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FORESTRY AND ENVIRONMENT IN THE SOUTH PACIFIC

by

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ABSTRACT

During the past decade, there have been a number of developments in forestry which may have significant effects on the countries of the South Pacific and our environment. Firstly, we have seen a marked reduction in the tempo of log exports from the ASEAN countries, accompanied by a burgeoning demand for raw material from the smaller island economies. Secondly, following the so-called energy crisis, the climate for investment (public or private) in reforestation has become more favourable than at any other time in history. Thirdly, there is widespread and growing concern about the environmental effects of large scale technologies, whether concerned with harvesting a resource or creating one. This paper discusses each of these features in a South Pacific context and suggests some safeguards which might mitigate the harmful effects of dangerous technologies and at the same time ensure a continued supply of goods and services from forestry. It calls for a reduction in the export of unprocessed logs, the adoption of light capital technologies and appropriate operational scales, and the further development of agriculture-supportive, multiple-purpose forestry.

THE EXPORT OF LOGS FROM THE REGION

The principal log exporters of the Asia-Pacific region are Indonesia, Malaysia (notably Sabah and Sarawak) and the Philippines. In the late 1960s (see FAO, 1980), Indonesia exported one million cubic meters in log form, Malaysia 10 million cubic meters and the Philippines 8 million cubic meters. By 1973, the respective figures were 18.7 million, 13.7 million and 7.8 million, representing an overall increase of over 100%. Conscious policies to restrict the export of unprocessed logs were introduced in the latter half of the decade and by 1979/80 export figures for the three countries had dropped to 15.0 million cubic meters, 11.3 million cubic meters and 2.3 million cubic meters. This year further reductions are expected of the order of 30%. Over this same period, log exports from Papua New Guinea rose by 400% and from the Solomon Islands by 200%. A recent forecast from the transnational forestry company Weyerhauser predicts an annual supply/demand deficit for south sea logs increasing from 3.3% (of demand) in 1980 to 21.7% by 1990; supplies from non-Asean sources are estimated to increase from 600,000 cubic meters in 1980 to one million cubic meters by 1985 (FEER, 1981) - (In absolute terms, the islands contribution to the log trade is very small; in relation to their own forest economies, it is highly significant).

Apart from the growth in volumes exported, there have been qualitative changes in trade. In 1974, Papua New Guinea began the export of wood chips - moving from zero to 300,000 cubic meters per annum by 1977. And in both the Solomon Islands and Papua New Guinea, the minimum log size has reduced dramatically with the acceptance of so-called super-small logs (of 25 cm diameter). These developments have had marked effects on volumes per hectare harvested; in some cases, the log yield/ha has quadrupled.

In attempts to reduce logging costs, producers are now looking for flat, easy terrain in sparsely populated areas - where there will be no inconvenient demands for environmental impact statements and where they may bring in cheap expatriate labour without arousing too much opposition. This takes them to the smaller islands (in Papua New Guinea, for example, to Woodlark and Umboi islands) where the impact of logging is much greater and its benefits more restricted than on the bigger, more densely populated, land masses; and where we simply do not know what effects may result from ecological change on this scale in a confined environment.

Our lack of knowledge is perhaps a sufficient reason for limiting the scale of logging operations and making serious efforts to monitor change in these fragile ecosystems (see Richardson, 1977), but this argument is unlikely to appeal to our political masters. There are, however, many other sound reasons for not exporting unprocessed logs. Some are economic : domestic processing before export will add value locally; processing makes available on domestic markets products which would otherwise have to be imported; it creates a demand for skilled workers; and it triggers other downstream effects by the provision of raw materials for secondary industry, such as construction, furniture, artifacts, etc.

