Table 9: Selective Management System (SMS)

Year	Operation
n - 2 to n - 1	Pre-felling forest inventory using systematic-line-plots and determination of cutting regimes (limits)
n - 1 to n	Climber cutting to reduce damage during logging. Tree marking incorporating directional felling. No marking of residual trees for retention.
n	Felling of all trees as prescribed
n + 2 to n + 5	Post-felling inventory using systematic-line-plots to determine residual stocking and appropriate silvicultural treatments.

industry. The extensive tree-crop plantations of rubber and oil palm annual replanting schemes also provide excellent source of wood (fibre) materials with the potential for industrial processing to compensate for the expected decline of wood materials from the PFE under the SMS. The sequence of operations under the SMS is shown in Table 9 (Thang, 1987).

6.0 REVIEW ON APPROACHES TO SUSTAINABLE FOREST MANAGEMENT

The management of tropical rainforests, including those in Malaysia has of late been the focus of world attention, especially in the developed countries. The major concern is the alarming rate of tropical forest deforestation worldwide, which was reported to be as high as 16.8 million ha annually for the period 1981 – 1990. It is now realised that forests are important, amongst others, for carbon dioxide fixation preservation of biological diversity and the maintenance of an equable climate. Concern has also been raised that the tropical forests will be completely depleted in the near future and hence, there has been an unfortunate tendency to discourage the use of tropical timber in Europe and North America.

6.1 Policy and Strategies

In the endeavour to ensure sustained development of the forestry sector in Malaysia and as a supplement to the National Forestry Policy, the following explicit management and conservation policy and objectives have been formulated and adopted for implementation, especially in Peninsular Malaysia:

(i) to manage and utilise the forest resource for maximum benefits based on the inherent capability of the forest and its optimal use;

(ii) to manage the utilisation of the forest resource, based on comprehensive forest land-use management plans;

(iii) to determine potential yield on the basis of systematic and in-depth appraisals of the forest resource base, its growth potential and other relevant factors;

(iv) to regulate log-flow, based on a careful balance of supply and demand, maximum utilisation prospects and constraints;

(v) to harvest the forest resource conservationally by selective felling and retention of adequate natural regeneration, consistent with economical harvesting, so as to ensure the sustainability of the forest resources base;

(vi) to apply optimal forest management regimes formulated on the basis of information generated by systematic integrated forest management and operational research;

(vii) to establish forest plantations of quick-growing industrial wood species;

(viii) to promote multiple-use forestry and environmental conservation;

(ix) to ensure that sufficient forested areas are protected for the conservation of genetic resources, soil and water;

(x) to promote efficient harvesting and utilisation of all forms of forest produce;

(xi) to attain a national balance between national industrial processing capacity and resource availability;

(xii) to stimulate planned development and product diversification of the existing forest-based industrial sector;

(xiii) to promote the exportation of more value-added forest products;

(xiv) to ensure that domestic requirements for all forms of forest products will be adequately met; and

(xv) to encourage wider use of the under-utilised timber species, small dimension logs and the development of new forms of wood processing industries.

Sabah and Sarawak have their own priorities in their management policy and strategies but, in general, they are quite similar to those of Peninsular Malaysia.

6.2 Natural Forest

In the pre-World War II era, forest and forest resources were abundant. Land development during that time was at a low ebb. There was little demand for timber and, subsequently, low pressure on timber exploitation. Thus, it was to be expected that the forest management system during that period was simple and straightforward as depicted in the early stand

Above: Mangrove forest at low tide. Note the painted trees soon to be felled. *Above right:* Peat swamp in Kuala Langet Selatan Forest Reserve, Selangor. The ground is often soggy but can be deep with litter. *Right:* Rural-based industry—a rattan chair being given fine finishing in a furniture factory in Negeri Sembilan.

Above: A nursery of *Rhizophora spp.* ready for planting in the mangrove forest. *Left:* Enrichment planting with marketable indigenous species of *Shorea leprosula* in Cikus Forest Reserves in Perak. Planted in 1968, measurements are made regularly to monitor growth. *Below:* Lowland Dipterocarp forest rich with *Dryobalanops aromatica* in Bukit Lagong Forest Reserves in Selangor.

