region and Menyamya a southern highland region.

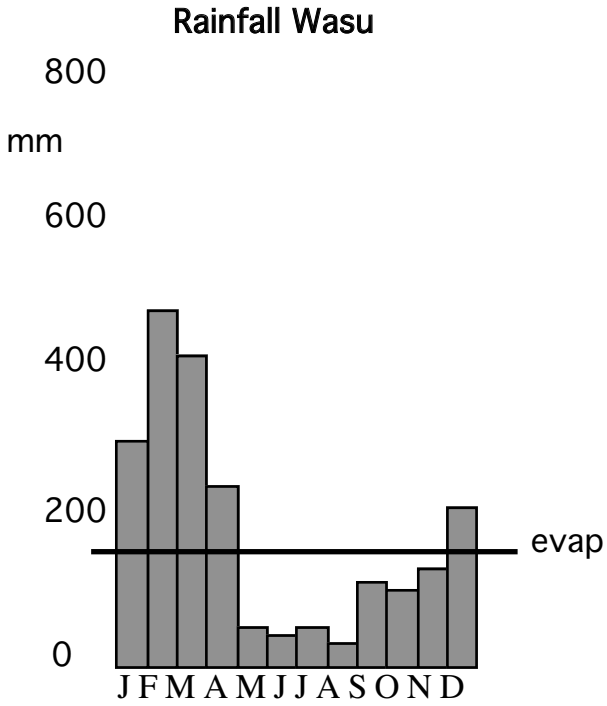
In the Menyamya district the majority of the people live in the 600 m to 2000 m altitudinal zone, although some have access to land in lower or higher areas.





In Kabwum the residential area stretches from sea level to over 2400 m with the majority of villages being in the areas below 1800 m.





From the nearest approximate evapotranspiration calculations for Saidor put against the Wasu rainfall data, it seems obvious that there will be serious moisture deficit for several months. This will determine a very

seasonal cropping pattern. Bananas, taro, sweet potato, yams and sugarcane are mentioned as grown in the lowland area.

It is mentioned in the Social Assessment report that sweet potato is the most common crop in the higher regions.

Sustainable Food Crop Farming Systems in Papua New Guinea.

The main concern with Sustainable Food Crops Farming Systems in Papua New Guinea is, in my opinion, not primarily policy formulation but policy and programme implementation. The main cause of this failure in policy implementation is not infrastructure problems, nor access, nor staffing even though these are real and significant, but that the people involved with agricultural production and extension are unsure of what to do. They need clearly and effectively formulated messages on what to do. They also need to know why they are doing it. Extension packages enabling them to overcome this barrier need to be developed.

For example, all over Papua New Guinea, corn is grown, and enjoyed and practically all corn in the country is seriously inbred which significantly reduces both yield and yield potential. In my opinion this inbreeding takes precedence over nutrient deficiencies or nutrient restoring strategies. Inbred corn does not have the potential to produce high yields even if the growing environment is improved. Again, this seed quality problem probably takes precedence over pest and disease problems even though 15 diseases and 34 insects pests are recorded on corn in Papua New Guinea. Once the inbreeding problem is being addressed, the other constraints need to be also faced and addressed. How to stop corn inbreeding is a simple message that requires few resources and could be taught all over the country by a diverse range of organisations such as schools, health workers, agriculturalists and mission agencies, but this is not being done. (Alternate strategies such as distributing good quality open pollinated seed or hybrid seed, or teaching village people how to produce their own hybrid seed are all possible strategies but at this point in time in Papua New Guinea, given the level of sophistication amongst village farmers, and the infrastructure existing, simply avoiding inbreeding by proper selection and production of open pollinated seed may be the most appropriate first strategy.) Corn at present remains inbred and the yield remains low. Corn is a highly liked food. Improving corn production although very useful, will not transform subsistence, as at least at this stage corn is only one component of the diet and a complement to a root crop or banana or sago, staple food. But instead of doing extension and teaching people about inbred corn and how to avoid it, or the many other obvious extension activities people could be undertaking, people consistently ignore basic food production problems and concentrate effort and great expense on issues that although valid and important and often popular, are peripheral to or ancillary to subsistence food production as it currently occurs under the present farming systems being practiced within the country. People seem

to be hoping the problems or systems will go away rather than simply walking into a food garden with their informed eyes open to confront the system of food production as it exists. Once they begin to do this and seek to become informed on food production methods under the agroecologically sound methods at present being practiced, they could begin to make innovations appropriate to the gardening system as it currently operates. To do this in any intelligent fashion, all agricultural workers will need to be as highly informed as possible on all aspects of the food crops and their production as they are currently encountered in the farming systems in the areas in which they work. At present the backup resources and support and information do not exist to allow this to occur. This significantly affects motivation, as well as the confidence, to act.

