FAO FORESTRY PAPER 31

appropriate technology in forestry

FOOD AND AGRICULTURE ORGANIZATION
OF THE UNITED NATIONS ROME

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report of the
consultation on intermediate technology in forestry

held in new delhi and dehra dun
18 october - 7 november 1981

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome 1982

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ABSTRACT

The SIDA/FAO Consultation on Intermediate Technology in Forestry took place in India from 18 October to 7 November 1981. It was held under the FAO/SIDA Cooperative Programme and made possible by a special contribution from Sweden. The Consultation was hosted by the Government of India and organized by FAO, in close collaboration with the Department of Agriculture, SIDA in India and the Logging Training Centres Project in Dehra Dun.

The purpose of the Consultation was to contribute to the development of intermediate local technology and to raise its level in rural areas; to spread information amongst forestry top supervisers and staff responsible for forest operations with regard to the balancing of equipment and investment in forestry against prevailing social conditions, and the role and status of intermediate technology in this.

The Consultation was attended by 37 participants sponsored by Sweden, from Bangladesh, Bhutan, Burma, China, Fiji, India, Korea, Pakistan, Papua New Guinea, Philippines, Malaysia, Singapore, Sri Lanka and Thailand.

The Programme of the Consultation included lectures, case studies, group work, general discussion and study trips.

The participants of each country were requested to present a Country Report reflecting the conditions prevailing in their home countries.

The Report is a compilation of the documents presented by the lecturers at the Consultation and the Country Reports prepared by its participants. The Consultation's Recommendations are also included in the Report. It has been published in order that the information contained herein can attain a wider distribution.

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Photo: Li-Guang-da

INTRODUCTION

The FAO/SIDA Consultation on Intermediate Technology in Forestry took place in India from 18 October to 7 November 1981. It was held under the FAO/SIDA Cooperative Programme and made possible by a special contribution from Sweden. The Consultation was hosted by the Government of India and organized by FAO in close collaboration with the Department of Agriculture, SIDA, and the Logging Training Centres Project in Dehra Dun.

FAO attaches great importance to the impact of a Consultation like this as a means of transferring knowledge and appropriate technology and providing a forum for discussions and exchange of experience between countries.

The problems encountered in the mechanization of forest operations need to be discussed thoroughly and guidance given on what can be done to adapt the level of technology in Forestry to the social conditions prevailing.

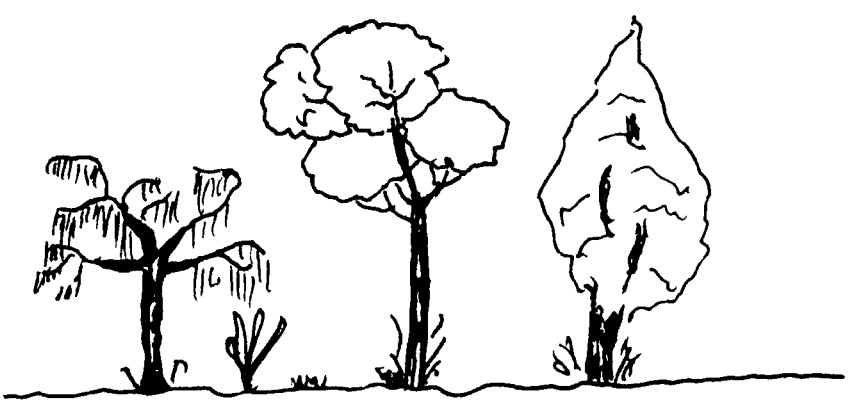
The Consultation was opened by the Minister of Agriculture, Mr. Rao Birendra Singh and the address given by the Secretary, Ministry of Agriculture, Mr. S.P. Mukherjee. The Inspector General of Forests, Mr. N.D. Bachkheti, welcomed the participants and the FAO Representative in India, Mr. J.G. Pumcan, also addressed the meeting.

During the first two weeks the Consultation was attended by 25 participants and, during the last week, they were joined by another 12 top level executives.

The following countries were represented: Bangladesh, Bhutan, Burma, Fiji, China, India, Korea, Malaysia, Pakistan, Papua New Guinea, Philippines, Singapore, Sri Lanka and Thailand.

The Director and Co-Directors of the Consultation were, respectively, Mr. Gunnar Segerström, FAO, Rome, Mr. K.C. Thapliyal, LTCP, Dehra Dun, and Mr. Floyd Werner, SIDA, India. They were assisted by Mr. Jagir Singh, LTCP, Dehra Dun.

The lectures were delivered by guest speakers from India, Sweden, Thailand, and the ILO. The programme included lectures, group work, general discussions and study trips.



Welcome Address

by

Shri N.D. Bachkheti, Inspector General of Forests

It is my proud privilege to extend to you all on behalf of the Government of India and myself a hearty welcome to this Consultation on Intermediate Technology in Forestry. The Consultation has been organized jointly by the Food and Agriculture Organization of the United Nations and the Swedish International Development Authority. We are happy that India was chosen as the venue of this Consultation, particularly at this time when we are introducing various types of new techniques and equipment with the help of SIDA. I understand that such programmes are underway in many of the countries represented in this Seminar. We are trying various techniques and machines, accepting some, rejecting others, and modifying still others to suit our conditions. There is general agreement that abrupt switchover from a low level technology in forestry being practised in developing countries to the very high level technology practised in developed countries is not desirable. We hear of push button operations, computerised saw mills, and radio controlled cable cranes as the usual operations in forestry in developed countries. This is very sophisticated equipment requiring a very high level of skill, training and maintenance. But, at the same time, they reduce the employment potential, which we can ill afford.

It has been observed that mechanisation could bring down the cost of forest harvesting to half, compared to manual working by conventional methods and tools, but employment would go down many more times. We would certainly not like to cut down employment because that provides means of livelihood to our many millions. In developing countries the process of advancement in felling techniques started from axe, changed over to saw and improved saw, then rapidly to chainsaw and now to tree shears. In this pattern of change we have to find our appropriate place and adopt the befitting technology and tools. I understand Malaysia has changed over completely to chain saws between the period 1969 to 1979, but most of the developing countries are still using a combination of chainsaws and hand tools in felling and crosscutting.

The change-over depends on the volume of timber to be cut, the skill and quantum of manual labour available, socio-economic conditions and working traditions. The same is true for off-road and on-road transportation of timber. For the developing countries, thus, a middle level of technology is considered the best solution that would balance man and machine in such a way that one helps the other. Such technology has been named as Intermediate Technology. Studies made in various developing countries by the International Labour Organisation have shown that intermediate or improved labour-intensive technology for forestry is prevailing in most of the developing countries. Adoption of such appropriately balanced technology has led to increased productivity when compared with more primitive techniques but decreased labour displacement when compared with more capital-intensive sophisticated techniques. In addition to generating productive employment these intermediate technologies combine in varying degrees the properties of improved working conditions and enhanced worker's safety. An example from the ILO study in Philippines is worthwhile quoting. The labour uses a machete or jungle knife called "Bolo" for debarking pulpwood. The project did not use the capital-intensive method of mechanical debarking but, instead, replaced the "bolo" by a properly designed debarking spade. The labour productivity increased from 33 to 129 percent, depending upon the type of timber debarked, without much significant reduction in labour employment.

When we talk of increased productivity, we have to keep in mind the vast gap in demand and supply of wood, which is going to widen further if remedial measures are not taken. FAO observed that the gap between demand and supply in the Asia-Pacific region which was about 20 million m^3 in industrial wood would rise further during the coming years. There is going to be a formidable gap between demand and supply of fuelwood in South Asia where nearly all our rural population depends on fuelwood as their main domestic energy source. With these facts staring at us, we are left with no choice but to improve our techniques, besides embarking upon large-scale man-made plantations. It is estimated that nearly one-third of the wood production in the world is left behind in the form of logging waste. Considering that the total wood production in the world is of the order of 3,000 m^3, one can imagine the scope that exists in augmenting wood resources simply by improving techniques of harvesting. In India it is estimated that a simple change-over in felling and conversion of fuelwood from axe to saw will save 12 million tonnes of fuelwood every year. Similarly, in the interior Himalayan region, where transport facilities are virtually absent, 50 percent of the coniferous wood is left in the forest to rot, the greater part of which can be retrieved by employing intermediate technologies suitable to the circumstances prevailing there.

This Consultation has very important tasks ahead. It will be your recommendations from which forest technologists will draw inspiration and guidance for improving the situation in their respective countries. I have no doubt that, after your discussions, meaningful recommendations will emerge which will have far-reaching effects on the working of our forests. Our ultimate aim in forestry is conservation of the existing forest resources and augmenting them further. In developed countries, due to the untiring efforts of foresters and conservationists and with the use of suitable technology, the forests have stabilized, but in developing countries this is far from the case. Forests are still being cut wantonly, wasteful harvesting methods are still in vogue, and the existing forests are getting thinned out without adequate replacement. It is against this background that we have to consider the question of adopting appropriate technology.

Before concluding, I again welcome you all to this Consultation and wish you a very useful and enjoyable time.

Address

by

Shri S.P. Mukerjee, Secretary of Agriculture, Government of India

The concept of technology is perhaps one way of seeking a better return on investment, financial or otherwise. Sometimes technology helps save energy or substitutes one kind of energy for another. In any case, technology is a purpose-oriented concept. When early man designed tools from flint, he wanted better productivity. When gathering and hunting economy gave way to land husbandry and disciplined crop production, it was yet another step towards better productivity. The point I wish to make is that technology has an attribute of "relevance" and is not just an academic pursuit but an applied science.

The Consultation here, as I understand from the background material, has relevance as a basis. Intermediate technology could perhaps be better understood if termed "Relevant technology". After all, if the intention is to develop or adopt a technology suited to a situation, it is one of relevance and not one of adopting a lesser or intermediate level of skills than the situation demands. Be that as it may, I wish to address a few points on relevance, with reference to the state of Forestry in developing countries and what is perhaps the needed orientation for technology in relation to Forestry.

The dependence of early man on forests was total. The yearning for better comfort and more productivity also necessitated by the pressure of increasing numbers, has led to a civilization which weaned him away from forests. The stages of such evolution can be visualized and need no elaboration. The pace of these developments was not the same in industrialized and developing countries. The role of forests in regulating the ecological equilibrium had come to be appreciated in the developed countries far earlier. Fortunately for them, new vistas had also opened up with the discovery of underground fossil resources. This helped them to depend less on forests for direct needs, so they conserve them for indirect long-range benefits. We are told that, in 1974, less than one percent of total energy used came from wood and wood products in developed countries while, in developing countries, it was as high as 25 percent. About 55 percent of the world's forests are in developing countries but, sadly, the per capita forest is hardly 0.71 hectare, while in developed countries it comes to 1.6 hectare. This is one dimension of the problem - an offshoot of population pressure. Then there is the question of utilization and management. It is reported that Finland and Congo have about the same size of forest and land area and yet the value of forest products from Finland is sixty times greater than that of Congo. Surely there could be several reasons, and one of them must certainly be underutilization or inadequate management. I cite this only in passing and it is not of immediate concern.

My anxiety is that, historical reasons apart, the developing countries also should sooner appreciate the more valuable indirect benefits of conservation, such as containing floods, droughts, maintaining the stability of river valley catchments, hydrological patterns, and so on. Today in certain parts of the developing countries the main preoccupation is not so much food but fuel to cook it. No wonder, as I understand, if it provoked a cynical title to a Forestry paper reading "Why grow more food? Soon there will be no way to cook it". Certain statistics are really astonishing. Fuel gathering, it appears, now requires 360 man days annually for a household in Zambia and 250-300 man days in Central Tanzania. In parts of West Africa people seem to have only one cooked meal a day. In the uplands of Nepal, we are told, only vegetables which can be eaten raw are grown.

It has been estimated that in 1975-76 about 60 to 80 million tons of cow dung were burnt in India as cooking fuel. This, it has been said, if used as fertilizer, would have augmented the food production by 45 million tons. In other words, we were burning

food to prepare food. This highlights adequately enough the importance of forests in our economies. With fossil fuels depleting at a fast pace, forests constitute the only easily renewable substitute resource of energy. But what happens when we cross the safety thresholds in cutting forests inadequately? IUCN tells us that desertification is proceeding at the rate of 60,000 m^2 or equivalent to twice the area of Belgium every year. Surely this is as bad a situation as not having fuelwood to cook food. This is the dilemma the developing countries are facing on the forestry front. One has to set the boundaries and thresholds to ensure that the resource endures and is not under utilized or over exploited.

Please address yourselves to these critical concerns of developing nations. Think of a technology that can alleviate the drudgery and provide the common man with a better quality of life. Do not confine application of skills to the point of conversion of primary produce but take it to tertiary level; maximizing per hectare the yield of fuelwood is just one step forward, but think of better thermal efficiency of fuelwood through improved versions of stove or hearth.

Let not technology be judged by mere output/input ratios. Assess in absolute terms how it benefits the end-user and how you can multiply such beneficiaries. In the immediate context let the emphasis be not only on saving energy for better productivity but also on saving forest and maximizing the utility of harvest.

Mr. Gunnar Segerström
FAO, Rome

Mr. J.K. Ganguli
Deputy Inspector General
of Forests, India

Mr. S.P. Mukerjee
Secretary of Agriculture
Government of India

INAUGURAL ADDRESS

by

The Hon. Rao Birendra Singh
Minister of Agriculture
India

Though the history of forestry development has varied from country to country yet the problems, concerns and aspirations of the people of the participating countries are similar. All are developing countries, as far as forest technology is concerned, and are concerned about their forests, forest resources and about providing employment to their men and women. The demands of our rapidly increasing millions and the resulting pressures on forests is a problem which is jointly shared by us all. On one hand, we have the problem of shrinkage of forests by deforestation, which as per different estimates is going on at the alarming rate of 10-25 m.ha per annum in the tropical countries and, on the other hand, we have the problem of wasteful methods of harvesting and converting trees into utilizable sizes, in which sometimes even up to 70 percent of the timber is wasted. I understand the present Consultation will mainly concern itself with the latter problem; though the former cannot be ignored for proper appreciation of the entire problem.

For meeting the problem of deforestation and impoverishment of existing forests different countries are adopting different strategies. Enrichment of the existing forested areas by better protection and interplanting plantation of fast growing species over denuded areas and blanks and replacement of poor stocks with higher yielding stocks have been widely adopted to increase the productivity of forests. In India, we have tried to curb the tendency for deforestation by enacting a legislation which requires that no deforestation of Reserved Forests, or use of forest land for non-forestry purposes, will be done except with the prior approval of the Central Government. I understand there are stringent measures adopted in the developed countries to ensure that the forest area is not reduced. I feel that such measures are all the more necessary to be adopted strictly in the developing countries in which deforestation is going on too fast.

Regarding the problem of wastage of forest products, particularly of wood, in the developing countries, most of the methods employed for conversion of trees are wasteful in terms of time, money and effort and uneconomical and inefficient in terms of output. While afforestation of wastelands and mountain slopes is imperative for maintaining ecological balance and harmony between man and his environment, it is equally important that trees, which come of age and become silviculturally exploitable, are not felled, hacked or hurled down in the ruthless manner in which the earlier wood gatherers had been doing for centuries. In the past the forest resources were abundant and population dependent on them was small. It, therefore, hardly mattered if due precaution were not taken to utilize every bit of the timber or other forest produce. The present day needs and shrinkage of forest necessitate that utmost caution is used to ensure that the forest products are properly conserved and wasteful methods of harvesting them are given up in favour of methods ensuring fuller utilization. It is here that proper technology has to play an important part.

The rise in population, the world over, is pressing us to augment our forest resources in spite of demand of land for agriculture and other non-forestry uses. At the same time, conservation of our present forest resources and maximum utilization of available timber have been engaging our attention more and more. Advanced methods and techniques of logging and timber conversion have been used, successively and progressively, in several of the countries represented in this seminar and much can be learnt from each other's experience. The seminar provides a forum for sharing expertise, experience and

insight and a mechanism for solving problems. It is in this perspective that we have to consider the various aspects of adoption and adaptation of technology in forestry relevant and suitable to different situations obtaining in different countries.

The world is facing an energy crisis. The non-renewable energy resources are fast depleting and hectic efforts are being made to find alternative renewable sources of energy. In this respect, forests and forest products play and will continue to play a major role, inasmuch as they provide an alternative. About one-third of the world's population depends upon wood as its principal source of energy and roughly half of the wood consumed in the world each year still fulfils its original role for humans, that is, fuel for cooking. In the developing countries, which consume nearly half of the whole wood production of the world, more than 80 percent of wood produced is consumed as fuel, whereas in the developed countries only about 15 percent of their wood production is consumed as fuel, the rest being used for industrial purposes. In the developing countries the rural population almost entirely uses fuelwood, crop residues and cow dung for cooking food. We are, therefore, faced with the problem of maximising our wood production and conserving our forest resources much more than the developed countries. We have been working our forests with outmoded and even primitive techniques, with the result that a large part of our forest produce is wasted. Even small changes and improvements in techniques will affect the output of forest products significantly. Control of direction of felling of large trees in the forest by use of wedges and ropes appear an insignificant change but hundreds of young seedlings which could form the future forests would be crushed if the tree falls in the direction where they occur. The whole bole of the tree can be smashed and entire timber lost if it falls in a wrong direction. In felling and conversion the use of saw instead of the conventional axe can make a considerable difference. Adoption of appropriate improved technology cannot be delayed any longer now. All these matters will, no doubt, be considered by you during your deliberations.

When we talk of technologies we talk of a number of interactive forces, together with the fundamentals of science. Technology is, in part, a set of techniques that are currently in use or may be of potential use and, in part, an amalgam of social, economic and cultural factors that are essential for successful use. Basic techniques may hold good in different countries but technology adaptable in a locality has to get conditioned by various local factors. This makes technologies not transferable as models from developed to developing countries. The application of a technology necessitates a thorough understanding and consideration of a number of interactive and interdependent economic, sociological, geographical and cultural aspects which emanate from factors like climate, local availability of materials, qualitative and quantitative features of labour resources, population dynamics and social and cultural traditions. Intermediate technology, as the phrase suggests, implies a mid-way advance in acceptance and application of technology from a 'low' to a 'high' level. In this context it will be relevant to mention the observations made by a United Nations team of Experts in a UNIDO Report. They observed that, with the widely divergent conditions in developing countries, no single pattern of technology or technologies could be considered as being appropriate, and that a broad spectrum of technologies should be examined and applied. An important overall objective of appropriate technological choice would be the achievement of greater technological self-reliance and increase of domestic technological capability, together with fulfilment of other developmental goals. It was noted that, in most developing countries, a major development objective was to provide adequate employment opportunities and fulfilment of basic socio-economic needs of poorer people resident in rural areas. The appropriate pattern of technological choice and application would need to be determined in the context of socio-economic objectives in a given set of circumstances.

In the highly developed countries very sophisticated machines have been used for forest harvesting. Chainsaws for felling and logging of trees, tractors, skidders and forwarders for handling and transport of logs, computerised sawmills for conversion of logs into desired sizes are things we hear of. Adoption of such machines ensures fuller utilization of the felled trees and cleaner operations but also results in considerable reduction in employment. In countries where unemployment is rampant, adoption of such

sophisticated machines will result in problems associated with unemployment. In developed countries, the number of people dependent on forest working for livelihood is comparatively small. In the U.S.A. the number of such people is just about one hundred thousand. With the use of sophisticated machines the number of such persons is further likely to be reduced. But this would not present a problem because the people weaned out from forest working will get alternative jobs. In developing countries, however, the position is different. The number of persons depending on forest working for their livelihood is much larger, and they would have no alternative jobs if they are denied the occupation of forest working. We have, therefore, to adopt a technology which, while ensuring better utilization of felled trees, does not rob people of their means of living and consequently create a national socio-economic problem. Our technology will have thus to be an advancement over the primeval and conventional level, but not of the high level which might create hiatus from employment point of view. The appropriate level will have to be different for different countries and in, fact, for different localities in a country, keeping in view the various local factors mentioned before.

One thing I would like to lay stress on is the adoption of or change over to a new technology taking into consideration the locally available talent. In fact, the local talent should form the basis for the change from the low level technology to intermediate technology. This would result in added employment and added expertise. In India, for example, there are people adept in blacksmithy which could be used as base for further development. I am very happy to learn that our SIDA consultants of the Logging Training Centres Project have given considerable thought to this aspect, and have taken pains to develop and motivate local manufacturers in the production of basic logging tools.

I would like this Consultation to discuss the applicability of different technologies under different sets of conditions in a comprehensive manner. In particular, I would like you to consider the ways and means of avoiding wastage in conversion of timber in situ in remote inaccessible areas. Remote inaccessible areas such as the interior valleys of the Himalayas, are highly sensitive and any excessive or ill-organized working in such areas will have many harmful effects, not only on the local ecology but also on the far distant plains. It is, therefore, important that whatever fellings are done in these areas, they are done with utmost caution, causing least disturbance to the local vegetation and soil and at the same time ensuring best possible utilization of the removed trees. Improvement in technology is also necessary in transporting the material from the felling sites to the main roads or rivers - as considerable damage is known to be caused in these operations at present. Exploitation of forests brings, in its wake, erosion of soil due to transport of heavy timber on land, particularly in tropical lands where rainfall is high and concentrated in short periods. The problem is much more serious on mountain slopes. No doubt, you will be considering several situations, but I mentioned particularly only these problems which are causing us a lot of concern presently in this country.

We have luckily had unrestricted access to international technology in the field of forestry through the good offices of the FAO. We have opportunities to foster and share our knowledge with organisations like SIDA. I understand Sweden is almost at the top in use of most modern technology. At the same time SIDA has intimate knowledge of the limitations of the developing countries and has done a lot to develop appropriate technology for different sets of circumstances prevailing there. We are indeed grateful to FAO and SIDA for organizing this International Consultation and for choosing India as venue. We are bound to benefit most, for your recommendations would reflect our conditions and needs, which you would appreciate during local tours.

With these remarks I now declare the Consultation open and wish a very fruitful interaction for the benefit of all participating countries and others.

General Introduction to Appropriate Technology in Forestry

by

Gunnar Segerström, FAO, Rome

Summary

There is a growing element of concern that forest operations in some developing countries are often overmechanized, if one considers the often high rate of unemployment prevailing and the often difficult social conditions. The reason for this mechanization at the expense of social and cultural factors is frequently a combination of the kind of training and education given to forestry officers and of the licencing system, which necessitates the use of short-term entrepreneurs and contractors for logging, for which the forest departments often do not have the technical capabilities to control these harvesting operations.

Most of the foresters in developing countries have a very sound silvicultural management background. However, the socio-economic side of forestry is usually not emphasized in their training.

Furthermore, there is an enormous disparity between the small amount of resources devoted to improving labour-intensive operations in forestry in developing countries and the amount of research and effort devoted to developing new machines and sophisticated methods in industrialized countries. If only a fraction of the research, experience and knowledge available in industrialized countries were directed towards basic or intermediate technology, the employment potential could be increased. This would, of course, bring positive benefits, amongst which the lightening of the workload of forest labourers in developing countries.

Background

In the old days educated foresters were mainly conservationists; they dealt with primary forest production, identifying, measuring and protecting trees. Forests were often locked into reserves and withheld from the people. Foresters often had a limited interest and/or knowledge regarding the technical side of forest operations.

As most of the machinery used then was simple and manually operated, priority was given to the control of the quantity of wood extracted and to prevent damage caused by logging and transport. Logging did not require any high degree of professional skill and could be carried out by local people who usually worked as contractors with short-term or seasonal assignments. But often it was not the machines which were responsible for the damage caused to soils or to residual stands but the manner in which they were operated, which was in turn a function of supervisory and managerial skills.

In developing countries especially, this type of forestry officer still has an impact on forest operations and this has created an artificial conflict between mechanization and silviculture or environmental management, mainly due to the conservative attitude of foresters which fails to take into account the real social and economic objectives and partly stems from the lack of technical background and practical experience in this specific context.

Mechanization in forestry should be regarded as a servant of social and economic objectives. The choice of the appropriate level of mechanization depends on conditions prevailing in the country. Promotion of research should be a fundamental priority in forestry policies so as to increase the national technological capacity of developing countries and reduce their dependence on the industrialized world.

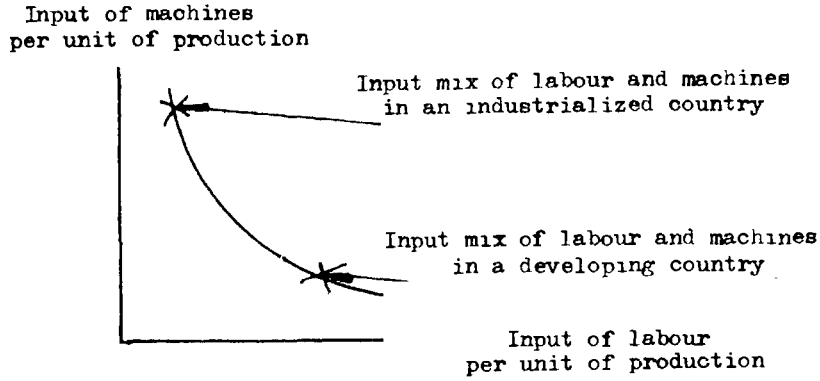
When going deeper into the subject of degree of mechanization, there is an enormous disparity between the small amount of resources devoted to improving labour-intensive operations in forestry, in order to make them more competitive, and those resources devoted to the development of new machines and sophisticated methods in industrial countries.