Above: Research on forest fire management—to determine litter content in relation to biomass and availability of fuel on the forest floor. *Above right: Acacia mangium* plantations just after first thinning at age six years. With more space and sunlight the released crown will close again very soon. *Right:* A waterfall in Sungai Gabai forest recreation area in Hulu Selangor.

improvement felling, viz. Regeneration Improvement Felling, Departmental Regeneration Felling and Commercial Regeneration Felling, which were primarily concerned with improving the existing timber crop for future exploitation. There simply was no need for elaborate forest management systems.

Immediately after the war, the MUS evolved when in 1948 it was discovered that the rampant and untended forest exploitation carried out in the war years had resulted in abundant advanced seedling regeneration on the ground which is adequate for natural regeneration.

Between the formulation of the MUS and the current Selective Management System (SMS) in 1980s, the demand for timber increased substantially due to land development and conversion being on the rise. The 1960s also saw the start of a series of five-year Malaysian Plans. The effects of these plans were greatly felt in the forestry sector when more and more lowland forest reserves were converted or cleared for development. This occurred especially between 1960-1970. The Forestry Department was virtually 'powerless' to stop the rapid loss of forested land. Forestry work, then, was mainly towards revenue collection where the already limited manpower had to concentrate more on administering logging activities rather than on silviculture and other forest development.

It was about this time too that forest exploitation was moving towards higher ground or the hill forests. The MUS, which was especially adaptable for lowland forests, failed when applied in the hills. In the mid '70s, there was a strong shift in forest management towards the 'conservational approach'. There was growing emphasis on multiple-use forestry and the emergence of topical issues by the NGOs. Around 1976, forest land clearance and conversion hit its peak which finally resulted in the need to conserve and 'defend' the forest and curb its rate of removal. All these factors eventually led to the current Selective Management System being adopted in the 1980s.

It should also be noted that, between 1965 and 1978, there was no proper Forest Planning Policy. The National Forestry Policy was approved only in 1978. Prior to its approval, the Forestry Department had to refer to the Interim Policy. Thus, there were no clear-cut policies, planning tools or legal support to uphold the industry.

The MUS was, undoubtedly, a good system but only applicable in lowland forests. Unfortunately, there is no MUS Forest Model because there are insufficiently suitable areas left in Peninsular Malaysia to warrant the existence of a defined sustainable lowland Dipterocarp forest management system. Obviously, the management systems that came into being in Malaysia were not products of development or refinement of the systems prior to it. In reality, the change from MUS to SMS, for instance, happened due to differing forest types, viz., lowland forests versus hill forests, and the SMS was not actually an improved version of the MUS. The MUS and SMS were two discrete systems. Nevertheless, the historical development of the management systems in Malaysia has been unique and the result of years of experience gained in managing the forests. In fact, the management system developed in what was then Malaya was adapted in many countries around the world.

In order to implement silvicultural operations more effectively, a Silvicultural Cess Fund was created in 1973 in all states except Sabah and Sarawak. The fund is disbursed for the implementation of the various reforestation activities in each state. With the adoption of the

National Forestry Act 1984, the Silvicultural Cess Fund is now known as the Forest Development Fund. While the modified MUS is still being practised, the tendency now is more towards SMS with less worries about insufficient natural regenerations. In pursuance of sound management objectives, forest-harvesting in Sabah is undertaken in accordance with the prescribed silvicultural practices of promoting the development of natural regeneration. Forest areas in Sabah are harvested on an 80-year rotation and only trees of 60cm dbh above are removed.

In Sarawak, the cutting cycle for the Peat Swamp forest is 45 years with the prescribed cutting limits for *Gonystylus bancanus* (Ramin) and that of other species being 40cm dbh and 45cm dbh and above, respectively. The cutting cycle adopted for the Hill Mixed Dipterocarp Forest is 25 years where the prescribed cutting limits for the Dipterocarp and Non-Dipterocarp species are for trees over 60cm dbh and 45cm dbh respectively.

