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An Assessment of the Future of Agriculture in Papua New Guinea.

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AN ASSESSMENT OF THE FUTURE OF AGRICULTURE IN PAPUA NEW GUINEA

by

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SUMMARY

The great reliance placed on agriculture by Papua New Guinea for both subsistence and export earnings makes its future development of paramount importance. The wide range of environments within the country offers considerable potential for agricultural expansion, although not all features are favourable. For the subsistence farmer, development should be mainly along the lines of increased productivity, both quality- and quantity-wise, per unit area through manipulating the crops themselves, rather than attempting to manipulate the environment through use of expensive cultivation techniques and agrochemicals. Forestry potential is very great but exploitation needs to be closely controlled, with integrated follow-up programmes wherever possible. Considerable development could occur through expansion of export-orientated crops, such as oil palm, coconut, cocoa, tea, coffee and rubber, preferably through joint ventures between government and private enterprise, using the design of the Hoskins oil palm development as a basis. Further expansion of the livestock industry, together with development of more specialised crops such as essential oils, fruits, spices and medicinal plants, are all indicated. However, to achieve the country's development, massive investment and dependence on foreign expertise will be required. To this must be linked high standards of management, greater individual productivity, and a considerable increase in research.

INTRODUCTION

The approach used in this paper has been firstly to summarize the present importance of agriculture in the country and then to deal briefly with factors affecting agricultural productivity. From these two basic considerations have been derived assessments of agricultural potential and priorities, with final suggestions of the means by which these aims can be achieved.

The various points made will be to some extent based on experience from a number of other tropical countries but it is apparent to even the most casual observer that agriculture in Papua New Guinea has many problems and requirements which are very diverse and which can vary considerably over relatively small distances. However, there are many instances where this country can benefit from the experience, and mistakes, of others, both in avoiding similar mistakes and in speeding up the process of development.

THE PRESENT STATUS OF AGRICULTURE IN PAPUA NEW GUINEA

There can be no doubt that the importance of agriculture in everyday life is immense. A dominant feature in any consideration of agricultural future must be the published statistic that of the population of about 2.7 million, about 90% exist by subsistence farming and small cash crop production. Annual income of subsistence farmers is very low. This will be an extremely important factor in considering methods of increasing productivity per unit area.

It is unusual for the population of an area in this country to be anywhere near its carrying capacity in relation to the production potential of the land, although a few problem areas of over-population are said to exist, as around Rabaul and Maprik. Most ethnic groups are gardeners, producing the staple foods of taro, sweet potato, yam, banana and sago. A number of other plants are grown on a small scale such as tobacco, sugar cane, peanuts, Casuarina, rice, sorghum and vegetables. Subsistence farming crops are produced largely by the method of shifting cultivation, in which the land is farmed for 1-2 years, or sometimes longer, and this is followed by a long fallow period. Most intensive use of land for food crops is made in the densely populated highland areas, particularly Chimbu and Enga.

Relatively few people work as long-term labourers on estates of variable size. Until copper production from Bougainville began, commercial cash crops accounted for about 85% of the country's foreign exchange, and they still comprise a very significant proportion. These crops are grown in predominantly estate-type agriculture. The major products are copra, cocoa and coffee, with smaller amounts of tea, rubber, chillies and pyrethrum. More recently, palm oil has started to be produced in significant quantities. In all instances the potential exists for greatly increased exports.

A fairly large cattle industry is developing in the country and this is one aspect of agriculture which could be expanded. Chickens are raised, but with limited organisation for large-scale production. Pigs occupy an important place since they are used not only for food but also feature in social and religious functions. With a diet which tends to be protein deficient, improved animal husbandry and expanded livestock production are indicated as important agricultural requirements. Fishing could be greatly increased. To get poultry and pig developments on any scale would require simultaneous development of a small grains industry for foodstuffs production.

Generally speaking, therefore, there can be no doubt as to the present status of agriculture as a most important element in both commercial and subsistence sectors of the economy.

FACTORS AFFECTING AGRICULTURAL PRODUCTIVITY

A very significant factor affecting agricultural productivity is the wide range of terrain contained within the country's land area of about 462,000 square kilometres, dominated by mountain ranges containing valleys and gorges. There are also many coastal plains, sometimes of high fertility (especially in New Britain), but also of a low fertility, such as the Sepik plains and Western Province swamps.