There should be no insuperable technical and economical difficulties preventing assistance to forestry people at grass root level in order to improve their traditional methods. It is a paradox of the western mentality to think that simplicity seems to be the least valuable of our capabilities.

The Need to Mechanize

The need to mechanize forest operations varies according to the countries involved. In the more developed countries labour is scarce and expensive and becoming increasingly reluctant to undertake arduous, uncomfortable and dangerous work. Similar trends are also emerging in developing countries. If the operations are not at least partly mechanized, it will be difficult to manage and harvest forests economically. There is, however, a well-known fact that the technological side of forest operations in developing countries, today, is an attractive playground for so-called progressive "new shots" in forestry where one tries to win one's spurs.

When the difference in labour costs can be up to 100 times less in a developing country than in an industrialized one, it is easy to understand that the level of mechanization must be different. The curve in the following diagram illustrates the balance between input of machines and input of labour.[1/]



Very often forest operations in developing countries are over-mechanized. What is the reason for this? If we take, for example, the introduction of chainsaws in the logging operations, we note that in many developing countries it is not yet economically feasible to compete with two-man crosscut saws, whatever the kind of chainsaw used. In some developing countries it has been shown that, with proper working techniques, two-man hand saws are economically outstanding, provided good maintenance and correct sharpening methods are applied. Nevertheless, the introduction of the new technology is proceeding at an alarming rate and is unfortunately destroying traditional methods, work sites and local production of simple handtools such as hand saws and axes. This places the poor forest worker in a more desperate and helpless position than he was before. Mechanization is introduced in order to increase productivity but it makes higher production more sensitive to equipment breakdowns and often contributes to increased unemployment.

1/ From an Analysis of Mechanization in Forestry.
A Method Study. Ulf Sundberg, The Swedish University of Agricultural Sciences, 1979

Basic Technology in Forestry

Basic technology in forestry represents something more than a simple, good, but poorly elaborated idea. Indeed, it means the development or improvement of tools and equipment for forestry which extends human labour and skills, whereas the use of machines tends to replace human labour and eliminates or minimizes human manual skills. It also represents a more comprehensible and controllable scale of organization and mistakes and it helps establish a self-sustaining and expanding reservoir of skills. Of course, a lot of skill is needed also of a good tractor driver but the difference is that he needs a well planned maintenance and service organization to be efficient. He is no longer self-sustaining, he is depending on a background of assisting service of fuel, spare parts and repair service, which make also simple mechanization more complex and vulnerable.

If, as is mentioned above, basic technology is so good, why hasn't it been more generally accepted in developing countries?

One of the main reasons seems to be that the training and education systems of foresters in developing countries have often neglected this aspect of the problem. Therefore, creativity and ingeniousness in this field have not been encouraged, as it is apparently a less exciting and progressive way to work than with the sophisticated methods used in industrialized countries. One can easily imagine what amount of will power a forester educated in modern methods must have in order to stick to basic technology in forestry operations, still using what he regards as old fashioned and traditional tools and equipment, particularly when dazzling information concerning new super-efficient machines flows over him from industrial countries. Often he is considered conservative, not only by his supervisors but also by his own workers, who have heard about chainsaws and efficient multi-purpose logging machines.

The Need for Research in Basic Forest Operations

The rapid technical development of forest operations in industrialized countries has made working conditions rather complex. In order to solve this problem from the economic environment and ergonomics point of view, a tremendous amount of research has been undertaken to ascertain optimal methods and equipment suited to various forestry conditions.

One important reason for this large input in research to improve forestry working conditions is that there is less chance for the forest worker to select the work methods to be used. Since decision-makers at management level have a good technical and economic education, they work on all data available regarding human beings (biological, maximum possibilities and restrictions) as well as on all technical data concerning the machines to be utilized. They are then capable of combining these data in order to get an optimized implementation. Research in this specific field of operational efficiency in industrialized countries is therefore pretty sophisticated and well advanced in comparison with the resources made available for forestry operational research in developing countries.

As an example, the need for more research about heat stress and nutrition for forest workers can be mentioned here. Some research done (Axelsson, 1974) has shown that the working capacity is reduced to 50% when environmental temperature rises from 25°C to 34°C. Unbalanced nutrition also strongly influences forestry workers performing heavy labour. In order to ensure an optimum adaptation of workers to heat exposure and adequate food, a thorough approach is needed so that the working conditions are better fitted to workability, to motivation and to existing living standards.

Basic Technology in Forestry (FAO, 1981) does not imply that technology is always primitive. Traditional methods utilized old fashioned tools and equipment which did not incorporate the improvements made available through modern technology. But with limited studies and some research, these tools and equipment can become much more efficient when applying good scientific know-how. We can think, for instance, of the old hand saw which involves so many problems of maintenance, setting and sharpening. For the same tool, modern technology has produced hardened teeth which often double the work output and, at the same time, reduce energy output by half, provided the saws are well designed and maintained.

This is why further work studies and research can be used to help to adapt simple tools and equipment, with the objective of lightening man's load and reduce the human energy required to perform many forestry tasks.

Minister of Agriculture
Mr. Rao Birendra Singh
Government of India

Mr. Gunnar Segerström
FAO, Rome

Mr. C.G. Mossberg
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Mr. Floyd Werner
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RECOMMENDATIONS

as adopted during the final session of the Consultation

The following Recommendations based on lectures, discussions, group work, documentation and field studies were drafted and adopted in plenary by the participants.

1. The Consultation recommends that the broader expression "Appropriate Technology" be used instead of "Intermediate Technology".

2. Technology should be "appropriate" with regard to local conditions and to the combined effect on:

- production, quantity and quality
- employment
- ergonomics, occupational safety and health
- socio-economic conditions
- ecology
- energy
- availability of tools and equipment

3. As these conditions differ from country to country, technology cannot be easily transferred but needs proper local analysis before adaptation, modification or further development to become acceptable.

4. Effective implementation of appropriate technology requires development of supporting management and organisational systems in line with the existing facilities and resources.

5. The Consultation further recommends that the following points be considered:

5.1 Production

Production must satisfy local demands (fuel, building material, local wood processing) in balance with outside market requirements.

5.2 Employment

5.2.1 Governments are usually aware of the employment potential in forestry but strong efforts should be made in implementing adopted policies by fully utilising these possibilities.

5.2.2 Human resources planning should be included in the forestry planning system. In areas with unemployment labour-intensive methods should be used.

5.2.3 Employment policies should also aim at creating a basic permanent work force of trained forest workers. Priority should be given to locally recruited labour.

5.2.4 Sub-contracting should be discouraged and workers be directly employed by forest departments, forest corporations, etc.

5.2.5 Agro- and community forestry systems, the collection and processing of minor forest produce and cottage industries should be promoted to increase employment possibilities in rural areas.

5.2.6 Efforts should be made to identify and study institutional obstacles in relation to the introduction and development of appropriate technology. Ways and means of overcoming these obstacles should be explored.

5.3 Ergonomics, occupational safety and health

5.3.1 Technologies cannot be considered appropriate without basic ergonomic requirements being respected.

5.3.2 Forestry work is usually physically demanding. Heat stress may considerably reduce the working capacity. Adequate nutrition and rest periods should take these conditions into account. Reasonable shelter and clothing is required, especially in cold winter climates.

5.3.3 Good collaboration between Government authorities, employers and workers is necessary in order to improve the ergonomic situation in forestry and to ensure that technology develops in line with ergonomic requirements. Safety regulations and instructions should be issued. Suitable safety equipment (e.g. boots, gloves, hard helmets, first-aid material) should be provided.

5.3.4 Ergonomics and safety should be included in foresters' training and workers' training.

5.3.5 Check-lists on ergonomics and safety should be set up in order to analyse different technologies applied in forestry operations.

5.4 Socio-economic conditions

5.4.1 The existing and potential manpower of each country should be studied with regard to method of production, living conditions and other socio-economic factors by means of a census or case studies.

5.4.2 The opinion of local populations and manpower should be considered in determining the technology to be adopted.

5.4.3 The Consultation stresses the need to uplift the socio-economic status of forest workers through appropriate fiscal and legal measures to a level comparable and competitive to that of other workers in the country.

5.5 Ecology

Attention should be paid to environmental conservation when deciding on forest technologies to be adopted as higher levels of technology can be more destructive to the environment if not properly applied. Therefore, care must be taken to ensure that introduction of new technology be preceded by proper demonstration, training and practice aiming at environmental conservation.

5.6 Energy

5.6.1 Appropriate technologies should be applied in respect of growing and harvesting fuelwood.

5.6.2 There is considerable scope to utilise logging waste as fuelwood or charcoal by promoting improved technologies, such as charcoal making with portable kilns, and briquetting and pelleting of charcoal powder.

5.6.3 Fuel-saving techniques should be promoted by introducing improved stoves, by supporting the installation of bio-gas plants and by developing machines operated by producer-gas (gasification of wood or charcoal).

5.7 Availability of tools and equipment

Local manufacture of improved tools and equipment is crucial to develop appropriate technologies. At the same time it will reduce or eliminate dependence on imports. Close collaboration between users, manufacturers and research organisations is needed to make sure that locally made tools meet the necessary standards.

6. Training

6.1 Training must be an integral part of technology development. It should be carried out on a continuing basis as regular activity. This requires institutional support at all levels.

6.2 Training should be provided for all grades of foresters, managers, supervisors, foremen and workers, to ensure that appropriate technologies will gain practical importance and receive large-scale application.

6.3 Training requires qualified instructors who should be highly motivated and who should be fully skilled in practical job requirements. Selection and training of instructors, adequate remuneration and prospect of promotion are of great importance to ensure that instructors remain on the job for a reasonable length of time.

6.4 Specialists in forest technology development and training should also be kept on their post for a reasonable period of time to fully benefit from their experience.

6.5 Workers' training should be based on adequate terms of employment and working conditions. There should be wage incentives for trained workers. Training should lead to upgrading the social status and prospects of forest workers.

7. General considerations concerning future action in the Asian Region related to the Introduction of Appropriate Technologies in Forestry.

7.1 To promote appropriate technologies in forestry an integral approach is needed, which combines the development of tools, equipment, techniques and methods with training at all levels including the worker level. Such activities should include logging, silviculture, community forestry and agro-forestry. They should be in line with environmental requirements and be based on adequate working and living conditions provided to forest workers.

7.2 Emphasis should be placed on national initiative aiming at strengthening, expanding or introducing the necessary research and training facilities. If required, regulations should be issued to ensure the application of appropriate technology.

7.3 Technical cooperation among developing countries should increase regional exchanges for the promotion of appropriate technology in forestry. In addition, international organisations and other donor agencies are invited to reinforce national and regional activities on appropriate technologies in forestry. It would be appreciated if FAO and ILO would pursue their collaboration in this field for the benefit of the Asian countries.

7.4 Furthermore, it is recommended that the international organisations concerned continue their efforts to pool international expertise on appropriate technologies in forestry at the interregional level; and to make it available without copyright restrictions to member countries through reports and training manuals for wide distribution in their official languages with such a proper layout which facilitates translation into local languages.

8. Specific recommendations on future activities

8.1 Participants in the Consultation should help to promote appropriate forest technologies in their home countries and to launch national activities in this field. Participants of future similar meetings should submit a proper report on these activities.

8.2 Focal points should be identified in the individual countries dealing with problems related to technology development and training in forest operations.

8.3 FAO and ILO in collaboration with other donor agencies should continue to carry out regional seminars and workshops on forest technology and training, and should provide fellowships for participants of member countries to attend such meetings. Among the subjects to be covered work study should be given special priority as a means to determine appropriate levels of technology. Collaboration with the International Union of Forest Research Organisations (IUFRO) in this area is recommended.

8.4 It would be highly desirable to keep countries of the region informed on new developments by issuing a newsletter on appropriate technologies and training (see 8.5). The draft of the Handbook on Basic Technology for Forestry Operations should be amended according to the suggestions made during the Consultation.

8.5 To promote regional exchanges it would appear necessary to create, on an ad hoc basis, a regional working group on forest working techniques and training in which FAO, ILO, donor agencies and countries particularly experienced in technology and training will collaborate. This group should be involved in preparing regional seminars and workshops and in issuing the newsletter (see paras. 8.4 and 8.5).

8.6 At the next meeting of the Asia Pacific Forestry Commission the status of this working group may be considered and a decision be taken on its future function.

WORKING PAPERS

Technology in Developing Countries - An Overview

by
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"Technology" has been defined as the "skills, knowledge and procedures for making, using and doing useful things". 1/ Broadly, this definition includes "knowledge of organization and methods of production in all economic activities, public and private". 2/ Technology is dynamic; ever since the cave dwellers made knives of bones and stones and invented the technology of skinning and cutting flesh, it has been developed to fulfill the increasingly diverse consumption needs of human beings.

Even in primitive, closed societies, a choice among alternative technologies was usually available to meet specific needs. With passage of time and the increased accessibility to knowledge and skills, such choice became wider. Yet, the technology adopted in a society for a specific purpose was, generally, the one considered most appropriate, that is, the one which best fitted into its existing social and economic fabric. 3/ Consequently, growth of technology was, in the absence of exogenous pressures, appropriate, even though, over time, the purpose of production changed, by and large, from auto-consumption to that for the market place.

With the emergence of market-oriented production the costs of technology, as might be expected, assumed importance, In laissez-faire societies, factor prices (of labour and capital) were, however, dependent on their relative availabilities. Technology, consequently, developed to take advantage of that factor of production which was in abundance and, therefore, comparatively cheap. It was because of such considerations that, in the labour-scarce, post-Industrial Revolution era in the West, technology became progressively more capital intensive. This process still continues, though not necessarily for the same reasons.

Experience has shown that when permitted to grow in the absence of external forces and domestic distortions, technology develops "naturally" on the principles of comparative advantage. Such development has, unfortunately, by-passed many developing countries in the recent past, with serious consequences. The purpose of this paper is to trace, briefly and simply, its causes, so as to permit meaningful and socio-economically sound suggestions for solution.

Technology in Developing Countries

Transfer of technology among far-flung, presently developing societies actually came in the wake of traders who sailed the high seas in the quest of commercial gains. Where appropriate, little difficulty was encountered in assimilating the same. The situation became different, however, after the Industrial Revolution took place in the West.

1/ Merrill, R.S., "The Study of Technology", Encyclopedia of Social Sciences, D.L. Sills, ed., Macmillan, New York, 1968.

2/ Steward, Frances, "Technology and Employment in LDCs", Employment in Developing Nations, E.O. Edwards, ed., Columbia University Press, London, 1974.

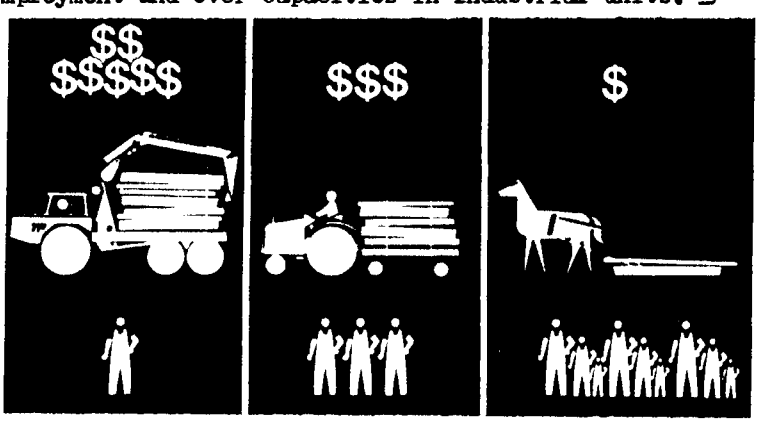
3/ Romanovsky, Peter, "Appropriate Technology", Development, December, 1980.

"Modern", capital-intensive technology, developed for use in comparatively labour-scarce countries, was transplanted by colonial rulers in their domains, primarily to meet the growing raw material requirements of the industries at home. Along with the growth of these technologically advanced enclaves, came also the signs of a "Dualistic" economy - a modern, capital intensive, high output sector side by side with the traditional, by and large technologically indigenous, agricultural sector. Although return to labour in these sectors was unequal, a comparatively low population, and its geographical dispersion, prevented the growth of social tensions.

Most developing countries, however, found the situation different when they attained their independence. There was, on the one hand, an established market of consumer products for the inhabitants of the economically advanced enclaves, on the other hand, there was a large surplus of labour, unable to find gainful employment in the traditional, basically agricultural, sector. Rapid industrialization appeared to be the obvious remedy, not only for promoting employment, but also for ensuring economic growth and prosperity.

Industrialization in the developing nations, at least in its infancy, meant a great dependence on imported tools and machines. Capital intensive in nature, they were more appropriate for conditions existing in the West. To ensure accelerated growth of industries, deliberate policy choices were also made. Those commonly followed in practice, among others, involved protecting the domestic consumer goods market, controlling foreign exchange, over-valuing domestic currency, lowering the rate of interest on borrowings, raising the rate of depreciation, providing tax-incentives, making import of capital goods easier, and linking import of raw materials to the installed capacity of individual industrial plants.

Such industrialization policies were, by and large, successful, just as they had been so in many of the developed countries in the past. The autarkic policies, scope for profitable investments and facilities for import of high output, technologically intensive, capital equipment, led to rapid growth of industries. Along with this, however, also came increased unemployment and over-capacities in industrial units. 1/



Implications of Modern Technology in the Developing Country Context

Most developing countries, with their high rates of population growth, are now faced with a large and growing force of unskilled and unemployed labour. Although dismal, the situation, at first consideration, suggests a simple solution - training facilities be provided and jobs created through establishment of new industrial units.

1/ Little, Ian; Scitovsky, Tibor; and Scott, Maurice, Industry and Trade in Some Developing Countries, Oxford, London, 1971.

Unfortunately, the establishment of new industrial units, together with the development of requisite infrastructure, can be a very costly proposition. It would, perhaps, not be an exaggeration to state that the number of technologically advanced units that need to be set up to provide work, even marginally, for this growing force of under-employed and unemployed labour is beyond the means of most developing countries. It is also unlikely that, in view of low domestic income and savings and foreign exchange constraints, this situation will change dramatically in the foreseeable future.

Under such conditions, when capital-intensive technologies are permitted to be transplanted without adequate thought, either for their prestige value or because of aid-tying and carpet-bagging, scarce resources get blocked without perceptible impact on the unemployment problem. Further, because modern technologies also require highly developed infrastructure and management skills not readily available in developing countries, the social costs of production tend to remain very high.

Establishment of a few, technologically inappropriate, production units, also has adverse effects on the societal income distribution. The existing dualistic structure of the economy becomes more pronounced, leading to potentially explosive, social situations.[1/]

Choice of Technology for the Developing Countries

Considerations cited earlier, therefore, seem to suggest more labour-intensive, intermediate technologies for the developing countries. Selection of such technologies is, however, not an easy task.

It could be extremely difficult, in most countries, to rationalize the policy choices made earlier to induce accelerated, modern industrialization. To try to rectify the resulting factor market distortions, a step necessary for inducing indigenous, but appropriate and efficient technological development, could not only be time-consuming but could also be fraught with severe political implications. Further, the intermediate technologies considered appropriate as a policy choice may not be able to produce the same bundle of goods and services to which domestic consumers have already become accustomed. In the absence of a market for the intermediate technology output, little purpose could be served by its introduction.

Another aspect of importance to be considered in this context is the linkage, both backward as well as forward, which an advanced technology implies. It is possible for a labour-intensive, intermediate technology to generate more employment in a particular production process directly. Yet, the overall employment could be less when compared to the modern, capital-intensive technology. This could be due to a fall in the total output, or to the absence of linkages, or to both. Indirect employment for activities such as production of intermediates, transportation, marketing of the final product, etc., could all be less, because of these reasons.[2/]

Despite the above, there appears to be sufficient scope for the introduction of appropriate, intermediate technologies in the labour surplus, developing countries. This can be achieved, among others, by the following means:

(i) Developing, through research, existing indigenous tools and equipment to make them more efficient. Because of their low cost, they can also be made widely available for self-employment. Since improvement would increase the output/labour ratio, returns to workers will become attractive.

[1/] Hirschman, Albert O., "The Changing Tolerance for Income Inequality in the Course of Economic Development", Under-development to Developing Economies, S.P.Singh, ed., Oxford, New York, 1978.

[2/] Baer, W., and Herve, E.A., "Employment and Industrialization in Developing Countries", Quarterly Journal of Economics, February, 1966.

(ii) Permitting and providing scope, through suitable policies, of the development of a labour-intensive, small-scale sector. Capital being comparatively dearer, innovation generally flourishes, leading to the development of appropriate, intermediate technologies. The scale of operations being small, managerial and infrastructural inefficiencies are also kept low. Studies have revealed that the small-scale sector is often more efficient than the large-scale sector, even though producing the same end product. Sawmilling and manufacture of such products as matches, furniture, low powered diesel and electric motors, are some examples of relevance.

(iii) "Capital stretching" in the large, organised sector through conscious effort. This appears to possess very large scope, particularly in those countries where modern technology has acquired a hold.

To understand the mechanism it is useful to recognize the distinction between capital (or the machine on which the technology is dependent), and the technology as a whole. While the demand of the product and other considerations discussed earlier may make the production process capital-intensive, it is yet possible to introduce labour intensive, appropriate intermediate technologies to related production activities.

To cite three forestry-related examples, the manufacture of plywood may be considered. Harvesting of trees can be undertaken by labour intensive processes rather than by power chain saws or more sophisticated means. Likewise, off-road transportation can be done through non-mechanised means wherever possible. Again, in the plant, defective pieces of logs can be cut by hand, the scraps saved, and used for plugging defects in other logs manually. Through such means not only can additional labour be gainfully employed, but a lower quality raw material can also be upgraded.[1/]

Conclusion

Introduction of intermediate technology appears to be the only solution for eradicating under-employment and unemployment in overpopulated, developing countries. The task is, however, unlikely to be simple. Proper appreciation of the considerations involved would, however, facilitate the process. To the extent that this paper creates this awareness, its purpose will have been served.

1/ Ranis, Gustav, "Industrial Sector Labour Absorption", Economic Development and Cultural Change, April, 1973.

Some Trends in Forestry Management

by

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The concept of management is different to most people depending on background, education, etc. To those in the business world, it might mean control, direction (Websters dictionary), while others might think of trickery, deceitful contrivance (Oxford dictionary). The concept of forest management is even more dubious, since the concept of forest and of its use also varies widely, geographically, and over time.

The history of forestry is well known to all of us: how the vast eolithic forests were slowly inhabited by man, seeking shelter and warmth from fires, living from roots, leaves and fruits; how man learned to hunt the animals and cook his food; how he discovered that seeds of certain grasses could be eaten; and that after forest fires, these grasses gave bumper crops. Agriculture was born as shifting cultivation.

The first management practices go back to those days, about ten thousand years ago in those areas. Man learned that after a few years crops decreased and he consequently moved to another area and so on. Finally he could come back to the first place and the rotation circle was closed.

However, as technology developed, other uses were found for wood; housebuilding, agricultural implements, boats, etc. Forests were still in abundance, but they slowly got a value, not only as hunting grounds, and potential agricultural land, but in themselves. Regulations were issued and later, under the combined pressure from agriculture and industrialization, management systems were developed, e.g. in Germany. These were to start with mainly protective and therefore biological in nature. The main emphasis was on the forests and little or no attention was given to the human resource. "Forest management deals with the organization of a forest property for its proper maintenance and utilization according to the wishes of the proprietor." 1/ As technology has further developed, management has become more technically oriented and, as a consequence, the financial influence has increased. Forest management systems today are mainly bio-techno-financial, where biology is still dominant. With increasing labour cost, mechanisation and labour planning have, however, become more important. Foresters "are now beginning to realize that men pose more problems than trees and, moreover, problems which are often more urgent". 2/

An important feature in this development has been that it has taken place more or less in isolation. Other disciplines have seldom taken part in the process. As a consequence "a lack of effective '<u>language</u>' prevents forestry from expressing its needs to important systems outside forestry (e.g. financial institutions, public authorities, etc.") 3/ The fact that this statement was made during a seminar on business administration for Forest Development Corporations in India, indicates that forestry is not for itself alone, but part of society and interrelated with other systems in society.

1/ Sagreiya, K.P.; Forests and Forestry.