Besides managing the inland forests systematically under sustained yield management and for the protection and conservation of soil and water, the mangrove forests in Malaysia are also being managed to achieve maximum sustained yield of wood for charcoal, poles and fuelwood. In practice, these mangrove forest are managed under rotation cycles varying from 20 to 30 years. In Peninsular Malaysia, mature trees are clear-felled with the retention of seven mother trees per hectare and a river and coastal strip, while in the states of Sabah and Sarawak a minimum girth system of 21cm and 23cm respectively are adopted. Harvesting of these forests is carried out in batches of several hectares in area and the timber is removed for firewood or for conversion to charcoal. The tree stumps and slash material are left to decay. If, after about two years, no natural regeneration occurs, these areas are planted up with *Rhizophora spp.* Commercial thinning for poles is carried out once or twice before clear-felling, on 15-year and 20-year old stands using 1.2m and 1.8m stick lengths respectively, such as being carried out in the Matang Mangroves of Perak (Haron, 1981). Working plans for these mangrove forests are revised every 10 years based on the principles of sustained yield management.

6.3 Forest Plantation

As stated in the National Forestry Policy 1978 (Revised 1992), sufficient forest plantations of fast-growing tropical timber species and forest plantations of high quality timber species would be established throughout the country to supplement supply of timber from the natural forests. In this regard, private sector investment would be encouraged to enhance its development.

Forest plantations which are capable of yielding a high volume of wood per unit area and in a shorter period of time are becoming increasingly important in meeting the future timber requirements of the country. In the 1950s a number of forest plantations trials were established mainly with fast-growing exotic species. It has been envisaged that by the year 2000 forest plantations in Malaysia will be about 500,000 ha.

Commercial establishment of forest plantations was started in 1957 with the planting of teak in the northern states of Perlis and Kedah. Although the area planted now is still small (455 ha), 150 ha have been planted annually since 1986. Teak is a prime quality timber species and its choice for plantation is mainly due to the favourable climatic conditions in these states

and the high quality of wood it produces, although it is limited by the unavailability of suitable areas.

In the late 1960s and 1970s, plantation efforts in Malaysia were directed at establishing fast-growing tropical pines to produce long-fibred pulp, with a view to setting up a local pulp and paper mill. Although almost 7,000 ha have been planted mainly with *Pinus caribea, Pinus merkusii* and *Araucaria spp.*, the planting of these conifers was terminated in 1980 due to a change in management objectives and strategy.

With the increase in domestic demand for timber and timber products as population grow, there is an urgent need to develop and expand the forest resources of the country. One of the strategies adopted was to implement a programme of fast-growing forest plantation species that could supplement the timber from the natural forest or compensate for the forested areas that have been converted to other land-use. Thus, the launching of the Compensatory Forest Plantation Project in 1982 in the states of Pahang, Johore, Selangor and Negeri Sembilan. The project was to establish about 188,000 ha of forest plantation in Peninsular Malaysia within 15 years with specific targets for the Fourth, Fifth and Sixth Malaysia Plan of 8,000 ha, 74,000 ha and 106,000 ha respectively. The estimated cost of establishment was $517 million but the three chosen fast-growing species of *Acacia mangium* (Akasia), *Gmelina arborea* (Yemane) and *Paraserianthes falcataria* (Batai) were deemed economically viable hardwood species for this project. These species were expected to yield 210 m^3 per hectare of sawlogs after 15 years. The average annual log production was estimated at 2.63 million m^3 from 1998 onwards. At first *Eucalyptus camaldulensis* was also included in the original planting, but ran out of favour after the first few years.

However, after a few years of implementation, many shortfalls were detected including a lack of suitable land, high maintenance costs (for weeding, pruning and thinning), poor tree (bole) form, and a high incidence of suspected heart-rot disease (particularly in *Acacia mangium).* Regarding the latter, Appanah and Weinland (1993) observed that generally the common defects of the fast-growing species in Malaysia were brittle heart, heart rot and fungal infection. The targeted area to be planted under this project was then reduced to 100,000 ha, but still by 1995 only about 55,000 ha was planted. This shortfall could have been due to the moratorium period between 1992 and 1994 when consolidation was necessary in view of the heart-rot problem. Lack of funding has also contributed to the slowing down. For these reasons the project target area was further reduced to 80,000 ha with the year 2000 as the new date of completion. The total area of compensatory plantation till 1995 is shown in Figure Eight.