To move to a more major crop, such as yams, the situation instead of being better is in fact worse and yam production is collapsing in several areas of the country. Yam production is a major crop in the Momase region. The normal dismissive comment is to say that yam production is unproductive and should be replaced by other crops. That is simply avoiding yam production for reasons of personal bias. If yam production exists, and it does on a very large scale, it needs to be intelligently addressed. Yam production also has a significant role and relevance in seasonally wet and dry areas because of the storability of the crop. In a yam garden, an extension agent may never notice yam anthracnose, silvering of yams, or even the conspicuous yam leaf spots unless they are made aware of their existence and given the facility to recognise them in the field. Even if yam anthracnose were the limiting constraint in yam production is some areas, it is not possible to effectively and meaningfully recognise this and respond if the extension agent lacks the capacity to differentiate the different yam diseases and to understand this in the context of the normal senescence of yam leaves. As well they must be able to discerningly identify the problem amongst the multitude of local explanations such as lightning strike and magic and menstruating women. Then they must be able to communicate to farmers within the present religious and cultural framework in which yam cultivation occurs. Unfortunately diseases do not come with individual labels saying, "Ignore all the other disease symptoms and only focus on me as the limiting constraint." People must be broadly aware and willing to observe in an intelligent and informed fashion before real implementation of improved techniques will occur. (About 7 leaf diseases are currently recognised on yams and 21 insect pests, but these are inaccurately documented and poorly observed and recorded, as basic attention has not yet been paid to yams as a crop, and almost none of the known information has been conveyed to field workers). Even if one yam disease were more important in an area than the others, the wider awareness is essential to any observations or innovations. Next the field worker would need a strategy to assist the management of this disease and this would need to be implementable in an average yam garden, by an average yam grower, if any wide scale improvement of yam production were to occur in a region.

Yam growers are known to show particular attention to their crop, and are just as willing to adapt or listen to someone who shows an intelligent interest and skill, as are other crop growers. Once someone becomes aware of yam anthracnose it quickly becomes obvious that there is significant varietal variation in resistance levels amongst yam cultivars. But before an extension agent assumes the appropriate strategy is to select for resistance amongst the cultivars, they need to be aware that normally another limiting disease, yam virus, often dramatically increases as the diversity of yam cultivars is reduced and selection for resistance to anthracnose is undertaken. Because yam viruses can produce yield failure not simply yield reduction, the outcome could be worse than before. What is needed is an overall "Good Gardening Philosophy" where several aspects of the conditions and constraints on the diverse yam species and cultivars is undertaken in an integrated fashion. In general, diseases are going to become more significant and more common as plant production deteriorates. Yams as with other crops are concurrently responsive to reduction in inoculum through crop hygiene, crop rotation, clean planting material etc. It is often the combination of these various factors of declining soil fertility, along with disease and pest occurrence, that causes farming systems to collapse and production of specific crops to cease. Crops produced under low nutrient status conditions (or imbalanced nutritional status) are normally more susceptible to disease and the impact of the disease or pest becomes more critical. Other agronomic conditions such as spacing, staking, planting time, aspect of the field, and general management, including damage to yam vines, will exacerbate the disease occurrence. Maintaining a diverse mixture of cultivars and often mixed-cropping situations, also assists in reducing the disease incidence. Maintenance of sufficient yam planting material also becomes a constraint in some areas. But yams have a distinct and decisive advantage in areas that have a clear wet and dry season because the tubers are storable. It is not always necessary to isolate the individual components of each crop, the cultivars, pests and diseases, to develop good crop production strategies. Often conditions that will reduce one fungal leaf pathogen will also assist in the reduction of others. Good production and agronomic practices often combine to reduce the impact and incidence of disease and pest constraints.