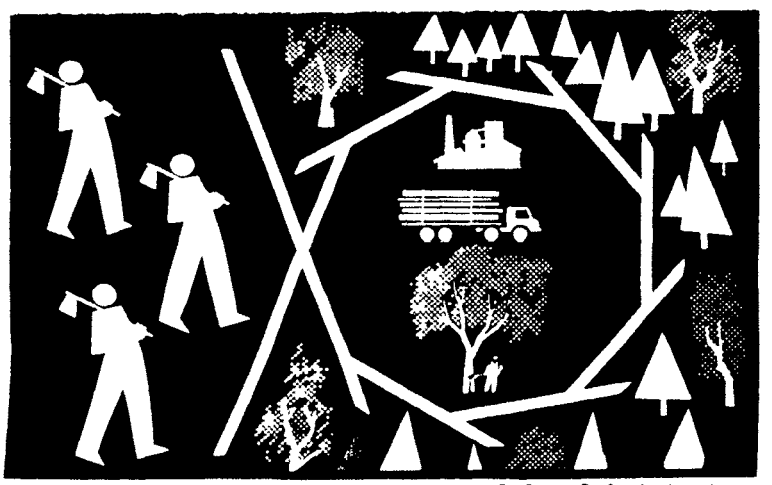
2/ Johnston, D.R., Grayson, A.J. Bradley, R.T.: Forest Planning.

3/ Report on Business Administration Training Project Seminar held in Trivandrum, April 10-23, 1977.

This means, in fact, a radical change in management. Not only will Forestry have to invite other disciplines to take part in the process, but the approach will be different altogether. Management objectives will no longer be dictated by "biological facts", but will be designed to serve society in the broad sense, with the limitations set by Nature. As each society is special, forest management, or forestry management in this context, will also be special from country to country and from case to case. Management becomes even more complex, as more factors are brought into the picture. The growing awareness of forestry as part of, not only the biological system, but also

- the ecological system
- the economic system
- the social system, and
- the political system

and having an important development role, is a significant trend. This awareness means greater pressure and more restrictions from politicians and general public but also greater possibilities for forestry to take its proper place on the scene. The noli me tangere period is over.



This broad-minded approach is true on the national level but it is not necessarily accepted by private companies. However, in the long-term perspective there is a common interest.

Objective	National	Private	
		Short-term	Long-term
Economic			
- Profit	(x)	x	x
- Financing	(x)	x	x
- Maximum wood production	x		x
Social			
- Employment	x		(x)
- Labour relations	x	x	x
- Social acceptance	x		(x)
Environment	x		(x)

Forest management is becoming more complex, not only because other disciplines are included, but also because the product mix is changing. This is happening in two ways:

- wood products are increasingly being processed within forestry and supplied direct to the consumer, and the marketing system is changing.
- other forest products are being paid more attention.

Traditionally, forest operations have been carried out by contractors or, in some countries, forests are given on long-term leases to companies or individuals.

Matrix for the Ranking of Strategically Best Production Forms [1]

Exploiting Agent	Ownership of Resource: Government	Co-operatives	Private
The owner with own labour			
Contractors/Entrepreneurs with short-term contracts			
Concessionaires with long-term contracts			

With the increasing social responsibility, but also with the direct aim to control and direct activities, this system is being more and more abandoned and forestry management is taking over the whole operation from seed to log and sometimes to finished lumber. This tendency is particularly true for government-owned forests. In Sweden, for example, this process took place during the sixties and seventies; in India it is ongoing right now; and in Canada the leasing system is being seriously questioned. This is an active approach which radically changes the task of management. Labour and technology become more important factors and the need for working capital increases considerably. Forestry management is becoming more like general business management. However, the special forestry characteristics are still there: long-term business, geographically spread production, ecology, social responsibility, etc. Forestry management becomes multi-disciplinary: engineers, economists, sociologists, etc., are employed; sections for training, labour relations, techniques, etc., are set up or strengthened.

Attention to forest products, other than wood, can be examplified by the growing emphasis on multi-cropping, the growing importance of "minor forest products", of agro-silviculture[2], silvo-pisciculture[3] etc., particularly in tropical countries. However, also in industrialised countries, berries, mushrooms, etc., are being increasingly utilised. Other forest products being more actively promoted are recreation, hunting, fishing, etc. The concept of "multiple use" is being accepted; non-wood forest products are being recognised; forestry activities are becoming more diversified and management systems have to change accordingly; integration, horizontally and vertically, becomes important.

Forestry management is becoming more active and the system more open. Public relations are, in this situation, very important.

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[1] Sundberg, U.: A Note on the Influence of Production Forms in Forestry on Employment Opportunities.

[2] King, K.F.S., Some Aspects of Land Use Planning.

[3] Project Profile for Agro-Silvicultural and Silvo-Piscicultural Programme to be undertaken in West Bengal. (Not published).

In order to improve the critical fuelwood situation in many countries and to control erosion, "forestry for community development" (sometimes called "village forestry"; in India: "social forestry") has been started and is quickly gaining momentum. This is another active approach, where forestry has really taken its social responsibility, but is also hoping to decrease the pressure on existing resources, improve environment, etc. However, to be successful the scheme calls for active participation by the people, i.e. management by the people themselves. This is in many cases a new situation for forestry management. The task is no longer purely executive but advisory and persuasive in nature, a task for which the present management set-up is usually badly equipped.

People participation is also increasing in the "executive forestry". Industrial democracy is coming on and employees often take part in managerial decisions through committees or "self-governing groups".

To summarize the most important points: forestry management is becoming:

- more dependent on other systems (ecological, economic, social, political).
- aware of its development role.
- socially responsible.
- diversified, multi-disciplinary.
- more active.
- more technical.
- more democratic and decentralised.
- more complex.
- adapted to local conditions.

The choice of technology directly affects all these points and vice versa. It is, in fact, one of the most important managerial decisions to be taken.

Management aspects must be kept in mind. One must not deal with different aspects in isolation from each other but apply a management approach, trying to scrutinize, compromise and optimize the very complex problem which today cannot be solved only by studying the cost relation man-machine.

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Relations between Technology and Forestry Planning Systems - An Example from India

by
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Scientific forestry is more than a hundred years old in India. However, the stress has been on the science of growing trees and conservation of forests. Planning of forestry has been almost confined to silviculture and management, ending with a set of prescriptions: when, where and how much to cut. The question of how to cut and wood transport from forest to the consuming centres was left to contractors and was not considered to be the responsibility of the Government until recently (in the 1960's). Logging carried out by Government agencies (Forest Departments and Forest Corporations) started in the early sixties in a few states (Orissa, Maharastra, etc.) and picked up momentum in the mid seventies with the creation of a number of State owned Forest Corporations. The necessity of preparing logging plans was thus felt only during the last decade. The traditional "working plans" are long-term plans (10 to 30 years) and are quite rigid in their prescriptions. In other words, they are strategic plans while logging plans now being prepared are only tactical short-term plans (generally annual or sometimes up to five years).

Logging plans are prepared within the framework of the working plans and they indicate the wood resource requirements in order to achieve the harvesting targets within the constraints of seasons and other local factors with emphasis on economic considerations.

The choice of methods is investigated in detail for every logging area. Improvement in operational methods has been made possible due to the taking-over of harvesting by government agencies from the hands of private contractors who could not invest money in any development work owing to uncertainties of getting fresh contracts in the years to come and to immediate economic burdens.

Indian-made saws. Photo Ivan Ruzicka

There is now a shift in the approach of working plans. Traditionally a working plan used to be based on the sustained yield principle, that is showing how much volume a given forest area could yield on a sustained basis without any drastic change in ecosystem. Now that the demand for wood is increasing steadily, forestry planning is being geared to meet the progressively increasing industrial needs of the country. At the same time, there is pressure on forest land for establishment of industries, hydroelectric projects, for rehabilitation of refugees and for providing housing and farm land to the increasing population. Thus the modern management plans are more dynamic, and are prepared on industrial catchment basis. (For example, Management plans for Bastar forests in M.P. Central India, and for East Godavari forests in Andhra Pradesh, South India.)

In India, there is a real awareness against mechanization, and rightly so. Due to the huge population (more than 630 million inhabitants) and alarming problems of unemployment and underemployment, mechanization of any operation is avoided as far as possible. The low labour rates and high rural population warrant more manual methods. However, there are limited areas where machines have been introduced with caution and they are quite successful. Such areas are where there is scarcity of men and animals in the logging season, where the logging season is restricted due to climatic conditions or when it overlaps the agricultural season, or where the terrain is so difficult that timber cannot be transported by manual means. For example, bulldozers are used for uprooting of trees and power saws are used for cross-cutting in Bastar, Central India, because the local tribal labour is not adequate to achieve the target of clearfelling 3 000 hectares of natural forest annually, and replanting with tropical pines, especially with more than 400 trees standing per hectare. Moreover, the State law forbids outside labourers to work in the tribal area. The introduction of engine-powered cableways in the inaccessible forests of West Bengal, Jammu and Kashmir, Himachal Pradesh and Uttar Pradesh is another example of mechanization dictated by the terrain conditions. It was otherwise impossible to take out the yield from such forests which were therefore left untouched as "uncommercial" forests until recently. Farm tractors have been used in Maharastra for skidding of logs, again because of concentrated working (clearfelling and planting up to 1 200 ha per year per Division) and unavailability of adequate animals in the logging season. The use of trucks for on road transport and railways for long distance transport is quite common. This is a necessity for this country where long distances are involved. Mention may be made of shipping of valuable timber and wood products from the Andamans Islands, where again no other means of transport could work. It is of interest to note that due to the high cost of shipping, only a few valuable species of timber are harvested and the remaining are left standing as "uneconomical" although many of them have a potential commercial value. There are plans to harvest these residual species for feeding a pulp and paper mill in the main land.

Wherever machines are used in forest operations, the emphasis is laid on using indigenous ones. As India is the tenth largest industrial power in the world, its Government policy is to encourage local industry. As a result, all tractors, trucks and most of the cableways used in forest operations are of Indian makes.

Another aspect which is receiving attention of forest operations planners is the local population welfare: the poor rural and tribal folks who depend on forests for their livelihood. Several states have launched training programmes for forest workers in the use of improved hand tools with the assistance of SIDA (Swedish International Development Authority). The improved hand tools are all being manufactured in the country.

There is also a growing awareness against conversion of natural forests into industrial monocultures, particularly of exotic species. Although these species (whether it is Eucalyptus, Tropical pines or Cryptomeria) are selected carefully, care is taken to leave patches of natural forest to provide fuel, fodder and other essential products to the local people.

Road planning has become an integral part of forestry planning during recent years. Several formulae are available for determining optimum road density and road standard for given forest conditions. The permanent all-weather roads constructed in the Himalayas by the West Bengal Forest Development Corporation have opened up large chunks of forests which had to be left as "uncommercial" in earlier years. The contribution of such roads to the overall development of remote areas need not be explained.

So far as the planning methodology is concerned, more or less manual methods are still in vogue in this country. The base map used is a topographical sheet, usually of 1:50 000 scale, sometimes of 1:15 000 scale. Aerial photographs are not yet popular. Volume estimation is done with the help of callipers and simple height measuring instruments (Abney's level or alike). Point sampling methods are just being introduced. Standard and regional volume tables are available for important timber species. The use of electronic computers in forestry planning is rather new and is confined to the activities of the central forestry organizations like the Pre-Investment Survey of Forest Resources.

In summing up, the present level of technology adopted in forest operations in India can be shown as follows:

Operation	Methods/Tools adopted	Percentage (approx.)
Felling & cross-cutting	Axes only	30%
	Axes & cross-cut saws	69%
	Power saws	1%
In situ conversion (in Himalayas only)	Frame-sawing	60%
	Pit sawing	20%
	Portable saw milling	20%
Off-road transport	Human carriage	5%
	Animals & carts	70%
	Dry & Wet slides	5%
	Tractors	10%
	Ropeways	10%
Major transport	Bullock carts	24%
	Trucks	60%
	River	10%
	Railways	5%
	Shipping	1%

There is an overlapping of methods in case of off-road and major transport. The Logging Training Centres Project of the Government of India, with the assistance of SIDA, is trying out new equipment which, if found suitable to Indian conditions, may change the trends shown above. However, the stress will be laid on their adaptability to local terrain, technical and socio-economic conditions.

Elephants moving towards next logging site
Photo Gunnar Segerström

Relations between Technology and Forestry Planning Systems: Example from Sweden

by

C.G. Mossberg, Project Co-ordinator, SIDA/LTCP

Background

During the last thirty years logging operations in Sweden have developed from being completely manual to becoming almost completely mechanized.

In view of a number of changes in the pre-conditions for forestry, such as:

- mechanization of agricultural work
- increase in labour salaries
- safety aspects

the logging operations had to change and, today, hand tools like saws and axes are not used any longer. Formerly the horse was used for extraction of all timber and fuelwood but also the horse is abandoned today. Instead machines have taken over and this to such an extent that not even a power chainsaw is regarded today as a machine but as a quite simple hand tool. The machines used are such as feller bunchers, delimbing machines, processors for delimbing and bucking and harvesters for the operations felling-delimbing and bucking. (Tables1 and 2).

Table 1. Delimbing Techniques used during 1970-80

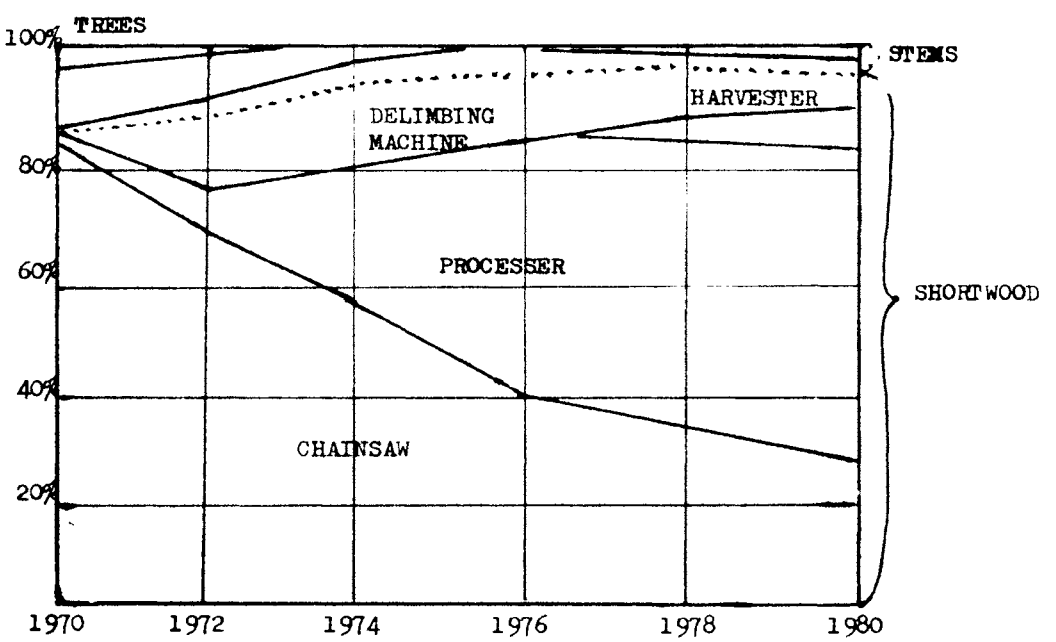
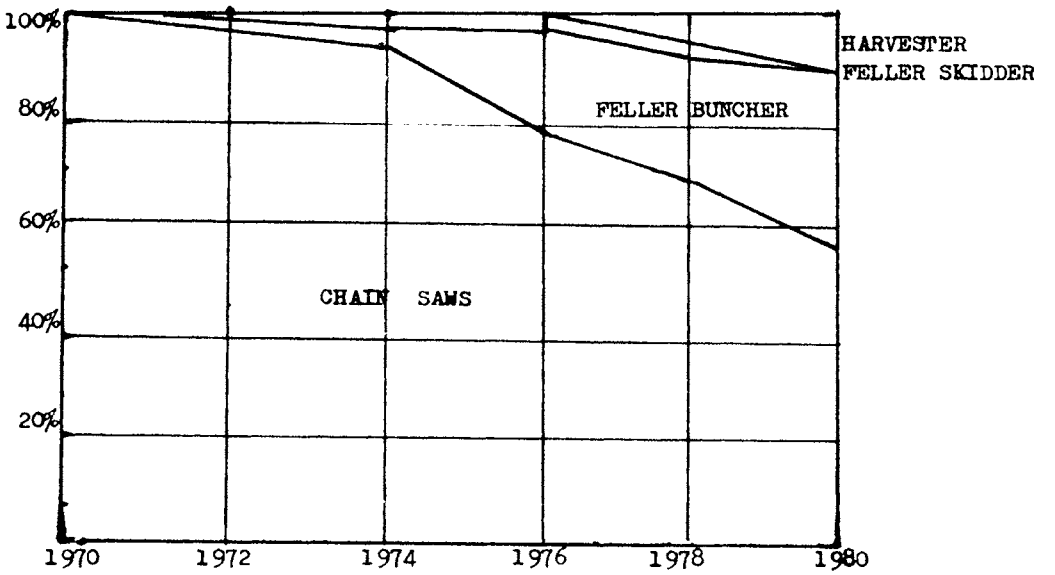


Table 2: Felling Techniques used during 1970–80



Extraction of wood is carried out by forwarders and the operation debarking is not done in the forest any longer but at the industry site itself. Previously the logging operations were the responsibility of contractors but today they are normally the responsibility of the forest companies (either private or state owned) and all staff is regularly employed and skilled to a very high degree. Work is also carried out on a year-round basis, where before it was normally concentrated in the winter season.

The development today in the field of logging is no longer concerned so much with the aim of minimizing costs and manpower but at utilizing to the maximum possible the limited resource of wood from both aspects, value and volume. To be able properly to manage the highly mechanized systems, an overall planning of each company in a number of aspects is necesary. They will be discussed briefly below:

Working Plans

Plans are prepared on many different time levels to try to ensure that available resources are utilized in the best possible way. (Table 3).

Table 3. Working Plans

Plan Time	Purpose
100 years	To decide annual possible cut in a long-term perspective.
10 years	To identify areas for operations in accordance with the policy of the company.
5 years	To prepare for start-up operations, such as road construction, landing construction, etc.
1-2 years	To plan in field how operations should be carried out, such as marking of boundaries, strip roads, etc.
6 months - 1 year	To decide in which order areas for operations should be dealt with, depending on terrain, location, type of assortments, etc.
1 month - 6 months	To allocate resources to each area for operation.

Besides all these planning activities follow-ups are also carried out to evaluate results compared with targets fixed in the plans and to find out, if a target was not achieved, why and how to improve on this point.

Training of staff

As can be seen from the working plans described above, a number of different staff categories are involved in the planning activities on different levels. As much of the planning work demands special knowledge, a number of specialists are normally in charge of different planning activities, but there is also a need of knowledge on how to ensure that all staff categories understand the basic planning principles which will help carry out all work in the best manner possible.

All staff categories are, therefore, regularly updated and informed about new methods and techniques, either through internal courses in each company, or they are sent to external courses where people from different companies, research organizations and manufacturers meet to learn and to exchange experiences on different subjects. An important feature is the involvement of the operators in these activities.

All this is done in order to make it possible to plan and carry out activities in the best possible way, as well as to motivate and stimulate all concerned, which, in itself, leads to better results.

One notable feature to be remembered in this connection is the management group of each company, which now consists of representatives from all the different staff categories from workers to managing director. They meet regularly to discuss all kinds of problem aspects and their solution.

Investments

As I said before, most operations are mechanized and this means that careful planning of investments, as well as planning for maintenance and repairs of machinery have to be considered. (Table 4). This is normally the responsibility of a special wing in each company.

Based on the ten year plans where areas to be operated are selected, they have to decide what investments to make and when, keeping in mind already available equipment in the company, how fast it will be worn out, estimates of cost development for spare parts, etc., as well as development of new or improved equipment. For this purpose often computer models to compare different systems are used where the models are fed with available information regarding costs, capacity, etc., of existing systems and assumptions a bout new or improved systems. In this way a final strategy for investments can be decided.

To better understand and to try to improve existing systems almost every company also works with trials of new equipment and systems. They either do this on their own or in co-operation with a manufacturer and/or research organization.

Table 4. Examples of Costs and Cost Distribution for Different Types of Machines

Maintenance

With regard to maintenance and repairs of equipment, the Swedish companies have either their own workshops or have an agreement with the manufacturer concerned to come and take care of the work. The daily service and routine check-ups are, however, the responsibility of the machine operator.

To avoid breakdowns as much as possible the machines are called back for major overhauls at regular intervals. When breakdowns happen in the field action is immediately taken to put the machine in order. The operator is the first person to take action. He has to make a diagnosis of what is wrong. This is reported to the workshop through the wireless telephone and necessary decisions for action are taken. This can mean that the operator himself is ordered to adjust the machine if the breakdown is minor, or a team is sent out, or the machine may have to be called back to the workshop.

Co-operation User, Manufacturer, Research

In the development process co-operation between research people, manufacturers and users is a must. By this systematic co-operation and with support in the form of funds from government bodies fast development has been possible.

Some Basic Facts about Forestry in Sweden

Productive forest area: 23.4 mill.ha (57% of land area)

Total growth 70 mill.m^3/year (3 m^3/ha /year)

Owner distribution	
- Public forests	25%
- Company forests	25%
- Other private forests	50%
Annual logging	65 mill.m^3
- Clear felling	80%
- Thinning	20%
Annual cut distribution on products	
- Sawn timber	37%
- Pulpwood	59%
- Firewood	4%
Methods of long distance transport	
- Floating (river)	5%
- Floating (sea)	8%
- Railway	8%
- Truck	71%

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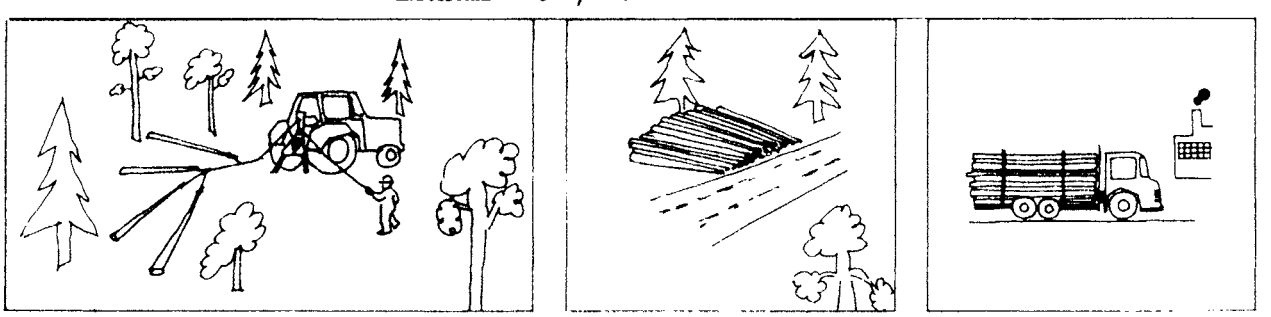


The Tree-Length Method with limbing and sorting at the landing, skidding with help of the winch and agricultural tractor from stand to landing

FORESTRY AND EMPLOYMENT

by

Bernt Strehlke
I.L.O.

It has been estimated that forests provide full-time employment in silviculture and logging corresponding to about 10 million man-years. This employment volume is shared by perhaps 100 million people. About 300 million people live in and around the moist tropical forests from which they derive practically all their livelihood. In dry forest areas there are about 600 million people for whom especially fuel wood supplies and forage from trees are vital for their existence.

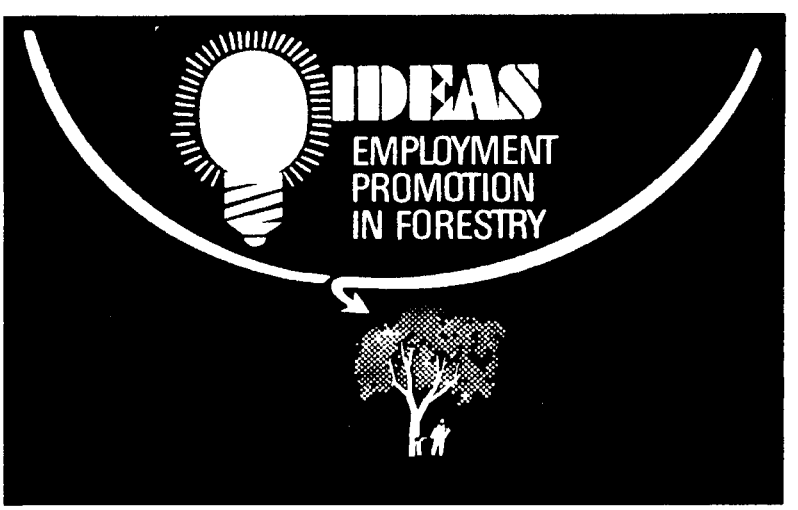
These figures are an impressive illustration of the importance of forests as a source of employment and revenue for rural people in developing countries. However, in many countries this fact is neither adequately considered in national policies nor is it a particular concern of forest services. Foresters tend to restrict themselves more or less to timber resource management and the wood industries have hardly other interests than maximising returns on invested capital.