Nevertheless, the other States of Perak, Kelantan and Terengganu have also embarked on fast-growing forest plantation. Selangor has also recently completed establishment of 150 ha of *Hevea brasiliensis* (rubber) as forest plantation species using specially selected clones for timber production.

Sabah has also recognised the need for the establishment of forest plantations to supplement the natural forests. Plantation forestry started in Sabah in 1973 with the formation of the Sabah Softwood Company. The development of forest plantations was further enhanced when the Sabah Forestry Development Authority (SAFODA) was established to re-afforest the

grasslands and areas denuded trough shifting cultivation by the natives. At the end of 1995, SAFODA succeeded in establishing 46,043 ha with *Acacia mangium* (Figure 9).

Forest plantation was also established by Sabah Forest Industries. The species planted were *Eucalyptus deglupta, Paraserianthes falcataria, Gmelina arborea, Pinus caribaea,* and *Acacia mangium.* The total area planted at the end of 1995 was 92,075 ha. The Sabah state government has envisaged the eventual establishment of 600,000 ha of forest plantations throughout the state.

Forest plantation programmes in of Sarawak mainly involved the rehabilitation of degraded areas in the Permanent Forest Estate that have undergone shifting cultivation. At the end of 1995, the total area planted were about 10,000 hectares, mainly with *A. mangium, G. arborea, Shorea macrophylla, Swietenia macrophylla* and *Araucaria cunninghamii.* It has plans to establish 14,060 ha annually in areas of the Permanent Forest Estate that have been deforested by shifting cultivation.

It must also be noted that a Rattan Information Centre has been established at the Forest Research Institute of Malaysia with the support of the International Development Research Centre of Canada with the objective of conserving and managing the rattan resource of the country in perpetuity. Rattan, especially *Calamus manan (Rotan manau)* and *Calamus caesius (Rotan sega)* has been removed in large quantities from the natural forest due to their great demand both locally and for the export market. Adequate measures have been taken to sustain the resource supply by planting rattan in the natural forest as well as in rubber plantations. Currently about 12,000 ha of rattan have been planted in the natural forest areas of the PFE in Peninsular Malaysia, and many rubber smallholders have planted rattan in between their rubber trees for a short rotation of 9 – 12 years. The embarkation into rattan planting on a commercial scale is viable to meet the future supply of this resource. Sabah had planted 20,600 ha of rattan by the end of 1995 through the SAFODA Kinabatangan Rattan project.

6.4 Forest Development and Rehabilitation

The forest planning and integrated operational studies carried out so far in Malaysia, especially in Peninsular Malaysia, have clearly indicated the feasibility of continuous economically viable hill forest production in terms of economic log-out-turn volume with periodic cuts every 25 – 40 years using locally-appropriate cutting limits and leaving an adequate number of medium-sized trees of marketable species for natural growth into commercial sizes. It has been shown that, with average growth rates of trees over 30cm dbh of 0.8 – 1.0cm per year in diameter and 2.0 – 2.5 cubic metres per hectare per year in commercial gross volume, about three-quarters of the hill forests in Peninsular Malaysia are capable of producing every 30 years at least 40 – 45 nett cubic metres per hectare which is about the average current log outturn of the virgin hill forest. However, it is imperative to curtail harvesting damage of the residual stand to not more than 30% of the intermediate-sized trees.

In fact, the current practice of selective harvesting in Malaysia would ensure that the larger trees that remain would reach maturity in 20 – 30 years to allow for a second round of harvesting. And the process goes on. This in itself is a form of silvicultural treatment

because natural regeneration is increased by the gaps created during forest harvesting. Several studies have also indicated that regeneration of desirable species occur naturally in and around the gaps left by logging, and the logged-over forests are silviculturally treated to aid their rehabilitation, only when necessary.