A similar dynamic occurs with other crops. For sweet potato, the major production variable centres around the need for the soil to be aerated for tuberisation. That is why a consistently variable pattern of mounding, composting, digging, draining etc has been developed throughout the diverse regions within the country as local responses to the currently existing soil and moisture regime. Even in one location, the farmers change the methodology with successive crops as soil conditions vary. The first crop after clearing from forest is planted un-mounded, but subsequent crops are planted in mounds. As well, nutrient balance can be significant in lowland regions where nitrogen balance can alter the foliar/ tuber ratio for sweet potato with subsequent limiting tuber yield. Potash and phosphorus inevitably become limiting constraints with tuber

crop production and their provision and maintenance must be considered in all production strategies. Farmers using shifting cultivation normally do a symptomatic assessment of the fallow vegetation and designate it as lacking in vigour, or as being dry and unproductive, from their accumulated experience over past years. Normally the response is to avoid such areas if land availability allows. But they lack the capacity to more specifically diagnose the limiting nutrient and where one crop is grown before an area is allowed to revert, any initial visual diagnosis is extremely valuable and practical. In some areas, nutrients are provided by composting fallow vegetation into mounds, but in many areas little is done to either conserve or enrich the nutrient status except by utilizing what is done naturally through the accumulation in the biomass within the fallow. About 30 disease organisms are known to affect sweet potato production. They are not all equally significant but the more commonly occurring ones need to be recognised by field workers and the epidemiology of them understood at least in broad outline. Elsinoe scab is commonly seen throughout the country, mostly ignored, and becomes significantly limiting when nutrient decline makes leaves more vulnerable as well as foliar mass more critical. Management of this disease has given yield increases in trial situations. Cultivars selected outside the pathosystem (such as those introduced from Taiwan) normally have low levels of horizontal resistance to this disease and therefore no real yield advantage. At least 19 insects have been recorded damaging sweet potato. Their significance and damage vary. In some seasonally dry areas the effect of sweet potato hawk moth larvae can be dramatic but effective recovery of the crop can occur and yields still be reasonable. Where low nutrient status means leaf production is already limiting, the impact can of course be far more significant. Similarly sweet potato weevil can be critical in cracking soils especially if harvesting is delayed to enable the maximum spread of harvesting time. Because insufficient emphasis has been given to dry matter content in sweet potato yield trials, complaints continue to be received about the cultivars distributed for yield increase. The cultivars still are classed a pig feed instead of human food due to their low energy status. Simply introducing higher yielding varieties can at times simply mean the soil nutrient status is being depleted to a greater extent rather than a more sustainable farming system being developed. Changing varieties, in a country that has about 5,000 cultivars already in existence and which are regularly and consistently being assessed in the field on a daily basis by farmers, can at times be only a cosmetic solution. The inappropriateness of sweet potato for some agroecological zones needs to be as strongly recognised, as does the need for it to be affirmed as the most important food crop of the country.

Taro is a particularly attractive crop to many people and its unique nutritional value for some people, makes it a crop worthy of continued attention even where it is subject to disparaging comments. Almost every report on subsistence in Papua New Guinea manages to mention taro blight but most of those who report its occurrence or record its existence seem oblivious that 9 other foliar diseases also attack the plant and little

attempt has been made to discern which causal agent is involved, and which areas the disease is limiting for production. This is creating a state of confusion with taro disease occurrence throughout the country. Some elementary information would assist in the clarification of this situation. Dry and wet rots although significant have received little attention. The 27 or so insect pests similarly need recognition and management. Any real progress with taro beetle control will have benefits more widely than with taro because of the polyphagus nature of the insect. The *antiquorum* subsp. of taro has not received the attention it deserves for seasonally dry areas of the country where its storable nature would have value. The accumulated tradition amongst taro growers although rich in wisdom is not infallible.

Land Use and soil maintenance.

Many village people pine the declining fertility and the inevitable decreased yields with fertility decline and increased distances to gardens or adoption of less attractive crops such as cassava. In most cases no viable alternative for improving production has been persuasively presented or demonstrated although regular innovations are being made and adopted. The long term soil sustaining virtues of mulching over the short term benefits of burning, need to be practically demonstrated. In most situations except urban sites, composting is going to be far too labour intensive to be sustainable. People cease its practice as soon as the external motivation is removed. Mulching needs to be the recommended procedure within gardens and enhanced fallows and biomass accumulation outside the current garden. Increasing soil organic matter has far wider implications than the nutrients supplied. Legume fallows and intercropping using tree legumes needs to be steadily promoted within the production system. Population growth rates and land pressure make these inevitable in the medium term. All recommendations need to be carefully adapted to agroecological zones. Strategies need to be adapted and adopted from equivalent production systems within and outside the country. Velvet bean fallows suits several lowland zones and are strategically used in central America. Cowpea can also be utilised up to 1200 m. Pigeon pea has a role as a short-term tree fallow in the lowlands especially the seasonally drier areas. Casuarina trees which nodulate and fix nitrogen are already a feature of farming systems in mid altitude zones. Other alternatives need continual adaptive research and application but within subsistence food gardening systems *Leucaena* has been found largely unacceptable because it is too hard to remove prior to cropping. Any tree crop legume has to be related to the crop used. Sweet potato cannot tolerate shading whereas taro can.

