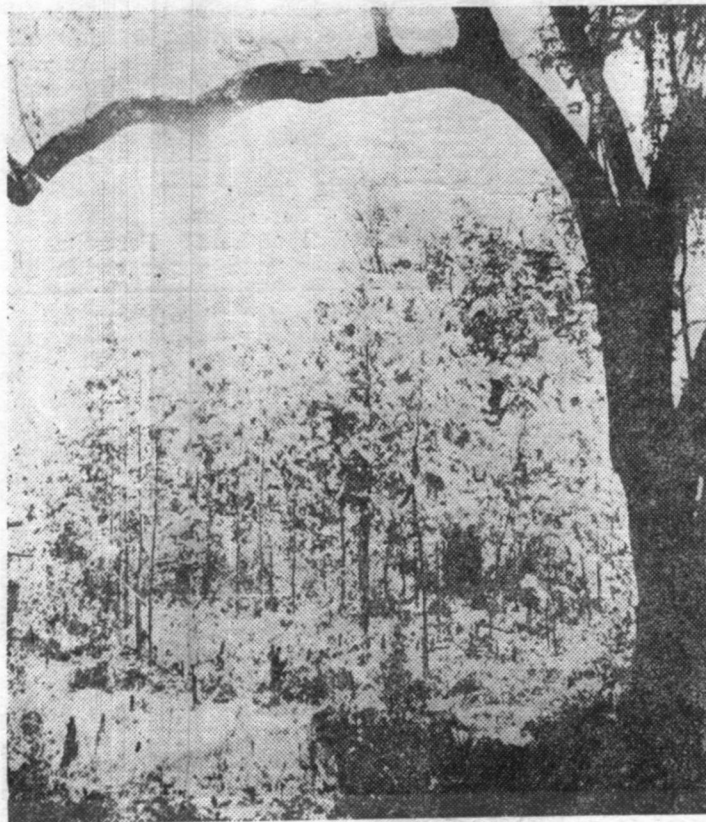
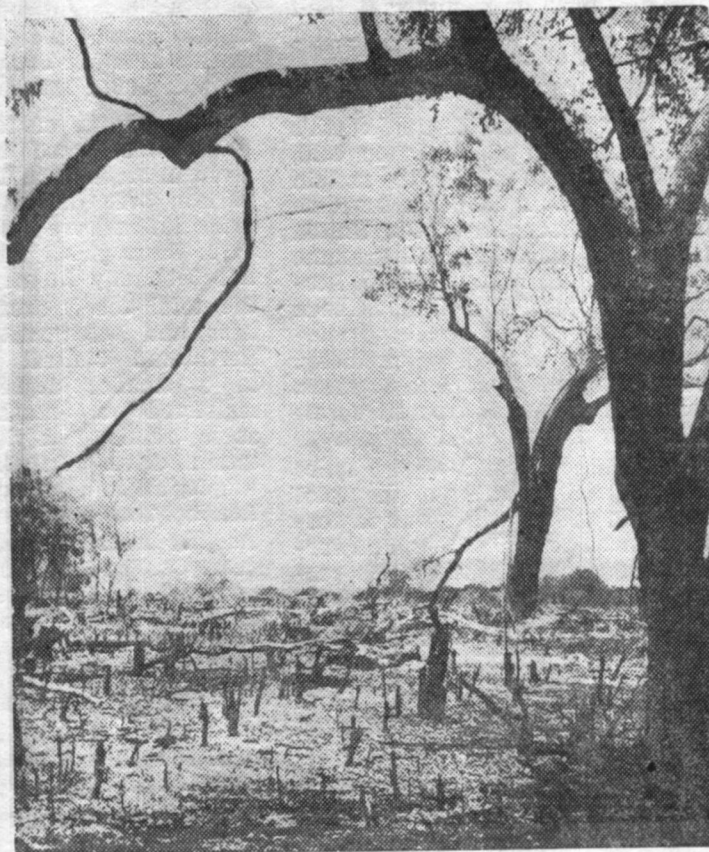


Low Productivity dry zone forests cleared, burnt and made ready for chena reforestation by villagers under a co-operative scheme with the Forest Department.



A few years later. A young teak plantation has been established, an acre of which at maturity is roughly the timber equivalent of 40 acres of original forest cover.

FOREST RESOURCES

The value of forest resources has been brought into sharp focus in Sri Lanka with current cries for more timber for industrial consumption and construction uses while conservationists continue to highlight the dangers of destruction of our forests. The government's programme to build 100,000 houses within the next six years stands the risk of being hampered through a lack of timber. The Building Materials Corporation is importing 300,000 cubic feet of timber to meet urgent housing and construction requirements, at the most the needs for 2000 new houses; while, the State Timber Corporation has also sought Government authority to import quantities of timber to meet part of the current total shortage estimated at nearly 4 million cubic feet. There is also a backlog of pressing needs piling up in the furniture, plywood and packing industries. Regular protests from the carpentry industry of timber shortages, in recent months, only further aggravate the situation. In the meantime, the Plywood Corporation has been deprived of its main raw material supply from Sinharajah with the government's decision late last year that felling in the country's only primeval rain forests should stop forthwith. Conservationists have more to care about with 650,000 acres, of mainly forest land, being brought under the Mahaweli Development Scheme.

The conflict of interests between man and nature is seen here in its most acute form. Many developing nations are busy reducing their forest wealth mainly through their growing populations and their increasing use of wood for fuel and for meeting timber demands of the developed world. Meanwhile, the uses of wood are now extending from construction and fuel purposes to chemical uses (cellulosic uses) and replanting cannot be

done at a pace that would replace felling.

A lack of appreciation of the value of forestry has led to the grave neglect of forest resources in most countries. People have always regarded forestry as an extractive industry. The result is that forests that originally covered over 40 per cent of earth's area have been reduced to less than 30 per cent of the world's land surface today. Of what is left nearly 40 per cent is being put into use for industrial purposes while the remaining 60 per cent is still bare mainly because these areas on which the forests stand are inaccessible or they are not suitable for industries. One result of the reduction of forest resources, along with growing population, is that the demand for timber products has continued to rise and will keep increasing as time goes on. This situation has necessitated much over-cutting of trees which has in turn degraded many forest areas in the world and even caused their destruction.

Except for naturally induced forest fires, man is the sole cause for the destruction of the climax forest types which covered the greater part of the earth's surface in historical times. These clearings were, of course, necessitated for the creation and expansion of agricultural land to feed an ever increasing human population as well as to raise pasture for domesticated animals which themselves kept increasing in numbers, sometimes in an uncontrolled manner.

