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Developmental Research In Tropical Forestry
A Malaysian Experience

Salleh Mohd Nor
Director
Forest Research Institute
Kepong, Selangor
Semenanjung
Malaysia

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by

Salleh Mohd Nor

Introduction

Forestry in the tropics is changing both in orientation and focus. To some extent, this is due to the interest world-wide in the tropical forest and concern over the future survival of these forests. Tropical forests have suddenly become the focus of attention of the world scientific community, just as the Middle East oil became a centre of focus of the world sometime back for very different reasons. Tropical forests have suddenly become "universal" property whereby their continued survival has suddenly become the concern of the whole world. Meetings have been held (Dickerman, 1978) and resolutions passed (Anon, 1981a), yet the tropical forests continue to disappear at an alarming rate.

The tropical rain forest is undoubtedly one of the most complex ecosystems in the world. Although much has been studied of this ecosystem, there still is a dearth of information on the dynamics and inter-relationships that exists within it. Human interference with the ecosystem is widespread and the resulting impact on its productivity, sustainability and viability is not yet fully understood. Yet Man professes to "managing" this valuable and renewable resource and the success of this "management" will determine the future of the resource.

A Depleting Resource

The most serious problem facing forestry in the tropical region, as in many other regions of the world, is undoubtedly the extremely rapid rate of forest depletion. The tropical forest is fast disappearing from the face of this global even before Man can properly understand the functions and roles of the myriad of biological species, including the trees themselves, in this ecosystem. Over 5 million hectares (ha) of tropical forests have been lost annually over the past 20 years or so in the various Asian countries (Table 1). From 1952 to 1975 the area of high forest dropped from about 48% of the tropical Asian land area to about 28%.

Table 1: Estimate of Tropical Rain Forest
(Area in Million hectares)

	Total land area (Whole country or part within tropics)	1952 (1) High Forest Area	1975 (2) High Forest Area
Burma	47.	69.	6.0
Cambodia	17.[illegible]	10.	6.0
India	172.	[illegible]	6.3

Indonesia	190.	122.	90.6
Laos	24.	14.6	5.
Malaysia	33.2	26.5	21.
Papua-New Guinea	48.0	N.A.	33.0
Philipines	30.	17.	10.
Sri Lanka	6.3	3.5	0.3
Thailand	52.	32.4	10.
Vietnam	32.8	13.5	6.

Sources:

(1) Asia-Pacific Forestry Commission, Singapore, Dec. 1952 FAO/APFC - 52/32, 33 etc.

(2) Tropical Forest Ecosystems, Natural Resources Research, UNESCO/UNEP/FAO 1978.

This rapid depletion is a cause of concern as much to the developed timber-consuming countries of the world as to the timber-exporting countries themselves. Of the countries listed in Table 1, only Burma, Papua-New Guinea, Indonesia, Malaysia and Philippines remain major timber exporting countries. Malaysia is expected to be out of the running within 20 years together with the Philippines, leaving Indonesia, Burma and Papua-New Guinea as the timber suppliers for our children, but for how much longer? This is thus not a local problem but a universal one that requires attention from all countries. Various fora have been organised to discuss this and solutions have been suggested, but to date the problem still looms dangerously and ominously over the countries concerned. A definite commitment is thus urgently necessary to save this ecosystem from total extinction.

Effective management is definitely one way in which the tropical forests could be maintained and even developed through time. However, management requires adequate, reliable and up-to-date information and knowledge. Compared to research into agriculture, the amount of money spent on research in tropical forestry is extremely small. There is definitely a need to accelerate research on tropical forestry. This has been recognised by many countries and many organisations but the capacity for research in producer countries is generally lacking.

Malaysia and Its Forest Today

The Country

Malaysia is often described as one of the more successful of the developing countries. There is a lack or total absence of most of the dour problems of under-development, such as near-stagnant living standards and sky-rocketing internal inflation. Our economy has been characterised by a combination of of a reasonably high growth rate (GNP went up by 6-7% yearly in 1970s), an acceptable internal price stability and a stable external balance of trade. Industrial output has grown annually by 11-12% in recent years, and has replaced the primary produce sector (traditionally the largest sector) as the leader in economic growth.