Vegetation varies considerably with terrain, with lowland rain forest dominating much of the country. Forestry potential is indicated by the large reserves in such areas as West Sepik and New Britain with valuable evergreens and oaks flourishing between 1000-3000 metres. Utilization of quite a large proportion of the country for agriculture would, however, be very difficult and expensive because of the high and almost impenetrable mountain ranges which make communications very difficult.

The considerable climatic variation found throughout Papua New Guinea necessitates a brief consideration of its effects on agriculture. Altitude has marked effects, with a tropical monsoon climate up to 1000 metres; wet tropical monsoon climate from 1000-2000 metres; wet-cool mountain climate with a persistent cloud cover from 2000-3500 metres, and a high mountain steppe climate above this. Vegetation is thus greatly affected and the flora very diverse, as will be agricultural systems, with a range from dry plains through humid jungles to cold peaks.

Whilst the country on average receives about 25 cm of rain per month, terrain and seasons make this very variable, with consequent effects on agricultural production. Strong influence is exerted by the north-west monsoon during the period December-March, and by the South-east trade winds during May-October. Thus, for example, agricultural requirements would be expected to vary considerably between Port Moresby with 100 cm per year, the relatively dry lower Sepik and Markham valleys with about 160 cm, and those areas over 1500 m ^{altitude} where rainfall is practically incessant. Wet seasons can be very pronounced in some areas, and an example of their effect, together with frequent precipitation throughout the year, is provided by the oil palm development at Hoskins, where the necessity for assisted pollination has become a permanent feature largely because of rainfall in the absence of insect pollinators.

Coastal temperatures are generally within the range of 23-30°C and are ideal for good vegetative growth of many food and export crops. In the more populated upland valleys, the average temperature range is considerably lower at 10-27°C, whilst frosts occur from about 3000 m.

Except where cloud cover is persistent, average sunshine hours are good, although variable with seasons. This feature enhances vegetative growth and yield in crops such as oil palm, provided other conditions are not limiting.

Over much of the country, soils generally tend to be quite shallow, washed out and with low inherent fertility. In the more mountainous areas they are subject to rapid wind and rain erosion, so they tend to be heavily weathered and leached, with great variations in both depth and type. There are some excellent soils as, for example, the andosols of Bougainville and New Britain; those in West New Britain support perhaps the fastest vegetative development of oil palm in the world. The alluvial soils of the Markham and Ramu valleys are also fertile, as are the peats in which tea is grown in the Western Highland Province. Particular nutritional problems will occur as, for example, where islands are of coral origin.

In considering factors affecting agricultural productivity, one result of physical inaccessibility and restricted contact between different ethnic groups is that traditional methods of agriculture are likely to be deeply rooted. It should be stated that this is not meant to infer that traditional methods are incorrect; often it would appear that they are best suited to local conditions. The mountain ranges, with broad highland valleys, bounded by very steep slopes, have created a range of climates and agricultural diversity for quite large communities in montane near-isolation, compared with the more readily accessible undulating plains towards the coast and the coastal islands.

Ethnic diversity and climate have therefore resulted in significant differences in agricultural systems between coastal and inland populations. Such differences have to be considered in any overall agricultural assessment. At the same time, exposure to more modern techniques and social influence has been spread over quite a short time period. Most agricultural influence has been through plantation companies, missions, and, most important, the former Department of Agriculture, Stock and Fisheries (now the Department of Primary Industries). The policy for the DASF officers, and one which is largely being continued, was to become general agriculturists, rather than specialists in any one field, with regular transfers to various parts of the country.

AGRICULTURAL POTENTIAL AND PRIORITIES

Considering now the agricultural potential and priorities, there can be little doubt as to the potential which exists for agricultural development and increased productivity in Papua New Guinea. However, some of the adverse factors already mentioned indicate that frequently development cannot be achieved easily or quickly.

Rural subsistence agriculture is, of course, of the greatest importance and this is one field which in some ways is difficult to improve rapidly. The main reason for this is that the economic status of individual small farmers does not permit the use of agrochemicals except under extreme circumstances. Thus, for example, whilst it is likely that yields of basic crops could be improved in many instances by such practices as fertilizer input, pest and disease control, or chemical soil amelioration, it is not economically possible to do so. It would be unwise for the country to become involved in any system of agrochemical subsidy unless it becomes absolutely necessary.