Apart from arguments which derive from classical economic theory, however, there is one overwhelming practical reason for banning the export of unprocessed logs - it reduces the opportunity for industrial malpractices, most of which in the tropical hardwood trade stem from the fact that logs are much more difficult to monitor than processed timber. First, the bark of the log - and the mud which may cover the ends of it - make it more difficult to identify the tree species, even for experts, than in the case of lumber (and royalty, export taxes, and other levies are usually assessed by species and value); thus, it may be in the interest of the logging contractor to misname the species - and high value Pencil Cedar may be exported as the lower value Red Planchonella (few foresters could tell the difference without cutting the end of the log). Second, measurement conventions are such that round log volumes are more difficult to check than the true volume of lumber, which has a square edge to it; for example, in some countries, logs are measured so as to give the volume of a squared balk which can be cut from the log (the so-called Hoppus volume) and this is some 27% less than the true volume; in other countries, volumes are expressed in board-feet, but the conversion of board-feet to cubic meters, true volume, may be at factors ranging between 280 and 424. (These conventions are, of course, known to experienced traders, but they are not always known to those responsible for monitoring exports, e.g. officials of the national bank, the deck officer of the export vessel, etc.; again, estimates of volume by eye are more reliable in the case of lumber than logs). Third, logs are usually shipped by weight and, since they are sold by volume, it is necessary to establish a density factor for conversion of volume to weight; there are case in which various density factors have been used - the density varying with the destination of the ship (and the nationality of the shipper!); neither the shipping company - usually, in these circumstances, a charter - nor officials of the country of origin are likely to be aware of any anomaly. Finally, there are malpractices which apply more generally, such as cartel-rigged pricing, transfer pricing, under-invoicing, etc. A recent paper prepared by the PNG Law Reform Commission (Finnie, 1980) estimates that as much as US $ 11 million may be lost to that country annually through transfer pricing of logs. The paper instances the near doubling of log prices in 1979, which resulted from one buyer breaking the Japanese monopoly by selling directly to Korea; it also highlights the common practice of transfer pricing logs to Hong Kong at an artificially low price and re-selling at a price some

100-130% higher to Japan; thus, taxes paid in PNG and Japan are minimal, the profits being taken in Hong Kong where - since they were earned off-shore - they do not attract any tax. Under-invoicing is common, and, in the case of PNG wood-chip exports, encouraged by the fact that since 1979 no attempt has been made to check the export volume; royalties, etc., are assessed on the volume declared by the captain of the export ship.

It is in fact difficult to see what benefits derive from the PNG wood-chip operation. The company removes about 100 cubic meters/ha on which it pays chip royalties of 32 kina (US $ 48/ha); it has declared no dividends in PNG, and, up to the end of 1980 (nearly 10 years after the agreement was signed), had paid no taxes; until recently, it segregated only one species (Intsia bijuga) for sawing, indiscriminately chipping high-value cabinet timbers like walnut, rosewood and ebony (the installation of a veneer plant, which was a condition of the concession agreement, has been delayed indefinitely). The cost of reforestation is currently about US $ 450/ha (almost 10 times the yield from chip royalties); consequently, less than 10% of the area cut-over annually is being replanted or cleared for agriculture. The avowed objective of this project was "to develop the forest resources of the Madang Timber Area"; the phrase has a hollow ring.

These are, thus, many reasons for reducing log and chip exports (and, in consequence, large scale logging) and I make no apology for treating an audience of environmentalists to a discourse on economics and trade malpractices; it is a sad fact that economic arguments are likely to bear more fruit than pleas based on our ignorance of ecology. Problems of reforestation are even more complex.

REFORESTATION

In 1978, the World Bank (IBRD, 1978) - closely followed by the Asian Development Bang (ADB, 1978) - published policy statements on investment in forestry and forest industries. Both announced commitments to reforestation, the World Bank setting an annual investment target of US $ 100 million. During 1980, the World Bank financed eight forestry projects and a further eight rural development projects which include a significant forestry component; Bank lending in 1980 totalled US $ 218 million - more than twice the annual target and representing a 10-fold increase over the average level of forestry lending during the five years proceeding the policy change. The ADB set even more ambitious targets (which, perhaps fortunately, it has signally failed to approach), and prepared a series of "Forest economy profiles" for some 12 member countries (including, in the South Pacific, PNG, Fiji, Kiribati, Western Samoa, the Solomon Islands and Tonga) purporting to identify likely investment projects for the individual countries. Prima facie, there is a greater preparedness on the part of the international finance agencies than ever before to make available concessionary funds for reforestation; at one stage, even, it was suggested within ADB that the importance of forestry in the South Pacific justified forestry lending being treated as supplementary to country targets.