Man who stands at the apex of the evolutionary tree in this final quarter of the 20th century is himself the creator of some of the worst 'deserts'. The legendary Gobi desert of China and the dust bowls of America are well known examples of what is in store if forests are recklessly cleared.

Modern man in the relatively short space of ten millennia or so of unimpeded development in his evolutionary history is once again looking back on his ancestral home, the forest; this time, with a feeling of nostalgia as if in atonement for all the desecration he has wrought on forests in the past few thousand years, possibly since the Iron Age. The real reason for this *volte-face* is neither compassion nor altruism but, to put it in Darwinian terms, a

matter of struggle for existence and of his own survival. Self centredness? Perhaps, but better now than never.

World Forest Situation

About one-third of the earth's land surface is too dry, too cold, too steep or too sterile to sustain plant growth. In addition to these naturally barren areas, the United Nations Environmental Programme has estimated that one billion hectares of tropical forests have been turned into unproductive wastelands. And it is widely predicted that within the next 25 to 30 years, most of the humid tropical forest as it now exists will disappear.

According to FAO statistics (Table 1), 30 percent of the total land area of the earth was in forest cover as at early 1950's, and surpassed agricultural land at 23 percent, as the overall major form of land use with a per capita forest extent of 1.6 hectares. The total forest extent situation for Sri Lanka at that time was well above the world or Asia average covering 55.6 percent of the land area but the forest area per capita was 0.4 hectares representing a high density of population well above the world average and on par with the average for the crowded Asian continent.

This survey revealed the extreme paucity of forest in certain countries in Africa and a few high-

ly industrialised countries like Britain (6.7 per cent and 0.3 hectares/capita) and the extreme forest wealth of other countries particularly in South America.

The status of forests in the 1970's is reflected by the figures given in brackets in Table 1. A comparison over the 20 year period after 1970 shows a significant feature: on a global scale there has not been any further reduction in the total forest area. Some countries and continents e.g. USSR, North and Central America and to a smaller degree Asia, have registered a marked increases as a result of a vigorous afforestation drive. In China, for example, an annual extent of 5 million hectares is afforested, an area roughly the size of Sri Lanka each year. On the other hand, due to a burgeoning population the forest extent per capita has reduced considerably by 37.5 per cent to a critical 1.0 hectares.

Forest Situation in Sri Lanka

The picture for Sri Lanka is more dismal because not only has there been a reduction of 1.1 million hectares of forest land during this period or at the rate of nearly 1 percent of land area each year but also a marked decrease in per capita extent by 50 percent to 0.2 hectares, which is below the Asian average. In effect, purely going by recent trends, we could

TABLE 1
FOREST AREA OF THE WORLD, ASIA AND SRI LANKA, AND
FOREST AREA PER CAPITA AS AT 1955 & 1973

Continent or country	Total forest x 10 ⁶ ha	Total land x 10 ⁶ ha	Forest as % of land area	Forest area per capita ha
Europe	136 (140)	479	28.3 (28.5)	0.3 (0.3)
U.S.S.R.	743 (910)	2189	33.9 (40.6)	3.8 (3.6)
N. and C. America	656 (716)	1816	36.1 (43.2)	4.1 (2.3)
S. America	890 (896)	2240	39.7 (40.0)	5.2 (4.3)
Africa	801 (605)	2970	27.0 (20.0)	3.9 (1.3)
Asia	525 (568)	2658	19.8 (20.6)	0.4 (0.3)
Oceania	86 (85)	855	10.0 (10.0)	6.7 (4.1)
Total	3837 (3990)	13207	30.0 (30.2)	1.6 (1.0)
Sri Lanka	3.532 (2.4)	6.355	55.6 (36.4)	0.4 (0.2)

Source: *World Forest Resources, FAO Publications, 1955 & 1973.*
(Figures in brackets denote 1973 figures).

be without any appreciable extent of forest in just another three decades or so and reach the stature of a 'desert', or the state of countries like Singapore and Hongkong which have absolutely no forests. It has to be remembered that unlike a 'desert', or these two countries which thrive on industries and tourism, Sri Lanka's economy is largely agricultural and total or major destruction of forests is fraught with serious consequences which will inevitably degrade biological productivity of the ecosystem. The importance of trees and the forest ecosystem has been spotlighted in depth in an earlier issue of the *Economic Review* (October 1975).

A general apathy towards forestry and an attitude of indifference stems from a widely prevalent view that forests are merely undeveloped land which could be cleared in the course of implementing development schemes. Calls for a change in this attitude have been made from time to time but with not much avail. The ominous signs by way of recurring floods and other natural disasters have not helped to stir adequate attention to the importance of forests in the stabilisation of our environment and to consider forestry management seriously enough in land resource plans.

Sri Lanka's forestry picture has changed considerably during the past 20 years. With the rapid strides being made in agricultural development and multi-purpose irrigation projects large extents of natural forests began to be cleared, and even in the forests maintained as reserves heavy exploitation has been carried out to meet the rapidly increasing demand for timber. When it became evident that the natural forests of the dry zone on which we depended for the bulk of our timber requirements was a fast diminishing resource, the Forest Department launched an intensive and annually increasing reforestation programme from the mid 1950's. The present extent of man-made forests in Sri Lanka thus totals nearly 150,000 acres of which more than half has been raised in the past ten years. Just as in the dry zone, in the wet and intermediate zones too, there is acute pressure for land and requests for the release of forests are frequently made and the incidence of illicit clearing is also high. The need to take stock of

the role of forestry in the country's development was never more urgent than today.

The loss of 1.1 million hectares of forest land has been accompanied by the gain of 0.5 million hectares to the organised agricultural sector, the rest to other forms of land use such as settlements and associated agricultural lands, shifting cultivation, grassland, scrub-land etc. Although the official statistic puts down the extent of forest land at 2.4 million hectares in 1973 which in turn is related to the land use figures obtained from aerial photographs of the country taken in 1956, it is well known that vast changes have taken place since then. There is an imperative need to up-date the figures to make them more meaningful and realistic for planning purposes. In fact satellite imagery under the LANDSAT programme has reduced the island's coverage to a mere eight picture frames and their analysis could afford up-dated data. However, it is widely believed that the present forest extent is in the region of 1.6 million hectares. In the next six years another 0.26 million hectares of mixed evergreen forests in the dry zone are expected to be converted to settlements and agriculture under the Accelerated Mahaveli Ganga scheme, reducing the forest area to around 1.34 million hectares or a critical 20 per cent of the land area. (See Box).