It would appear that the aim should be to develop varieties of the essential plants which are more closely adapted to their environment, together with selection of material to give greater production per unit area, rather than try by theoretically possible but financially impracticable means to change the environment to suit the crop. This same type of approach also applies to pest and disease control, with biological control being exploited wherever possible, together with research to indicate where control measures can be most effective, with the overall aim being to devise an integrated control programme. This applies to all agricultural situations but might be expected to be of greatest importance in extensive monocultures.

The same programme of increasing output per unit area should also incorporate an assessment of the food value of newer varieties. Well-known examples of this are the higher protein contents of some newer groundnut and maize varieties. It is also possible that storage practices for both produce and planting material could be improved. Here, the emphasis again would need to be placed on inexpensive simplicity.

In some communities, fuller utilization of land is already being obtained through use of intercrops or catch crops, and this could probably be improved through experimentation. This would involve a simultaneous policy of improving soil conditions through crop selection and agronomy, especially through use of legumes, with the ultimate aim of soil enrichment rather than impoverishment.

It is, of course, very easy to suggest that changes in diet should be made because one particular crop is more readily grown than the traditional food source. But most people resist such change, and there is very little justification for attempting this approach, especially where crops have socio-religious associations. In the main, therefore, research effort needs to be directed towards improving the quality of crops which are readily accepted, with gradual introduction, and possible acceptance, of new types.

Switching now to agricultural export commodities. Whilst considerable revenue is likely to continue to be derived from Bougainville copper, dependence on a wide range of export commodities is far preferable. Crop diversification is also desirable economically since it is basically unwise to base an agricultural industry on too narrow a range of products. Price fluctuations on world markets are notorious, but it usually happens that loss in export earnings through price depression in one commodity is offset by higher price of another. To the local producer, wide price fluctuations can hit very hard, and this is one reason why commodity marketing boards with guaranteed minimum prices have been

proposed. This is not the place to go into the pros or cons of such organizations except to say that both country and producer should benefit in the long term provided - and this is the major consideration - that the organization is streamlined and highly efficient.

Both as a means of providing capital for other developments quickly, and for allowing very valuable long term investment, forestry should feature prominently as a priority development. In a recent article, Peter Eddowes has provided some useful data to indicate the potential importance of Papua New Guinea's timber industry. About 87% of the country's land area is covered by forests but, because of unsuitability or general inaccessibility, only about 17% is suitable for commercial exploitation at present. What might seem to be a comparatively small proportion does, however, represent something in the region of 8 million hectares suitable for development. The forest species include a variety of commercially valuable softwoods and hardwoods, including some of the finest furniture timbers to be found anywhere in the world, such as ebony, rosewood, walnut and oaks. In addition there are other areas which could be planted up quite quickly with rapidly growing species to provide the raw materials for pulp and chipboard industries, and a forestation programme has already begun.

Whilst the commercial exploitation of these forest areas seems to be a high priority requirement, uncontrolled forest exploitation is perhaps the last thing the country needs. There have been all too many examples from elsewhere of the virtual rape of the country in the interests of quick and high profits in the absence of a good forestry policy and its implementation. There is no doubt that a well-managed and experienced timber company, using the correct equipment and comparatively small labour force, can run an excellent extraction operation in a very straightforward manner. However, this usually requires an initially high financial input for machinery and development infrastructure such as roads and housing. A fair return on such investment must be expected, especially as timber prices are also subject to the vagaries of the international market. Wherever possible, joint ventures between government and private enterprise seem to offer the most equitable approach, provided one partner does not attempt to exert undue dominance over the other. Further processing of the timber before export should increase profitability, as well as create employment.

There is no point in attempting to underestimate the damage caused by timber operations. Some soil erosion during logging is inevitable. Earlier this year during a feasibility study in a high rainfall area in Sabah it became very obvious to the writer that logging was very efficient in ensuring rapid transfer of a high proportion of topsoil from the top of a hill to the bottom. Up to 30% of topsoil erosion is by no means unusual in a controlled extraction operation, whilst the damage caused where all standing timbers of any dimension are allowed to be ripped out leads to more massive erosion and useless scrub development unless immediate replanting occurs. What nature has built up in the way of soil structure and fertility over hundreds of years disappears virtually overnight, with soils varying considerably in their powers of recovery.