Only very recently has the social dimension of forestry become apparent. Especially the 8th World Forestry Conference in Jakarta has helped to put the social benefits of forestry into focus. In the wake of this conference there is now a greater readiness to acknowledge that forests have an important social role to play.

Quantity of Employment

In a world where unemployment is rapidly increasing the first question to be asked in this context concerns the problem to which extent forestry is able to generate jobs.

During the past decade both harvesting of fuelwood and industrial wood increased (the latter rose in the developing countries from roughly 200 to 300 million cu.m. per annum). This trend is expected to continue and will provide until the year 2000 in developing countries presumably an additional employment of 1 million man-years.



However, it is also expected that in the coming two decades about 240 million hectares of forests will disappear of which about 100 million hectares are situated in Asia. To compensate this loss about 50 million hectares of fuelwood plantations and 10 million hectares of industrial tree plantations must be established providing about 3 million man-years of work for an annual planting areas of 3 million hectares.

This planting programme is about five times larger than the one carried out up to now. Considerable investments and efforts are required at the international, national and local scale to put it into practice.

More people are employed in plantation forestry than in indigenous forest management. Whereas the latter one provides only about 1 man-day of work per hectare and year, teak plantations may range from about 5-10 man-days, tropical pines around 20 man-days and fast growing hardwoods such as Albizzia and Gmelina about 25 man-days.

Combination of forestry with agriculture through agro-forestry systems such as the Taungya system or tree farming may increase the labour input two to fourfold.

The establishment of wood-based industries such as saw mills and the manufacture of furniture is another important means of multiplying employment in rural areas. Wage payments will promote local market economies and thus favour further employment through the production and distribution of consumer goods. This in turn requires upgrading the rural infrastructure (e.g. roads, water supply, electricity) and providing services (e.g. in traffic, health, education and public administration) by which still more jobs are created.

Forestry can thus be an important catalyst of rural development leading to employment in the primary, secondary and tertiary sector. To fullfil this role foresters must overcome their professional isolation and actively participate in an integrated approach to solve rural employment problems.

Quality of Employment

Working and living conditions in rural areas are often so poor that in spite of jobs available people tend to leave for towns and cities where their misery continues in urban slums.

Work supplied in rural areas must therefore satisfy certain minimum standards as regards wages, social security, working time and protection against health and safety hazards.

If excessive physical strain is required from a worker who is in a poor state of health and nutrition or if accident risks are pronounced turn-over of workers can be expected to be high and it may even be difficult to recruit workers in spite of prevailing unemployment.

It is therefore necessary to minimize physical effort through efficient tools, techniques, methods and organization. This requires training at the supervisor and worker level.

The quality of employment will also be considerably upgraded if stability in employment is provided meaning continuous employment throughout the year or regularly occurring seasonal employment which can be combined with other work, for instance in agriculture.

The quality of employment is high if the worker is able to continue his job throughout his working life and if he is in a position to increase his skills and his earnings in the course of time.

Long-term and regular employment requires regular forest management of which labour planning should form an integral part with a view to satisfying both the industry's requirements and the individual's aspirations.

Last but not least quality of employment means participation in decisions concerning the general employment conditions. For this reason the establishment of workers organizations and the active participation of rural communities in village forestry are of great importance.

Employment Promotion

There are many ways in forestry to promote the quantity and quality of employment of which some examples shall be given. Unfortunately, in developing countries most foresters are not yet very sensitive to employment questions. This is to some extent a result of forestry education which must in future be more specifically geared to cover social aspects.

Quite obviously forest services have a crucial position in respect of promoting employment in forestry and forest industries at the national level. Their efforts have hitherto been mainly restricted to directly employed labourers who are usually engaged in silviculture. The work force of concessionnaires and of small contractors is often exposed to much inferior employment conditions. Concession agreements should therefore be used to clearly stipulate employment conditions at acceptable levels. They should also ensure sustained forest management in order to provide stability of employment. Reforestation must therefore be in balance with logging in areas permanently dedicated to forestry. Such agreements must be controlled and if necessary enforced.

In the case of small contractors control is more difficult and the solution may be to transfer their activities to the forest service or to cooperatives as has been done in India to some extent. However, such transfers are only successful if the work is organized efficiently. Better wages and employment conditions must be paid for by adequate work productivity. Otherwise the quality of work may improve but the quantity of work may decrease because jobs become uneconomic and will eventually be abolished. This again is a problem which can be solved through staff education and worker training. In fact, in some of the industrial countries logging jobs are quite efficiently handled through forest services disposing of the necessary knowledge and expertise among supervisors and workers. To create such conditions, significant training inputs are required.

Another problem of employment promotion concerns the application of appropriate levels of technology. In the developing countries between inefficient traditional work and highly mechanized operations there are often intermediate alternatives of efficient manual or simple mechanized methods which are superior for economic and social reasons. This was clearly shown by an ILO/Finland forestry project in the Philippines during which activities such as tree felling, barking, loading, planting, tending and pruning were studied.

Practical foresters should be in a position to make such assessments themselves based on simple work studies and calculations of time and expenditure for labour and machines. Forestry graduate and technician training should provide basic knowledge and experience how to carry out such studies. Forest services could also employ work study units consisting of specially qualified foresters.

Whether a machine is to be introduced in low wage areas or not should be carefully studied in advance. There are cases where machines are inevitable, e.g. for the transport of big logs, but next to such machines it may still be advisable to use manual tools, e.g. for felling.

An interesting case in this respect offers the chain saw. In some Asian countries it was well spread already in 1970 (e.g. Malaysia), in others it gained wide acceptance during the last decade (e.g. in Thailand) and in still others is quite uncommon (e.g. in Bangladesh and India). At the global scale the annual sales of chain saws in developing countries number about 100,000 and this is probably equivalent to the displacement of several 100,000 workers. There exists now a big world market in chain saws but little interest in producing and marketing cross-cut saws. To continue using cross-cut saws (as well as other manual tools) requires among other things local manufacture in the developing countries at an adequate standard of quality. India but also some other developing countries have made remarkable progress in this field.

Whereas logging work requires very skilled workers, tree planting, erosion control and rural road construction are activities which have often been selected for work programmes for unemployed people for instance within FAO's World Food Programme or ILO's public works programmes for the least developed countries. If such projects are carried out efficiently and if working conditions are adequate they will have an important social impact and help to create new forest resources which will generate further employment when harvesting starts as can be seen in the case of New Zealand, where forests planted fifty years ago during the depression period are now providing raw material for a flourishing industry and export trade.

If foresters learn and understand that forestry is not an end in itself, that it is not restricted to trees, that it must serve the human community in the best possible way, only then will it be possible to make the fullest use of its employment potential. It would be an interesting task for the consultation to discuss which obstacles must be overcome to attain this goal.

For more detailed information, reference is made to the report on employment promotion and vocational training in the Timber Industry (Forestry) submitted to the Third Tripartite Technical Meeting for the Timber Industry, ILO, Geneva 1981.

TRAINING FOR INTERMEDIATE TECHNOLOGIES

by

Bernt Strehlke
I.L.O.

There is a wide-spread belief that intermediate technologies are so simple that training is not really needed. Traditional skill and knowledge in tree felling, for instance, would be sufficient to change easily over from axe to saw. Only when it comes to using more complicated and costly machines such as tractors or trucks, would the operator require some special instructions.

There is also a tendency to educate foresters in some sort of a botanical garden to provide them with a lot of theory and to keep them far away from operational realities. How many foresters finished their professional or technical education without having ever planted or felled a tree, without having themselves experienced for some weeks what it means to work in the forest as a labourer?

If this state of things is not overcome there is little chance to use intermediate technologies in the forestry sector of developing countries as a means to increase working efficiency and to improve working conditions.

When the industrial countries experienced such problems several decades ago the situation was rather different. There was a continuous change from traditional to improved tools to simple machines and finally to more sophisticated and powerful ones. Productivity and wage levels increased steadily up to a point where it was economic to substitute machines for labour or animal power or sophisticated machines for simple ones.

Developing countries are faced with the difficult choice between totally different technology levels. They are put under considerable pressure by those marketing modern technology but also by those insisting on the necessity to provide jobs for more and more unemployed people. Even if work studies show that intermediate technolgies in a given case are the least expensive alternative of carrying out a job, such results are not easily accepted and there is often a tendency to choose only between traditional and advanced technologies.

Intermediate technologies in the forestry sector would probably be more readily adopted if there were more confidence in the results of studies as being reproducible in every day practice and if there were an instrument to make them widely known. This instrument is training, training at all levels from top to bottom.

From left: Messrs B. Strehlke, G.M. Bedekar and K.C. Thapliyal discussing training

Let us consider what may happen if intermediate technologies are introduced just by exchanging traditional hand tools through improved ones, for instance replacing axes by saws in tree felling:

- Trees may fall the wrong way, get lodged, break or destroy regeneration because the worker does not know directional felling.
- The worker may have or provoke accidents because he does not know the specific risks.
- The saw may be damaged if not withdrawn before the tree falls.
- Sawing techniques may be ergonomically unfavourable and expose the worker to excessive strain.
- Saw maintenance may be insufficient to a point that workers prefer to return to axe work.

The trained worker should be able to master these problems. Training should help him to uplift his knowledge and skills above the traditional level. It should also give him more confidence in himself and help him to become more self-reliant. Such type of worker has of course definite advantages in forest operations where the work place changes continuously, where workers are scattered and where the supervisor is not always right away available to solve problems.

When introducing new technologies the most reasonable approach consists of the following steps:

- Analysis of existing conditions for the jobs concerned (workers, tools, techniques, methods, organisation, wages, output, unit costs, working conditions) and diagnosis of deficiencies.
- Pilot activity to test new technology, to instruct workers and supervisors and to establish training objectives and methods.
- Information courses for employers and supervisors on new technology and on worker training systems.
- Training of instructors.
- Broad-scale worker training activities.
- Checking of training methods and results, revision of training methods, improvement of technology, if indicated.

This procedure is not easy to apply in countries where forestry education is weak in practice and where worker training has never been carried out. Initial outside help is indicated under such circumstances, and continuing efforts over many years are needed to create the necessary structures and to build up local know-how and experience.

However, quite a number of developing countries have in recent years started to introduce training in intermediate technologies and it is interesting to learn from their experience. Some of the problems encountered shall therefore be briefly discussed.

If a training unit is established it should be given a clearly defined status. Links should be established with forestry schools, forest research institutions, employers and workers' organizations and with training institutions in related areas such as agriculture or wood working. The overall responsibility should preferably rest with the Government service concerned, e.g. the State Forest Service.

Collaboration with the private sector appears to be often rather different for a variety of reasons. If training is paid for by a tax on wages (e.g. 2%) - as is being done, for instance, in a number of Latin American countries - this does not only help to raise the necessary funds but also motivates the private sector more strongly to participate in training activities.

Training staff plays a crucial role in training. It will usually include graduate and technician level foresters and experienced foremen or highly qualified workers. Training staff needs special training and the more experienced the better. Time and again rapid staff turnover seriously interfered with promising training activities or stopped them altogether. Training staff should, therefore, enjoy attractive employment conditions and stay on the job for periods of not less than at least five years (but care must be taken that the wrong people are not attracted by favourable employment conditions).

Training must go down to the worker level. This requires - at least initially - training at the work place but outside production hours. Training should be practical and basic. The local supervisor should be present. He should have undergone a previous information course. In the longer run the establishment of permanent training centres for the training of instructors, supervisors and specialists may be envisaged. However, as long as there is still a shortage of forest technicians such training centres tend to be used for the training of this category of staff to the detriment of worker training.

The worker trainee will usually be an adult person with some practical experience, he will often be illiterate and he will, in many cases, be reluctant to change. He will only accept new tools, techniques and methods if he sees that he has something to gain from them, for instance, easier work, a shorter working day, more pay. Often it is necessary not only to change tools, techniques and methods but also the whole organization of work as well as clothing, feeding and resting habits. This requires patience, time and repeated follow-up visits. But the result will be longer lasting and workers be more inclined to stay on the job instead of quitting after some time.

Intermediate technologies depend largely on the existence of improved hand tools in acceptable quality and quantity and at acceptable prices. In India this was already recognized about twenty years ago when forest worker training was first carried out by Swiss forestry experts. It will be most interesting to find out to what extent India is now in a position to supply its own forestry tools and possibly also cater for the requirements of other countries of the region.

The introduction of intermediate technologies should not be carried out in isolation from ongoing graduate and technician level forestry education. In fact, the problems encountered and the solutions found should enter into their programme of study. There are many ways of doing this such as involving the training unit in special lectures or in excursions and study visits arranged for forestry students.

Intermediate technologies are also an interesting subject for work study which may be a responsibility of forest research organizations but could also be directly connected with training activities, especially in cases where forest research is limited to other subjects. Work study would also be a further means to check up on the result of training activities.

Further information on training of forest workers including literature references will be found in ILO's report on employment promotion and vocational training in the Timber Industry (Forestry), prepared for the Third Tripartite Technical Meeting for the Timber Industry, Geneva 1981.

Messrs. K.C. Dayananda, Floyd Werner and Jöran Fries preparing the Recommendations
Photo Gunnar Segerström

Aspects of Ergonomics and Safety to be considered in choice of Technology

by
Bengt Frykman
The Swedish University of Agricultural Sciences

The purpose of this paper is to serve as a guideline in the choice of suitable technology, especially regarding ergonomic and safety aspects. A special checklist has been suggested as useful for improvements of ergonomics and safety in manual techniques. The prinoiple of the checklist, however, can also be used for a higher degree of mechanization in forestry operations. In Sweden, for example, a similar checklist has been used in analyzing highly mechanized logging systems in order to improve ergonomics and efficiency.

In the following text ergonomics and safety aspects will include all measures which could be taken to better adapt the work to man and to better adapt man to work. The term "intermediate technology" was, during the Consultation, amended to the term "appropriate technology" and the following definition was recommended: Technology should be "appropriate with regard to local conditions and the combined effect on production(quantity and quality) employment, ergonomic conditions, ecology, energy and availability of tools and equipment.

Choice of Technology

Choice of suitable technology for a special process depends on a lot of factors. Various technologies can be used to produce a special product or to extract raw material for manufacturing. This is also true for forestry and even in a very industrialized country you can still find the whole range of technologies; for example, in the operation "felling of a tree". Some forest farmers may still use a handsaw for this operation. The most common tool is, however, power chainsaw, but felling machines or harvesters are used more and more, especially in large companies. Probably the most important factors in the choice have been the relation between machine costs and labour costs and the employment situation.

The ergonomic and safety aspects seem to have had very little influence on the choice of technology. Today, some bad consequences of the neglect of these aspects have been discovered. The introduction of power chainsaws in forestry has increased the severe accidents to a high degree and it is still the most dangerous tool in forestry operations, in spite of improvements.

In Chart 1 some aspects of ergonomics and safety have briefly been checked against different levels of technology.

In the first column of the Chart you will find the three different levels of technology combined with certain other conditions chosen.(Ager, Jakarta 1978). These are:

1. Manual techniques under unfavourable socio-economic and climatic conditions

Forestry has low priority as far as capital investments are concerned. Forest work has low status compared with other types of work and very little vocational training is given. Employment is unstable. Pay is very low, perhaps close or even below subsistence General living conditions (housing, food, medical care, other services) are very poor. Felling, cutting and limbing is carried out with axes or handsaws, short distance transport with animal, or manually by labourers. Trucks are loaded manually or with simple loading equipment. Silvicultural operations (reforestation, clearing of young stands, etc.) are also carried out by hand.

2. Moderately mechanized operations

Felling and limbing are carried out with power chainsaws, transportation by tractors and trucks with loading equipment. Planting is carried out with hand tools, ground preparations with tractors and cleaning with power chainsaws or sometimes with brushsaws.

3. Highly mechanized operations

Felling and transport of wood is carried out with machines. Silvicultural operations are mainly carried out by hand, or simple power tools but mechanized methods are being introduced, especially for cleaning of planting sites. This level of mechanization is common in harvesting tropical hardwoods in natural forests. It is also being applied in large-scale industrial plantations. To some extent machine operators are trained under the management of expatriate companies.

In the following columns on the Chart you will find the ergonomic and safety aspects which have been analyzed. They are the following:

- Nutrition, i.e. demands for a sufficient intake of different foods.
- Physical working load, i.e. demand for a sufficient physical capacity in relation to the job.
- Heat stress, i.e. the influence of heat and humidity on man's capacity to work.
- Risk of diseases, i.e. the influence of the work and work environment on the exposition or risk of diseases.
- Accident risks, i.e. the influence of the work or work environment on the risk of accidents.
- Mental load, i.e. the psychological influences on man, owing to job characteristics, such as monotony, high workpace, machine-directed workpace, short work cycles and tiedness to work.
- Influence on work speed, i.e. the degree to which the individual can decide on his own work speed.
- Motivation, i.e. the possibility of technology to stimulate the individual to a high work motivation.
- Flexibility, i.e. the degree of adaptation of technology to different conditions such as terrain, stands, infrastructure, etc.
- Repercussion on local self-reliance, i.e. the possibility of technology to develop positively within the country or region under study.
- Training needs, i.e. qualifications needed to carry out the job satisfactorily.

Other Aspects

- Employment opportunities, i.e. the influence of technology on work opportunities.
- Productivity, i.e. output of products per man-day.,
- Capital cost, i.e. costs of investment and maintenance of machines, equipment and tools.
- Earning possibility, i.e. the existing condition regarding the amount of daily salary for forest workers.

At a first glance on Chart 1 the choice of a manual technology seems to be unfavourable in many aspects, but, as will be discussed in the next section, there are a lot of possible actions to improve ergonomic and safety conditions in this technology.

Measures to improve ergonomics, occupational health and safety

In order to illustrate and analyze systematically the relations between objectives and means, a matrix (check list) has been set up in Chart 2. In the following, only the relations of objectives and means in the connection with manual technology will be discussed but the principle of the matrix can also be used for other levels of technology (Ager, Garpenberg 1978).

In the first column some of the general aims for production have been put up, i.e. employment, health, safety, job satisfaction and productivity. Other objectives may be added like resource conservation and the aims can also be broken down into subgoals. In this chart mainly measures which could improve ergonomic and safety aspects of the work are included but it is often of value to show the influences on employment and productivity in such an analysis as well. In the author's experiences, improvements in ergonomics and safety also increase productivity and decrease drop out and absenteeism of the labourers. In the Chart the sign x will show that changes in the different measures can have a positive influence on the objectives of goals chosen.

The present situation in the various goal areas can be summarized as follows:

Employment

Lack of work opportunities is a common and severe problem in most of the developing countries. To increase employment in rural areas is an important objective. This will decrease the urbanization and improve the socio-economic conditions in rural areas. Forestry has a potential to contribute to a positive development in this context. An important goal in this connection is also to increase the quality of the employees.

Safety and health problems

The health situation is alarming. Diseases, many of which are endemic to the tropics, are common (Oseni and Ward 1974). Malnutrition, poor hygienic conditions (drinking water, etc.) and the absence of adequate medical service are the main reasons. The work capacity of the forest worker is, therefore, comparatively low. Exposure to heat is another factor restricting work capacity of human beings in these regions (Axelsson, 1974, Sundberg, 1974). Considering that manual forest work is very heavy, it is easily understood that overload and exhaustion are other health hazards for these forest workers.

Accident risks are also alarmingly high. According to studies carried out in South East Asia and West Africa (Strehlke, 1974), in tropical logging the forest worker is liable to have up to two accidents per year. Out of every five workers employed for their full working life, one will be killed in an accident. The main reasons are:

- the work is hazardous in itself.
- poor training in the work, especially in safety aspects.
- lack of legislation, standards, instructions in the field of safety.
- poor condition of machines and equipment.
- lack of personal protective equipment
- wage incentives promoting fast but not safe work.
- tiring work, reducing observance.

Job satisfaction

This objective refers to the value of the work itself, i.e. that the labourer should find his employment meaningful and stimulating which will, apart from money, motivate him to stay in the job and get him more involved in the quality and quantity of the work, suggest improvements, etc. A better realization of this objective may have a positive influence on the objective "productivity" as well. One recognized problem in connection with this objective is the low status of forestry work in many developing countries.

Productivity

Many industrialists say that, if we cannot keep a satisfactory productivity in our industry, we cannot afford employment, healthy jobs, job satisfaction, etc., either. The author's opinion is that you often can approach the question the other way around, i.e. by increasing health and safety conditions in work and designing more meaningful and stimulating jobs, you will also increase productivity. There seem to be a lot of possibilities to improve ergonomic and safety conditions in manual techniques. As have been shown in an Indian survey (Kant, 1980) manual techniques, as far as logging costs are concerned, are more economic up to a diameter at breast height of 45 cm. Other surveys reported by Cortes 1978 are in favour of appropriate manual techniques, compared with more mechanized alternatives.

The following measures have been analyzed in the chart:

Tools and maintenance and equipment for maintenance. Here there is much room for improvement. The possibilities of local manufacturing should be examined and training in maintenance should be given (Hansson, 1966). Such measures should influence profitably all objectives. Positive experiences are reported from India (Shandra, 1978). Improved tools of good quality, which are used by well-trained employees, will also decrease the frequency of accidents.

Safety equipment and personal protective equipment. This includes provision of dispensaries, first aid and stretchers but also felling levers and tools to take down trees which have got stuck in other trees or safety belts in lopping operation, etc. The possibility of local manufacturing should be examined and training in first aid and in the use of the equipment should be given.

Personal protective equipment, including helmets, eye protection device, clothes, footwear, etc. The possibility of local manufacturing of some equipment should be examined. Tests of different manufacturers' equipment should be carried out. Firm regulations regarding the use of safety and personal protective equipment should be elaborated. In order to reduce the risk of heat stress, the worker should preferably wear clothes which permit as free evaporation of perspiration as possible.

Nutrition service. Forest work is heavy and needs a high intake of calories and other nutrition. Malnutrition reduces both physical and psychological work capacity. Locally, a nutritional programme should be planned within the existing framework of food restrictions. It is evident that the level of nutrition plays a profound role in work output. It is also evident that lack of food contributes to lower resistance to disease and leads to higher absenteeism and higher rates of accident. There are certain measures by which employers and enterprises can ensure an adequate and balanced diet for their own employees. These measures consist of the establishment of non-profit-making food stores or of canteens at the work place. Apart from humanitarian considerations, the extra cost involved should be more than compensated by increased production. In some World Food Program projects canteens at the working place providing one meal a day have been established. Good results in health and productivity have been reported from, for example, Algeria and East Africa.

In this context it should be recalled that working in the heat means loss of considerable amounts of water due to perspiration. A sufficient supply of water should be provided to workers under heat stress. Extension programmes to change family traditions on intake of food may also be used. Note that the water supplied should be drinking water of sufficient quality. The workers and their families have to be given information on how to tell whether water is drinkable.

Health service. The general level of health is usually low in developing countries and many diseases are endemic, especially in the tropics. The state of health is closely related to diet, especially to lack of proteins and vitamins. The medical services are often also poor in rural forested areas. Diseases are a very serious obstacle to work efficiency and measures to improve the state of health of the labour force should be included in all forest operations. Such measures will cover a wide range of items, such as improved diet, adequate housing with appropriate sanitary and hygienic facilities, weather shelters, medical service, clothing and provision of first aid facilities (FAO 1976). The whole family should be involved in these provisions.

Safety programmes. The following text is quoted from Strehlke (1974)

"Accident statistics are needed to find out in which occupations accident frequency and severity are particularly high. In these occupations accident prevention measures must then be focused. To some extent, safety rules, as set up in industrial countries, can be applied in a fairly uniform manner, such as in tree felling. However, it is preferable to check to what extent adaptation to local conditions is required."

Three examples are given of occupations where accidents are particularly common:

"Tree felling. This is by far the most dangerous job in forestry, where the largest number of fatalities occur. The most important preventive measures are safe working techniques and the wearing of hard helmets.

Sharp cutting tools (axes, machetes, saws). These lead very frequently to open wounds from cuts. Preventive measures: covering of cutting edges during transport, tight grip on well-shaped handle, working space clear of obstacles and onlookers.

Walking in the forest. Slipping on wet surfaces and stepping barefooted on protruding or sharp objects lead to numerous injuries. Proper footwear is, therefore, essential. Walking and working barefoot results in an excessive rate of injuries which often get infected.

Once the main sources of accidents have been detected, it is necessary to draw up safety regulations and to launch a safety campaign involving the management, foreman and workers. It is very difficult to motivate employers and employees for accident prevention sufficiently to obtain lasting results. Efforts in accident prevention must, therefore, be a continuing concern".

Work methods

It is important to study existing work methods with special attention to workload safety and how the methods might be improved. The near accident method could be used in such an analysis apart from workload measurements (Gustafsson, 1970). Special interest should be paid to different methods to reduce felling accidents and back injuries, i.e. using saws instead of axes for crosscutting and felling, taking down entangled trees with wheeled carts, using natural work benches or portable ones, using slides or sledges for off-road transportation, etc.