The critical level of forest area had been exceeded in the sensitive wet zone of Sri Lanka which forms the major catchment of all main rivers. The central hills or the montane region is also included in this zone where annual rainfall exceeds 2,500 m.m. well distributed throughout the year and there is no moisture deficit at any time

for plant growth. The climax vegetation is the luscious tropical rain forests which are regarded as the best primary producers on earth (Table 2). These forests have a complex multistoried structure and physiognomy (or form), are floristically quite rich in species and carry a high growing stock of timber with potentially rapid increment rates until mature. Their luxuriance has led some into the belief that their conversion to agricultural land would result in high crop yields but this concept is fallacious. It is only the tree element which is able to utilise on its own to the maximum the growing space above and below the ground to put on high increment and dry matter production. It is only the trees with their roots which penetrate the deeper enriched B horizon of the lateritic profile that can make use of the nutrients in this layer for enhanced vegetative growth and through leaf fall, litter, breakdown and mineralisation complete the biogeocenosis cycle to maintain high sustained yield production. Remove the tree layer and then all that is left is the impoverished upper A horizon which can ill support agricultural crops unless heavily fertilised. In hill and mountainous country there are added risks of soil erosion and flooding. When left uncultivated these lands lapse into poor quality 'talawa' grasslands with *Chrysopogon*, *Themeda* grasses and *kekilla* fernlands with *Gleichenia* whose underground rhizomes form a dense matting, rendering further cultivation or succession by other species extremely difficult.

It has often been thought that because thick forest or jungle growth occurs in an area, that area is ideal for growing food crops. This is one reason why many tropical areas have been indiscriminately deforested so that farms,

TABLE 2
NET PRIMARY PRODUCTION AND BIO MASS ESTIMATED
FOR DIFFERENT TYPES OF VEGETATION

	Net Primary Production dry tonnes/ha/yr.	Biomass dry tonnes/ha/yr.
Tropical forest	20 (10-50)	450 (60-800)
Savannah	7 (-20)	40 (2-150)
Temperate forest	13 (6-30)	300 (60-2000)
Boreal coniferous forest	8 (4-20)	200 (60-400)
Tundra and alpine grassland	1.4 (0.1-4)	6 (1-30)
Steppe and other temperate grassland	5 (1.5-15)	15 (2-50)
Agricultural land	6.5 (1-40)	10 (4-120)

Range is given in brackets.

Source: *Whitaker's Almanack* (1970).

settlements, roadways and other facilities for human habitation could be set up. More alarming is the fact that following the fuel crisis much of the tropical deforestation in recent times is aimed at producing firewood and charcoal in many developing countries. It has been estimated that about one half of the world's wood is used for burning in some form.

For agriculture, however, it has been found that unfortunately these areas of luxuriant forest growth will commonly support crops for only two to three years. The main reason is that the forest growth is fed by humus, overlying the actual soil, generated by decaying flora and fauna.

The soil itself is lateritic, and contributes little more than physical support. Such soil is rich in iron and aluminum and poor in just about everything else. When its forest cover is removed, in certain cases, it eventually may take on brick like characteristics. When the forest cover is removed to convert such land for crop raising, the residual forest humus will sustain the crops with decreasing efficiency until its nutrient value is depleted. That process normally takes 2 to 3 years. Chemical fertilizers may extend this time, but once the soil hardens, nothing does much good.

Some of many of the features listed above may have been known to the local inhabitants in historical times. Reference to history and the epigraphical map of Sri Lanka upto the 3rd century A.D. show that most of the clearing and cultivations of land was mainly restricted to the lowland dry zone and the tropical rain forests were left intact ensuring a perennial supply of water in the rivers, canals and tanks for irrigation purposes. With the prudent system of forest soil - water management and planning, agriculture was in its hey day and continued practically unaltered until a few centuries ago. The first serious inroad into these forests started with the enactment of the 'Waste Land Ordinance' of 1840 and the sale of large tracts of especially virgin forests to foreign planters for the cultivation of coffee and, with the coffee-blight crisis, for tea. This unleashed problems of severe erosion especially at higher altitudes and flooding. Wild life too took a heavy beating. Elephants which formed the normal

denizens of these forests fell ready victims to planter's guns and were soon reduced in numbers as to be virtually wiped out from these jungles.

The necessity for the conservation of forests and the stoppage of clearing above 5000 ft. was first brought into prominent notice in 1873 by Sir Joseph Hooker. Mr. F. C. H. Clarke, the first Conservator of Forests in his Administration Report for 1887 states:

"Sir Joseph Hooker, on the report of Dr. Thwaites, then Director of the Botanical Gardens, Peradeniya, addressed the Secretary of State for the Colonies on the subject of the destruction of forests in Ceylon, and the evil effects resulting therefrom upon climate and upon the natural resources of the Colony in future generations. Based on Sessional Paper No. 43 of 1882 by Mr. Vincent of the Indian Forest Service, an Ordinance was passed in the session of 1885 which instituted the "Forest Ordinance."

The Forest Ordinance envisaged the demarcation of Forest Reserves by survey and promulgation by gazette with the intention of conserving them in perpetuity. A Forest Department was set up by Government the same year to deal with: (1) Demarcation of forest reserves (2) Timber and firewood supply (3) Re-afforestation and (4) Extra — Establishments (mainly protection against illicit felling etc.)

It is only in the recent history of Sri Lanka that extensive areas of the wet zone were cleared for the raising of plantation crops and for urban development. The situation would have been very much worse today for our forest resources if not for this law enacted almost a century ago on the advice of the eminent botanist, Joseph Hooker, that no land over 5000 feet in elevation should be cleared. This rule was adhered to rigidly until recent times and the preservation of the montane forest is said to be due almost entirely to this enlightened piece of legislation.