An integrated forest policy seems essential if utilization of the country's most valuable asset - land - is to be maximized. Timber extraction should, wherever possible, be linked to a replanting policy. In some areas, replanting with economic timbers will be the most suitable follow-up, and the excellent growing climate over much of the year in many parts of the country makes this a good proposition for some of the most sought-after timbers. In other instances, plantation crops can follow close behind timber extraction since much of the necessary infrastructure is already available or can be readily supplemented. For example, one planned venture in Sabah for a 20,000 hectare timber lease has shown land suitability for 6,000 hectares of cocoa under coconuts, and 4,000 hectares each of rubber and oil palm, all of which could be developed over an 8-year period, provided management is good. This type of exercise tends to highlight the need for good government-private enterprise ventures since such a wide range of expertise and policy implementation are required from the initial planning stage.

With such a wide range of soils and climates, the possibilities of agricultural exploitation must be considerable. In addition to controlled exploitation of existing timber stands, which lines of development offer most in the way of fulfilling the country's requirements, both of its people and the need for foreign exchange?

High on the list must be expansion of crops usually regarded as suitable for plantation-type development, especially cocoa, coffee, tea, coconut, oil palm and rubber. The oil palm story in West New Britain is well known to many. Whilst one person has described the Hoskins scheme as 'a cesspool of environmental and social pollution', to the writer it will be to the everlasting credit of the former territory government and the Harrisons and Crosfield group of companies that the project forged ahead whilst the

international financial experts dithered. No one would try to deny that mistakes have been made and that difficulties of both technical and human nature continue to arise. However, the basic design of the Mosa nucleus estate, containing the expensive processing facilities, surrounded by organized settler sub-divisions, has proved so successful that it is being copied by both governments and international agencies in various parts of the world. Two other similar schemes have already begun in this country, at Bialla and Popondetta, and the popularity of the Hoskins scheme has resulted in applications for blocks in the new schemes being heavily over-subscribed. The new schemes will doubtless benefit from the Hoskins experience. Provided the problems can be overcome, especially those of pollination, height increment, settler motivation and better estate labour productivity, then the future of the oil palm industry in this country is bright. Natural conditions favour high productivity, and large areas exist where further oil palm planting could take place.

An equitable arrangement has been reached for settler payment for handling and processing their fruit. Certainly, casual observation is all that is needed to show that setting up the settlements has not forced smallholders into the poverty trap, which was just one of the ludicrous statements made in a widely-publicised, destructive contribution to the Waigani seminar in 1976.

Extensive work in the settler blocks around Hoskins has intensified earlier belief that the potential for agricultural development in Papua New Guinea is enormous. As in any population and in any type of job, the range of personal capabilities and capacity for work in the settlements is wide, but those in the upper end of the productivity scale have done very well indeed. It is mainly this consideration that prompts the belief that schemes along similar lines for other plantation crops could be equally successful and perhaps even more profitable.

The new hybrid coconuts contain tremendous potential for rejuvenating the copra industry, through both estate and smallholder developments. Hybrid coconut production is well suited to this country in that sophisticated techniques are not required and processing facilities are inexpensive when compared, for example, with the large investment required for a palm oil factory. Greater use of coconut land is made when the coconuts are inter-planted with cocoa, another crop for which a reasonable price seems assured. There are also areas suitable for cocoa development as a monocrop, with the relatively low investment in processing facilities being another attractive aspect of the crop. With both cocoa

and coconut being relatively easy to grow, there is a danger of mediocrity being allowed to take over, and it needs good management and husbandry to ensure that the yield potential of good planting material is achieved.

Subject to the usual fluctuations in price, it is difficult to envisage a decline in the demand for tea and coffee. Replanting, expanded production and research into these two crops are required. Rubber is another crop where the potential seems good. Provided production costs can be maintained at a reasonable level, and this again requires good management, ventures along the lines of the oil palm developments, in which high-yielding and disease-resistant rubber clones are planted could prove very profitable. The recently-developed system of puncture tapping instead of the traditional method of knife tapping could be of particular relevance to Papua New Guinea.