Wage form

In Sweden the transition from piecework to fixed wage forms in 1975 has caused the following consequences (Pettersson, 1980):

- Accidents now less frequent and less severe
- A fall in productivity (around 15%)[1/]
- Reduced physical stress and a feeling of greater financial security among the cutters
- Enhanced prospects for organizational changes such as better co-operation between team members and greater possibilities of keeping older and disabled workers on the job.

This Swedish example will show the great influence the wage form has both directly on the different objectives and indirectly affecting the possibilities to use other means, such as organizational measures.

Team composition

It is important that the team members are selected in such a way that they can work in harmony with each other and have the same language, culture and religion. The right composition of the team will mainly effect job satisfaction and productivity in a positive way.

Work time distribution

In order to avoid heat stress and increase productivity the heavy work should preferably be done in the early morning or the late afternoon and should be avoided during the hottest hours of the day. Short breaks should be taken during working hours to allow the body to recover. Consideration has to be given to the workers' need for time for their personal affairs, if any. Many employers have, for example, their own farms or animals to care for. A system where one man works in the morning, another in the afternoon and the next day they change, may be a suitable solution in some places where under-employment is high.

Job rotation

A job rotation system where labourers shift between heavy and light work may be a solution in some cases. The system may be designed so that heavier work can be done in the morning and lighter work during the hot hours of the day.

Role of supervisor

Apart from traditional supervisory tasks like planning and control of work and labourers, the supervisor should, to a high degree:

- actively help his team members to develop their skills and abilities
- actively work for better health conditions in the work and take measures to prevent accidents
- be able to create unity and contribute to a good spirit within the team
- be able to pass on information both up and down between the team and the rest of the organization
- be able to show (with his hands) correct working techniques and plan for a continuous training of the workers

To meet these new demands the supervisor needs more training and other support from the management. (Frykman, 1980).

1/ In long-term planning the fall of productivity will not be such a high figure, due to better working conditions, less absence from work, higher job-satisfaction, less accidents etc.

Training and Education

Training is a key measure in many aspects. Not only can training directly contribute to better goal satisfaction, but it is often essential before other measures can be used, as in the example above regarding the new role of the supervisor. Training of labourers is one of the most neglected fields in many developing countries.

"It is found that vocational training for forestry in developing countries is largely non-existent and that, in spite of the growing realisation of this fact, very little has been done to change this situation. As a line of direction and a starting goal, it is suggested that at least 25 percent of the investments in professional and technical forestry education should go into vocational training." (Strehlke, 1971).

Mobile short courses in first aid, safety tools and machines, working techniques and working methods should be done on the job by specially trained instructors. Preferably the instructor should come from the same tribe or, at least, talk the same language as the labourers. Efforts should also be taken to increase the ability to read and write among the workers.

Social security

Provisions should be made to have at least minimum compensation for injured workers in case of accidents and to provide free medical care in such situations. Some kind of worker's compensation in case of sickness and unemployment may be desirable but this depends also on the country's general economic standard.

Casual work should, wherever possible, be replaced by permanent employment, enabling the worker to improve his knowledge and skills continuously and enjoy a secure means of livelihood. Permanently employed or regularly employed seasonal labourers will, furthermore, be far more efficient and require much less supervision.

In this connection the employees' situation can be improved by avoiding contractors and organizing logging teams under the management of the State or Provincial forestry services.

Housing, transport to workplace, etc.

This includes activities where the workers' families will be more involved or integrated into the work situation. Employers may provide housing at low rates or furnish building materials. Wherever feasible, preference should be given to permanent settlements, enabling the worker to return home to his family after work. Transportation should be arranged by the employers. Further facilities may be provided for cultural, extension or recreational events, such as temples or community centres which permit the projection of films, or which can be used for local festivals, etc.

Community and Agro-forestry

A combination of farming and forestry as, for example, the Taungya system has, in many cases, shown a positive influence on the work force. Better motivated workers and more stabile employment conditions are some of the positive results. Community forestry with its main goal to supply fuelwood, will have the same positive influence.

Other sources of income

For the general rural development and stability of the employment conditions for the workers and their families, there is an advantage if other sources of income can be developed within the villages, such as cottage industries of different kinds.

Conclusions

At a first glance at Chart 1, manual technology may not have special importance, as far as ergonomic and safety aspects are concerned. As can be seen in Chart 2 and the foregoing sector, however, there are a lot of measures which could be taken to improve these conditions. There are, of course, several problems and obstacles which have to be eliminated before all these measures can be implemented.

However, many of the measures suggested can, at least on a small scale and at little cost, be implemented in forestry operations already existing in developing countries. Problems and obstacles are normally specific for each country or region of a country and must be discussed and solved on the spot. A checklist such as the one presented in this paper may serve as a useful instrument for this. This checklist can further be developed for practical use in different workplaces by formulating under the different aspects applicable questions and checking the existing conditions, in order to make necessary improvements. A short example of how this can be done is shown on Chart 3. During the consultation one group worked on ergonomic aspects of appropriate technology. The results of this group work is presented hereafter.

Rest Hut for Forest Workers

CHART 1	ASPECTS OF ERGONOMICS AND SAFETY										OTHER ASPECTS			
LEVEL OF TECHNOLOGY	NUTRITION	PHYSICAL WORKING CAPACITY	HEAT STRESS	RISK FOR DISEASES AND ACCIDENTS	MENTAL LOAD	INFLUENCE ON WORK SPEED	MOTIVATION	FLEXIBILITY	REPERCUSSION ON LOCAL SELF-RELIANCE[1]	TRAINING NEEDS	EMPLOYMENT OPPORTUNITIES	PRODUCTIVITY	CAPITAL COSTS	EARNING POSSIBILITY
MANUAL TECHNOLOGY	High demands	High demands	High	High	Low	High	Low	High	High	High	High	Low	Low	Low
MODERATLY MECHANIZED OPERATIONS	High demands	High demands	High	High	Inter-mediate	Inter-mediate	Inter-mediate	Inter-mediate	Inter-mediate	Higher	Inter-mediate	Inter-mediate	Inter-mediate	Inter-mediate
HIGHLY MECHANIZED OPERATIONS	Inter-mediate demands	Low demands	Inter-mediate	Inter-mediate	High	Low	High	Low	Low	Highest	Low	High	High	High

1) Very important aspect because other aspects can be influenced positively when this aspect is high.

CHART 2	MEASURES (MEANS OR STEERING AIDS) TO ACHIEVE OBJECTIVES WITH SPECIAL REGARDS TO APPROPRIATE TECHNOLOGY															
OBJECTIVES (GOALS) IN PRODUCTION	TOOLS AND MAINTENANCE	SAFETY EQUIPMENT	NUTRITION SERVICE	HEALTH SERVICE	SAFETY PROGRAM	WORK METHODS	WAGE FORM	TEAM COMPOSITION	WORK TIME DISTRIBUTION	JOB ROTATION	ROLE OF SUPERVISOR	TRAINING AND EDUCATION	SOCIAL SECURITY	HOUSING, TRANSPORT TO WORK PLACE ETC	COMMUNITY AND AGRO-FORESTRY	OTHER SOURCES OF INCOME LIKE COTTAGE INDUSTRY
QUALITY AND QUANTITY OF EMPLOYMENT	(X)	(X)	X	X	(X)	(X)	X	X	(X)		(X)	X	X	X	X	X
HEALTH AND SAFETY	X	X	X	X	X	X	X	(X)	X	(X)	X	X	(X)	X	(X)	(X)
JOB SATISFACTION	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	(X)
PRODUCTIVITY	X	(X)	X	X	(X)	X	X	X	X	(X)	X	X	(X)	X	(X)	(X)

X = influence to a high degree

(X) = influence to a certain degree

CHART 3

CHECKLIST FOR WORKPLACES (EXAMPLE)

Aspects of ergonomics	Questions	Yes	No	If yes, what, which kind etc If no, what can be done
Safety equipment	Does it exist first aid kit on the work place?			
	Is any of the team members trained for first aid?			
	Is there snake serum available near the work place?			
	Is there any quick transport facilities available for injuried persons?			
Personal protective equipment	Do the workers use proper foot-wear?			
	Do the cutters use helmet?			
	Do the workers use covering of cutting edges during transport?			

(Continue to formulate questions regarding other aspects shown in chart 2).

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Local Children watching Field Demonstration
Photo Gunnar Segerström

Workers Training - A Socio-economic Study

by
N. Basu, PAICONS

The need for providing training in improved logging did not receive sufficient attention until, with the assistance of FAO, the first logging training programme was started in Jammu and Kashmir in 1958. As a follow-up, this was institutionalised as a Logging Training Centres Project (LTCP) in 1965.

With the termination of FAO collaboration in 1969, the LTCP continued as a Government of India Project. Substantial support was accorded to it in 1977 by the Swedish International Development Authority (SIDA), the main thrust of its programme being on the training of forest workers in basic logging.

Logging in India belongs to an unorganised sector; the labour is recruited on a seasonal and ad hoc basis from a wide spectrum such as agricultural labourers, marginal farmers, small farmers and others. There is intra- and inter-state migration, depending on demand and supply of labour. The technology is mostly traditional and the sector, as such, lacks both vertical and horizontal integration. The scene is changing and there are positive signs of modernisation and the training of forest workers for better productivity and increased income can be an important stimulus for change from within.

It was found necessary to conduct a socio-economic study on forest workers to assess the social profile, economic status and attitude towards training. The study was assigned to Paicons and the basic objectives of the study were as follows:

(i) Labour recruitment policies of the existing organisation and incentives provided to labour for stepping up productivity.

(ii) Criteria adopted for the selection of participants for workers' logging training programme.

(iii) The social and economic background of the past and potential trainees and their attitude to forestry work as well as impact of training on productivity and disposal of trainees' incremental income through household surveys.

(iv) Commitments and motivation of instructors, incentives offered to instructors and institutional or organisational set-up, if any, for the training progrs

(v) Range of basic amenities and safeguards provided to workers.

(vi) Range and quality of tools available for logging.

(vii) Comparative advantages and disadvantages of trainees attached to trade unions and those working independently.

The study was conducted in two selected States of each of the four zones of the country. These States were West Bengal and Orissa in eastern zones; Uttar Pradesh and Jammu and Kashmir in northern zone; Tamil Nadu and Andhra Pradesh in southern zone, and Gujarat and Madhya Pradesh in central western zone.

In each of the selected States one forest division, having more than one logging agency, was selected, viz., the Forest Department, Forest Corporation and/or independent contractors. The selection of the forest ranges and coups was made with the help and co-operation of the Forest Departments and Corporations of the States for in-depth study. In each coup, workers were selected and details about their logging operations, use of tools and logging techniques, were noted. Besides this, household surveys were conducted to assess the socio-economic conditions of the workers engaged in logging operations. In all 146 households were surveyed in the different States.

In three States, viz., Uttar Pradesh, Andhra Pradesh and West Bengal, where the LTCP workers training programme had made substantial progress, advantage was taken of these surveys to assess the impact of training on productivity, income and expenditure pattern of the trained vis-a-vis untrained workers.

Similarly, a work-time study was organised in Pilibhit Division, Surai Range, Uttar Pradesh, to assess the productivity of workers at different periods of time, i.e. before and after the training.

Some broad findings of the study and observations are presented below:

Labour Recruitment Policy

Until recently the harvesting operations were under the control of the contractors who had no set labour recruitment policy and employed workers mainly on consideration of minimising cost and maximising profit. The contractors' system is being gradually replaced by departmental working but the progress in the formulation of labour recruitment policy varies from State to State. In fact, there is no fixed or uniform labour recruitment policy. Different States have adopted their own modus operandi to suit their own convenience and there is no well defined criteria and eligibility norms for recruitment of forest workers.

In fact, most of the States of India are passing through a transitional period from contractor to departmental working. In a State like West Bengal, there are forest settlement colonies and forest villages may be found in Madhya Pradesh. It becomes easy for the Department or Corporation to recruit the forest labour from these colonies as and when required.

It may, however, be mentioned that the transition would take three to five years and that the bulk of the area is under the control of the contractors who recruit their labour usually from their own places of origin and occasionally bind them with forward payments, etc. For instance, West Bengal had 25 percent harvesting area under the control of the Forest Department or Corporation in 1979-80. The share is progressively increasing every year so as to cover the entire area by the end of 1982-83. In some cases like Jammu and Kashmir, even now the Forest Corporation entrusts harvesting operations to mates and sub-mates, i.e. small contractors and petty contractors who, in turn, recruit workers without offering any assurance of continuous employment on a piece rate basis.

In Gujarat there are about 140 forest labour co-operatives and harvesting of timber is the sole responsibility of labour co-operatives except in the Dang Division. Even in the Dang Division, labour co-operatives share harvesting operations with the department on a 50 : 50 basis. The workers in the co-operatives are paid on a piece rate basis; in addition they receive a handsome amount by way of their share from the sale proceeds of the harvested forest produce. The labour co-operative, as an organised sector, looks after the employment opportunities for its members and provides other amenities. The Forest Department provides labourers with job opportunities in plantation work when the logging operations are over. Thus it ensures continuous participation of these workers throughout the year.

In Tamil Nadu, the State Forest Department is in sole charge of harvesting of timber but wood-based industries engaged in the production of pulp and paper obtain logging rights from the Forest Department and engage contractors for the recruitment of labour from a panel of contractors retained by the industries. The contractors cannot offer any assurance of continuous employment to the workers as they themselves do not enjoy assured business.

Employment of logging workers during off-season in plantation, raising of nurseries, etc., requires close coordination between the Forest Department and Forest Corporation and there is yet no single agency to ensure continuous employment for workers throughout the year. To meet these difficulties, it has been suggested, inter alia, that a roster of eligible forest workers may be prepared who may be employed on a regular basis. Slowly there should be a permanent core of such workers and others should be invited to join as and when there is need for their services.

Criteria for Selection of Workers for Training

Our study has revealed that it is mostly the landless labourers and thereafter the marginal and small farmers comprising Scheduled Tribes and other backward classes who depend on forestry as their major source of livelihood. Consequently, it is natural to expect that this section of workers could benefit most from the training programmes and the authorities, in turn, would also be able to secure a continuous stream of trained workers for development of logging. In the short run, however, it may not be possible to confine the choice only to this section of workers in areas where there is labour shortage, or where the workers in and around forest ranges are mainly agriculturists and to whom forestry is only a supplementary source of income.

The forest workers in India are not a compact homogenous group and there is wide diversity in their outlook and attitude towards training. The tribals dominate the forest workers in central and southern zones. The attitude of the tribals towards training varies from area to area and has a positive correlation with the degree of monetisation.

There are some practical problems in the selection of workers for training as they belong to an unorganised sector and it is difficult to coordinate training with follow-up. It will, therefore, be helpful if training is imparted to local workers who would operate within a given radius so that necessary follow-up can be organised.

On-the-job training for furniture production, with simple tools. Photo Gunnar Segerström.

Impact of Training on Productivity and Disposal of Trainees' Incremental Income: Household Survey

A reliable assessment of the productivity is possible only when there is a detailed work-time study. An assessment of productivity of a group of untrained workers was made with traditional tools. The same group was given training and time for practising advanced tools. Subsequently, an assessment of productivity was made of the same group working in the same forest range. Such an exercise was made among a batch of workers in Uttar Pradesh in the Pilibhit Division in the Surai range for a period of two months. It was found that the productivity of trained workers improved nearly by 25 percent and that there was about eight percent reduction in wastage of timber as a result of the employment of improved logging methods.

Household surveys conducted around forest belts in Uttar Pradesh, West Bengal and Andhra Pradesh revealed that in these three States a trained worker's household had a higher income with a larger contribution from forestry and a more nutritive food intake than in an untrained worker's household. Exceptions have been found but these tend to prove rather than disprove the general pattern.

Expenditure on intoxicants was found to be a common feature among all the workers, trained and untrained. Views have been expressed in some quarters that incremental income could be diverted to expenditure on intoxicants without affecting improvement at the level of nourishment. Our case studies have, however, found no definite proof in support of this hypothesis. Consumption of intoxicants seems to be a manifestation of a pernicious social habit rather than a direct impact of income level. It was found to affect both the rich and poor, the trained as well as untrained. The remedy in our view lies in social education.

Motivation of Instructors and their Attitude towards Training

The LTCP has trained a large number of forest personnel with the expectation that they would train forest workers in their respective areas. Our study reveals that these trained officials have not been utilised even marginally. The trainers were sponsored on an ad hoc basis by the State Governments without a clear perception of how to build up an organization for training of forest workers on a large scale.

Training being a highly skilled function, it is desirable that a definite criteria for the selection of trainers may be developed and the aptitude for training and practical experience in logging should be given due weight while recruiting future trainers.

The personnel trained in various courses in improved logging are employed mainly on supervisory jobs rather than as instructors for training of workers. In many States neither the Forest Department nor the Forest Corporation has provided any incentive to these personnel to take up workers' training programmes. Fortunately, the picture is somewhat different in Andhra Pradesh, West Bengal and Uttar Pradesh. The former State has evolved a micro model to impart training to workers, while Uttar Pradesh has set up a separate logging training wing exclusively for the training of workers. In West Bengal, the training programme was mainly centralised in northern areas. Proximity to forest settlement and regional LTCP, as well as the interest of the State Government have helped in training a large number of forest workers.

Basic Amenities Provided to Workers

Under the contractor system workers do not enjoy basic amenities like housing facilities, free medical aid, safety devices, financial assistance in case of emergency, drinking water facilities at camp sites, etc. This is true whether the contractor is working on his own, working on behalf of a Governmental agency, or any wood-based industry. Even in some States where the forest workers are under the control of the Forest Department or Forest Corporations, some of the basic amenities are not provided.

The position is somewhat encouraging in States like West Bengal, Madhya Pradesh and Gujarat. For instance, in West Bengal, the forest settlement colonies provide land, building sites and various other facilities so as to settle the forest workers in a permanent manner. The forest villages in Madhya Pradesh have also provided some services.

In Gujarat, however, the labour co-operatives provide services like education, health cover, access to credit facilities, etc. In Gujarat the Department also provides a large number of services in addition to those provided by the Labour Co-operatives, such as food banks from where they receive cereals, which they can pay back in kind without any interest.

It appears that the package of basic services required by the workers has not been fully realised or given effect to. The progress has been partial in all States and a clear cut national policy is yet to emerge.

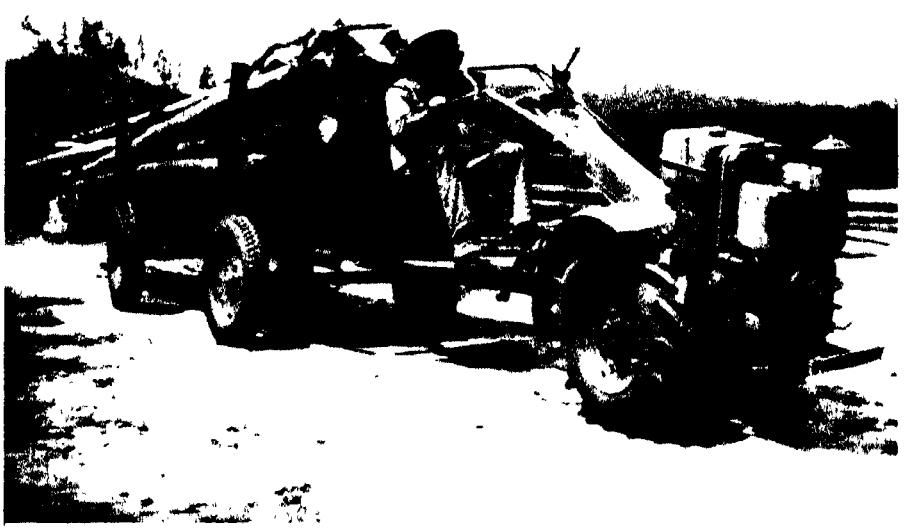
Range and Quality of Tools

The untrained workers use old and primitive tools. In some States, peg-tooth saw is used for sawing and cross-cutting, but these saws are devoid of proper gullets and are equipped with fixed handles which do not facilitate their use in different positions. Logging techniques are also defective and there is considerable wastage of timber on account of high stumps, faulty sink cuts and wrong felling directions. Trained workers use improved axe and both peg-tooth saw and raker saw for felling and cross-cutting. The use of power chain saws has also been introduced in some areas of West Bengal and Madhya Pradesh.

During the study it was observed that the maintenance of tools is one of the major problems in introducing better saws. In the backward areas there is a general feeling that very few tribals will be able to maintain their saws at this stage, in view of the fact that they do not realise the importance of well maintained tools and their impact on productivity. In these areas, as in Madhya Pradesh, the saw doctor system has been introduced for the maintenance of tools of workers. However, even in these areas it is felt that saw doctors should be entrusted with the maintenance of raker saws and that peg-tooth saws should be maintained by the workers themselves.

The quality of indigenous tools supplied to some Forest Departments and Corporations was found to be sub-standard. There is also no proper system for periodic tests or quality control of these tools. It is difficult to keep up quality and monitor supply of raw materials to a large number of small manufacturers unless a Certification of the Indian Standard Institution becomes binding and LTCP has the necessary facilities to test and approve a particular make on behalf of ISI.

In order to motivate the manufacturers of tools, it is desirable that the use of better tools become compulsory in developed areas, so that the manufacturers are also assured of an expanding market and they would then keep up the quality and formulate their production plan accordingly.



Hauling Poles in China with S.C. Walking Tractor and Trailer
Photo Shi Ming Zhang

Energy from the Forest

by
B.P. Srivastava
Inspector General of Forests (Retired)

The energy crunch is a problem which mankind is faced with today. In the tomorrow of the foreseeable future, it may turn into a disaster, unless human ingenuity and forethought find a workable solution in time. The world's scientists are concentrating in a big way to develop alternative sources of energy to keep the wheels of civilization moving, even after the earth's resources of petroleum and fossil fuels have been exhausted, and there is no doubt that a solution, or rather a packet of solutions, would be found and adopted long before the crisis turns into a disaster.

The alternative sources of energy that are being much talked about these days are:

- atomic energy
- solar energy
- geo-thermal energy
- hydro-electricity
- energy from the sea by harnessing the tides
- wind energy
- and last, but not least, biomass energy.

Biomass energy is that which can be obtained from plant and animal materials using conversion processes such as direct burning, gasification, fermentation and digestion to give heat and/or gases, liquid or solid fuels. It is this form of energy and the role that the forestry sector can play in augmenting the resource base and improving the utilization of this renewable resource through the adoption of appropriate technology, that I am going to talk about today.

The use of wood as a source of energy has been known to man since he learned to eat cooked food. It may not be a very efficient fuel, but its cheapness and, till comparatively recently, abundant availability, makes it the most popular form of fuel, particularly in the poorer developing countries of the world. About one-third of the world's population depends upon wood as its principal source of energy for cooking and domestic heating. Approximately half of the wood consumed in the world each year still performs its original role of providing fuel for cooking and a source of warmth to human beings. The rural population in the developing countries of the world depends almost entirely on wood, crop residues, and dung for cooking food. About 90 percent of the entire wood production in the developing countries is consumed as fuel. The following tables show the percentage of wood production of certain countries used as energy.

Woodfuel Consumption Pattern

Country/Region	Percentage of Wood Production consumed as fuel
Argentina	82
India	91
Kenya	93
Lebanon	48
Nigeria	86
Pakistan	77
Sudan	94
Tanzania	96
Thailand	77
Turkey	59
Uganda	92
Zambia	90
World	52
Developed Countries	13
Developing Countries	86
Southeast Asia and Oceania	88
South Asia	95
China and the rest of Asia	75
Near East and North Africa	88
West and Central Africa	93
East and South Africa	93
Central America	75
South America	83

In the rural areas of most developing countries the dependence on wood and other non-commercial fuels such as animal dung and crop residues is often total. According to one recent estimation the energy from the use of animal dung is equivalent to nearly 13 percent of the energy being used in the form of wood fuel. and energy from crop residues is at a level equivalent to about 16 percent of the energy produced from animal dung. Wood fuels, therefore, account for about 85 percent of all non-commercial energy in developing countries. In India, despite the fact that we have a well developed commercial energy sector and there is a shortage of wood in most rural areas, wood fuels were estimated in 1970/71 to account for 34 percent of total energy consumption and all non-commercial organic fuels, including animal dung and crop residues accounted for 56 percent of total energy and for as much as 93 percent of rural domestic energy requirements. The recorded production of fuelwood in India is of the order of 16 million cum per annum, whereas, according to the estimates prepared by the Fuel Policy Committee of the Government of India, the annual consumption is of the order of 175 million cum.

There is a wide gap between production and actual consumption which can be attributed to the fact that a large quantity of fuelwood is collected from the forest by way of rights and concessions and perhaps an even larger quantity by pilferage by the adjoining villages, which go unrecorded. Pilferage of fuelwood is particularly heavy in the vicinity of urban centres of consumption. Felling and lopping of trees standing in village lands and in roadside avenues and groves and cutting of shrubs, bushes and forest undergrowth further acoount for bridging the gap between recorded production and actual consumption.