In addition, large private companies (including several transnationals) are becoming involved in plantation forestry. Two companies, which responded to the Fiji Pine Commission's recent invitation to prepare proposals for utilisation and financing reforestation, were the giant oil companies, British Petroleum and Shell Oil; in South America, the biggest private reforestation venture ever attempted (the Jari river project) is underway; and in several countries the availability of financial concessions for reforestation is creating a new international industry of tax avoidance forestry.

A common feature of these variously financed ventures is their large scale. The Development Banks do not like projects costing less than several million dollars (the project cycle of identifivation, preparation, appraisal, inception and review requires the same amount of time and money for small as for big projects, and small ones can be more difficult to monitor). Inevitably, reforestation is with monocultures of, usually, an exotic species chosen not for its compatibility with the environment, but for a high rate of uniform fibre production. A recent publication from the U.S. National Academy of Science on energy plantations (NAS, 1980) contains a prefatory warning that the species described are aggressive and in equable environments may pose a serious threat as weeds. It is not surprising that in some countries (my own country, New Zealand, is one) reforestation is as much a target of environmental action groups as logging. And as with logging, small island economies are less able to absorb the impact of large scale reforestation than the bigger countries.

Whether financed from public or private sources, there is a concessionary element in most large-scale reforestation projects and it is pertinent to ask, therefore, who will benefit from them. In the Asia-Pacific, if the present pattern of forest utilisation continues, the major beneficiary will be Japan and there can surely be no justification for poor countries borrowing scarce capital at concessionary interest rates to subsidise the provision of raw materials for Japan. It is not generally realised that the forests of Japan cover more than 25 million ha., representing 67 per cent of her land surface area - a proportion only exceeded in the South Pacific by PNG. Japan's gross volume of timber available in operable forests (according to FAO data) amounts to more than 2,000 million cubic meters (more than in the whole of the South Pacific). Yet Japan's domestic wood production declined from 62 million cubic meters in 1960 to 44.6 million cubic meters in 1975 - a decline accompanied by a five-fold increase in log imports. Japan's domestic wood production is now significantly below the annual increment of her forests, while that of many of her hardwood log suppliers is greatly in excess of annual growth. Thus, Japan is conserving her own resources while avidly garnering logs from the less developed countries (logs which could and should form the raw material for value-adding domestic processing). To encourage the less developed countries - after exporting their natural resources - to undertake large scale reforestation for the primary benefit of Japan adds insult to injury; yet if international finance is not provided, it is unlikely that there will be significant reforestation. The dilemma is as simple - and as complex - as that.

FORESTRY AND THE ENVIRONMENT

Concern over the environmental effects of both logging and reforestation needs little documentation. Quite simply, more people than ever before care about what is happening to their biosphere. Moreover, the present generation is much better informed about many aspects of environmental management than is mine. Canny (1972) and Richardson (1974) have documented an exponential growth rate in numbers of University students opting to take courses in biology and in something they have learned to call ecology; this audience will not be fobbed off with paternalistic postures and technical jargon in response to demands that forest resource managers justify their prescriptions. We need all the honesty we can muster; and we need a lot of knowledge that we are at present quite unable to muster.