According to the Administration Reports of the Forest Department from that time Forest Reserves had been progressively demarcated and declared in various parts of the country, more particularly in the wet and montane zones. According to the Administration Report of 1902, based on returns furnished by Government Agents and Assistant Conservators of Forests, there was

an extent of 175,853 hectares (439,632 acres) of Forest Reserves and 2,741,845 hectares (6,854,613 acres) of 'other forests' in the country making a total of 2,917,698 hectares (7,294,245 acres). It has to be remembered that while the extent of Forest Reserves may be taken as accurate that of other forest is an ocular estimate only. The first accurate estimate of forest cover was the air survey of 1956 carried out by Hunting Survey Corporation, Canada and the compilation of a Forestry Inventory of Ceylon. The total extent of forest was determined to be 2,865,884 hectares (7,164,710 acres) and 1,196,734 hectares (2,991,835 acres) of Forest Reserves forming 44.1 per cent and 18 per cent respectively of the total land area. From these figures it can be probably inferred that from 1902 to 1956 there was hardly any change in the area of forest cover. From the forestry — soil — water standpoint the extent of forest in the wet zone in 1956 was found to be 240,000 hectares (600,000 acres) covering only 15.9 per cent of the land area in this zone of which 156,574 hectares (391,434 acres) or 10 per cent were Forest Reserves. A more recent study by a Committee on the Conservation of the Natural Forests of the West Zone has shown that 29 Forest Reserves had disappeared altogether or almost so between 1956 and 1972 on account of illicit clearings, village expansion schemes etc., while the extent of Forest Reserves (and probably all forests) had dwindled to a mere 9 per cent of the total land area of the wet zone, a dangerously low level. Land releases, therefore, have been restricted to the most urgent ones and that too for small blocks of land.

Even exploitation of these forests by the State Timber Corporation have been curtailed while in the controversial Sinharajah Forest Reserve, the only primeval forest left in Sri Lanka, fellings have been stopped altogether after nearly seven years of mechanised logging operations. A study of how this operation has affected the conservation of soil, water, forest and other plant species, and fauna may yield interesting results. One of the main reasons to preserve Sinharajah Forest free of human interference is to conserve the genetic resources of this pristine forest which has reached its climax state after aeons of evolutionary growth.

Problem of Forest Protection

A growing problem that militates strongly against forest conservation is that of illicit encroachment and illicit timber cutting of trees and their removal. Although the Forest Ordinance has been in existence from 1887 with certain amendments to make it more of a deterrent, it does not appear to have had the desired effect. Every year as many as 8000 forest offences are registered but the march of forest crime continues unabated which can but cause serious concern to the authorities and to the cause of conservation of an important natural resource. Undoubtedly the problem is a complex one ranging from landlessness (on account of population pressure), timber scarcity (which is becoming more real now than in the past), irregular practises, lack of education and appreciation of forest values, to forest crime committed by purely criminal elements. Inadequacy of the law and lack of certain institutional facilities may have aggravated this problem. A factor which may be of importance and relevance at the present juncture is the need to engage public participation in the management of forests because, often, the forest is looked upon by anti-social elements as a possession of the State to be illicitly exploited and not as property existing for the welfare of the people. (See box on "Lessons from the Chinese experience").

ROLE OF FORESTS

Let us pause to consider the role of forests and forestry. Much has been written and known and disseminated on this subject. The protective, productive and aesthetic roles of forests have been succinctly included in a declaration of the Seventh World Forestry Congress which, inter alia, states: "Forests counter erosion, protect agriculture, reduce floods, assure clean water, provide amenity and recreation, shelter wild-life, reduce pollution, generally constituting a defence against environmental deterioration; provide timber, wood based industrial products and forest products which enter into every sphere of man's activities, and also provide employment. In short, forests make a decisive contribution to environmental, social and economic progress."

In afforested and other planted areas, trees and forests also make a positive contribution towards environmental improvement.

Green plants, particularly trees among land plants, act as vehicles for maintaining the delicate CO₂ ratio in the atmosphere through photosynthesis and respiration.



During photosynthesis the plants take in CO₂ and evolve O₂ in the presence of sunlight. It has been shown that photosynthetic rate leading to the manufacture of carbohydrates is increased within limits by increasing the CO₂ concentration of the air. Hence the anticipated CO₂ output in the biosphere could naturally and most effectively be utilised by trees and forests to increase primary production. Increased absorption from a CO₂ polluted atmosphere by forests could be expected to lead to a corresponding increase in liberation of O₂. From the equation above it follows that for every molecule of CO₂ absorbed a molecule of O₂ is liberated in the forward process. During respiration which is more obvious by night the reverse takes place. Over-all, the amount of O₂ output for exceeds CO₂ output in order to maintain the normal gaseous ratio in the air (CO₂ — .03% and O₂ — 21%). For this reason forests are also referred to as the 'green lungs'. The vast virgin stretches of tropical rainforest in the Amazon estimated presently at over 250 million hectares are said to help in maintaining global gas exchange at normal levels for sustenance of life, also referred to as 'the green lung of the world'. The normal situation can well be imperilled because forest areas are going under the bulldozer even in the Amazon. Yet man can live without normal supply of air for only 5 minutes! The need to cover the countryside with trees cannot be over emphasised.

Protective Role — Pollution

The untrammelled growth of industry, transport and human population since World War II has focussed attention in recent years on grave pollution problems of the biosphere. It has been estimated by M. M. Khamshilov in his book "Evolution of the Biosphere" that about 6000 million tons of carbon-dioxide are released into the atmosphere every year by industrial plants. At this rate the amount is expected to double in the next 150 years causing a considerable rise in the earth temperature. According to this source, the sea level will rise 60 metres inundating coastal areas accompanied by an all-round reduction in land surface by 10 per cent. Melting of the glaciers in the polar regions, especially the Antarctic, would follow and this has been predicted by the same author to lead to a change in inclination of the earth's axis and to alter the velocity of the earth's rotation. Geologists predict earth movements and volcanic eruption. To the carbon-dioxide efflux from industrial plants must be added the amounts respired by the human population which is growing daily by about 50,000 persons (and estimated to be 8 billion by 2000 A.D.), that from burning organic matter; and the vast quantities of both carbon-dioxide and carbon emitted as exhaust gases from motor vehicles; esti-

mated at 0.5 million tons of carbon 100,000 tons of hydrocarbons and 26,000 tons of nitric oxide daily, from about 250 million cars alone that travel this planet.

Atmospheric pollution by CO₂ and exhaust gases is not the end of the story. Internal combustion engines withdraw O₂ from atmospheric circulation and compete directly with living matter, including man. According to V. I. Vulfson as quoted by Khamshilov, by 2000 A.D., the O₂ withdrawal will amount to 95 per cent of the annual output from photosynthesis by all land plants. Concentration of dust, soot and other noxious chemicals like CO₂ and SO₂ are said to exceed admissible quotas by 5 to 10 times in heavily industrialised cities.

These are perhaps only some aspects of the pollution problem but portend a real danger to the environment and all living things including man. Unfortunately this evil is no respecter of boundaries between countries so that a danger in one point can be spread by air or water to other countries during global circulation. Global pollution despite rigid anti-pollution laws and measures in several countries has been blamed for increased health hazards (e.g. bronchitis, cancer etc), breakdown in normal weather cycles causing floods, droughts and other natural disasters such as violent earth-

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quakes and tidal waves which appear to be occurring with greater regularity in our own life time.