In addition to existing crops, introduction of new crops seems possible because of the range of environments found in the country, varying from herbaceous crops to timbers. Particularly attractive are those with a high productivity per unit area, such as might be expected from certain fruits, spices, essential oils and medicinal plants. The list includes cinnamon, quinine, peppermint, aniseed, clove, patchouli, essential oils, citrus (such as bitter orange oil), ipecac, angelica and saffron. Some of these may have already been tried. There are also a number of plants of which the economic potential is uncertain but on which research might pay big dividends.

A plea is made for strict quality control of all export commodities in an expanded agricultural situation. This applies especially to those products which are not in very short supply and where competition is already strong. This country is perhaps not yet producing sufficient to warrant introduction of nationally specified standards to supplement those already laid down by commerce. But once a product gets a bad name, it could take a long time to get rid of that reputation.

Import replacement is currently something of an issue. In the most simple approach, it seems that decision on developments to effect such replacement must hinge on economic viability. For example, it would seem pointless investing a million kina in developing a

crop which can always be imported more cheaply, whilst at the same time that million could be used to develop an easily-produced and export-oriented crop which would easily pay for imports of other goods. On the other hand, it does seem ludicrous that vegetables and fruit which the country could grow so well and cheaply should need to be imported.

A brief consideration of livestock. It is likely that productivity of animal protein could be increased, and it is likely that this has been examined in some detail, ranging from chickens to cattle. Protein levels in the average diet are sub-optimal. Obvious priority requirements for those areas most likely to be suitable for cattle rearing are: selection of breeds most suited to the broad river valleys; improving fodder availability and quality, such as might be provided through varieties of readily-grown plants as *Stylosanthes*; comparison of rearing techniques, such as free range versus stockade; introduction to currently-ungrazed pastures; and undergrazing in coconut monocultures.

An economic evaluation would be worthwhile of the possibility of utilizing the bye-products of palm oil and copra production for animals raised under intensive rearing conditions. It is likely that the amounts of such substances from the various developments in the country could be very useful, but a careful study would need to be made of this, including possibilities of further processing of products prior to export.

Whilst only about 5% of the population lives in towns, their agricultural needs are still important. This is particularly the case in the Port Moresby area, where a regular supply of reasonably-priced foodstuffs would be welcome. A venture in which an area close to the township is intensively utilized to supply the needs of the community, using hybrid seed and modern but inexpensive irrigation techniques, could probably prove profitable both for the community as a whole and the entrepreneurs.

DEVELOPMENT REQUIREMENTS

Finally, having indicated the lines along which it is felt development should occur, what are the means by which such a programme could be achieved? Large scale development can be achieved in several ways. Firstly, there are estate type developments, with which the country is already quite familiar. Quite honestly, the majority which have been seen have not been very impressive and it is felt that a new philosophy is required in which expert management, the best cultural techniques and good estate social conditions to establish a stable labour availability, should replace the

old order. The second method, that of a nucleus estate, with surrounding smallholder settlements utilizing the expensive processing facilities of the estate, has already been mentioned in connection with oil palm. Thirdly, smallholder developments on their own could be considered, but the general experience elsewhere is that they require very tight organization and control if poor standards are to be avoided. Fourthly, introduction of new crops to less-developed areas could be on a fairly large scale.

But in all instances, discipline in its widest sense is a basic requirement. It is both depressing and seemingly almost criminal to allow good land, bearing the best available planting material, to be under-utilized through slackness. At the same time, an investor in expensive processing facilities needs to be guaranteed a regular supply of raw material, whether the investor is government or private. It is also felt that fair and just estate management which abides by the labour code - and it is often found that more is provided for its workers than the legal minimum - should not be subjected to the more destructive aspects of trades unionism.

In some instances, upgrading of existing estates is required. For example, statistics show that copra production is declining, which is due mainly to a combination of senescence and no replanting. If it is true that the threat of nationalization hangs over the older estates, then it is not surprising that such a situation has developed, since such a threat has extremely adverse effect on fresh investment in replanting. The need for a clear policy statement of intent seems obvious. At the same time, talks with agriculturists suggest that a clear policy on land tenure for future developments will be needed.