The annual coupe of the Permanent Forest Estate under the Sixth Malaysian Plan (1991–1995) in Peninsular Malaysia was 52,250 ha of which 31,805 ha and 20,445 ha were managed under a 30-year (SMS) and a 55-year (MUS) cutting cycle, respectively. In addition, a total of 101,429 ha of stateland forest was also being harvested annually but no special attention was necessary here because they did not come under the PFE, and may sooner or later be converted to agricultural tree crop plantation or other land development. The annual coupes for the Permanent Forest Estate for the same period in both Sabah and Sarawak were about 60,000 ha each. Besides, the total area annually harvested in stateland forests of both states was about 300,000 ha. These states have also taken appropriate steps to control the rate of forest-harvesting, particularly in the PFE, in accordance with sustained yield principles.

Malaysia is committed to ensure that all harvested production forests of the Permanent Forest Estate are silviculturally treated. In early 1996, a total of 1,461,370 ha of the logged-over forests in Peninsular Malaysia have been silviculturally treated by poison-girdling and climber cutting while 21,286 ha have been enriched with commercial indigenous species (Figure 10). The main species that have been planted include *Shorea leprosula* (Meranti tembaga), *S. parvifolia* (M. sarang punai), *S. platyclados* (M. bukit), *Anisoptera spp.* (Mersawa), *Dryobalanops aromatica* (Kapur), *Scaphium spp* (Kembang semangkuk), and *Dyera costulata* (Jelutong). Annually, it is targeted that 80,000 ha of logged-over forests will be silviculturally treated while an area of 850 ha will be enriched with indigenous species. This progress, when compared to the annual rate of forest harvesting in the Permanent Forest Estate of 52,250 ha is very encouraging and certainly is a positive step towards more effective conservation and rehabilitation of the forest resources.

In Sabah, the total area which has been silviculturally treated is 298,000 ha with another 1,645 ha of poor forest being enriched with indigenous species. Annually, an area of about 12,000 ha of logged-over forest is planned for silvicultural treatment.

In Sarawak, a total area of 289,000 ha of logged-over forests was silviculturally treated by early 1996, in the Peat and Mixed Swamp Forests and the Hill Mixed Dipterocarp forests. Annually, an area of 6,000 ha of logged-over forests will be similarly treated.

Apart from rehabilitating the harvested natural forests, the planting of rattan in natural forests, as well as, in rubber smallholdings is also being implemented. As mentioned earlier, about 12,000 ha of rattan has been planted in Peninsular Malaysia, mainly with *Calamus manan* and *Calamus caesius,* 20,600 ha in Sabah, and 2,000 ha in Sarawak. The annual target for rehabilitation with rattan is about 2,000 ha, mainly in the natural forest and rubber smallholdings.

Moreover, *Parkia speciosa* (Petai), *Durio zibethinus* (Durian) and other fruits come from the forest during the main fruiting season annually. The Malaysian community enjoy these fruits despite the current high prices. As the Forestry Departments feel obligated to meet this demand by the community at reasonable cost, they have embarked on traditional fruit tree-

planting to supplement and complement the dwindling supply. The various Forestry Departments in Peninsular Malaysia have planted 2,606 ha of *Parkia speciosa, Durio zibethinus* and other fruit trees along fringes of forested areas which are located in the vicinity of existing villages. In Sarawak, about 400 ha of these species have also been planted. It will help the rural population a long way towards improving their quality of life.

In the mangrove forest reserves 1,500 ha are harvested annually. These areas will either be naturally regenerated or planted mainly with *Rhizophora spp.* (Figure 11).

6.5 Helicopter Logging

Helicopter logging was first introduced in the state of Sarawak in April, 1993. It is used mainly for logging in hilly and the less accessible forest areas. The ability of the helicopter to uplift logs vertically greatly helped logging operations in these areas.

The helicopters used in Sarawak are the Sikorsky S-64E which is also known as the Erikson Air Crane, and the Bell helicopter. The Sikorsky S-64E, with a lifting capacity of 20,000 lbs (9,000 kg), is used to vertically uplift logs from felling areas in the forest onto the roadside drop zone. The flying range of the helicopter is kept within 3 km from the drop zone. The Bell helicopter is used for transporting felling crews to the felling areas and for aerial supervision of the logging operations.