It is at this point that trees and forests constitute a bulwark against deterioration and make for environmental improvement. Forests abate noise, act as pollution 'sinks' by filtering dust, soot, radioactive fall out and even absorb toxic chemicals to varying limits depending on the tree species. They also serve as pollution indicators through exhibiting such symptoms as yellowing, browning or leaf scorch which when correctly correlated are helpful in developing remedial strategies. Lead from lead-tetra-ethyl of exhaust gases of motor vehicles is absorbed by leaves of several species thus preventing further dissemination. For this reason alone planting good lead — absorber species alongside the main highways in Sri Lanka ought to be most welcome. In view of reduced growing space along side roads in urban areas, species, planting and tending methods may have to be well chosen and improvised so as to cause minimum obstruction.

It is not surprising therefore that the protective function of forestry has been given precedence over the production function for the supply of timber. It is generally accepted that forests play a vital role in moderating the effects of climate and reducing the noxious impact of pollution in the atmosphere. Forests help in ameliorating the effects of rain and wind, in checking soil erosion and controlling the water regime of the soil. A major problem, however, in trying to evaluate the economic benefits of forests is to quantify in economic terms their protective role and benefits. If the role of forests were only, or mainly, that of producing timber or any other commercial product, it would not be difficult to make an economic evaluation of forests as an investment. The difficulty in quantifying the importance of the protective role of forests however, precludes the straightforward assesment of its importance within the national economic framework.

The minimum extent of forest cover required in this country will depend on several factors such as the rainfall and soil. What should be considered adequate protection would also depend on the value placed on soil and water resources

and there is no doubt that these are of great significance to the economy of Sri Lanka. This factor has not been considered seriously enough in this country. Thus the protective role of the forests must assume greater importance in the wet zone where rainfall is high and the terrain generally steeper than in the dry zone. But recommendations have been made from time to time by various experts either ignoring the zonal differences in this country or not giving due attention to them. Recommendations are often made for the retention of a minimum extent in forests for the island as a whole.

Forestry Integrated Agriculture

In many areas of the world forestry is intimately integrated

with agriculture to mutual advantage of both. The use of shelterbelts (several rows of trees) and windbreaks (one of a few rows of trees) in windy and/or arid regions have rendered otherwise unproductive land suitable for agriculture. Research and experience have shown that shelterbelts when correctly designed and planted with the requisite species can reduce windspeeds effectively for distances upto 15 to 20 times the mean height of the belts, lower mean annual temperature (by lowering the maximum and raising the minimum), increase relative humidity, reduce evapotranspiration on the sheltered sides and as a consequence of these effects significantly raise agricultural yields. Noteworthy

examples on the successful use of shelter-belts are to be found in China, India, Pakistan, U.S.A. and parts of Europe and Africa. In semi-deserts shelterbelts also minimise soil erosion by wind and are a prerequisite to agricultural production. In Sri Lanka too the familiar example is that of shelter-belts in the Uva basin which have rendered the windswept patana areas fit for agriculture and human settlement. More use could be profitably made by integrating shelterbelts with agriculture in the dry and arid zones of Sri Lanka. The vast area of 260,000 hectares (650,000 acres) of mainly forest land coming within the command of the Mahaveli Ganga scheme in the dry zone is a case in point. Rather than plant shelterbelts be-

latedly a wiser course of action would be to leave behind the far more effective belts of natural forests in vantage positions to meet this need. In practise, however, such belts when left even in chena reforestation areas have been often subject to depredatory fellings by cultivators under the guise that these interfered with agricultural crop yields and supposedly harboured monkeys which damaged crops. To counter this harmful trend demonstration plots

and education could go a long way.

Yet another method of forestry integrated agriculture is a forest or timber farm where regular rows of timber and/or fruit trees at wide espacement (10 to 20 metres) are grown with agricultural crops as a permanent form of land use. This system is applicable in less windy areas than where shelterbelts are necessitated and where there is pressure for agricultural land. It is a good compromise bet-

ween forestry and agriculture and the demand for both their products can be met simultaneously. These farms are common in Central China and are worthy of consideration for emulation in parts of Sri Lanka where there is an ever growing pressure for land. Of particular relevance are the highland allotments in settlement schemes and chena areas in the vicinity of villages and hamlets.

In hilly and mountainous countryside forests are *a priori* necessary for soil and water conservation and for the maintenance of agricultural production in the valleys below. Where this cardinal relationship has not been observed, as in several instances in Sri Lanka, farmers have suffered agricultural losses as a result of irreparable harm to the biological and physico-chemical productivity of the affected ecosystem. Other notable effects are on dry weather flows of streams and rivers and siltation of reservoirs on which depend not only irrigation but also the successful harnessing of water resources for generating hydro-electric power. Ready reminders are water and power cuts experienced in the country from time to time.

The importance of water resources for agriculture and industry have been repeatedly emphasised as in these two statements made by two leading local scientists. "Water resources and vegetation, particularly forests, are inextricably linked. Without sufficient water and excellent management of it, our agriculture will not be successful. Water is also a source of power and without it our industry would collapse". (R. L. de Silva).

"Let us not forget that besides the land, water is our greatest basic resources and on it depends all the plans for the development of agriculture and for the generation of electric power, and a steady supply of silt free water can be ensured by keeping the catchments in forests. Having removed 86 per cent of the forest cover in the wet zone region the best we can do now is to retain every bit of the balance." (L. C. A. de S. Wijesinghe).

Productive Role

The use of timber for a wide variety of constructional and structural purposes, such as fuelwood, industrial wood products (e.g. plywood, chipboard, hard board, paper and paper boards and the like) and of forest products like

medicinal plants, tannin, resin, essential oils, wild game etc. demonstrate the extent to which forests enter the daily lives of people and of society. In fact man is so dependent on forests that the two have become inextricable companions and one cannot do without the other, particularly the former. That this is so can be inferred from the amount of all forest products that are produced the world over and kept in global circulation. (See Table 3.). The demand for this renewable resource are bound to measurably increase in the foreseeable future with the prediction of its increasing use the world over, competition from substitutes like steel and plastics notwithstanding. Based on per capita consumption, the trend is one of increasing use of industrial wood which is being met more and more by import substitution via the Salawa woodworking complex, the Embilipitiya pulp and paper mill and similar industries established locally.