Elsewhere (Richardson, 1977), I have discussed our woeful ignorance of the effects of large scale clearance of coastal and lowland rainforests on the mobility of sand bars, tidal and current movements, fish breeding, etc. - as well as the more immediately disruptive effects on villagers whose lives and livelihoods may partly depend on these forests. Nor do we know much about the nutritional status of the coastal forests, and their capacity to accommodate logging (and, often, the subsequent clearance for agricultural development - usually by burning) or reforestation with fast growing monocultures. Certainly, the alleged luxuriance of the rainforest is a myth - deriving no doubt from the large size of the trees, the storeyed structure of much of the forest and the impenetrable appearance of its edges when viewed from rivers, roads, and airstrips. In from the edges, however, the ground flora is often sparse and vegetation growth rates are extremely low. The rainforest is no teeming cornucopia; much of it is of low fertility adapted to survival by its almost leak-free nutrient system and rapid re-cycling. In an undisturbed state, losses from the system are made good not by weathering of the parent rocks (which occurs well below the level of the characteristically shallow root systems of the trees), but by additions of rainfall. It is not without significance that the most successful agricultural crops grown in rain forest areas are those from which only small quantities of nutrients are removed in harvesting (rubber, cocoa, oil-palm, etc.). The predilection of foresters to prescribe short rotations of fast growing exotic species - which will remove large quantities of nutrients from soils ill-fitted to provide them - is frightening.

Again, in a South Pacific context, we do not know enough about what is coming to be called "community forestry" and its implications with respect to choice of species, production modes, harvesting and utilisation technologies, and marketing. Among the spate of publications issued during the past few years from FAO (see e.g. FAO, 1978, for a partial bibliography), the U.S. National Academy of Science (the recent issue on firewood crops - NAS, 1980 - contains a title series), the International Council for Research on Agro-Forestry (ICRAF),

the Worldwatch Institute and the many organizations concerned with appropriate technologies, etc., there are few of direct relevance to the South Pacific. Yet community forestry perhaps has more pervasive benefits to offer the island economies than either logging or industrial plantations.

Against a background of professional ignorance, it is surely not unreasonable to eschew the dual juggernauts of chip-logging and industrial plantations. In the small islands, large scale ventures of any kind take on a particular significance simply because of their undiluted impact. Thus, mining operations which can be absorbed on Bougainville or New Caledonia (though not without considerable ecological trauma), have been totally overwhelming on Nauru on Ocean Island. Similarly, an export logging venture containable on the mainland of PNG - though cutting some 150,000 cubic meters annually - and, again, not without a traumatic impact - would be utterly devastating on the smaller islands. It is not an exaggeration to describe these technologies as dangerous and posing problems analagous to those of supertankers (and the new dimension assumed by problems of oil spillage) or nuclear testing. The issue then becomes one of ethics rather than economics - are we justified in using technologies which may prove dangerous and uncontrollable ?

Yet the countries of the South Pacific have as much need of the goods and services provided by forest as any region. Recorded forest products imports into eight island economies exceed US $ 20 million annually; and there is more to forestry than import substitution, as has been outlined by Watt (1980) and is treated in more detail in the ADB Sector Paper (ADB, 1978).

The role of forests as a climatic buffer has yet to be analysed in detail, but it is undoubtedly important; more readily evident is their crucial protective role in agriculture and water supplies. The distinctive physiognomy of forest ecotypes - in certain critical areas and in certain tupes of watershed - effectively controls the siltation of rivers and reservoirs, prevents flooding and denudation; and enables the survival of agriculture. Forests also contribute a wide range of goods for which demand in the island economies is growing. Apart from traditional industrial production of poles, logs, sawnwood and panels, increasing attention is focussing upon forest production of fuelwood (both domestic and industrial),charcoal, artifacts, medicinal products and biocides, foods (fruits, nuts, berries, tubers, fungi and honey), wildlife (especially pigs and birds), fodder, dyes, cloth fibres, gums (copal, damar, etc.), rattan, oils (sandalwood, massoy, cinnamon, candle-nut), silk, cutch and orchids. In PNG, several of these non-wood products enter commercial production and some promise to form the basis of new, small-scale industries (e.g. silk and shiitake mushroom production). Trees can also play a recreational role in the alleviation of mental and physical stress and in creating the illusion of privacy which is necessary to all people, no matter how gregarious their cultures may depict them. Finally, trees have a role - increasing in importance unfortunately - in hiding the scars of open-cut mining.