Provision of resources.

In my experience in Papua New Guinea over the last 25 years I have seen very few attractive resources which would induce people to either inquire or show awareness of and concern for many of the aspects of crop

production and constraints as they apply to the 40 major food species currently most significant within the country or the additional 60 species commonly used. This needs to be remedied, as the first and major priority, to change the perceptions of subsistence food production and Sustainable Farming Systems for Papua New Guinea. Other departments and organisations continually highlight the needs and priorities for attention to subsistence food production, but is the responsibility of the agricultural section to address the problems and concerns through the porvision of information and resources that all can use. Typical comments and policies include:

Papua New Guinea Women's Policy Department of Home Affairs and Youth Goal No. 4 For Government to enhance women's critical contributions to development as the primary food producers and processors and distributors, as the mainstay of family community health and as the principle educators of future generations. Objectives. To provide avenues for women to have access to more efficient and labour saving devices. Implementation. Department of Agriculture and Trade and Industry Development to provide to rural women labour saving devices and methods to ease their workload and to train women to improve their methods of production, processing and marketing. To assist agencies in research and development of appropriate technology for women in Papua New Guinea.

In many of the more disadvantaged areas government services are sparse and expensive to maintain. Little motivation or incentive exists for addressing these situations. Therefore the role of those already there in Christian mission and other agencies needs to be affirmed and utilised. For example, the Project Completion Report for the Enga Provincial Development Project emphasised that the most successful components that far exceeded planned outputs were achieved through the high cooperation of the Christian missions and churches in the area. “A very high level of performance has been achieved by the non-Government organisations, particularly the missions of various denominations, involved in the project; their effort has contributed much to the success of the road component and of the good functioning of the health component.” (report p 11)

Some women's organisations are significant. One of these visited is the **East Sepik women's Council.** They have a long established record of working with women and women's concerns. As part of this programme they have made various innovations and done training in food production, nutrition, food processing, application of appropriate technology, business training, and other areas of concern for women and families. They have a library of resources for training and high levels of awareness of the process of development and change. A range of techniques in relation to food production and processing have been demonstrated and tried but promotion of them all has not been continued due to the diverse demands and funding and support service

they have available amongst this small group of women. They had less complaints about funding restricting activities than with other groups although some activities such as developing sago processing require greater inputs than they currently have available. Some of their sources of funding was through Community Aid Abroad and through women's groups in other countries as well as Provincial allowances. A sago technology and food processing workshop was held using the assistance of an Indonesian women trainer but only the techniques which are possible with current resources have been followed so far. "Sago pops" are produced and marketed in the region. Some of the other sago utilisation technologies required moulds and utensils that they do not have access to and which were not supplied from Indonesia as promised at the end of the course. They were of the opinion that appropriate innovations in sago processing do get adopted and some of them, such as washing sago in perforated plastic bags were being done by men instead of simply being dismissed as women's work.

Some of the areas of innovation to which they responded were seed production and supply of quality seeds of corn, winged bean, and planting material for fruit trees etc. Some of the nutrition and education programmes by them were not followed up because a regular supply of necessary materials was not available. Similarly, some of the more adaptable tools for gardening and equipment such as suitable small plastic bags for packing produce were only available irregularly. Didimeri's (female agricultural workers) had been allocated to work with them but they felt these people had been totally unsupported by DPI/DAL in terms of strategies, information or resources. They therefore became discouraged and unmotivated.

One of the crucial needs identified was for storage facilities near markets not only so that produce could be kept fresh but also so that women could get back home at an appropriate time of day instead of in the dark.

They were keen to know of and have access to appropriate simple technological packages of ideas or information that could be promoted and implemented amongst women. eg foliar sprays of urea onto edible greens, pineapple hormone, corn seed production to overcome inbreeding, production of edible cooking oil at village level etc.