Total wood consumption per capita in Sri Lanka can be regarded as high, of which fuelwood forms a major component. According to a UNDP survey carried out in this country between 1964

TABLE 3 WORLD FOREST PRODUCTS — IMPORTS, EXPORTS & PRODUCTION (1975)

	World	Africa N. & C.	America S.	Asia	Europe	Oceania	USSR
Imports value in US \$ x 10 ³	2875811	928286	5059899	880989	5753794	15123593	546759
Exports value in US \$ x 10 ³	26136681	802716	8454590	381309	2653371	11607579	302050
TOTAL PRODUCTION (x 10 ³ m ³)	2430755	31976	461499	236372	702532	294851	28132
roundwood equivalent							387600 F

Source: 1975 Yearbook of Forest Products, FAO Publication

(F-FAO estimate)

Sri Lanka is heavily dependent on imports of industrial wood products as seen from the recurrent net deficit in her balance of trade in forest products from 1964 to 1975 (Table 4) computed at official par rates of exchange (without FEECS).

TABLE 4 FOREST PRODUCTS — IMPORTS, EXPORTS & TOTAL PRODUCTION FOR SRI LANKA

	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
IMPORTS (x10 ³ Rs.)	52402	45200	67539	56820	46651	58100	56318	72018	55741	55741	74924	71842
EXPORTS (x10 ³ Rs.)	2665	3051	3584	5255	5374	3722	217	176	120	120	120	128
NET DEFICIT BALANCE (x10 ³ Rs.)	49737	42149	63955	51565	41277	54378	56101	71842	55621	55621	74804	71714
TOTAL PRODUCTION (x10 ³ Rs.)	4180	4260	4345	4415	4500	4595	4675	4755	4855	5054	4961	5026
roundwood equivalent												

Source: 1975 Yearbook of Forest Products, FAO Publication.

TIMBER FOR HOUSING AND OTHER INDUSTRIES — DIMENSIONS OF THE PROBLEM

The problem of timber for housing and other industrial needs could reach crisis proportions if concerted action were not taken early. For instance, in national housing a target for the construction of approximately 100,000 housing units has been set and the possibility of achieving such targets would depend very much on the problems of materials supply such as timber.

A former Chairman of the Ceylon Plywoods Corporation has estimated that even for a comparatively small house for the low income groups, a minimum of about 40—50 cu. ft. of sawn timber would be required for roofing, door frames, doors, window frames and window sashes. Additionally timber is also required for shuttering, scaffolding struts etc. In terms of sawn timber requirements the average requirements per housing unit would work out to about 70 cu. ft.

To obtain the amount of sawn timber about 100 cu. ft. of logs would be required. Hence to achieve the national target for the year a minimum of 10 million cu. ft. of logs would be needed. A more reasonable assessment of log requirements per annum would be about 15 million cu. ft. of logs.

At present extraction of timber is carried out mainly by the State Timber Corporation. The Plywoods Corporation and other private agencies also contribute to log supply. An annual timber harvest of nearly 6—7 million cu. ft. of log timber is produced by these three agencies. Extraction by private

agencies include the supply of Albizzias (mainly for the match industry) from private gardens and log plantations, as well as the supply of rubberwood obtained chiefly from re-planting areas in the country.

The allocation of timber based industries is as follows:—

Plywood	2.8 million cu. ft.
Furniture	1.5 million cu. ft.
Railway sleepers	1.0 million cu. ft.
Packaging industry	1.0 million cu. ft.
Tea chest pattens	0.5 million cu. ft.
Match industry	0.5 million cu. ft.
	<u>7.1 million cu. ft.</u>

It would therefore be seen that the entire timber resources of the country are needed to service the above industries and that hardly anything is left for national housing. Hence there is a serious constraint in timber supplies for the successful implementation of the national housing policy. This situation would be further aggravated by the natural expansion in the future of the other timber based industries mentioned above.

Hence if the problem of national housing is to be adequately solved it would be of paramount importance to formulate a crash programme giving the highest priority to the exploration of alternative sources of supply and the rationalisation of the use of timber, if timber imports are to be limited and their use optimised.

and 1967 total industrial wood consumption was found to be in the region of 17 millions cu. ft. equivalent to a per capita consumption of 1.5 cu. ft. while fuelwood from State forests, rubber plantations (the main source), palms etc. was as high as 125 million cu. ft. or per capita 11.3 cu. ft. for all types of fuel wood, according to the Pre-Investment Study on Forest Industries Development — Ceylon. Vol. II. UNDP / FAO Report, 1969. Although there are a few hundred tree species in the natural forests, only a limited number constitute utilisable industrial wood for various reasons, chiefly durability. However, with the progress of wood technology it has been

possible to render 'inferior' species utilisable. A noteworthy example is the boron treatment of rubberwood which has revolutionised use of this timber for high value purpose such as furniture.

Some idea of the productive role of timber (including firewood) merely as a raw material can be gained by its contribution to total GDP. Based on certain surveys it has been estimated at current factor cost as follows:—

	1963	1972	1973	1974	1975
1. Value-added amount (million Rs.)	88.6	2119.9	229.8	243.4	248.6
2. % of Agricultural Sector	3.1	4.7	4.2	3.1	3.0
3. % of Total GDP	1.3	1.6	1.5	1.2	1.1

Source: Department of Census & Statistics.

However, in any total assessment of the impact of forest products on the national economy, their indirect contribution to other sectors of the economy such as in Manufacture, Transport and Storage, Employment etc. have also to be taken into account.

Rise of Plantation Forestry in Sri Lanka

The demand for constructional and locally manufactured wood products had, upto a few years ago, been met almost solely from the natural forest resources of the country. However, past exploitation of these resources or more aptly 'timber-mining' together with a rapid diminution in extent of forests have led to a not unexpected depletion of timber output. Increasing reliance has therefore been placed on the creation and management of compensatory man-made forest plantations which have risen steeply from 20 hectares of teak in 1880 to a phenomenal 101,348 hectares of various species mainly teak in 1976, according to the Administration Report for 1976 of the Conservator of Forests. This is still a small proportion of the total forests in the island, being probably around 6.3 percent and a still smaller fraction of the total land area, being 1.6 percent. However this cover is bound to increase to 300,000 hectares (0.75 million acres) or 4.6 percent of total land area by 2000 A.D. at the present rate of formation of nearly 8000 hectares (20,000 acres). The long term Forestry Development Plan, 1970, foresees the satisfaction of the demand for industrial wood from this source in the future, one of the clear objectives of present day forest policy anywhere in the world.