Forestry and the Timber Industry

Forestry's importance in the national economy lies in its generation of income and employment. There are over 8.1 million ha of forests in Peninsular Malaysia of which 2.83 million ha will eventually go to agriculture and 4.1 million ha of the remaining 5.3 million ha will be managed as productive forests. These forests provide the raw materials vital to the growing wood processing industry. Highly export-oriented, the timber industry for the past decade has contributed annually some 12% to Malaysia's export earnings. Production of sawlogs increased from 19.1 million cubic meters (cu. m.) in 1975 to 28.2 million cu. m. in 1978 but dropped to 26.7 million cu. m. in 1979. Sawn timber production has increased from 3.8 million cu. m. in 1975 to 5.2 million cu. m. in 1979. Of the 5.3 million cu. m., 4.7 million cu. m. was produced in Peninsular Malaysia (Anon, 1979a). The progress in the development of the manufacturing sector of the forest industries can be depicted in three ways: capacity expansion; modernization through increased mechanization; and, increased efficiency in production.

It must be remembered that whilst the timber industry is an important contributor, it is unlikely to remain as one of the nation's major industries for long, in view of the diminishing forest resources. The diminution of forested land has been a perennial source of concern to the forestry authorities. Accelerated land development programmes of the last decade have succeeded in expanding agricultural output but at the expense of forestry activities. Over 127,000 ha of forest lands were lost to land development from 1976 to 1979 (Anon 1978a). It was largely due to uncoordinated land use planning of past years in which much of the regenerated forests in Forest Reserves were excised in favour of agriculture. Further, large areas of unexploited forest lands were subject to immediate conversion, giving very little opportunity for thorough logging.

In the face of increasing pressure for forest land, the Forestry Department, Peninsular Malaysia drew up long-term plans for establishing a permanent forest estate Peninsular-wide over an area of 5.3 million ha chosen basically from residual land determined unsuitable for other land use. This Permanent Forest Estate (PFE) concept will hopefully guarantee the stability of the forest base.

In the field of timber utilization, the main characteristic is the large percentage of wastage, both in the forest and in the processing industries. It is estimated that the average available wastes, excluding sawdust, generated by forest industries in Peninsular Malaysia amounts to over 6 million cu. m. per year. In addition to this, a considerable quantity of forest residues is available from land clearance for agriculture. Because the timber industry is mainly exported-oriented, the species of timbers that are exported are also not processed by the local timber industries, and consequently are not available even for local consumption. There is a tremendous potential for secondary and tertiary timber industries and there is also an urgent need to do research on more complete utilisation of timber.

Malaysia remains as one of the few countries in the tropical world that has truly attempted managing the natural tropical forest. The effectiveness of Malaysia's attempt is clearly illustrated by the success of the Malayan Uniform System (MUS) in lowland forests. However, with the conversion of lowland forests to agriculture and the location of the Permanent Forest Estate (PFE) on more rugged hilly terrain, the efficacy and applicability of the MUS has been found lacking. Thus Malaysian scientists have to return to the drawing board in an attempt to devise an effective silvicultural system for these forests.

The National Forest Policy

Peculiar to the Constitution of Malaysia is the division of legislative power between the Federal Parliament and the State Legislative Assemblies, wherein the power concerning matters which have directed influence on land use, such as forestry, are placed under the direct control of the State Governments. Thus by Constitution, the role of the federal government is to guide and advise State Governments on the management of land. The Director-General of Forestry, Peninsular Malaysia provides the State Governments with technical advice (via the State Directors of Forestry) on the management of their forest resources and coordinates the efforts of the States as feedback for a review by the forest planners on a national scale.

The National Forest Policy, in addition to the traditional declaration of dedicating sufficient forest lands as the Permanent Forest Estate for conservation and economic production, places importance on the development of amenity forests for recreational as well as for educational and scientific uses (Anon 1979 b). Several other declarations have been made pertaining to sound management of the forest estate, maximum economic utilization of the forest, and fostering public consciousness of forestry affairs. Due emphasis is made on the importance of forest rehabilitation, development of forestry staff and cooperation with other land-use agencies for optimum resource utilisation. Thus it provides for a systems approach to national land resource development.

The National Forest Policy was accepted by the National Forestry Council and subsequently approved by the National Land Council on 31st April, 1978. This policy has been presented to the State Governments and now awaits ratification (Anon, 1979b). This is indeed a significant step in the development of forestry in Malaysia.