Involvement of churches and mission agencies

In the Enga project completion report, the invaluable assistance of mission agencies was recognised. To constructively build on this potential through Christian and mission agencies, which is an important part of the infrastructure throughout the country, several factors need to be considered. Intermission cooperation is essential; educational assistance to understand the integral nature of development to Christian mission is needed; assistance is understanding the nature of sustainable

farming systems agriculture, particularly in the tropical subsistence food crops sector must be developed to prevent ad hoc and inappropriate assumptions and innovations; and the distinction (but not separation) between rural development and agricultural production components and personal spiritual development or worshipping community components needs to be specified. Much of the motivation for missions, and the high level of commitment and resource funding, is derived from the worldview commitment which embraces the inherent spirituality of people. This reality cannot be denied or both the *raison d'etre* or reason-for-being is removed, but also the complementary of their “whole person” concern for health, welfare, nutrition, and economic development is jeopardised. What must be determined and specified is any association or allocation of funds so that the integrity of the wholistic view is maintained but a part of some of the activities can be recognised and affirmed as developmental. This has been effectively done with other government assisted programmes between churches and Christian aid organisations in a number of contexts. Food production, for example, being a women's activity to a significant extent, could gain both an audience and input through church related women's groups but would be only one component (say 25%) of their activity. Much whole-of-life, including agricultural production, perspective is integral to the Biblical view and is being highlighted to motivate Christians in this area through multimedia resources produced by World Vision; MARC Europe etc. Promoting such resources through mission agencies or facilitating their use would create capacity in one of the more richly endowed and consistently motivated infrastructural systems universally distributed even in the most remote and "disadvantaged" areas of the country. This can be done in a way that neither compromises the integrity of the mission nor the secular impartiality of World Bank style programmes for development. The practical skills concomitant with some of these organisations could be utilised in a consultative, training role in wider contexts. Rus Alit, the World Vision appropriate technologist based in Queensland Australia has a world-wide reputation for practical application of technologies in situations which are technologically simple. The Lutheran Church in PNG has a very effective agricultural development programme called Liklik Didiman that has been running for 21 years. They have effectively administered funding from government and other sources with good accountability and effectiveness at the village level. The Baptist Mission in the Telefomin area has been effectively used in health and nutrition development programmes. Through their literacy programme, village and life related messages had been included from health strategies and been widely disseminated. The structure would also be equally suitable for the promotion of simple appropriate agricultural messages. CARE Australia is increasing its involvement in PNG although not at present in Momase region and World Vision has an established role in health and education.

One of the groups interviewed was GROW a NGO. Those involved highlighted the difference in motivation and satisfaction despite lower

funding when they felt fulfilled in their role and task. One member, at least had previously worked in the Health Department. This highlighted the disparity in comments about delivery of extension services. Many people have commented negatively on the effectiveness of extension at the village level. Often the rationale for justification of this lack of output has been related to lack of funding. In most cases the real issue is lack of people priorities that therefore did not development commitment amongst those involved. People to remain motivated and productive need to be recognised and affirmed and made to feel worthwhile and noticed. There are people working in health and education and agriculture extension in remote areas in this country who are overcoming the problems because they are a part of a structure that meets their wider personal needs and sense of purpose and belonging. eg the Lutheran Liklik Didiman programme. Lack of finances is only one component of the lack of action in field situations. A sense of mission and belief in the inherent worth of what they are doing and the recognition of effort are fundamental to any work place productivity anywhere. Similarly, if an agricultural extension officer is regularly moving around village gardens, asking questions and taking an interest, the quality and productivity will increase significantly without any "extension packages" or "innovative interventions" being practiced. Subsistence gardening is a thankless task which no one seems to notice or appreciate and is done by normal human beings who also need encouragement. Of course many observations, interventions, innovations etc will start to flow as soon as the basic affirmation and interest are created and the concern and credibility is established. It is not possible to see gardens from a 4 wheel drive vehicle and many gardens are at least an hour's walk from a village or road. Using small motorbikes is a far more useful means of transport giving far more efficient access as these can negotiate many walking tracks and can be lifted over logs, streams etc. The cost efficiency is great.

Economic activities

Amongst DPI/DAL there is an assumption sometimes presumed and sometimes stated that commercial production is the priority or aim. This makes some fundamental economically invalid presuppositions. These are that subsistence production comes at no cost, makes no economic contribution, will continue with no assistance, and therefore can be ignored. This is a totally incorrect assumption. It is just as much an economic activity where a women along the Sepik exchanges her processed sago or fish with another woman from the grassland area who has yams to barter. Whether or not a kina coin is transferred each way during this transaction is irrelevant to whether or not this is an economic activity. Food does not become an economic transaction only when European cabbages are grown in Mt Hagen and flown to Port Moresby for sale. The only difference is that this second transaction with the cabbage is a non-profitable economic transaction due to the funds diverted out of the country during the production and transfer. The economy of Papua New Guinea has become poorer due to the cabbage growing activity and