The main species used in reforestation are teak in the dry zone, Jak/Mahogany in the intermediate zone and Eucalypts and Pines in afforestation of fernlands and grasslands in the wet and montane zones. Indigenous species which are far slower growing than the exotics referred to are grown to a limited extent. Compared to over two decades ago, forest plantations have become relatively ubiquitous in Sri Lanka. These yield fairly

standardised premier timber as reflected in the high value component of the total turn over of the State Timber Corporation. Of a total turn over of Rs. 54 million during 1976, yield of plantation timber amounted to Rs. 13 million or 25 per cent although its volume was only 13.9 percent of the total. This contribution is likely to rise steadily with the progressive maturing of the plantation forest estate, according to the Conservator of Forests.

Teak in the dry zone, the species planted most (60 percent of total), carries by far the highest socio-economic gain. In raising this species blocks of poor quality dry zone forest are leased out to local villagers, who fell, burn the jungle and plant rows of teak at 3 m x 3 m (10' x 10') and tend them over a 3 year period. In return, they are paid Rs. 250/- per hectare (Rs. 100/- per acre) as rewards and allowed to intercultivate with cash crops like paddy, chillies, bananas, mustard, millet, maize, vegetables etc. between the rows of teak. It is estimated that apart from providing direct employment to about 2000 persons and indirect seasonal employment to another 10,000 persons per annum, this method of raising teak (also referred to as the Chena Reforestation System) with an integrated extensive form of agriculture results in the production at present prices of about Rs. 10 million worth cash crops in the first year alone.

The enormous capital value of teak plantations can be gauged from the fact that at a rotation age of about 50 years on a good site it is worth about Rs. 100,000/- per hectare at the very minimum. A fifth to a sixth of this amount is also harvestable in the form of intermediate thinning yields. Based on these figures, the potential capital value of all teak plantations is equivalent to at least Rs. 7,750 millions, as estimated in the Forestry Development Plan (1970). It has been estimated that teak can yield Rs. 87,500/- per hectare profit over a rotation period of 50 years at current cost and price levels or a financial return of 10.6 per cent on capital investment. In other words, forestry under these circumstances is a financially safe and sound investment.

Eucalypts and Pines are grown on shorter rotations, 15 to 40 years, depending on site but the financial yields are lower than for teak but more attractive than tea or rub-

ber on poor quality or degraded sites. Under the current UNDP sponsored "Crop Diversification Project", forest species like Eucalyptus and Pines have been advocated for growing on uneconomic tea and rubber lands. It has been estimated that there are about (248,000 acres) of such tea and about (75,000 acres) of rubber lands. Forests still have the ability to resuscitate gradually an ecological imbalance brought about by a century of land mismanagement by man.

Forests are managed not only for timber but also for any of its products like wood, chemicals including essential oils, resins, gums, bark, edible fruits and seeds, medicinal plants, honey, wild life and a wide array of produce and they also promote environmental conditions so unparalleled by any other ecosystem that Lord Buddha characterised a forest as "a peculiar organism of unlimited kindness and benevolence".

AMENITY ROLE

In the inter-relationship between man and forest the wheel has turned one full circle from a civilisation which looked upon forests as an impediment to progress to one at the present time which looks upon them as a much needed entity, amenity being one of the potent reasons. In highly industrialised countries amenity forms an important aspect of forest policy. Amenity forests, belts and individual trees of various species noted for certain intrinsic values are planted for the beautification of urban and rural areas and to embellish roads, parks and the general landscape. The use of trees for landscape designing is widely recognised and the trend is one of greater use in the long term. In China, for example, millions and millions of trees, mainly saplings or 'instant' trees, have been planted under '4-sides' planting i.e. along roads, railway lines, villages (and homesteads) and rivers (and irrigation canals) to invigorate an enervated countryside caused by centuries of reckless deforestation. In Sri Lanka, tree planting on a limited scale is carried out each year under the annual tree planting campaign to good purpose, though a more sustained campaign can bear greater results.

Any one taking a walk in a forest cannot fail to be convinced about the 'freshness' of the forest air and its coolness but above all

LESSONS FROM CHINA'S FORESTRY EXPERIENCE

Forestry holds one of the keys to rural stability and well being in a largely agricultural country exemplified by the case of China. That this is so is amply borne out by the disastrous effects of wide-spread and uncontrolled deforestation in historical times which led to floods, droughts, serious erosion, by wind and water alike, desertification etc., all factors which promoted destabilisation of village settings and led to haphazard migration of populations to more secure rural and urban areas. The end result was a depopulated countryside with barren mountains and flood plains at lower elevations, and desert in the north and north-east parts of the country.

Among the quantifiable benefits from China's forestry development programme are that it: improved micro-climate; improved soil and water conservation, increased agricultural, animal husbandry and fishery yields; increased timber and wood products yields; aided full employment; increased revenue; improved standards of living; improved infra-structural support; and stabilised townships (communes) and villages (brigades).

POLICY

The call in China to 'cover the countryside with trees' with mass participation is well worth including in our forest policy to adequately compensate for massive deforestation over the past three decades and which is likely to still continue under the impetus of big and small development schemes like the Mahawell, village tanks etc. The preservation of natural trees and protective belts or forests in vantage positions within developed areas to cater to environmental and population needs can save us from the experience of China where once green areas were converted to desolate deserts due to the folly of reckless deforestation.

The twin call to 'integrate forestry with agriculture, animal husbandry and fisheries' is eminently suited as part of national forest policy in order to maximise productive potential of entire local ecosystems. This will alleviate greatly the long-standing competition that has existed between forestry and agriculture in overall land use planning.

The incorporation of public or every citizen's support in fostering and protecting trees and forests in our forest law, as done in China, would overcome its purely prohibitive and penal nature and on the whole serve the cause of forestry. One of the striking points about China's forest law is its simplicity and clarity of expression and intent so that it could be understood and practised even by the simplest peasant.

Forestry Support

In its present state of development Chinese foresters categorise forestry into: Conservation or Protection forestry; Timber forestry; Industrial forestry; and '4-sides' tree planting.

The most abundant of the forests in China are those created and maintained purely for timber and its products, but the most important from the point of view of support for agriculture are the different kinds of protection forests. The conservation or protection forestry is divided into shelterbelts or windbreaks, sand dune forests and soil and water conservation forests.

The mainstay of production forestry in China are the natural forests which at present are relegated to the Northern Coniferous and Mixed Conifer Broad leaves forests of North East China and the Tibetan region. In Central and Southern China tree species such as *Thea oleosa*, *Aleurites fordii*, *Sapinum sepperferun*, *Juglans* and *Castanea* are cultivated for the production of edible and industrial oils on lands marginal for agriculture but considered too good for timber trees.