Waste Wood to be used as Fuel at a Forest Industry in India
Photo Gunnar Segerström

It is obvious that with almost 90 percent of the fuelwood consumed coming from unrecorded sources, which, in other words, means through unregulated and unscientific exploitation of forest and tree growth, the pace of deforestation and denudation in India has assumed alarming proportions in the last few decades. While haphazard and uncontrolled collection of fuelwood is not the only reason for the rapid and large scale deforestation that is occurring in the country, it is certainly one of the major causative factors. I shall not deal with the other factors here as they are not directly connected with the energy problem, except to the extent that, due to the decimation of forest and tree wealth of the country and the constant shrinking of the forest areas, the availability of fuelwood for domestic energy is getting less and less.

This sets up a vicious cycle. With no fuelwood available the villager has to turn more and more towards the use of animal dung as fuel. In large areas of this country where all forest and tree growth have disappeared, the villagers rely almost entirely on animal dung for fuel, which is as much a necessity of life as food itself. This diversion of animal manure from the field to the hearth results in a drop in food production which, in turn, means the need for more land for agriculture. This results in a further clearance of forests in a country where the forest oover is already below the desired minimum. With the reduction of forest area the availability of fuelwood decreases further and the vicious cycle is completed. In the Gangetic plains of Uttar Pradesh, where there are hardly any forests left, the average farmer with a holding of about one hectare, burns enough cow dung every year which, if used as manure, would have given him a minimum increase of at least 600 kilograms of food grains. In other words, he is burning almost one and a half kilograms of food per day in order to cook his food. It has been estimated that the total quantity of animal manure burnt as fuel in India eaoh year is equivalent to the fertilizer production of eight fertilizer factories of the size of Sindri. According to another estimate (by the N.C.A.) about 200 million tons of dung is burnt as fuel every year which, if used as farmyard manure, would increase the country's food production by 40 million tonnes of food grains. In terms of effective energy value 200 million tonnes of cow dung are equivalent to 56.5 million tonnes of fuelwood. Theoretically, therefore, all that is needed to solve this massive problem is to raise plantations of fast growing species over

an area sufficient to produce 55 to 60 million tonnes of fuelwood per year. In addition, to install a sufficient number of biogas plants to change 200 million tonnes of cow dung into clean and smokeless biogas fuel and nitrogen rich, odourless and aseptic organic fertilizer in the form of a slurry.

To convert this theoretical concept into reality is the challenge which the forestry sector has to face and to overcome to solve the country's energy problem, as well as the food problem which is closely interlinked with it. This is a massive challenge and a historical one because never before in the more than one and a quarter century of its existence has the forestry sector been faced with anything of this nature and magnitude. The existing knowledge and technology have to be transferred and applied to the seven million villages in this country and new technology appropriate to various climatic, edaphic and socio-economic conditions developed through purposeful and time-bound research programmes.

Energy from Biomass

Wood

The total energy requirements of India in 1978-79 and the forecasted demand for the future is as under:

FUEL*	YEAR		
	1978-79	1983-84	1990-1991
Coal	85	124	198
Oil products	173	273	380
Electricity	100	167	320
Total commercial energy	358	528	898
Non-commercial energy			
Fuelwood and charcoal	125	124	116
Dungcake (dry)	26	26	21
Vegetable waste	44	44	44
Total	195	194	181
Total energy	553	722	1,079

* In million tonnes of coal replacement.

On perusal of the above table it will be observed that non-commercial fuels form a significant percentage of the total energy requirements of India. In order to meet the energy requirements of India and to conserve the non-renewable fossil fuels, the only solution lies in developing biomass energy resources by raising enery plantations.

The principal advantages of wood as a source of fuel are that it is socially and environmentally acceptable, has low sulphur and ash content, is often locally available, is not particularly hazardous, and can be burnt in large or small and simple equipment which can be locally made. The only by-product is a small amount of ash which has some value as fertilizer as it contains all the potassium and other minerals, except nitrogen, which were present in the original wood. But wood does have some undesirable characteristics. When harvested, it has a moisture content of approximately 50 percent; it is difficult and slow to dry; it is costly and difficult to transport because of its bulk; and it burns with a long flame and considerable smoke, both of which result in a loss of combustion efficiency; the efficiency is also reduced by the presence of moisture and thus it must be sheltered from the rain during storage, since wood is hygroscopic.

Despite these undesirable characteristics of wood, fuelwood represents a most important source of energy in very many developing countries. In India, fuelwood accounts for nearly 34 percent of all the energy consumed. In fact, most of the energy needs of the rural population in India are being met by fuelwood. It is also an important source of energy for several industries such as brick, tiles and ceramic manufacture, food processing, rubber production and even steel manufacture. It is also used by the sugar industry to start the sugar-mills until such time that sufficient bagasse, which is another important source of biomass energy, is produced to keep the sugar-mills running. It can be and is used to fuel boilers to produce electricity and steam. Even in developed countries like Sweden and the U.S.A. fuelwood represents an important fraction (8 percent and 2 percent respectively) of the energy used. With the oil crisis the use of fuelwood for domestic heating, as well as for power generation, is likely to increase in the near future.

Fuelwood can be raised as an energy crop by the establishment of local fuelwood plantations. A table of the calorific power of some Indian woods is attached to this paper.

Emphasis has to be laid on making each village self-sufficient in energy. Very often there is enough common land available for raising small woodlots but where such land is not available each farmer can raise sufficient trees to make himself self-sufficient for his fuel and smallwood requirements, along his field boundaries or even on a part of his holding. Urban areas also use large amounts of biomass energy and can usually pay more for the product. Therefore, the implementation of biomass energy schemes around towns and cities also needs to be considered.

Energy Plantations

The basic questions that arise are: what types of plants are best suited for energy plantations or village fuelwood lots; what stem sizes are optimal; what conversion process should be applied, or what fuels produced, and what long-range planning and research will be necessary for the achievement of specified goals. The ideal plant for energy farming would be one that is quick-growing, easy to raise, coppices well, has a high energy density and requires minimum processing into transportable fuel. There is no one ideal plant but plants can be selected to best fit conditions of site, climate, extent of processing and economics. The range may extend from Euphorbia species, the latex of which can be cracked into low molecular weight hydrocarbons, through sugar-cane, sugar-beet, and cereals which can be relatively easily fermented, to any type of woody shrub or tree species which can be used to produce a variety of fuels with or without processing.

While conversion of plant latex into hydrocarbons and sugars and starches into alcohol require sophisticated technology and use of energy for such conversions, which will reduce the net availability of energy, the biomass from shrubs and trees can be converted directly into energy without relying on any sophisticated technology and without any significant energy inputs. With plenty of cheap manpower available in the country all operations, such as soil working, planting and harvesting can be done by manual power.

For India, therefore, the solution to the energy problem lies in raising plantations of quick-growing woody plants with high energy density. But the growing of trees, even short rotation trees, takes time and the production of wood per hectare per annum is not high enough for the individual small farmer to take to the growing of fuel on his land, unless he happens to own a very large area of land. The forester all over the world has so far been involved in raising trees of a certain minimum diameter and height. Consequently the minimum rotations have been of the order of eight to ten years, using fast growing species. The espacement of plants has been throught of in terms of hundreds or thousands per hectare in order to allow sufficient growing space for the trees. The

concept I wish to propound here is that of energy plantations raised at the unheard close spacing of 40,000 to 1,000,000 stems per hectare, worked on a rotation of one to two years. According to trials conducted in Sweden, birch grown at a spacing of 30,000 to 1,000,000 per hectare can yield a biomass of about 55 tonnes per hectare, which yields 18 tonnes of dry matter which is equivalent to eight tonnes of oil. Under Indian conditions a farmer can expect to grow four tonnes of dry matter per annum on one-quarter of an acre, which should suffice for the domestic energy requirements of a family of five for one year. This opens up a tremendous and exciting possibility, not only in the saving of enormous quantities of cow dung being burnt at present, but also in saving the forests which are being rapidly denuded through large-scale indiscriminate collection of firewood.

In the last two decades our country has made tremendous progress in food production, through the introduction of high yielding varieties of wheat and rice and the use of required inputs of fertilisers and water. But the production of foodgrain is not enough. The production of fuel in matching quantities to cook food is of equal importance. So far no thought has been given to the raising of fuel as part of an agricultural crop for the simple reason that no technology was known for maximising fuel production so that is could be raised on a minimum area in the shortest possible time. Now that a possibility exists, no time should be lost in developing this technology and propagating it. It is a challenge which the forestry sector should take up immediately and in earnest, with the co-operation of agricultural scientists. I have no doubts that, if concerted efforts are made, within a few years our farmers will learn to earmark a small section of their holdings - say ten to fifteen percent - for growing of fuel crops in order to make themselves self-sufficient in fuel. The loss of food production due to the diversion of this small percentage of land from food to fuel will be more than made up by the increased yield in the remainder, due to the increased availability of cow dung manure. An objection may be raised that the growing of ultra dense crops on a very short rotation of one to two years will not yield billets or logs of wood but only sticks. The answer is that the Indian farmer is already using stick fuel in his hearth, in the shape of jute sticks and stems of 'Arhar' or 'Tur' (Cajanus indicus), as well as other agricultural wastes. Energy plantations of the type mentioned above are not only suitable for providing domestic fuel to the rural population, but also for generating electricity in the rural areas for lighting, irrigation and small-scale industries. For this purpose the fuel could be converted into chips for convenience of feeding into boilers.

We need not think in terms of giant power plants with outputs in the megawatt range. What would be more appropriate would be a large number of comparatively small power plants generating from ten to 500 kilowatts, each with its own captive plantation of denser than conventional spacings and shorter than conventional cycles, which could provide fuel on a sustained basis. The land area required for these fuel plantations would not be excessive and village wasteland and poor quality low density forests could be converted into such plantations. In other words, these areas could be placed under what may be termed High-density Short Rotation Forestry.

Charcoal

Fuelwood has low thermal efficiency, is bulky and consequently costly to transport over long distances. It burns with a long, luminous flame and produces soot and smoke. Charcoal, on the other hand, is more energy efficient and has twice the heat value per unit of weight of wood. It is, in fact, a high quality fuel which, for domestic use, may actually be cheaper than fuelwood. It is smokeless and has good burning characteristics, being less bulky, it can be conveniently stored and transported over long distances. However, it has one drawback: it is brittle and consequently tends to get pulverized during transport and repeated handling, with the result that a considerable portion gets reduced to charcoal powder which cannot be normally utilized in a conventional stove. The calorific value and the burning efficiency of charcoal depends on the density and cellular structure of the wood from which it is made and not all species yield charcoal

of acceptable quality. Dense and heavy woods generally make good quality charcoal whereas charcoal from lighter and softer woods is very light and brittle and burns too quickly. Coniferous woods such as pine, spruce and fir do not make good charcoal. During World War II, when there was a shortage of petrol, charcoal producer-gas plants were used in this country for the propulsion of motor vehicles. The Forest Research Institute, Dehra Dun, conducted trials on the thermal efficiency of charcoal made from different species of wood and came to the conclusion that the best charcoal was made from tamarind (Tamarindus indicus).

Charcoal is obtained by the destructive distillation of wood by burning it in a limited quantity of oxygen. With more oxygen the charcoal gets reduced to ash. The distillate consists of acetone, methyl alcohol and pyroligeneous acid and combustible gases such carbon-monoxide and methane are produced during burning.

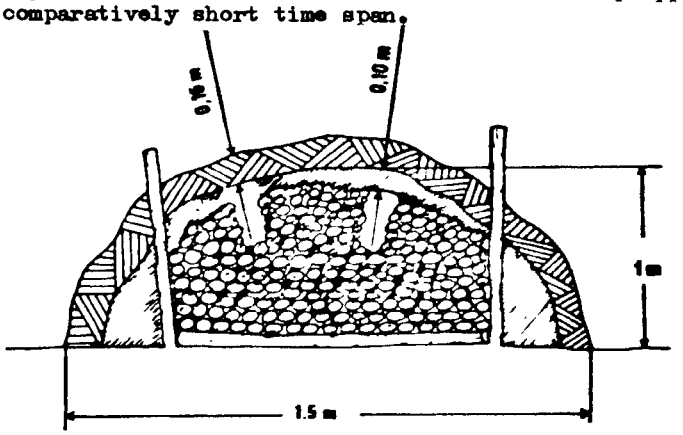
By far the major portion of charcoal produced in India is through cheap indigenous kilns, of which there are various kind - heap or earth-mound kilns, pit kilns and paraboloid kilns. All are cheap and easily made by the charcoal burners but they are inefficient and wasteful. The charcoal yield is low and all the chemical by-products literally go up in smoke. The recovery of charcoal by these indigenous kilns varies from 17 percent to 22 percent by weight of wood. Recovery of by-products is nil. However, more efficient kilns and retorts are in use in the country by industries such as iron and steel, ferro-silicon, cement and mineral industries in South India and in the States of Haryana and Punjab. In the latter two States permanent brick kilns of improved design with exhaust fan controlled draught are used. The charcoal recovery is 22 percent to 25 percent and about 50 percent of the by-products are recovered. Continuous vertical retorts and horizontal mechanized retorts are used by the bulk consumer industries in the south. The charcoal recovery is 25 percent and 33 percent and the by-product recovery 50 percent and 100 percent respectively.

The drawback in these efficient methods of charcoal production is that they are capital-intensive, immobile, and require large quantities of wood for economic operation. Therefore, despite their efficiency, they are not the answer to the energy problem in this country, which is one of vast distances and scattered forest resources. The answer lies somewhere between the two alternatives. It lies in the development and use of portable or at least easily transportable metal kilns with higher charcoal conversion efficiency, with or without arrangements for the recovery of the by-products. Some work has already been done at the FRI in the past, but without adequate follow-up, to popularise the portable kiln. Portable kilns, using cylindrical sections which are joined together by an ingenious sand-filled joint, have been developed and are in use in Ghana and Thailand. Further research is needed to develop cheap, portable and more efficient kilns which would be acceptable to the charcoal burners. Chemicals recovered as a by-product could be sold in the raw condition to chemical refiners for further processing.

And now I take the liberty of throwing up a new concept in the manufacture of charcoal. As has been mentioned earlier, charcoal is brittle and its quality entirely depends on the wood from which it is made. It therefore follows that only certain species can be used for its manufacture, which means that it cannot be universally made from whatever woody material is locally available. It also means that it can only be made from the larger sections of the trunk, branches and roots and not from the very thin branches and twigs which, though convertible into charcoal, will not be acceptable because of small-size and susceptibility to pulverization.

The answer is to make what may be called 'reconstituted charcoal' by the carbonization of any kind of woody or cellulosic material, irrespective of size, shape or species, powdering it finely in a ball-mill and then compressing the powder into pellets or briquettes under pressure. These briquettes will have uniform density and size and high calorific value. They would be able to withstand long transport and rough handling and would have

the same burning qualities irrespective of density, shape or size of the material from which they were made. All forest waste, including small branches, twigs, chip , sawdust, brushwood, and even rank grasses could be converted into a very acceptable source of energy and agricultural wastes such as wheat and rice straw, rice hulls, corn cobs and bagasse could also be used. Since small-sized material has to be used, the carbonization process will have to be carefully controlled to prevent over-burning resulting in ash formation. I daresay that it should not be difficult to develop appropriate technology for this process in a comparatively short time span.



A cut through a simple kiln covered with soil. The carbonization is ready after about 2 days and the kiln has been sinking to about half of its original height.

Biogas

Organic waste both of animal and plant origin can be a cheap and plentiful source of energy in the form of methane gas produced through anerobic fermentation. The slurry discharged after fermentation is an excellent fertilizer rich in nitrogen and totally free of odour and any pathogens or insects. This is the best method of utilizing animal dung from which energy in the form of a clean burning gas is obtained, without sacrificing any of the nutrient value of the dung. In fact, the fertilizer obtained through this process is far superior to the farmyard manure obtained by composting. According to one estimate, if all the dung produced in India could be so treated, the biogas generated would be of the order of 30,000 million cubic metres, equivalent in energy to about 160 million cubic metres of fuelwood.

China has taken great strides in the development of biogas technology suitable for rural areas and set up 4.3 million plants during the three year period from 1973 to 1976. In India also efforts are in hand to introduce biogas in the rural areas on a massive scale. The forestry sector has to make a concerted effort in the introduction and popularization of this programme, particularly in the villages situated in and around the forest areas. The introduction of biogas in villages in the vicinity of forests will significantly reduce damage and denudation due to collection of fuelwood and, by improving the economic condition of the villagers as a result of higher food production, also tend to reduce pilferage of forest produce in which the villagers indulge to augment their meagre resources.

Energy from Waste

In spite of the fact that serious efforts have been made and continue to be made over the last quarter of a century to introduce modern and more efficient logging tools and techniques in forest harvesting in India, harvesting processes in the country are still far from efficient. The tools used are antiquated and inefficient and the methods employed are wasteful of time, human labour and, above all, of wood. In a country where the forest resources are far below the demand, such colossal waste of a valuable natural resource should not be allowed to continue. The Logging Training Project has been doing valuable work in introducing improved logging technology into the country and it is for the forestry sector to take up the introduction of this technology on the widest possible scale.

I would like to touch upon a few items of significant waste in the existing harvesting techniques which need to be stopped in order to conserve our forest resources and to utilize them more completely. This is particularly important in the context of the energy crisis because the wood wasted in various harvesting processes, if utilized, could significantly improve the energy situation. At present it just rots in the forst and very often adds to the fire and disease hazards.

Sources of waste

(a) Felling. In many areas fellings are done leaving very high stumps. This is particularly true in the tropical evergreen forests and the Himalayan forests. Sloping terrain, presence of buttresses and the use of axes for felling are usually the cause of leaving excessively high stumps. If fellings are done with saws alone or with a judicious combination of axe and saw, using the correct felling technique, it is possible to have very low stumps under any forest condition.

Another source of waste in the felling operation is the total lack of any control over the direction in which the tree falls which causes damage not only to the tree felled, but also to the standing crop. The damaged material is seldom brought out of the forest but is left to rot.

(b) Cross-cutting. Cross-cutting of the main trunk and bucking of branches is done with axe instead of using cross-cut or bow saws. A tremendous amount of wood is thus wasted in the form of chips.

(c) Squaring of logs with an Axe. This extremely wasteful practice is prevalent in the Himalayan forests where logs are squared with an axe before being sawn into scantlings. 30 percent to 50 percent of the volume of the log is reduced into chips which are left lying in the forest. If the squaring were done by saw the side slabs could be utilized for resawing into small sizes, or used as pulpwood or fuel.

(d) Billeting. Firewood and pulpwood billets are invariably cut with an axe, thus wasting about 12 percent. If they were cut with a bow saw the fuelwood availability in the country would go up by a very significant figure. This point is of great importance in the context of augmenting energy resources.

(e) Logging Residues. Logging residues left in some of the forests is to be seen to be believed. This is particularly true of the Andaman and Nicobar Islands where enormous quantities of residue are left behind. Only logs above a certain girth are extracted and the rest of the tree left unutilised. There being no demand for fuelwood, the smaller sizes are not extracted. A more or less similar situation obtains in evergreen forests in the north eastern and southern regions, as also in the Himalyan forests.

High transport costs prohibit the utilization of these residues for fuel - a problem that could be tackled by converting them into charcoal and, where possible, briquetting it.

(f) Sawing Waste. In many areas sawing of logs is done at the stump site by hand. The entire quantity of sawdust produced, which is eight percent to ten percent of the volume of timber sawn is left scattered all over the forest. If the timber were extracted in the log form and sawn at a centrally located sawmill, the sawdust would be available for making particle board and as fuel in the form of briquettes, or even directly in stoves designed to use sawdust.

Table of Calorific Power of some Indian Woods

Name of Species	Locality	Air-dry Moisture %	Ash %	Calorific Power (for completely dried materials) Calories	B.T.U.
1. Abies pindrow	Jaunsar, U.P.	11.97	1.05	4,522	8,139
2. Acacia arabica	Bijapur Div.Bombay	9.34	0.78	4,814	8,665
3. Acacia catechu	Dehra Dun, U.P.	10.47	0.78	4,566	8,219
4. Adina cordifolia	" " "	13.04	1.25	3,855	6,939
5. Aegle marmelos	" " "	13.29	1.02	4,209	7,576
6. Aesculus indica	Jaunsar, U.P.	12.90	0.97	4,216	7,589
7. Albizzia procera	Dehra Dun, U.P.	10.76	1.36	4,652	8,373
8. Anogeissus latifolia	" " "	10.70	1.76	4,156	7,481
9. Bauhinia ammonille	" " "	12.01	1.49	3,761	6,769
10. Berrya ammonille	Pyinmana, U.Burma	12.24	1.50	4,648	8,366
11. Bombax malebaricum	Dehra Dun, U.P.	12.74	2.04	4,517	8,130
12. Boswellia serrata	Siwaliks, U.P.	11.81	2.53	4,314	7,765
13. Bridelia retusa	Mandla, C.P.	9.65	1.24	4,905	8,829
14. Buchanania latifolia	Dehra Dun, U.P.	12.28	2.06	4,068	7,322
15. Calophyllum spectabile	Andamans	10.82	0.82	4,105	7,389
16. Carallia integerrima	Rangoon Division	11.02	1.34	4,766	8,579
17. Casurina equisetifolia	Dehra Dun, U.P.	11.18	1.28	4,577	8,239
18. Cassia fistula	" " "	11.84	1.10	4,005	7,239
19. Cedrela toona	" " "	12.40	0.94	4,577	8,239
20. Cedrus deodara	Jaunsar, U.P.	10.27	0.52	4,577	8,239
21. Chloroxylon swietenia	Mandla, C.P.	13.26	1.70	4,759	8,566
22. Dedbergia sissoo	Dehra Dun, U.P.	10.77	1.52	4,618	8,312
23. Gardenia gummifera	Raipur, C.P.	13.00	1.10	4,486	8,075
24. Gardenia latifolia	" "	11.61	1.60	4,577	8,239
25. Gardenia turgida	" "	14.06	1.00	4,640	8,352
26. Garuga pinnata	Dehra Dun, U.P.	11.69	2.20	4,417	7,950
27. Gmelina arborea	" " "	11.25	2.51	4,486	8,075
28. Grewia vestita	" " "	13.56	1.56	4,641	8,354
29. Holoptelea integrifolia	" " "	13.21	1.25	4,882	8,788
30. Homalium tomentosum	Toungoo, Burma	9.18	0.08	4,577	8,239

(Continued

	Name of Species	Locality	Air-dry Moisture %	Air-dry Ash %	Calorific Power (for completely dried materials) Calories	Calorific Power (for completely dried materials) B.T.Y.
31.	Kydia calycina	Dehra Dun, U.P.	12.54	1.92	4,522	8,139
32.	Jagerstroemia perviflora	" " "	13.53	2.82	4,379	7,882
33.	Lagerstroemia tomentosa	Pyinmana, U.Burma	12.55	1.91	4,577	8,239
34.	Mallotus philippinesis	Dehra Dun, U.P.	11.12	0.86	4,080	7,344
35.	Odina wodier (sap wood)	" " "	10.40	2.10	4,394	7,909
36.	Oroxylum indicum	" " "	12.29	1.66	4,383	7,889
37.	Ougeinia dalbergoides	Balaghat, C.P.	11.02	0.78	4,649	8,368
38.	Picea morinda	Jaunsar, U.P.	12.14	0.31	4,577	8,239
39.	Pinus excelsa	" "	10.74	0.34	4,976	8,957
40.	Pinus longifolia	" "	13.04	0.48	5,080	9,144
41.	Podocarpus neriifolia	Andamans	11.06	0.64	4,271	7,688
42.	Pterocarpus macrocarpus	Ruby Mines U.Burma	13.77	0.65	4,852	8,734
43.	Pterocarpus marsupium	Balaghat, C.P.	11.30	0.55	4,069	7,324
44.	Quercus dilatata	Jaunsar, U.P.	11.87	0.62	4,485	8,073
45.	Quercus incana	" "	10.70	0.75	4,393	7,908
46.	Quercus semecarpifolia	" "	11.89	0.89	4,214	7,585
47.	Schrebera swietenioides	Mandla, C.P.	14.65	1.55	4,852	8,733
48.	Semecarpus anacardium	Dehra Dun, U.P.	10.86	1.05	4,584	8,251
49.	Shorea robusta	" "	11.72	0.75	4,934	8,881
50.	Spondias mangifera	" "	11.68	0.85	4,028	7,251
51.	Sterculia villosa	" "	12.13	1.42	4,028	7,251
52.	Taxus baccata	Jaunsar, U.P.	8.86	0.80	4,101	7,394

(Continued)

Name of Species	Locality	Air-dry Moisture %	Air-dry Ash %	Calorific Power (for completely dried materials) Calories	Calorific Power (for completely dried materials) B.T.Y.
53. Tectona grandis (i)	Plantation growth teak from Zigon Burma	10.11	0.80	4,760	8,568
(ii)	Naturally grown teak from Burma	9.27	0.66	4,753	8,787
54. Terminalia belerica	Dehra Dun, U.P.	15.81	2.28	4,882	8,787
55. Terminalia tomentosa	Mandla, C.P.	11.94	2.10	4,923	8,862
56. Xylia dolabriformis	Bijapur Div.Bombay	14.72	2.65	4,905	8,829

Fuelwood on its way to the market
Photo Gunnar Segerström

Charcoal Production using a Portable Metal Kiln

by
Shri A.R. Maslekar
Forest Development Corporation of Maharashtra Ltd. Nagpur

Introduction and Background

There has been a rapidly increasing demand for charcoal from a number of industries using carbon in various forms. According to an authoritative estimate, the annual consumption of charcoal in Karnataka alone is 75,000 M.T. Large quantities of charcoal are used for the manufacture of carbon bisulphide, which is used in many chemical processes and in the viscose rayon factories. Sizeable quantities are also used by the expanding activated carbon industry. There is a demand for charcoal for the manufacture of explosives and case-hardening compounds. Substantial quantities of charcoal (10,000 to 12,000 tonnes annually) are consumed by the carbide industry like TECIL. Century Rayons consumes 3,100 M.T.. Large quantities of charcoal are also exported every year to foreign markets mostly for use in outdoor grilling and barbecues. There is a growing demand from the iron and steel industries for charcoal to be used as a reductant. The Visveswarya Iron and Steel Company of Bhadravati alone requires 30,000 M.T. of charcoal annually for its ferro-silicon plant. The Maharashtra Electrosmelt Ltd. for their steel plant at Chandrapur has an annual requirement of 14,000 M.T. of charcoal. Substantial quantities are also in demand from Firth (India) Steel Company, Nagpur.