richer due to the sago/fish and yam barter. **Maintaining subsistence production is the most important agricultural activity for the whole country, and it will not just happen.** Given a stable and improving base of subsistence production, then any cash earning activities are a genuine enhancement of the opportunities available within the village. Throughout the country subsistence systems are collapsing and people are adopting the only option they have, which is to change production system to one adapted to declining fertility as an interim measure until that system too collapses. The whole job of an agriculture worker is to avert this collapse through assistance to farmers. Although the mixed cropping systems based on diversity at species and variety level are inherently stable, declining fertility due to land pressure is bringing these systems under great stress. Over the last few decades the food production systems have collapsed in Bougainville, Manus, and Oksapmin (Tekin Valley) with taro production; several areas have yam production declining eg Maprik, and sweet potato production systems have collapsed in Okapa, Nembi Plateau (Southern Highlands) etc. Even banana systems are under stress in the Gazelle and in some of the grassland areas people are now having trouble with cassava production and peanuts which is the bottom of the food production cycle before land will no longer produce anything useful. All over the country farmers are subjecting the land to fertility depletion and not only are areas being converted to grassland but many of the higher fertility demanding crops can no longer be grown. The pattern of collapse has common features. Crops have a nutrient demand sequence with taro (*Colocasia*) and yam needing high fertility, sweet potato and Chinese taro (*Xanthosoma*) being less demanding; and cassava and Java banana (ABB triploid) being the least demanding. As a system comes under stress, disease occurrence becomes of more significance. Taro blight seems to have had relatively recent introduction during the second World War and has led to significant collapses of taro production systems especially in continuously wet coastal (below 800 m) areas such as Southern Bougainville. Taro seedling occurrence occurs within villages and some genetic evolution toward stable horizontal resistance is undoubtedly being made independently of the taro-breeding programme. Such new introductions of disease (or pest) inevitably cause a crisis due to the lack of a stable pathosystem. A similar process occurs in coastal regions with every sequential introduction of giant African snail into an area. In the first year that snails occur, a dramatic crisis occurs but becomes stabilised in subsequent years as snail pests produce an equilibrium. Agricultural officers should be aware of the dynamics of such new pest introduction systems and the inevitable fluctuation and crisis as the new introductions occur. But a far more regular process occurs within the farming system, with well-established disease and pest sources, as fertility decline proceeds. Diseases that are of normal occurrence become of greater pathogenic importance as the system is under stress. Diseases such as yam anthracnose (*Glomerella cingulata*), yellowing of yams (*Botrydiplodia theobromae*), leaf spot of lesser yam (*Phyllosticta dioscoreae*), taro shothole (*Phyllosticta colocasiae*), taro viruses, yam viruses, sweet potato

scab (*Elsinoe batatas*) etc assume greater significance until the gardening system collapses. Insects too become a significant part of this collapse. Sweet potato weevil (*Cylas formicarius elegantulus*), taro beetles (*Papuana spp*), Cluster caterpillars (*Spodoptera litura*) and a range of other insects - especially leaf eating pests on edible greens, take on a new significance as plant vigour declines, growth rates are reduced and production becomes less. Changing the staple crop eg from taro to sweet potato, or yam to Chinese taro is only a concession not an agricultural production strategy. Instead of facing and addressing the production system, the fundamental problems within subsistence production are ignored and therefore exacerbated. A similar process can be observed where families establish new gardens in newly cleared forest and relocate the home to be near the garden. In the early stages people have easy access to food especially the nutritionally strategic edible greens but before long fertility decline means that even edible greens are no longer easily available and can quite quickly get dropped from the diet. The continuous production of the favourite greens such a tulip and aibika in close proximity to houses should be a priority for all people committed to assisting subsistence production. Amongst the high risk groups such as young children, pregnant and lactating mother's and those subject to parasite and disease problems this helps create a health/nutrition intervention programme which is a memorial to the inactivity of agricultural workers in the areas of food production. Many small animal (non ruminant) introductions can actually increase the land pressure and soil nutrient decline where food production energy and/or scarce resources are allocated to these productively inefficient additional consumers.