Each felling crew consists of a chainsaw operator and an assistant. On average, each crew can only cut eight to nine trees a day. This is because of the difficult terrain conditions and the need to select only good merchantable trees. The lifting operation by the helicopter is carried out continuously, and because of the short runs, it is necessary to ensure that there is a sufficient quantity of logs for the helicopter to lift (Figure 12). As such, the felling operation is planned so that it has a headstart of at least 14 days from the helicopter lifting operation. All logs are numbered with paint and located on a map to assist the pilots in identifying the location. The logs are lifted to the drop zone, after which they are transported to the stacking area by a front-end loader.

A study made by the Forestry Department, Sarawak had indicated some positive attributes of helicopter logging. These include the following advantages:

(i) Suitability for logging in hilly and the less accessible forest areas.

(ii) High machine productivity of 70 per cent.

(iii) Average production rate is 671 m^3 per effective working day which is 15 times more than that of the tractor.

(iv) Harvesting damage to surrounding trees in helicopter logging areas is almost four times less than that using a tractor.

(v) Land erosion resulting from building of roads is minimised because the flying range of the helicopter is three km, whereas the optimum skidding distance of tractors is only one km.

(vi) Negligible increase in stream turbidity.

The study also indicated some disadvantages in that the operational cost of helicopter logging is very high. The maximum lifting capacity of the helicopter of 9,000 kg also meant that only good, merchantable logs were selected to be lifted which resulted in low utilisation of felled trees. The study showed that about 1.76m^3 of each felled tree were not utilised. As harvesting of the forest was very selective, the growth rate of the residual trees will also be slow.

From the above observations, it is clear that helicopter logging is a low environmental impact harvesting system. It also reduces pollution caused by land erosion as it minimises the building of logging roads. However, its implementation would depend largely on the ability to absorb the high operating costs.

6.6 Multi-Storied Forest Management

The Multi-Storied Forest Management Project was established in 1991 and funded with expert assistance by the Japan International Cooperation Agency (JICA). The purpose of the project is to collect useful data through the establishment of a Multi-Storied Forest Management System in the tropics, which will contribute to the promotion of reforestation/afforestation by the private sector and the sustainable development of the forest. The system has been tried in both plantation and logged-over forest.

The Multi-Storied Forest Management System is a management system for diversified timber production developed to create a mixed forest of complex structure taking into account environmental considerations and resistant to pests and diseases. Two sites were chosen for the project, viz. Chikus Forest Reserve and Bukit Kinta Forest Reserve with an area of 500 hectares each respectively. The Chikus Forest Reserve site comprises three to four year-old *Acacia mangium* plantations while the Bukit Kinta Forest Reserve site comprises logged-over natural forest. The species suitable for the planting of multi-storied forests are *Shorea leprosula, Shorea parvifolia, Neobalannocarpus heimii* and Hopea odorata.

Two models have been tried under this project, as follows:

a. Model I (three-storied type)
Planting with *Acacia mangium* (short-rotation species) as upper trees and *Shorea parvifolia* and *Shorea leprosula* (long-rotation species) as lower trees.

b. Model II (four-storied type)
Same as Model I, but medium-rotation species such as *Tectona grandis, Khaya ivorensis* and *Swietenia macrophylla* were planted to provide income before long-rotation species could be harvested.

6.7 Bentong Model Forest

The Bentong Model Forest, initiated in 1995, comprises the whole district of Bentong in Pahang State. The State Forestry Department of Pahang, Peninsular Malaysia and Canada are the co-implementors of this Model Forest. It provides for the establishment of Permanent

Forest Estate (PFE) and for the proper and effective management, utilisation and development of the forest resources. This 'Malaysian' Model Forest is the third international example to be initiated by Canada, after Mexico and Russia, and may also be the third of its kind in the world. The goals and objectives of the Models Forest are as follows:

(i) maintenance of a healthy forest ecosystem;

(ii) to ensure renewable and sustainable source of economic, social and ecological benefits;

(iii) generation and assurance of stable revenue and employment;

(iv) implementation of integrated resource management principles incorporating environmentally sound technology;

(v) raise awareness and total commitment in the sustainable development of forest among forest users;

(vi) resolving conflicting land use;

(vii) promotion of better understanding on the multiple role of forest.