The challenge for the South Pacific forester is to ensure the continued provision of benefits from the remaining forests without permitting their destruction through excessive logging or requiring large-scale, mono-specific reforestation. In some countries, this calls for light capital harvesting and utilisation technologies and in others the development of agriculture-supportive reforestation using multiple purpose species; in all countries, there will be opportunities for small-scale industries based upon non-timber forest products. In the rest of this paper an attempt is made to indicate how some of these desiderata might be achieved.

APPROPRIATE HARVESTING AND PROCESSING TECHNOLOGIES

Countries with extensive forest resources, but at a low level of industrialisation (and, therefore, dependent upon imported technology for substantial utilisation of the resource) are PNG, Solomon Islands, Fiji and Western Samoa. It would be unreasonable to expect them to place a moratorium on forest utilisation in the undefined interests of conservation and environmental amenity. But it would not be unreasonable to expect them - in their own interests - to utilize their resources in a rational fashion and in the medium-long term interests of their people. Appropriate technologies to these ends were outlined in a paper entitled "Appropriate Operational Scale in Forest Industries" prepared initially for an ADB Workshop on "Appropriate Technology in Forestry" (see Richardson, 1978). They include : use of 7-15 ton San Tae Wong winch lorries for logging and timber transport (costing US $ 20,000 as against US $ 150,000 for the more usual skidder); a sawmilling system incorporating a series of transportable, carriage-less flitch mills servicing - and serviced by - a central statis re-saw and maintenance shop (which, because it cuts only flitches, needs only small, relatively inexpensive saws and handling equipment); wood-panel manufacture by means of a batch-type blockboard plant using wood residues and 100% sliced veneer; and the use of chemi-thermo-mechanical pulping (CTMP) integrated with agricultural development to enable an economically viable papermill of 50 tonnes per day - compared with the current Scandinavian norm of 1,000 tonnes per day (and costing over US $ 800 million). Other examples of light capital wood processing equipment include flitch chainsaws (which move along the log) and bicycle-driven turning lathes. Some of these are currently being evaluated by the Timber Industry Training Centre (TITC) in Lae and the Forestry Department of the University of Technology, Lae.

These examples offer small-scale alternatives to conventional forest industries which are in no way luddite, but which give every indication of financial viability in the situations for which they are designed. This is important because, in both private and public sector financing agencies, it is the financial analysis of a project which determines the availability of funds to implement it. (Perfunctory

genuflections may be made in the direction of social cost benefit ratios and so-called economic analyses, but in forest industries they seldom represent more than lip-service and social costs are never counted). There are nevertheless benefits attaching to small-scale industry which are impossible to quantify, but which in the long term may be more important to society than a high investment return. Four areas in which small-scale industry can contribute more beneficially to society's needs than large-scale can be recognized : skill development - because of the variety of jobs an individual in a small unit may be called upon to perform; job satisfaction - because small-scale operations can engender and sustain realistic ambitions (the driver's mate on a San Tae Wong can envisage himself owning one, while a skidder driver could never aspire to the wealth required to buy a skidder); self-reliance (which is self-evident in small-scale operations); and ecological impact. The last is perhaps arguable, but considerable evidence can be adduced that small-scale operations usually involve closer utilisation of the resource (reducing wastage) and usually have a more gentle environmental impact than large scale projects.