Forestry Research in Malaysia

Historic Perspective

Forestry research in Malaysia is primarily carried out at the Forest Research Institute (F.R.I.), Kepong but smaller research set-ups exist both in Sarawak and Sabah. The F.R.I. Kepong is a division of the Forestry Department,

Peninsular Malaysia while the set-ups in Sabah and Sarawak are units of the respective State Forestry Departments. The universities carry out some research particularly on the more basic fields.

Forest research began under the British Colonial Administration. The British had a vested interest in converting its newly acquired colonies from economic liabilities to economic assets. Within the colonial framework, forestry research followed a well-defined and easily understood course, which may be characterized as follows:

Inventory

Having come into possession of a land of incredible diversity in natural resources, the first priority was to inventory, describe and quantify the plant, animal and mineral resources of the country and to systematically document their economic usage as foods, fibres, drugs, construction materials, manufacturing materials, etc. The first Forest Research Officer was appointed in 1918 but the phase of inventory was begun much earlier, first by scientist based at Calcutta and later by scientist based at the Botanic Gardens, Singapore. The inventory phased resulted in the publication of H.N. Ridley's (1922-1925) five volume "Flora of the Malay Peninsular, I.H. Burkill's (1935) two volume Dictionary of the Economic Products of the Malay Peninsula, C.F. Symington's (1943) Forester's Manual of Dipterocarps, H.E. Desch's (1941, 1954) tow volume Manual of Malayan Timbers, to mention some of the more outstanding works.

The sheer diversity of the plant resources necessitated periodic revisions to accommodate new discoveries. Hence in 1965, work on a new four volume Tree Flora of Malaya was begun, and is expected to be finished in 1985. New descriptions of Malayan timbers were published by P.K. Balan Menon (1967) and T.M. Wong (1976).

Inventories of timber volume by species and districts did not commence until the early 1960s when a crash project was started which led to the publication of about 20 Forest Resources Reconnaissance Survey Reports between 1965 and 1970. The reconnaissance survey was followed by a series of updating inventories carried out by the Forestry Department Headquarters Management Unit.

In general, the inventory phase may be said to have settled down after the 1960's into a fairly routine updating exercise in Peninsular Malaysia. In East Malaysia it never developed quite the same momentum.

The purpose of the inventory was to lay the foundations for planning, organized exploitation, revenue-collection and export promotion.

Export promotion

In order to promote export, it was necessary to determine and describe the properties of each economic product and to impose some form of grading or standardisation. Research during the British Administration led to grading procedures for Gutta percha, Jelutong and Damar penak (now mostly obsolete due to decline of these commodities). For timber, the long process of

mechanical, anatomical, chemical and biological (e.g. durability) properties of up to 3000 species, a task still uncompleted, necessitated the setting up of a Timber Research Laboratory in 1929. This laboratory is now a Division of the Forest Research Institute. Based on research, hundreds of the commoner hardwood timbers were put into 52 commercial groupings, sharing the same physical and mechanical properties, under a uniform code "The Malayan Grading Rules".

Hence when timber supplies began to dry up in Eastern Europe, North America and Africa in the 1960s, Malaysia was able to step into the vacuum with timbers of known and guaranteed properties. Since then, there has been no looking back, and the Malayan Grading Rules have set a precedence and standard for South-east Asia.

Resource renewal

Research to develop methods of forest regeneration began almost as soon as the inventory phase but never gained the same momentum. The difficulties were immense, the ecosystem was poorly understood, and the colonial foresters had only temperate forest-management models to guide them. Also, the seemingly inexhaustible resource led to some degree of general complacency despite the efforts of several outstanding individuals to practice foresty as an integrated system of exploitation-cum-regeneration. By the 1970s the gross imbalance between exploitation and regeneration could no longer be ignored. However, the massive land development schemes of the 1960s and 1970s forced a hasty realignment of priorities to emphasize hill forest regeneration. About 90% of all previous research had been in the lowlands.

There were however, some notable achievements. The closest to a simple temperate forest ecosystem that we have is mangrove forest and here practical methods of silviculture and managment were established by 1928 and published in J.G. Watson's Mangrove Forests of the Malay Peninsula. For inland forests, J. Wyatt Smith attempted to summarise all colonial work in his monumental "Manual of Malayan Silviculture for Inland Forests" (1963). This was published in parts and never completed. The projected sections on plantation forestry were never written up. To date, we do not have a proven, generally accepted system of silviculture and management for hill forests, in which the permanent forest estate will mainly reside.