Potential introductions

Crop introductions can occur from within the country as well as from other countries. No crop introduction solves the problems as all crops are subject to pest, disease, production procedures, nutrient depletion, etc but some improvements can be made towards crops suited to specific agrocecological zones. Several crop species are still regionally located within PNG. Fruits such as Bukubuk (*Burckella obovata*) are very popular in Rabaul and New Ireland but seem to be unknown along the MAMOSE region. Fruit from Manus such as "Mundroi" (*Corynocarpus cribbianus*) do not seem to occur in the MAMOSE area. *Baccaurea papuana* or *Horsfieldia sylvestris* from the coastal region in Gulf Province do not seem to occur along the North coast. Edible greens such as "Kalava" (*Ormocarpum orientale*) suited to coastal margins and used in Rabaul and Southern Papua coast does not seem to be grown along the north coast. It has the advantage of being leguminous. Bougainville sago (*Metroxylon solomonense*) has advantages as house roofing material and may suit drier microclimates than the common sago (*Metroxylon sagu*). It is grown from large seed and should be an easy introduction to facilitate. Before any serious consideration is given to *Colocasia* taro exports, the sub species *Colocasia esculenta* var. *antiquorum* that is grown in Western Province should be tried in the seasonally dry areas of the North Coast

due to its far superior storability due to dormancy. (This is, for example, the only taro that is sold in stores in Tasmania.) *Ipomoea tuba* is a species utilised in Western Province in yam gardens but seemingly unknown elsewhere. Most of these introductions should be made carefully but made straight into village garden situations as the better gardeners have the capacity to discern any production advantage in their situation. They don't need to be made as "policy" introductions to be promoted but simply with adequate production and utilisation information and any perceived advantages mentioned.

Some introductions internationally should be considered but these should not be presumed to be successful nor superior. For example, the sweet potato cultivars introduced from Taiwan have in general been highly susceptibly to *Elsinoe batatas* scab, as they were selected outside the Papua New Guinea pathosystem and have therefore not shown superiority over local selections.

Introductions should be made to fill gaps in specific ecosystems rather than just a random selection from the 5,000 or so edible food plants species in the world. Plants utilised in similar production systems in similar agroecological environments and under similar sociocultural situations are more likely to gain acceptance and be productive.

Salak (*Salacca edulis* Reinw.) from Indonesia is a fruiting palm that may be a valid introduction in sago type environments. The production and utilisation technology should be brought at the same time and the introduction made to suitable local village farmers, not to a research farm.

Sauropis (*Sauropus androgynus* Merr.) a highly nutritious and attractive edible green that grows as a shrub, occurs in Solomon Islands, (as well as a range of other tropical countries) and may be an introduction worth considering.

There are also MAMOSE region plants that could be contributed to the country as a whole. *Amorphophallus merkusii* of the edible cultivated kinds are more commonly grow and used by Sepik people than other groups. Although production is significantly declining the storage capability of this crop warrants greater consideration. *Clymenia polyandra* an indigenous citrus which occurs mostly on off shore islands but also in coastal regions possibly has international interest to the citrus industry and may enable more tropical citrus plants to be produced. Such a plant is unknown to the wider scientific community and therefore remains un-utilised. It does not appear to have unique resistance to common citrus diseases.

Palpal (*Erythrina variegata*), pao nuts (*Barringtonia novae-hibernae*); sis (*Pangium edule*); and some other plants get greater utilisation in the Momase region than in other areas of the country.

Seasonality of production and food security

One of the commonly highlighted difficulties for food production in PNG is the isolation and lack of infrastructure. That is why subsistence gardening exists. At least a part of this project proposal is to address subsistence gardening. As soon as produce is sold, it is not subsistence farming but market gardening. It is undoubted that most people would like road access, safe water, rural electrification, market access, cash income avenues etc. These need to remain the clear goals for development. Normally nutritional problems decrease where these development factors are established. But for an agriculture programme at this point in time in PNG these conditions do not exist for the majority of the population and are unlikely to be provided in a sustainable fashion in the immediate future. Therefore, in the interim, the ongoing frequently raised questions of nutrition, increased work loads for women, increasing population and land pressure, and declining productivity of existing farming systems with their inherent land degradation should not be endlessly delayed. Something agricultural needs to be done in the interim. To suggest that the Markhum Valley is the "food basket" for PNG food security simply creates the problems in reverse. If commodities cannot be got out of the rural areas where the major inherent problems occur, neither can food be got in, in an economically feasible fashion. To focus on a rice and grain production programme to address the needs of the urban elite (less than 5% of the population) in terms of rice import replacement for humans and grain import replacement for poultry and pig production, does not address or engage in any real fashion the underdevelopment issues facing the country. Given the land tenure and population distribution realities of the country, as well as the agroecological and sociocultural food and dietary preferences of the diverse people groups throughout the country sound principles for enhancing and increasing productivity without increasing women's work loads needs to become a consistent feature of all rural development.