To achieve the kind of appropriate operational scale proposed here, it will be necessary to persuade governments - and the financing agencies - to accept a programme-type package of many small projects for concessionary loan finance and, at the same time, legislate to enable government agencies to borrow from the National Development Banks (which in most countries at present cater only for the private sector). My experience with the ADB leads me to believe that the International Banks would welcome proposals for light capital rural industry projects in the South Pacific presented as a country package which adds up to some US $ 1-2 million. Certainly, under regular prodding from its U.S. director, the ADB is very conscious of appropriate rural technology and is beginning to pay more than lip-service to environmental protection. Moreover, the Banks are aware that they are not serving the interests of the island economies as well as they might and they are anxious to be seen to be doing more. Proposals, of course, have to be in an approved format and (usually) subject to feasibility studies, but this is an area in which the Forestry Department of the University of Technology, PNG, can offer some assistance on a regional basis.

My suggestion that government departments gain access to National Development Bank finance stems from a belief that the original purpose of these banks - the provision of finance to small entrepreneurs - is not being served. Rather, loans are going to the big companies, in cases those with transnational links. (The two biggest forest industry borrowers from the Development Bank of PNG a few years ago were JANT - the wood-chip exporting subsidiary of the pulp and paper giant Honshu - and a saw milling company linked with the Fletcher group. In Western Samoa, the biggest development bank loan is to the big state-owned company, Samoan Forest Products). This has arisen because the big companies know how to prepare the required documentation - feasibility studies, discounted cash flow projections, balance sheets, etc. -

and their accounts can be monitored (superficially, at any rate) more easily than in the case of e.g. a small contractor who wants to buy a chainsaw or a charcoal kiln. Since the banks have lending targets as well as requirement for low-risk lending, their reluctance to leave the haven of precedent is perhaps understandable. What is needed in many countries is a government agency which will establish the necessary precedent for small scale lending in little-known areas - including the preparation of appropriate documentation and monitoring procedures. Loans would be government-guaranteed (so the banks need have no qualms about credit-ratings) and the agency would soon develop the required expertise and experience.

AGRICULTURE-SUPPORTIVE FORESTRY AND NON-TIMBER FOREST INDUSTRIES

There is a long tradition of agriculture-supportive tree planting in the South Pacific. Casuarina oligodon has been grown in the highlands of PNG (and Irian Jaya) for - probably - thousands of years; originally, it was established to maintain soil fertility, but, with the introduction of coffee, its value in the provision of shade was recognized; more recently, the high cost of fuel in the highlands has drawn attention to its merits as firewood. Elsewhere, Leucaena leucocephala, Albizia falcataria, Terminalia and Canarium spp. serve similar functions and exemplify one aspect of agriculture-supportive forestry. Another is the provision of shelter for livestock (as is currently under investigation in the Solomon Islands and PNG). If Leucaena is used for this purpose, it can be browsed, stall-fed to the animals or used to prepare leaf meal - a useful export commodity as well as a means of tiding ruminants over a dry season.

Several agricultural crops - and cropping systems - can incorporate trees to advantage. Even traditional annual monocultures may show increased overall profitability from light-canopied trees along margins and in under-utilised areas; conversely, the plantation mode of agriculture (coconuts, rubber, oil-palm, etc.) calls for inter-cropping - often leguminous cover crops such as Pueraria phaseoloides, Centrosema pubescens or Calopogonium mucunoides, though there is no reason why cash crops should not be grown.

In the Pacific islands, because of high transportation costs, high value cash crops are of particular relevance. Examples which require - or tolerate - the shade of trees are cardamon (Ellateria cardamoni), the related ginger (Zingiber officinale), turmeric (Curcuma longa), Capsicum (Capsicum annuum) and other peppers (Pipper nigrum, etc.). Though usually marketed gree (where they are grown in the islands), they are all amenable to further processing locally (e.g. by the distillation of essential oils, etc.). Most root crops (e.g. taro, yams, sweet potatoes) can be grown in combination with widely spaced trees. Finally, there are high value tree crops which can be grown widely spaced in a forest environment on poor soils; they include nutmeg (Myristica fragrans), Cinnamon (Cinnamomum zeylanicum), camphor (C. camphora) and - at high altitudes - tanbark wattle (Acacia mearnsii).