Current Perspectives

Political independence generates demand for economic independence. An independent country needs to protect and nurture its resources, protect its industries, and safeguard and create employment, protect its environment, boost earnings and resist economic encroachment. An independent economy places national interests first and is therefore radically different from a colonial economy. In so far as research is perceived as the technical/scientific arm of national economic development, research priorities should have been realigned after Independence. However, it took a long time for

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the new realities to be perceived, so that the research programmes of the 1960s and 1970s continued to bear the stong imprint of the pre-Independence programmes. A reconsideration of the role of research is overdue. Among important considerations to be evaluated are the following:

Resource renewal

With the years of abundant forest resources already numbered, and the rate of exploitation still far exceeding the rate of regeneration, forestry cannot escape a major replanting effort which must be upgraded and recognised as a major plantation industry on par with rubber of oil palm. The government has recognised this and has recently launched an ambitious Compensatory Plantation Programme, which has as its main aim to establish plantations of fast growing trees to "compensate" for the anticipated shortfall in timber supply in the 1990s. Among the species identified are Gmelina arborea, Acacia mangium, Albizia falcataria, Pinus caribaea and Euclayptus degulpta. Initial steps have been taken to embark on this program. The scientific manpower for such an effort (silviculturists, physiologists, plant-breeders, soil scientists, entomologists, pathologists etc.) has to be increased to reflect the change. At present the scientific manpower supporting agriculture exceeds that supporting forestry in the ratio of 10 to 1.

Industrial servicing

In order to stay competitive, the processing and manufacturing sector needs an advisory and research service upon which it can depend to solve technical problems. The change from large logs to small logs, well-known to lesser-known species, and changes in market standards for plywood, chipwood, etc., will bring this need sharply into focus throughout the 1980s and beyond. Research has therefore to be geared for and prepared to meet this demand.

Promotion of new materials

Research can play a catalytic role in promoting the use of "new" materials such as rubberwood, palm stems, sawmill waste and branchwood. The demonstration on laboratory or pilot scale that such material can be economically processed to make products, will help to catalyse the development of new processing industries. In other words, Government research starts the ball rolling, for the private sector to score.

Development of new products

In many industrial laboratories the development of new products is a major aim of applied research. This requires a more aggressive approach than the promotion of new materials. Colonial research institutions promote materials,

in consonance with the role of colonies to sell raw materials. Research institutions in independent developed countries emphasize value-added product development; cases in point are research organizations in Japan and U.S.

Prevention of foreign substitution

There are few products that are safe from foreign substitution, but the substitution process generally requires heavy investment in order to overcome market conservatism. Malaysian forest based products have successfully penetrated the market. Hence market conservatism, initially a barrier, now acts in our favour. However, this advantage will be lost if we cannot supply the goods in the required quantity and quality. In the wings of the competitive stage, Amazonia and New Guinea lie waiting for their opportunity. All forest based products, from plywood to rattan furniture, face this challenge. The decline of any industry is followed by the closure of mills, dispersal of skilled workers, and rise of foreign competition. It is extremely difficult to put the pieces back together again at a later date. Witness the difficulties in attempting to revive the collapsed palm oil and cocoa industries in West Africa. It is difficult to maintain status quo, let alone to forge ahead, without research and development.

Environmental monitoring

As logging proceeds into steeper and higher terrain, as swamp forests are drained and mangroves filled, there will be drastic environmental impact. Water quality, water flow, aquatic and coastal fisheries and wildlife resources will be affected. To monitor and quantify these changes and to provide guidelines for safeguarding the interests of all sectors, is properly the role of research. In view of forestry as a major user of environmentally critical lands, environmental research is an essential function of forestry research.

Developmental Research

The review of forestry research in Malaysia, covering both the past and current perspectives, illustrates an inherent behavior in Man in general, which is the quest for knowledge (Galileh, 1979),. This quest normally passes through four characteristic phases, viz. to seek, understand, experiment and develop. The inventory activities reflect the seek and understand phases where work was concentrated on specimen collection, botanical and taxonomic descriptions of the forest, establishment of arboreta, herbaria and virgin jungle reserves and basic forestry surveys. These research activities then emphasise the concept of knowing and understanding the environment.