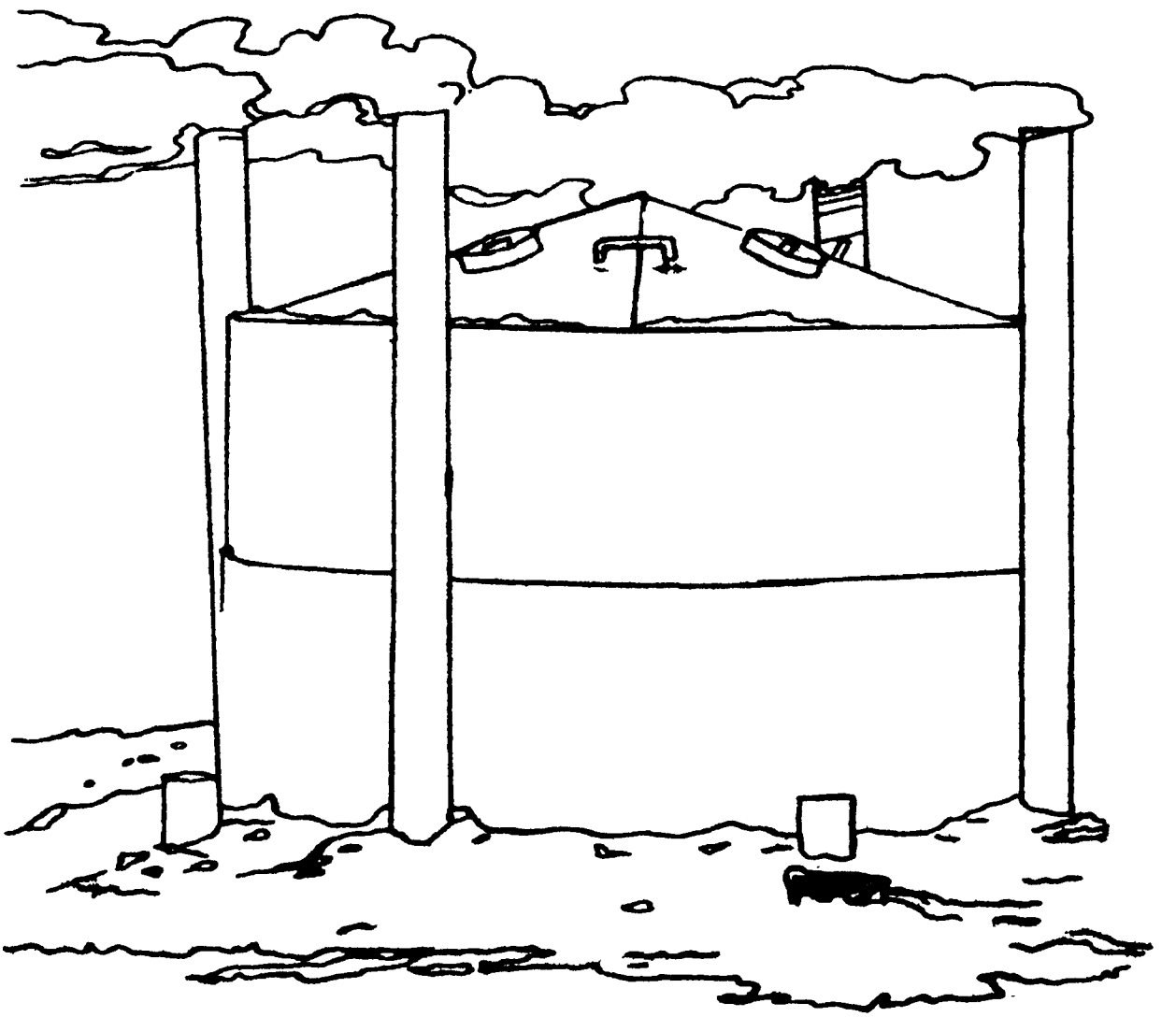
Because of the expanding market for charcoal, the price of the commodity along with its demand, has been steadily increasing. Our own experience in Forest Development Corporation of Maharashtra Ltd. shows that vast quantities of fuelwood obtained from harvesting of Crop-I and also other unsaleable wood, can be profitably marketed by conversion to charcoal. The Forest Development Corporation of Maharashtra Ltd. during the last four years has established sufficient skills and intrastructural facilities for manufacturing about 10,000 M.T. of charcoal annually. This activity has also created employment opportunities for the tribals in the remote forest tracts.

The Forest Development Corporation of Maharashtra Ltd. uses the traditional country kiln method for manufacturing charcoal. This method has several drawbacks, like slow rate of conversion, presence of impurities, improper burning, etc. Hence, to prepare superior grade charcoal, which is readily acceptable to the industries, it is necessary to use better methods and techniques. One alternative is to use the portable metal kiln, which is fairly simple to construct and operate, can be shifted from place to place, and superior quality charcoal is produced at a much quicker rate. Another important point is that, while charcoal preparation in country kilns is a rigorous process involving constant supervision and exposure to risks from fires and explosion, the portable kiln offers a much softer and totally risk-free alternative process.

In fact, a number of developing countries like Ghana, Thailand, Zambia and Uganda have already taken to ambitious projects for modernising their charcoal industry by gradual replacement of the country kilns with portable kilns.

The FAO/Norway Training Course on Logging Operations, held in Sri Lanka in September - October, 1979, adopted several recommendations regarding practice of logging in the developing countries. One of these was as follows:

Portable Metal Kiln for Charcoal Production
Forest Development Corporation of Maharashtra Ltd.,Nagpur



- Charcoal-making from logging and saw mill residues, from thinnings of forest plantation, and from trees removed for timber stand improvement of natural forests can provide a most important source of low cost energy, while at the same time providing employment to jobless people in rural areas in the region.

  Special attention should be paid to the introduction of portable steel kilns which facilitate and speed up the carbonisation process, while yielding twice as much charcoal of higher quality when compared with traditional methods of charcoal-making.

  It would be very much appreciated if outside help could be made available to make this technique known to all countries of the region. This should be done by means of a regional training course, plus seminar for technical foresters and planners to be held as soon as possible. These meetings should also include the promotion of charcoal marketing.

The TPI Kiln

The most advanced portable charcoal kiln which is very simple to fabricate and operate, and yet has a remarkable efficiency, is the one developed by the Tropical Products Institute (TPI), U.K. The FDCM had two such kilns fabricated locally and extensive trials have been made with these kilns at Nara Depot and Hiwra Work Centre of Nagpur Forest Project Division. Besides a higher yield of charcoal, the product was found better suited for industrial use, the operations were simple, and twigs, lops and tops and even bark were found to be carbonised effectively. In country kilns the bark gets completely converted into ash and hence it is treated as an impurity in charcoal for industrial use. It is also not possible to convert branchwood of less than 15" in girth as smaller twigs get burnt off completely.

Trials in FDCM using TPI Kilns

To begin with, trials were first taken using one kiln at Nara Depot on the outskirts of Nagpur, from 4 November 1980 to 22 January 1981, when 8,068 M.T. of charcoal were produced. The kiln was subsequently shifted to the Hiwra work centre. A second kiln was fabricated and shifted to Hiwra. With the help of these two kilns and using mostly logging wastes, trials were taken from 12 March 1981 to 1 August 1981. A total of 49,999 kg. of charcoal and 5,905 kg of breeze (charcoal less than $\frac{1}{2}$" in size) were obtained, using 678 m^3 (piled) of firewood.

The kilns were fabricated strictly according to the design specifications provided by the Tropical Products Institute, which also supplied the instructions for operating the kilns.

Description of the Portable Kiln

The complete details of design, construction and operation of portable kiln are given in the Technical Report No. G 119 of the Tropical Products Institute, U.K. This report is freely available from the Institute on request.

The kiln is fabricated from mild steel sheets. It consists of two interlocking cylinders. The top is fitted with a conical lid which contains four outlets for steam and smoke. The bottom cylinder rests on eight smoke outlet channels, four of which are alternatively connected to vertical smoke stacks. The height of the kiln is 2.4 metres, including the chimneys. With a diameter of 2.26 metres, the kiln can hold about 6.64 m^3 stacked or about 2,500 kgs of firewood to produce 490 kg of charcoal and 60 kg of charcoal breeze. (Churi).

Manufacture of Charcoal

The process consists of loading the kiln with firewood up to the top and then setting fire to the kiln from the bottom. Four of the alternate bottom supporting channels are fitted with smoke stacks. As the wood burns and carbonization proceeds, smoke is emitted through the chimneys. For uniform burning, the position of the four smoke stacks is changed to the other remaining four channels after eight hours from the ignition of the kiln. Thus each of the channels acts alternatively as an air inlet and smoke outlet, facilitating draught reversal, which helps in burning the wood evenly. The process of carbonization nears completion in about sixteen hours when the volume of emitting smoke reduces considerably and it turns transparent. The kiln is then completely sealed off with sand after removing the smoke stacks and is allowed to cool for twelve hours. Thereafter it is opened and charcoal is unloaded and bagged.

Experiments conducted by us indicate that for optimum operational advantage a batch of four kilns can be operated by four labourers working round the clock in carefully co-ordinated shifts.

Conclusions reached from Trials with Portable Kilns

From our extensive trials we observed that, although the cost of production of charcoal by the portable kilns was comparable with that by the country kiln, the former has several distinct advantages over the latter:

i) The charcoal from portable kilns is free from burnt earth, grass and other impurities which are invariably present in the country kiln.

ii) The chemical composition and related properties are also better and more favourable for industrial use as the following comparative tabular statement will show. The data on portable kilns is from trials at Nara Centre, and that on country kilns is from the FDCM Charcoal Division

Chemical Analysis of Charcoal

Contents	Percentage present in	
	Country kiln	Portable kiln
Fixed carbon	60%	70%
Moisture	4%	2%
Ash	6%	4%
Volatile matter	19%	14%

(iii) Twigs, branches, lops, tops, anything that is left on the forest floor after extraction of timber, pulpwood and fuelwood, can be easily carbonised in the portable kiln. It thus offers a very simple but efficient technique for utilization of forest biomass, which would otherwise go to waste.

(iv) The period required for manufacturing charcoal is very much less. A single kiln can prepare 0.5 tonne of charcoal in less than 45 hours.

(v) The portable kiln can be easily operated by anyone after a short training and it does not require possession of any special skill. Manufacture of charcoal in a country kiln is a highly skilled job, for which labour has to be imported from Rajasthan. This is a serious bottleneck for manufacturing charcoal in the interior areas of Chanda.

(vi) The hazards of fire, explosion, etc., with the country kiln, are almost totally absent when operating the portable kiln.

(vii) A very important and interesting advantage of the portable kiln is that it can be operated in the rains. The trials at Hiwra Work Centre were taken throughout the rainy season. It was observed that once the charge was ignited, the process of carbonisation continued even when it rained. This has opened a highly significant possibility of manufacturing charcoal in the forests throughout the year without a break.

(viii) A country kiln requires 200 to 300 fuelwood stacks for preparation of charcoal. This involves transporting of fuelwood from scattered locations in the forests. This is not required for the portable kiln, which can be rolled to the site where firewood is stacked and can be used for converting much smaller batches of firewood.

Economics of Manufacturing Charcoal with Portable Kilns

Basic data:

(i) The kiln costs Rs.9,700 ex-site, has an expected life of three years and a scrap value of Rs.1,000.00.

(ii) Firewood required per charge - 3.32 stacks (1 stack = 2 m^3(piled)

(iii) Output of charcoal per charge: 490 kgs.

(iv) Output of Churi (breeze): 60 kgs.

(v) Number of charges obtainable in a year: 100.

Production Cost

The cost of production for 1 charge is calculated as follows:

	Rs.
(i) Depreciation and interest on capital for the kiln at 12.5% (by capital recovery factor)	31.30
(ii) Operating costs for the kiln (including collection of sand, minor repairs to kiln, etc.)	37.40
(iii) Hence production cost for 1 charge	68.70
Therefore production cost for 1 tonne of charcoal	140.00

Overheads and Marketing Costs

(i) Overheads and railhead depot expenses	25.00
(ii) Bagging, including costs of bagging	25.00
(iii) Cost of maintaining a depot at kiln site	3.00
(iv) Transport from Allapalli area to Ballarshah at 5.90 per bag of 40 kg.	148.00
Hence total overhead and marketing cost	201.00
Hence cost of 1 tonne of charcoal, including production costs (1+2):	341.00
Gross cost per tonne, after adding 10% as supervisory charges:	375.00

Cost of production including Royalty

At present the FDCM manufactures charcoal out of unsaleable firewood. The profitability of manufacturing charcoal depends on the value tha can be added to the market price of this unsaleable firewood when it is converted to charcoal. Assuming that royalty of firewood is the price of firewood obtained in open auctions, minus the cost of its production, the royalty obtainable for firewood for different sale prices of charcoal made from it is given below:

Assumed cost of preparing one stack of firewood (calculated for Pedigundam Division by Prof. Maslekar in his report); Rs. 21.13

No. of stacks used for one tonne of charcoal = 6.64

Rate obtained for charcoal per tonne ex-Ballarshah railhead	Gross royalty of firewood per stack for this rate	Net royalty obtained per stack
550.00	26.36	5.23
600.00	33.89	12.76
650.00	41.42	20.29
700.00	48.95	27.82

Wage Benefits to Adivasi Workers

The present method of using country kilns is not of any significant benefit to the local Adivasis, since this highly skilled job is mostly carried out by the labourers from Rajasthan. A pair of Rajasthani workers (husband and wife) prepares about 3,000 bags of charcoal in a season of eight months and earn a total wage of Rs.3,600. On an annual basis this works out to Rs.4.93 per labourer per day.

After a short training the local Adivasis can easily operate the portable kilns. A group of four Adivasis working with dedication can operate a battery of four kilns round the year. Assuming that each kiln can be charged 130 times throughout the year, and the labour charge paid for producing one tonne of charcoal is Rs.68.00 (which will be enhanced if the charcoal fetches higher prices), the team of four Adivasis can earn a total wage of Rs. 17,362.00, which comes to an average daily income of nearly Rs.12/- per head round the year.

Organization of Charcoal Co-operatives

The opportunity for the local Adivasis to earn handsome wages by manufacturing charcoal with portable kilns provides a scope for the FDCM to organise the kiln operators into charcoal co-operatives. The State Bank of India has shown its willingness to finance these co-operatives by offering loans at a differential rate of interest of only 4 percent. With most of the profits on charcoal passed on to these co-operatives, the bank loans can be repaid conveniently by the Adivasis. The FDCM will be responsible for collecting and marketing the charcoal, as well as for procurement of kilns and training the Adivasis.

BASIC LOGGING TOOLS

Compiled by

Mr. Göran Skarner, LTCP, Dehra Dun

1. Some hints about the background for Basic Logging Tools

As in almost all other countries in the world, India has a long tradition of different types of locally made axes in different regions and corners of the country. These axes remained a long time as the main Basic Logging Tools (BLT). The first evidence of a saw in Indian Forestry dates back to 1852 in Kerala, South India. Since that time active development of BLT is of late date, and the following events may be mentioned.

1957 Mr. Winkelman, from Switzerland, introduced,during a half year assignment, some boxes with European made BLT to different states in India.

1957 The Logging Branch at the Forest Research Institute at Dehra Dun was established.

1958 A big manufacturer in Calcutta, with European made manufacturing equipment started the production of cross-cut saws with improved tooth pattern.

1965 A Logging Training Project was set up with support from FAO. FAO withdrew in 1969 and.....

1977 The Swedish International Development Authority (SIDA) started its support to the Logging Training Centres Project (LTCP) nine years after FAO's withdrawal.

1980 LTCP started the Tool Unit for active BLT development and quality checking.

Power chain saws are not locally manufactured. Imported power chain saws were introduced during the FAO-supported project in 1960's, but these have not been successful depending on the following reasons:

- cheap labour available
- unemployment in large areas
- difficulties with spare part supply and storing
- difficulties to organise proper maintenance
- raising petrol and oil prices

With some few exceptions,only manual saws (cross-cut saws and bow saws) are in use for felling and cross-cutting. Axes are banned for commercial use in these operations in most of the states because of the big wastage of expensive wood.

2. BLT manufactured today

2.1 General

Through active participation of LTCP in manufacturing BLT locally, some manufacturers have started to produce improved BLT. The tools may be divided into four groups (Fig. 1).

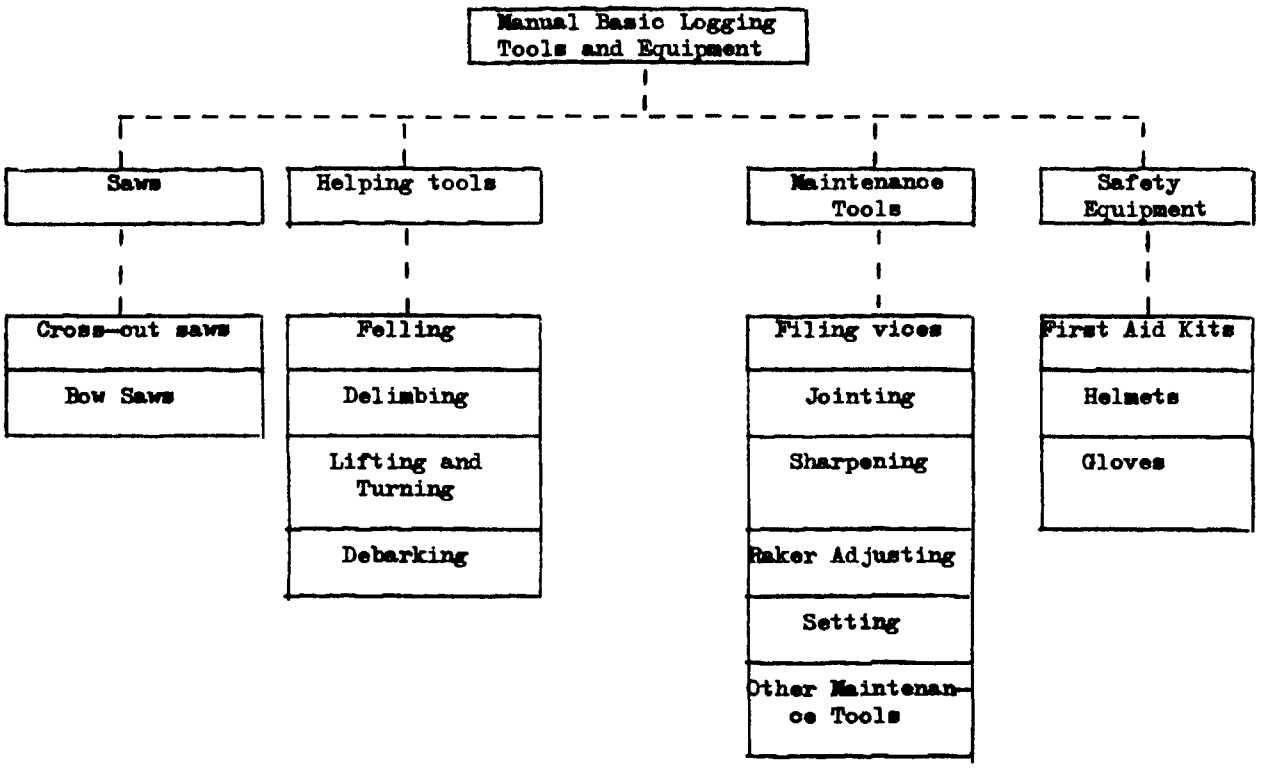


Fig. 1 - Manual Basic Logging Tools and Equipment

LTCP is now erecting a building for a Tool Testing Station at Dehra Dun. A saw testing machine and a bow saw frame tester have been locally manufactured. Together with other purchased testing equipment, the Tool Unit will be able to follow up the quality of BLT with different manufacturers and give recommendations to both manufacturers and purchasers. The Tool Unit will carry out this work in close cooperation with the Logging Branch of the Forest Research Institute, who will carry out the basic research regarding BLT.

2.2 Saws

2.2.1 Cross-cut saws

Cross-cut saws are the most important BLT in India and are produced by all saw manufacturers.