Industrial Forestry

The silviculture and growth of *Thea oleosa* (tea seed oil) was detailed by the forestry technicians of Chu Chu county where it has been grown as plantations for over 300 years. It grows best on acid, deep soils in warm, humid regions with precipitation varying from 700 to 2400 mm. Two varieties have been identified: a small fruit variety with light green leaves and a large fruit one with dark green leaves, preference being given to the latter because of ease of picking them. Since 1970 intensive cultivation using horticultural methods

have been adopted such as use of select vegetative grafts, manuring and fertiliser application, pruning, terracing and soil working, all of which have increased per hectare yields from 20 — kilos two decades ago to 100 — 120 kilos at present. Similarly seed oil content has increased from 33% to over 42%. The oil is yellow, fairly viscous, odourless and stored well up to 10 years. Besides making for good cooking, it is used as lubricant, rust-proof agent and raw material in soap manufacture. Tannin and activated carbon are also made from their fruits making *Thea oleosa* a most versatile species. It has a few fungal diseases which are easily controlled by use of fungicides. Disease resistant trees are therefore proliferated. Intercropping with agricultural crops eg. peanut, legumes, sweet potatoes etc. is common.

'4-sides' Tree Planting

One of the most remarkable features of forestry in China is '4-sides' tree planting. By this is meant the planned planting of trees in serried or single rows along roads (and rides), railway lines, villages (and homesteads) and rivers (and canals) — RRVR planting. The ubiquitous and meticulous manner with which this type of planting has been done, obviously by mass participation, strikes the eye of a visitor from the time of arrival at Peking airport to the remotest brigade. Literally millions and millions of trees of numerous species and uses have been planted to 'green' and improve the landscape and even render inhospitable deserts from N-W to N-E China habitable areas.

The species used under this scheme are commonly the ones used for afforestation namely: *Popars*, *Pines* in the northern regions; *Pawlonia*, *Plane Willow* in Central China and *Thea oleosa* *Aleurites*, *Meelia azadirach*, *Eucalyptus* and *Casuarina equisetifolia* in South China and Hainan Island.

Although there is evidence of limited roadside planting in earlier times such as those seen on pavement walks of the cities of Zanchow and Changsha, the bulk of the plantings seen on my tour date from the time of liberation. Trees planted out are mainly saplings or 'instant' trees raised in large tree nurseries at different levels.

Observations of a Forester, recently returned from China.

Benefits of Forestry Development for Rural Poor — World Bank Plans

Warning that forest areas in developing countries could disappear altogether within 60 years, the World Bank has now announced plans to step up its investments in the forestry sector.

In the next five years, the Bank plans to lend some \$500 million in the sector, and to change radically its approach to forestry development. The outline of the problem, and the ways in which the Bank will seek to help bring a halt to dwindling forest resources in the developing world are contained in a comprehensive report titled "*Forestry*". Some of the report's findings:

The forest area in developing countries today total more than 1,000 million hectares, or only one-half of what it was at the turn of the present century. Population pressure is the principal cause of the rapid over-exploitation of what is — or at least should be — a renewable resource, which endows the world with benign ecological effects and whose uses are all but limitless.

Humans are — out of perceived necessity, destroying the basis of their own livelihood as they violate the limits of natural systems.

The most vulnerable are the poor of the world. Their search for the basic requirements of food and fuel often force them to hasten the destruction of their own productive environment.

What must be done, is to bring about a change that will result in a large share of resources being allocated to rural afforestation programs that will directly benefit small farmers.

The way ahead is to establish fuelwood plantations; shelter belts, fruits, nut, and fodder trees; and rural forestry protection works,

including reforestation of eroded catchment areas and sand dune stabilization.

There is now greater concentration on rural forestry projects, and increased attention is being given to environmental and forestry protection during the formulation of forestry projects.

Future Directions

As for directions for the future, there is a need for continued emphasis on rural development projects. Such lending on a large scale to low-income groups, is an appropriate response to ecologically destructive patterns. The challenge is to bring about, in the policies of developing countries, a change that will result in a larger share of resources being allocated to rural afforestation programs that have a wide impact on the incomes of small farmers.

Emphasis on research activities in a number of countries that will help the Bank implement more effectively its forestry policy objectives. Attention should be given,

the other things of nature's creation. The imperative need is to foster the development of man's love to live with nature if he is not to perish probably like the dinosaurs of old.

On balance, there is an equal need for an integrated approach to multiple use management of land which aims at prudent development of this resource without sacrificing conservation requirements of the biosphere.

It is evident from recent experience that exploiting our forest resources can be quick and easy but building them up must be a long and by no means an easy task. Forestry has a vital role to play in the disposition of our land

for example, to hydrological studies in forest catchment areas; development of low-cost catchment afforestation and soil protection techniques; systematic field crop trials with special emphasis on agroforestry/crop/livestock combinations; technological research into low-cost wood burning, heating, and cooking systems with increased efficiency of combustion; trials of fast-growing industrial plantation tree species; and research into appropriate technology for smaller wood-processing industries.

Action to reverse the current trend of environmental degradation cannot come quickly. The Bank report states that "in almost every country, the environmental benefits from forestry are being ignored..... (and that) the acceptable limits to the rate of forest exploitation are being breached.

Yet, the study notes that though, in places, these trends are worsening, "there is an awakening interest in managing forests for development. This awakening is manifest in a reorientation of perceptions about the ways in which forests can be used to further the goals of development and in the number of modified approaches being tried in practice."

resources. In land use planning it should not be looked upon as a competing form of land use, but as being complementary to agriculture. With the increasing emphasis on food production, and rice production particularly, there has been created to some extent in place of natural forests a man made and very delicately balanced ecosystem. Foresters have been preaching the importance of forests in maintaining the balance of nature, in conserving soil and regulating water flow, in acting as natural barriers to the spread of disease and in harbouring birds and other useful animals which prey on pests and parasites on cultivated crops. For long the foresters voice was not heard by many, but this is no longer the case today with scientists of all disciplines, governments, international organisations and all enlightened persons beginning to take serious note of the various inter-relationships in the biosphere.

the mental tranquility induced in this environment. Persident Kennedy was reported to have said that he often conceived his high ideas while strolling amidst the giant Sequoia trees. Did not Lord Buddha attain nibbana beneath the serenity of a bo-tree? Trees and forests, therefore, are necessary not only to meet physical needs but also for mental survival. Little wonder that people especially in highly urbanised societies yearn to get away from it all to the countryside where they can hope to be 'at one with nature' midst trees, birds, bees, butterflies and