The supreme example of a multi-purpose tree in a Pacific context is, of course, the coconut, and we should perhaps offer a prayer of gratitude for the Rhinocerus beetle which has triggered so much valuable work into ways and means of using the stems. But if there are few species quite so versatile as the coconut, there are many that yield food as well as wood. A greatly under-utilised species is Artocarpus integer, which produces large and excellent fruits as well as a fast-growing timber which is unrivalled as a cabinet wood and decorative veneer. (And there is now available a small longitudinal veneer slicer which enables its production in almost all countries). Mango, too, yields a decorative wood, while mulberry, jujube, Terminalia kaernbachii, T. catappa, Canarium, Pangium edule, Pandanus spp., several Acacias, illipe (Shorea macrophylla), Calophyllum inophyllum, durian, cashew (Anacardium occidentale), carob (Ceratonia siliqua), Aleurites, Pithecolobium spp., produce wood and either fruit, nuts or oil - and have been established (at least on a trial basis) in the Pacific islands. Most of them too can yield honey and some of them lac. There is even a possibility for excessively dry sites which yields a unique and versatile wax (Simmondsia chinensis); while the range of medicines, biocides and other non-wood products has scarcely been tapped.

There are, thus, alternatives to large-scale monocultural plantations which will provide the goods and services which derive traditionally from forestry. Moreover, the close integration of agriculture and forestry assures the preservation of environmental amenity and ecological stability; and is in close harmony with traditional island husbandry.

Turning now to non-timber forest industries, potentially the most important is that of charcoal production. Coconut shell charcoal is, of course, well-known as a relatively high value, pharmaceutical grade material; but the most pervasive impact will come from the design and operation of charcoal-fired inter-island shipping. The needed technology is already available and the production of coconut stem charcoal in every inhabited island is entirely feasible. The adaptation of the internal combustion engine to operate on charcoal-generated producer gas and the trial of existing steam engines would perhaps form a project suitable for S.P.C. sponsorship; certainly, it would be in accord with the aims and objectives of the Commission.

Apart from charcoal, there are good prospects for a number of low-impact productive industries. The growing of green manure - to replace expensive petrochemical derivatives - is possible on all but the poorest of soils in the islands; mushroom culture can be extended beyond shiitake and the products can be dried for storage; silk production is not site-specific and most islands could grow at least some suitable species; honey could be produced wherever there is vegetation; spices and medicinal products have more specific requirements and their success depends on access to markets, but they merit study in an island context. There are doubtless other possibilities, and a guiding principle of selection should be that they can contribute to an equilibrium state of biological self-sufficiency.

CONCLUSION

The goods and services which forestry provides can contribute significantly to the welfare of people of the South Pacific island economies. Moreover, in so doing, forestry can sustain ecological stability and enhance environmental amenity. But it will do none of these things if we allow ourselves to be hustled into large-scale exploitative logging operations or to be established "By Imperial Appointment" as raw material suppliers to the industrialized nations.

Constraints on development in the Pacific islands stems from geographic isolation and dispersal, the restrictive ecological environment, our political unimportance and our economic impotence. At the same time, these accidents of geography have enabled the survival of cultural attitudes which can mitigate economic hardship. A recent survey of four islands of Kiribati (Geddes et al, 1976) has revealed the vitality and integrity of the subsistence economy; a cash income is not regarded at the village level as an alternative to subsistence but complimentary to it; this resilience augurs well for the ultimate achievement of that equilibrium state of biological self-sufficiency.

The SPC has an obvious role to play in triggering regional development. I believe my own institution should become more involved than hitherto in regional programmes through teaching, research and consulting; as the only tropical forestry school in the Pacific, we have a responsibility to give a regional flavour to our teaching and to establish practical research projects in the Region. In these ways, I believe, our islands can come to realise what Ward and Dubos (1972) have described - in one of my favourite quotations - as that "combination of modern science with local inventiveness and local responsibility that is at the core of the only really effective and sustainable ecological balance".

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