The third phase of experimentation attempts to test theories and hypotheses arising from the "understand" phase. Provenance trials, species trials, propagation experiments, growth and yield studies, wood utilisation experiments

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are some of the research activities in this phase. This phase marks the beginnings of applied research. It is in this phase that applied experimentation can be carried out, although basic research can also be carried out in this phase. The Research Programmes of 1968-1972 (Anon, 1972) show some beginnings of experimentation research which is further developed in subsequent research programmes. However, a study of the current Research Programmes of 1981-1986 (Anon, 1981b) still reflects a considerable amount of the understanding phase. This is a indication that even after 50 years of research, there is yet considerable basic research that needs to be done. A clear case in point is in the field of botany, where knowledge on the flora of the country is yet far from complete. Research in tree physiology and a whole range of other studies aimed at providing a deeper understanding of the forest dynamics and the timbers produced from the forest, is generally basic research.

Nevertheless, a stage has been reached where forestry research must venture into the development phase. With knowledge gained in the other three phases, developmental research aims at solving specific problems, develop or produce specific products or develop new techniques. It implies the concept of improving existing systems, taking into consideration the trials and tribulation of the real world conditions. Developmental research includes the creation of new things, new technologies and new procedures. It is applied research and is the culmination of quest.

Forest research in Peninsular Malaysia has begun to venture seriously into developmental research. Whereas the Research Programme of 1976-1980 (Anon, 1976) is primarily subject oriented, the Research Programme of 1981-1985 (Anon, 1981b) is more project oriented. This shift in emphasis is a major change in direction and target objectives and is reflective of the mood and problems of forestry today. With a depleting resource comes a sense of urgency - an urgency to understand the natural forest before it disappears and an urgency to develop techniques of managing the ecosystem.

Since the mid 1970s, a range of integrated studies have been carried out in one of the major forest industrial complexes in the country under a memorandum of understanding between the Department and the company. Research is actively being pursued under a variety of forest conditions and situations of commercial harvesting, in order to provide guidelines on forest harvesting and subsequent silvicultural treatment for the proper and effective management of these forests. Mention has been made earlier of the MUS. What is needed to be developed inow is an effective successor to MUS for the hill forests. It is recognised that there is a interplay of many factors in forestry and these studies try to consider as many of these factors as possible by using commercial logging techniques, large area plots and adequate replications.

In the environmental field, the Institute has initiated hyrdological studies with clear objectives of developing management guidelines to protect and enhance the production of water during forest harvesting and to minimise detrimental impacts of harvesting on the hydrology of watersheds.

One could also classify this research as experimental, but herein lies one of the problems of forestry due to its lengthy time frame. Due to the long duration of the research, the developmental phase has been incorporated into the experimental phase, while orientating the research to provide the developmental aspects.

Other developmental research efforts in the forestry field include the development of effective and economic nursery techniques for the production of planting stock, including techniques of vegetative propagation; techniques in effective plantation management for specific tree species; cost-effective techniques of weed control; and effective techniques in climber cutting and tree girdling.

Developmental research is much more clear cut and potentially more rewarding in forest products research. Such research has been widely and successfully carried out in other countries. However, due to various organisational and manpower limitations, such research work is still in its infancy in Malaysia. Past achievements include development of the Malayan Grading Rules; treatment and drying schedules for different timber species and possible uses of locally grown pine and teak.

However, the potential for such research in tremendous, considering the demand for the numerous forms of wood-based products. A major step has been taken in the project orientation of the current research program. Given a stronger manpower base and a increased research capability, there is definite and exciting growth potential in developmental forest products research.

Issues of Applied Research in Forestry

The distinction between basic or pure research and applied research is difficult to define, because they often intergrade into each other. Nevertheless, pure research is often characterised as research for research's sake. It is the sort of research that is not expected to yield results of immeidate use. Another definition regards pure or basic research as attempting to answer questions while applied research attempts to solve problems. Research which does not consider uses of its result outside the domain of science is also considered as pure research (Ackoff et. a;, 1962).

In the framework of earlier discussions, experimentation marks the beginnings of applied research. While one recognises the need for and importance of applied research, pure or basic research is still necessary and important especially in tropical forestry. Most research expenditure in forestry in the 1970s had been related to industrial utilisation of natural forest resources (Anon, 1981b). This had covered both pure and applied research. However, much is still lacking in the understanding of the tropical forest ecosystem, reputedly to be one of the oldest existing cummunities in the world. There is yet ample need and opportunity for pure or basic research.