The implementation and execution of the Bentong Model Forest is carried out within the existing administrative and legislative structure and framework of the government. In highlighting the values of the forest resources, a number of forestry functions are taken into account, namely:

(i) Regulatory function, which includes climate, waterflow, protection of water catchment, prevention of erosion, maintenance of biodiversity and fixation of carbon dioxide.

(ii) Carrier function which includes:
- living area for people, especially indigenous populations;
- areas for cultivation of agricultural crops;
- areas for recreation.

(iii) Production function which includes:
- timber production;
- non-timber forest produce; and
- genetic resources.

(iv) Information function, which includes spiritual, religious, cultural, technical, and educational purposes.

The recognition of the District of Bentong as a model forest reflects a holistic and integrated approach to the management of the forest resources. All aspects of forest management are included and there is full participation of all the interested groups in the locality. Undoubtedly, enormous efforts have been taken to ensure sustainability of the forest resources in the overall context of the socio-economic growth of the area.

The establishment of the Bentong Model Forest is seen as a commitment by Malaysia, and in particular the state of Pahang, to be more transparent and accountable in its commitments towards sustainable forest management. Unfortunately, however, the implementation of this project has been deferred by the authorities concerned.

7.0 MANAGEMENT ISSUES AND CHALLENGES IN FORESTRY

It is envisaged that more intensive forest management will be carried out in the coming years, particularly with increasing emphasis now being placed on topical forest with regard to its sustainability, conservation and development. This is in line with Malaysia's stand as a member of producer countries where it is required that all trade in tropical timber follow the decisions agreed in UNCED which was held in Rio de Janeiro, Brazil in June, 1992. There the "Non-Legally Binding Authoritative Statement of Principles for a Global Consensus on the Management, Conservation and Sustainable Development of all Types of Forests" was agreed and the "Convention on Biological Diversity" by the European Economic Community and 153 countries, including Malaysia, was signed. Malaysia ratified the convention on Biological Diversity on 2 June, 1994.

Efforts will also be taken by Malaysia to facilitate the full implementation of this UNCED statement on forestry and the obligations as required under the convention on Biological Diversity. Malaysia will be examining closely and identifying, in particular, the areas under agenda 21, especially Chapter 11 (Combating Deforestation) and Chapter 15 (Conservation of Biological Diversity), where financial assistance and the transfer of environmentally-sound technologies are required to ensure their successful implementation.

In 1992, Malaysia and United Kingdom conducted a wide-ranging programme for the biodiversity conservation, management and development of Malaysian forest resources. This programme also conducted research into these imaginative concepts ??? as it has a prodigious diversity of plant and animal life, and large areas of the permanent forest estate. The programme was divided into two sub-programmes, A and B, concerning 'upstream' basic research and 'downstream' developments dealing with industrial and commercial aspects, respectively. Sub-programme A for the research activities taken place in readily accessible 'Demonstration and Development Areas', was intended to be show-cases for learning and training in suitable forest management, while sub-programme B focused on the valuation of costs and benefits of non-timber forest products and services.

The Development of Indirect Values for forest recreational areas in Peninsular Malaysia was also carried out between Malaysia and United Kingdom (ODA – Overseas Development Agency) for the purpose of developing a method to determine the indirect values of forest recreational areas. In 1995, analysed data from 20 study areas were computerised and a training workshop was conducted on the methodology of the study methods, concepts, use of the data and its applications.

Malaysia will redouble its effort towards achieving sustainable forest management in the overall context of sustainable development. In this regard, Malaysia will operate the "ITTO Guidelines for the Sustainable Management of Tropical Forest Management" and its "Criteria for the Measurement of Sustainable Tropical Forest Management" in managing its natural