Motivating staff and facing production realities

If the MOMASE project is to be an agricultural development project directed towards areas that are disadvantaged, then at least two things ought to feature highly. These are agriculture and appropriate strategies for working in disadvantaged areas. These need to be highlighted in the project outlines, or they will be marginalised. PNG still has subsistence-based economies in a tropical region. Subsistence production systems based on agricultural strategies utilising tropical crops or other productive activities should feature. The worldview, perception paradigms, and sociocultural constraints and level of technology and management, need to be constantly assessed and understood in programmes. Many of the farmers within Papua New Guinea use technologically simple methods but they are not therefore stupid. They

are quite capable of sophisticated adaptations of crops and methods to agroecological zones.

It is most unlikely that any bottom up planning activity will request assistance in the form of simple refinements to existing farming systems, nor towards subsistence food production, as the village people have no concept of improved production based on traditional foods and food production methods. Such concepts have not been formed because the status of the appropriate environmentally suitable foods (ie the 100 or so significant tropical food plant species currently utilised) has been seriously eroded and food production has a very low status as a task. In a world where anything which has "value" is attractively presented and marketed to stimulate demand, nothing is done in the traditional food crops area - no posters, no books, no quality cooking demonstrations, no TV advertising, often even no commonly accepted name. Most attempted production adaptations have increased labour demand and intensified management requirements and neither of these are sustainable or attractive options unless the reasons can be validated and the capacity increased.

It is taken as axiomatic that because the majority of the food production in subsistence farming systems is done by women that women facilitators will be employed as the primary agents in the development of the farming systems process. All the failures in achieving this employment goal of women in the past need to be dismissed and appropriate recruitment procedures, tenure arrangements, in service training, safety provisions and other necessities to engage, equip, assist and ensure the continuity of female agriculturalists as the front line people in the field situations as well as in the planning and policy areas and any adaptive research components, is established as fundamental and integral. The incentives need to be adequate to ensure recruitment of highly motivated, adequately educated, residentially stable (? married women with children) females who are willing and able to operate long term and perhaps under flexible employment arrangements. As many of them may not have chosen subsistence agricultural food production as their career path, short term training through short block courses and in service training with adequate consideration to family matters may be necessary to get suitable older married women trained. Often these will be the wives of agricultural officers or teachers already working in a rural area.

Careful sociological analyses for Papua New Guinea Societies by Papua New Guineans are scarce. One of the more carefully designed and executed studies in this area was presented at the Consultative Seminar on Agricultural Reforms and Delivery of Farming Services to Papua New Guinea Villages (15-17th March, 1994) at Port Moresby. It was presented by Kule'en M P Hamou, Acting First Assistant Secretary, Resource Management Wing, Department of Manus. Lacking anything of equivalent calibre it has been decided to use the indicators from it as a base line for

the reappraisal. For their study the Principle objective for development was accepted as: "To achieve total development of every man, woman and child of Manus to the maximum level the Province's resources can afford".

From this study the ranked priorities for basic minimum needs were:
1. Shelter - improved housing
2. Spiritual development – self-realisation of the purpose of living
3. Medical care - healthy person, family and community
4. Family life- healthy happy marriage and family
5. Peace and harmony – self-respect, caring & understanding of other people
6. Population and family planning- sustainable growth & management of the population growth rate
7. Water- adequate supply of safe water
8. Food - sufficient quality food
9. Communication - improved communication network
10. Money - wise and careful use of money
11. Education - education for living
12. Land - rational & productive use of available land.

In conclusion for the project to achieve its potential there is a need to make development work at the village level an attractive option that is developmentally effective, gender sensitive and sustainable. To do this it will be necessary to ensure staff are maintained at base camp/ subdistrict level who can comfortably read English and make effective use of books and written materials and have a basic agricultural training, and are affirmed in their job, supported adequately in their lifestyle, adequately supplied with information and back up resources, receive regular training preferably at a location conducive to them, their wives/husbands and families. Provision will need to be made for a break from village life and this can be as an endorsement of them and recognition of the strategic importance of their task. To ensure these goals are achieved housing will need to be well maintained; good water supplies will be needed; good communications will need to be maintained and appropriate transport will need to be ensured. The overall strategy will need to allow those working in this way to be promoted and endorsed to make automatic transfer out at the earliest stage a less attractive option. Provision of information needs to be facilitated using the skills and resources of those working at field level as well as the wealth of experience held by village people.

Dracontomelon dao

Pangium edule

Pandanus juilianettii

Nastus elatus

Solanum nigrum

Pandanus conoideus

Amaranthus tricolor

Abelmoschus manihot

Polyscias scutellaria

Ipomoea aquatica

Dicliptera papuana

Psophocarpus tetragonolobus

Castanopsis acuminatissima

Diplazium esculentum

Stenochlaena palustris

Talinum triangulare