However, in the face of depleting resources, in view of pressure for conversion of forest lands to agriculture, there is a greater need for applied research to solve problems, and problems there are galore! Let us consider some of the major problems facing tropical forestry that require urgent and immediate research attention. Logging of tropical forests is inevitable but is the technology known for the effective management of these forests? It is my considered opinion that applied research to solve the problems of forestry management should be given top priority. Other problems include forest hydrology or watershed management, wildlife management, multiple use (including recreation) management, environmental conservation and effects of large scale tropical forest conversion into non-forestry crops. Applied research into maximising the utilisation of the resources including other "minor" forest products should be given priority.

Research in tropical forest faces many peculiar problems. The heterogeneity of the tropical forest is well documented (Anon, 1978b) and well known. It is this inherent and dominant characteristic of tropical forests that makes applied research extremely difficult. There are too many variables, too many site characteristics and too many linkages and relationships that need to be considered. Applied research to solve a particular problem finds itself in so complex and complicated a situation that the scientist is faced with a dilemma. If he ignores the complexity of unknowns that surrounds his experiment, he may not come up with proper solutions or he may be strongly criticised. If he attempts to cater for all his "nuisance variables", the experimental design would be so complex, so complicated and probably so large that he would be physically overwhelmed! The way out is to compromise, and to acknowledge and accept certain assumptions and limitations. Such are the realities of the real world situation.

Modern technology, especially computer simulation and modelling, can assist to a certain extent. Attempts have been made to simulate the dynamics of the natural tropical forest under management (Salleh, 1977). However, the practical application of such models have yet to be realised due to certain limitations in the assumptions used in such modelling exercises. Nevertheless, computers are expected to play an increasingly important role in helping the tropical forest scientist overcome many of his experimental probelms. Simulations can be used but much preliminary research has yet to be carried out to provide the necessary models.

The lengthy time period needed for research in tropical forestry is yet another issue that hampers development. Due to the lengthy period, the scientist is faced with many natual changes and events that occur through time that are difficult to determine, measure or even detect. Of significant importance in some experiments are changes in the economic and even social environment that can take place through time which can have various impacts and effects on the experiments. Since applied research is directed at problems, and since problems can change in nature, perspective and importance through time, so would the research itself be affected through long time changes. The greatest frustration of the applied forest scientist is that he can do little to control

the environment that affects his research. What starts off as an applied problem-solving project may end as a basic knowledge acquiring project because the problem has changed in the meantime, so that the solution, when finally obtained, is rendered irrelevant, as far as immediate application is concerned. For example, research on regeneration of heavy hardwoods (Wyatt-Smith 1963, Manual of Malayan Silviculture for inland Forests) was overtaken by changing market preferences in favour of medium and light hardwoods. Research in the 1960s on pine plantation establishment for pulp production was overtaken in the 1970s by loss of interest in setting up pulp mills. The information obtained nevertheless remains potentially useful.

Applied research assumes that there is adequate basic scientific information available. In tropical forestry this is never true, as has been emphasised earlier. The lack of such knowledge makes the problem of applied research much more complicated. What often happens then is that the scientist sees and acknowledges the causes and effects without actually understanding what happens in between. This may be acceptable in some cases, but may bring about certain problems of application in others. A case in point is research on the problems of poison girdling trees and climber cutting (GCL) and its influence on tree growth. There is so little basic information on the effects of climbers on trees that to determine the combined effect of GCL on growth leaves open many unanswered questions. As a result of such problems, the scientist often is forced to carry out basic or pure research together with his applied research, which further complicates the experimentation.

When a scientist attempts to combine both pure and applied research, he is often faced with the problems of expertise. This is particularly true in the developing tropical countries. Applied research in forestry requires scientists who have a basic forestry training or background, in order to make a link with problems of forestry management practices. On the other hand, pure or basic research requires in-depth knowledge of certain specific disciplines. It is seldom that one can find both conditions fulfilled by an individual. This however can be overcome by teamwork or joint research, and this indeed is the direction that forestry research in Peninsular Malaysia tries to follow.

However, forestry research in the tropics has seldom been given the recognition and boost that it needs in order to develop the scientific knowledge necessary for the proper and effective practice of forestry. Iyamabo (1976) discusses very effectively the problems faced by forestry research in developing countries and the World Bank - FAO paper (Anon 1981c) suggests some ways and means of overcoming this.