Wide-ranging expansion of existing export commodities will, in the first instance, require foreign investment or loans and, equally important, expertise. Provided adequate national identity can be retained, it is worthwhile using every facility offered by international organizations for both long-term developments and expertise for immediate and ad hoc problems.

Every development must be fully examined before a start is made in the field. A detailed feasibility study is a basic requirement. With increasing costs resulting in higher costs of failure, there is nowadays no room for any heuristic approach. In this respect also, caution is required in selection of expertise to prepare the feasibility study; ideally, the persons or company chosen should be of proven ability and completely objective in outlook, with recommendations unclouded by political or commercial bias. One article has appeared in which it was stated that agriculture in Ghana had been hindered by expert advisers since the different groups had given conflicting advice.

During this paper, from time to time the need has been mentioned for good management if success in new enterprises is to be assured. It is pointless trying to ignore the fact that a high standard of agriculture cannot be obtained without the necessary managerial skill. It is also pointless trying to ignore the fact that such skills are very limited at present in Papua New Guinea, but there are good reasons for this. Large-scale agriculture has not been a great feature of the country, so the opportunity to train managers has not been available. Unfortunately, experience cannot be derived from stock but is acquired only with time. For example, in the leading plantation companies in Malaysia, it is by no means unusual for an agricultural graduate to take up to 10 years or more to reach a position of substantive estate manager. Therefore, the need for imported expertise must be faced realistically, albeit a rather unpalatable truth for a new and energetic nation, but with the balance gradually changing through joint ventures, training and adequate experience being gained.

All too often the weakest link between known means of improving productivity and their widespread implementation in rural populations, is that of communication. This represents a tremendous waste, and an efficient extension service should be regarded as an absolute necessity. To use a straightforward example, it has become very evident that use of a simple pictorial extension technique would be of considerable potential benefit for settlers in oil palm developments. Unfortunately, in other countries, extension is a facet of agriculture which has been allowed to slip into inefficiency, or be regarded as a rather unglamorous occupation. Development of such a situation must be avoided here, and this should be possible through the 200 or so graduates produced annually from the agricultural colleges in the country.

To realize the full agricultural potential of this country will require a considerable research input. However, the country's resources in research experience, technical ability and research facilities are inadequate to meet the requirement at present. There is an obvious need to build up research expertise, preferably from within the country, but this is a long-term process which cannot be greatly accelerated. Two basic needs seem to stand out, namely utilizing fully what the country already has, and supplementing it by outside assistance.

There is a tremendous amount of information pouring out from numerous countries which have extensive national or international research programmes, and it is likely that many aspects would be useful to Papua New Guinea either immediately or indirectly. Whilst realizing the inherent dangers of attempting to transpose results from one country to another, making full use of this work makes sound economic sense, since duplication is wasteful and no research is cheap. In addition to published work, close links should be established with various organizations abroad carrying out work which could be of potential value to this country - the Australian CSIRO and the International Centre for Tropical Agriculture in Colombia are just two examples. One should never be too proud or inwardly-looking to seek advice or information from others.

The means of maximizing present research capabilities, and the basic philosophy behind research in a country such as Papua New Guinea, can be rather contentious. It is felt that all research should be subjected to multi-disciplinary examination, both before it is started and during its progress. Constructive criticism will be welcomed by any sensible person. It is likely that opinions will differ on the necessity for research direction, since it is often suggested that in a country such as this there are too many pressing problems to permit so-called academic freedom in selecting research topics and that all but applied research should be ignored. A compromise is required between pure and applied approaches. As an example of this, perhaps the greatest progress for subsistence farmers could be made through the efforts of crop physiologists, whose basic studies are decidedly fundamental but whose derived conclusions could well have a considerable impact on improving productivity.

Finally, it is believed that real cooperation between the various factions comprising the agricultural community is essential if an agricultural development programme is to forge ahead. This requires the greatest possible liaison and cooperation between producer the agricultural colleges, the university and the Department of Primary Industries. The importance of this aspect of cooperation cannot be over-emphasised if there is to be a coordinated development programme, devised to obtain optimum return from what needs to be a massive investment in agriculture.