International Cooperation

It has been recognised that the natural tropical humid forests, especially the lowland forests, are under imminent danger of extinction, the main causes are conversion to non-forest uses and forest logging. It is acknowledged too that time is a critical factor. If the human race is not to lose out

and if future generations are to inherit the knowledge and information of ths generation, it is imperative that a concerted effort be made to study and learn about this resource as soon as possible. Various fora have voiced this concern, the latest being the 17th IUFRO World Congress in Kyoto, Japan (Anon, 1919b). The U.S. Department of State made strong recommendations on this resource, with specific suggestions on policy and strategy for the U.S. (Anon, 1980a). The Experts Meeting on Tropical Forests in its Overview Document (Anon, 1980b) discusses in detail the problems faced by the tropical forests, the problems of the countries that own these resources, and the programme of activities that are suggested to be followed. The meeting itself came out with a series of recommendations on steps to be taken.

In all these fora, reports and consultations, the element of international effort and cooperation is emphasised. The format of such cooperation varies but the central problem is the weakness of research and technical capacity and capability in developing countries. It is therefore obvious that an immediate step would be to deploy to the developing countries some of the abundant scientific manpower currently available in developed countries. This would solve the immediate shortage of trained and qualified manpower in the developed world, while providing the much needed expertise to carry out research and management of the natural forests. However, is this in the best interest of all? Would this help solve the problem?

Budowski (1974) calls it "scientific imperialism". I call it scientific colonialism. Whatever name it is called by is really of little importance, but there is truth an wisdom in the warnings sounded then, and very much so now. Maybe the message did not reach everyone or if it did, the message was not clear enough. In spite of all the limitations and problems of the developing countries they have, above all national pride. They seek national identity and they strive for complete independence, including scientific and economic independence. They yearn for recognition - recogition as equals.

It is almost a decade since Budowski's warnings and yet, the practice of "scientific imperialism", in the various forms that it can take place, still continue unchecked. Indeed in some cases, it may be an honest case of sincere assistance but unfortunately in the wrong format. The Forest Research Institute, Kepong has had its share of assistance, all of which had been requested for either as bilateral assistance or through international agencies. Although in general, it must be admitted that the institute and the country, has gained through these "experts", in retrospect, there has been much to be desired. The shortcomings may not have been deliberate but their impacts did leave a bitter pill in the mouth. If this has happended to Malaysia, which is comparatively better-off in many ways than many other developing countries, one can imagine what is going on the other less fortunate countries, where local staff may be even less able to keep track of the activities of foreign experts.

The so-called scientific imperialism can take another form which the F.R.I. keeps experiencing from scientists from the developed world. These are requests by mail. The Institute's files on overseas requests make extremely interesting reading. Requests are varied and range from simple requests for a slide or photograph to ridiculous requests for pollen samples from all the tree species of the country, unpublished data from the Institute's files on certain subjects, tens of thousands of recalcitrant tropical rain forest seeds to support storage projects carried out in temperate countries, etc. These extreme requests indicate a total lack of understanding of the local, natural, scientific and economic environment.

The Institute also receives the occasional visitor from overseas unannounced and uninvited, but nevertheless demanding assistance of transporation and manpower, including scientific manpower, to enable him to carry out his favorite experiment here, or to test his favorite hypothesis of his computer model. It has happened when the local botanist has identified all the specimens collected by the visitor, only to be acknowledged in a obscure manner. It has also happened when a scientist who is here legally on an assistance program, carries out something else on the side and as a result writes books on his return to his home country and subsequently becomes acknowledged as the expert in the field.

What is lacking therefore is sensitivity, sensitivity to the local sentiments, and particularly, sensitivity to the professional aspiration of local scientists. Scientists from the developed world must make an effort to be sensitive to the local environment, and to avoid exploiting local scientists and institutions for their personal advantage. Any co-operation must be on the basis of mutual understanding and mutual respect, in the truest sense of the word.

The developing world cannot do without assistance from the developed world, but the best assistance that can be given is in developing the local expertise and local capability. As the saying goes, "Give a man a fish and he eats for a day; teach him to fish and he'll never be hungry again!" Thus, assistance and co-operation should give priority consideration to training and institution building. The ideas and recommendations proposed in the World Bank - FAO paper presented at the last IUFRO Congress (Anon, 1981c) are good and deserve support. However, it may all come to naught if the spirit under which its is implemented does not reflect the deeper moral aspirations of the developing world.