For maintenance of cross-cut saws, the following tools are required as a minimum:

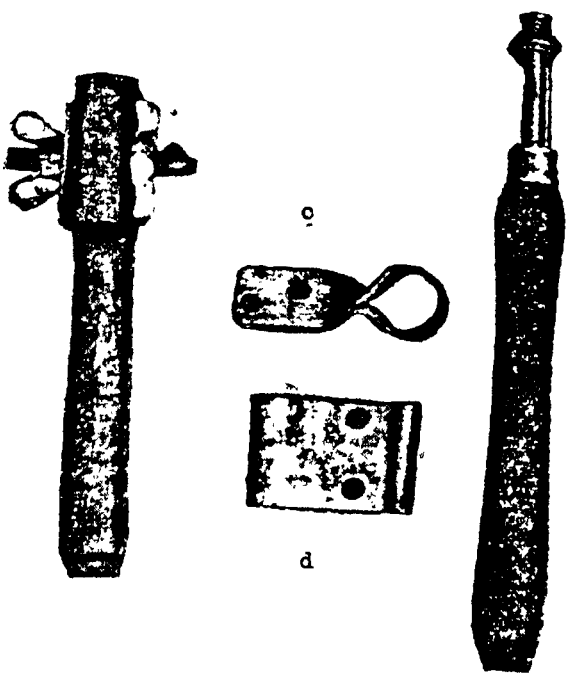
Peg-tooth

- Jointing tool with worn-out flat file
- Flat file, smooth coarseness, single cut, one or both end round, length 200 mm (8") and thickness 4 mm
- Setting iron
- Setting gauge

Raker-tooth

- Jointing tool with worn-out flat file
- Flat file of the same type and dimensions as for peg-tooth
- Round file, smooth coarseness
- Raker adjuster
- Setting iron
- Setting gauge

Traditionally straight clamps with handle pins are in use for handles. Reversible handles and loop handles have been introduced, of which the reversible handles have been most popular (Fig. 2).



a Reversible handle
b Loop handle
c Twisted clamp
d Straight clamp

Fig. 2 - Handles and clamps for two-man cross-cut saw

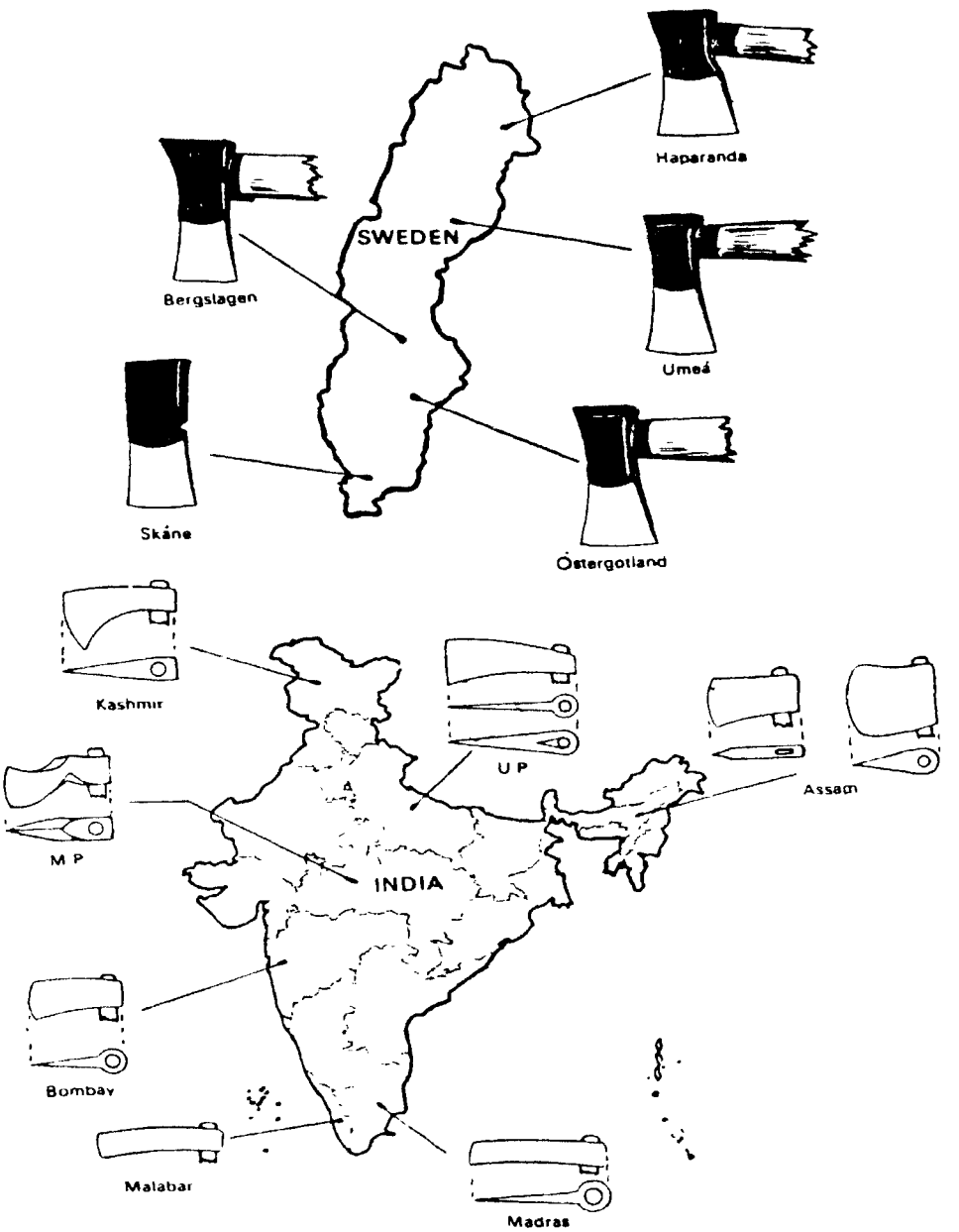
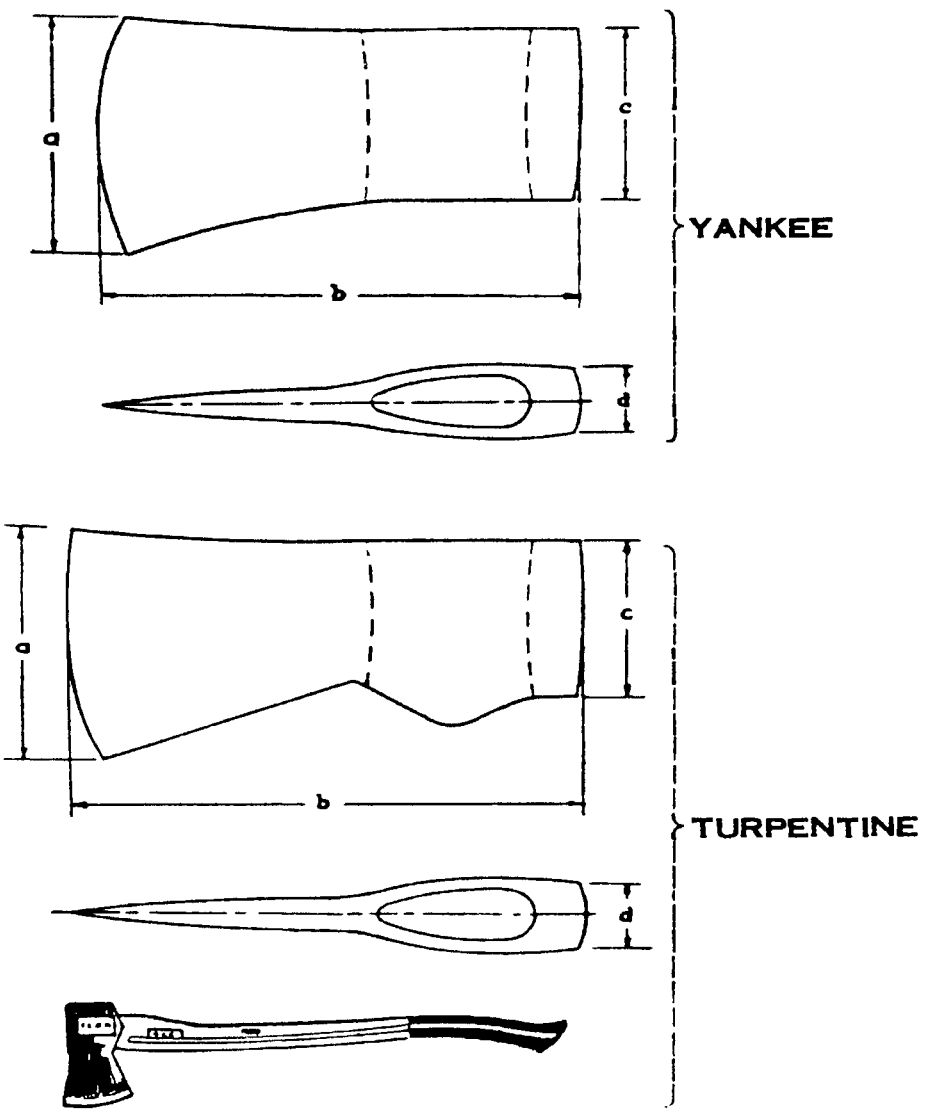


Fig. 3 - Traditional axes in Sweden and India



Dimension For 0.8 by axe (mm)

Axe model	a	b	c	d
Yankee	90	160	60	25
Turpentine	88	172	56	25

Fig. 4 - Axes introduced to Sweden and India

2.2.2 Bow saws

The bow saw is an important BLT for felling and cross-cutting in forests with small dimension trees. The bow saw consists of the frame and the blade. LTCP has worked out a checklist on bow saws with steel frame.

2.3 Helping tools

2.3.1 Felling tools

To support the saw in the felling work, steel wedges are in use, either made of solid steel or with wooden shaft. Aluminium wedges are made for support of work with power chain saw.

Felling levers have not been used in India, but it is probable that a simple felling lever will come on the market as well as a modern type of model EIA.

2.3.2 Delimbing tools

Axes are made in small blacksmith workshops all over India, in various shapes and quality, as was the situation previously in Sweden (Fig. 3). Today, only two American types of axes - Yankee and Turpentine - remain in Sweden and these two types have been introduced in India (Fig. 4).

The only big axe manufacturer in India with industrial forging hammers for shaping of the axe is Kumar Industries. They are making Turpentine axes on big orders. Small workshops have tried to make axes of Yankee type; M/s Onkar Chand Doegar and Shubh Industries are able to supply this type of axe.

For bamboo cutting the axe is the most important tool. However, none of the big manufacturers has taken up this item.

2.3.3 Lifting and turning tools

Cant hook is the most popular tool for turning of bigger logs and for releasing entangled trees. Three types are manufactured: a simple type with one or two hinges, and a bigger cant hook of Swiss type (Fig. 5). The cant hook with two hinges is most popular. The Swiss type is only manufactured by Heat Treatment Unit.

Fig. 5 - Lifting and turning tools

For dragging, lifting, turning, rolling, stacking and loading, small and medium sized logs lifting hooks and tongs have been introduced. Hooks have practically not been accepted by the workers.

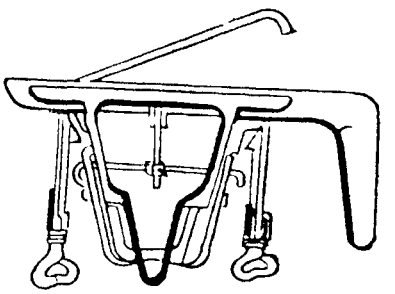
2.3.4 Debarking tools

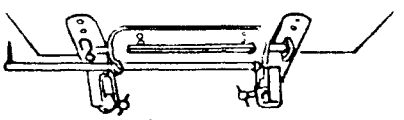
Mostly axes, knives and wooden clubs are used for debarking of logs. Four types of debarking tools have been introduced as alternatives, but have not been commonly in use. They are debarking spuds with and without hooks, a Swiss type debarking spud and debarking bow. The bow is not manufactured, and the Swiss type only by Heat Treatment Unit.

2.4 Maintenance tools

2.4.1 Filing vices

To get good result in filing, proper clamping of the saw is very essential and four vices have been introduced. These are steel filing vice, steel and wood filing vice, wooden filing vice, and wooden horse (Fig. 6). The steel filing vice and the wooden horse are not manufactured in India.





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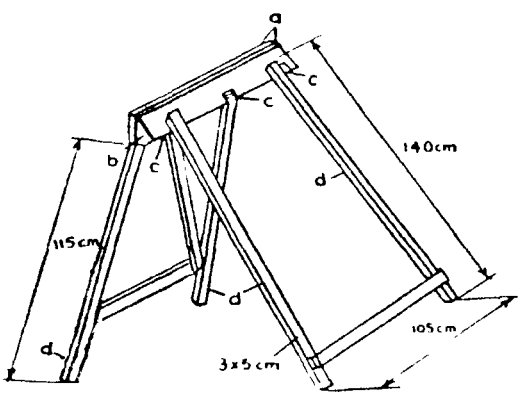

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Fig. 6 - Filing vice

a steel filing vice
b steel and wood filing vice
c wooden filing vice

2.4.2 Jointing tools

Jointing is the process of levelling the teeth before trimming. Five different types of jointing tools have been introduced. These are wooden jointer, big and small steel jointer, raker adjusting-cum-jointing tool, and a bow saw blade jointer (Fig. 7). The most popular jointing tool is the wooden jointer, but the raker adjusting-cum-jointing tool should be regarded as superior.

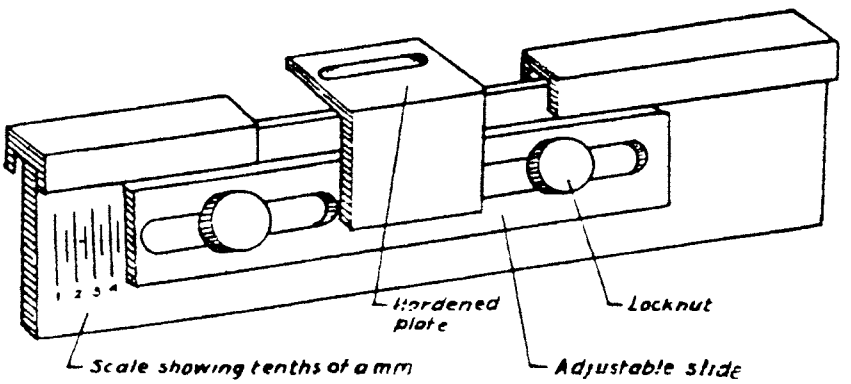


Fig. 7 - Raker adjuster

2.4.3 Sharpening tools

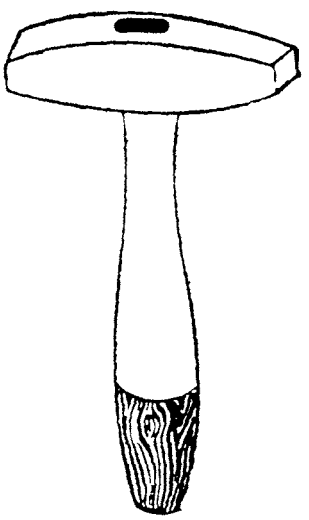
There are three main types of sharpening tools. These are files, whet stones and grinding stones. For detailed specifications of a file, the following distinguished features are recognised: shape, length, diam/width, thickness, cut and coarseness.

2.4.4 Raker adjusting tools

Raker adjuster is used for keeping the raker slightly lower than the cutters for raker saws. The only Indian manufactured raker adjuster which can adapt to different height differences is the raker adjusting-cum-jointing tool. A proposal for another type of adaptable raker adjuster may be seen in Fig. 7 above. Other simple raker adjusters are produced by three manufacturers.

2.4.5 Setting equipment

There are a great variety of tools used for adjusting setting and checking of setting. To make setting, hammer and anvil are used for saws with hard steel, but setting iron is most commonly used in India. For bow saw setting, a setting plier is used. This is manufactured by M/s Onkar Chand Doegar & Co. Aiming to quick and accurate setting, this Company has also developed a special saw setter. The most popular tool to check the setting is the small and simple steel gauge. Setting indicator is used by instructors but it is not manufactured locally (See Fig. 8).



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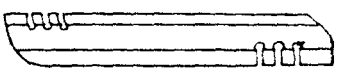

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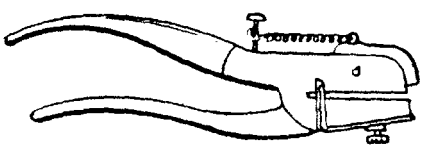

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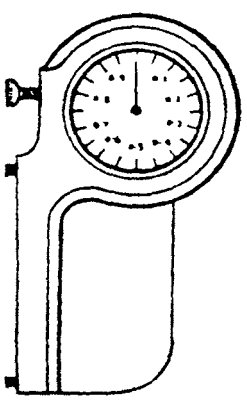

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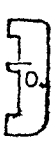

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Fig. 8

a setting hammer
b setting anvil
c setting iron
d setting plier
e setting indicator
f setting gauge

2.4.6 Other maintenance tools.

Angle gauge is necessary for checking of proper angles of the saws. However, such gauge is not manufactured in India. M/s Onkar Chand Doegar & Co. has instead put special check gauges for different tooth patterns on the tool market.

2.4.7 Maintenance kit

M/s Onkar Chand Doegar has made a special maintenance kit consisting of a canvas container with eight maintenance tools for cross-cut saws.

2.5 Safety equipment

Safety equipment is a very important part of the logging equipment and too often neglected, also in India. Helmets and a great variety of forestry gloves are made locally. In addition, a small and a big first aid kit have been compiled by LTCP and are sold on the market.

3. Pit saws

Pit saws are used for in situ conversion. The pit sawing method has been proved to be the most useful method for in situ conversion in the Himalayas, according to a LTCP study made by Mr. Lars Gabrielsson, Sawmill Adviser, when compared with the following three methods:

- frame sawing
- Forest King (power chain saw with special locally made attachment)
- portable sawmill

The tools and equipment required per pair of pit sawers are the following:

1. Pit saw
2. Upper handle
3. Lower handle
4. Wooden jointer
5. 200 mm (8") flat file with rounded edge (5 nos.)
6. Combined setting iron - gauge
7. Sleeper gauge
8. Whet stone
9. Plumbbobs
10. Ball of thread (for sooth line)
11. First aid kit (small)
12. Axe (Turpentine or Yankee)
13. Bow saw with 5 spare blades
14. Helmet with viser (for the man under)
15. Chovel
16. Mattook

Project Forestry in Maharashtra State

by

Mr. M.Y. Sowani, Managing Director

Forest Development Corporation of Maharashtra Ltd., Nagpur

The foundations of the intensive forestry management practices that are now followed all over the country were laid in Maharashtra in 1969, with the formation of the Forest Development Board (FDB). The need to convert the low economic value forests to high yielding plantations of teak and other important timber species had been recognised in the country, but the absence of adequate finances had proved a great obstacle. The concept of self finance which was enunciated, tested, and proved in Maharashtra has truly been the guiding philosophy of all the forestry development corporations now set up in the country.

Under conventional methods the forests were worked under a conservative system of management, wherein hardly 15-20 percent of the crop was harvested after long intervals by removing trees which had attained maturity. The removal of these trees did not in any way contribute to improvement of the growing stock because the regeneration was mostly of the same species as before. Introduction of valuable timber species meant high investments on plantations which the normal financing patterns did not permit, except on a very limited scale.

Thus, a stagnant position was reached, where, in spite of the urgent need to improve the economic value of the forests, no positive steps could be taken for lack of finances to invest in long-term plantation forestry programmes. At this stage a brillant idea was put forward by the then Chief Conservator of Forests, Maharashtra, seeking no additional finances from Government. He argued that, if the standing crops were clear-felled to make way for plantations of valuable timber, the higher cut (100 percent against 15-20 percent) would bring in additional revenues, which could be treated as a special fund for financing the plantation or man-made forestry programme. He assured Government that the past average returns received from areas chosen for the development programmes would be paid to Government, provided the excess earnings were permitted to be diverted to the plantation forestry project. The Government of Maharashtra, always known for its pragmatic approach, readily agreed to the proposal. A small beginning was made in 1969 by setting up a Forest Development Board which aimed at clearfelling annually 3,200 ha of mixed forests of low economic value and planting the areas with teak, which is timber par excellence.

The added advantages of the project were lower infrastructural costs because of concentrated working and creation of higher employment potential in areas where such opportunities were most needed.

Almost from the beginning the programme undertaken by the FDB proved to be an outstanding success. Within a short time it was demonstrated that the higher earnings were sufficient to defray the plantation costs, even after paying the past average revenue from the areas to Government. Employment also rose from about 150 to 4,000 labourers per day.

Formation of Forest Development Corporation of Maharashtra Ltd.

Encouraged by the success attained by the FDB, the Government of Maharashtra had begun considering the establishment of an autonomous body for undertaking plantation programmes on a much larger scale. Originally, the programme was operated in three districts in eastern Maharashtra (Nagpur, Chandrapur and Bhandara). It was then contemplated to expand the activities in these three districts, as well as to open new centres in western Maharashtra and Marathwada. The Project Report prepared by the Department for

setting up a Forest Development Corporation was accepted by Government and, as a result, the FDCM came to be established on 16.2.1974. Against the original four project divisions, a total of 17 project divisions were established in eight districts, three districts in eastern Maharashtra, four in western Maharashtra and one in Marathwada. (A new division of Social Forestry Activities has been added this year). Incidentally, these three regions form somewhat distinct ethnical and geographic regions of the State of Maharashtra.

The Government of Maharashtra has set apart 4,560 m^2 of reserved forests for the FDCM. The FDCM programme envisages conversion of the low economic value forests to valuable teak forests over a period of thirty years.

Organization of the FDCM

The Management of the FDCM is governed by a Board of Directors. The policies and programmes are executed by the Managing Director of the Company. He has four Regional Managers at Thane, Nasik, Nagpur and Chandrapur respectively who, amongst themselves, control the working of 18 project divisions and three functional divisions, each division headed by a divisional manager. The total number of employees is in the order of 1,900.

Activities of the FDCM

The FDCM has an annual target of clearfelling 12,500 ha of mixed miscellaneous forests and replanting them with teak. Beginning with the current year, in addition to its normal planting programme, social forestry projects are being implemented with an annual target of 860 ha to rehabilitate degraded forests and to raise 85 km of road, canal and railside plantations. Average employment works out at 22,000 labourers daily, half of whom are females. The annual turnover from sale of forest products obtained from clearing of standing miscellaneous forests is of the order of Rs.155.24 million. For the harvesting of this crop the FDCM acts as an agent to the Government of Maharashtra and is paid a commission amounting to 2 percent of the gross sales.

The Agricultural Refinance and Development Corporation, the premier institute of the Government of India for financing agricultural and forestry projects, has sanctioned a loan of Rs.232.00 million to the FDCM, which represents 80 percent of its project costs, the remaining being met from the equity contribution of the Government of Maharashtra.

A number of forest-baset industries has been set up by private entrepreneurs, depending principally on supplies made by the FDCM Ltd. One of the largest paper mills in the country purchases over 80,000 tonnes of hardwood for manufacturing paper. Two principal plywood manufacturers of the country depend on the FDCM for supply of high grade teak for veneer and teak firewood for manufacturing particle board. Large quantities of poles are being supplied to the western coalfields, to be used as props. There are several other small industries which are prospering on raw materials supplied by the FDCM.

The FDCM has also played a great role in supplying poles and bamboos as relief to flood affected people in eastern Maharashtra.

Diversification Activities

i) Woodworking Units

A small woodworking unit has been set up at Salekassa, in Bhandara District, to train tribal boys in basic carpentry. A proposal is under active consideration for the setting up of two mechanized woodworking units in Chanda and Thane districts.

ii) Handmade Paper Unit

The FDCM is establishing a small handmade paper unit with an annual capacity of 150 tonnes at Chandrapur. This unit will utilize logging wastes and bamboo scrap as raw material and will provide employment for 60 men and women.

(iii) Charcoal Production

The FDCM at present manufactures about 4,000 tonnes of charcoal in the remote areas of Chandrapur by converting unsaleable firewood, using the country kiln method. To boost this highly labour-intensive energy industry, better methods for manufacturing charcoal have been explored and the use of portable metal kilns is found to be the most suitable alternative. Initial trials with four portable kilns designed by the Tropical Products Institute, U.K., have been highly successful. It is expected that these portable kilns will gradually replace the country kilns of the FDCM for large-scale manufacture of industrial grade charcoal.

Logging Practices in FDCM

From the clearfelling of the standing miscellaneous crop to achieve an annual planting target of 12,000 ha, the FDCM produces more than 150,000 m^3 of timber and 500,000 m^3 of firewood each year. Felling and logging is carried out using saws (both raker-tooth and peg tooth saws are used), while conversion of firewood is done mostly by using axes. Off road transportation is done using manual labour and draught animals like bullocks and buffaloes. Tractors are used extensively for dragging over distances beyond 400 to 500 m. Firewood is mostly stacked at site or brought to jungle depots in bullock carts and sold. Most of it is converted into charcoal at site, using country kilns. Almost the entire timber harvested is transported by trucks to central depots and sold by auction. The logging operations are done according to pre-determined schedules and logistics contained in the logging plan prepared for each work centre.

The Logging Training Centres Project (LTCP) which has a zonal office at Nagpur (where the head office of FDCM Ltd. is situated) has taken a keen interest in training the field staff and labourers of the FDCM Ltd. 30 foresters from the FDCM have attended the regular courses in basic logging recently conducted by LTCP. These foresters, in turn, have trained about 300 workers. Thanks to the efforts made by the LTCP, reasonable standards in basic logging have been achieved in all the project divisions of the FDCM. In fact, cadres of local tribals trained in the use of saws by instructors trained at LTCP have largely replaced imported labour in the remote tracts of Chandrapur. These tribals had never used saws before.

The World Food Programme and FDCM

The World Food Programme of FAO/UNDP has been offering food assistance to the forest workers since 1971, when only the earstwhile Forest Development Board existed. Under the current project-572 (Exp.), WFP has committed 34,143 tonnes of wheat and 2,305 tonnes of edible oil for supply to the forest workers of the FDCM. Each worker gets a daily family ration of two kgs. of wheat and 135 gms of edible oil, in lieu of a nominal wage cut of Rs.1.00. The amount so deducted is pooled in a labour welfare fund. This fund is used for financing a large number of welfare projects like provision of housing, medical and schooling facilities for the workers, their families and children, supply of drinking water and other community development projects.

Productivity and Nutritional Studies

The services of the National Productivity Council (NPC) were hired on a consultancy basis to study the productivity of the forest workers and to enumerate norms for various forestry works. The study has been quite useful in rationalising the work norms and wage structures. The NPC has also made several useful suggestions about method improvement in logging and transportation and these are being examined.

The Shrimati Nathibai Damodar Thackarsay (SNDT) Women's University, Bombay, was entrusted with the task of surveying the nutritional status of the forest workers. Recommendations made in the report to supplement the diets of the forest workers to increase their intake of calories, vitamins and calcium are being considered for implementation.

Research Activities of the FDCM

i) Intercrops

Techniques were developed by the FDCM to plant mesta (kenaf), jute and other cash crops in between the plant rows as intercrops to generate income for off-setting the costs of maintaining the plantations. However, intercrops are not being raised at present until the user industries such as the paper mills, demand this raw material on a scale which is economic for producing it.

ii) Establishment of Seed Orchards

The importance of using seeds from genetically superior origins for raising plantations has been long realised in Maharashtra. Using the well-established technique (pioneered by Mr. N.R. Chowdhury) of grafting buds from plus trees on teak stumps, the FDCM has so far raised nine seed orchards in Chanda and Nagpur regions covering 41.38 ha. Seeds obtained from these orchards are also supplied to various organizations and states for provenance trials.

iii) Multiplication of Teak Seedlings using Tissue Culture Techniques

The FDCM sponsored a research project as a result of which the scientists of the National Chemical Laboratory have succeeded in developing a technique for multiplying teak seedlings by tissue culture of terminal buds of plus trees. This represents a breakthrough in clonal propagation of superior teak trees, in which all the genetical characteristics of the original mature trees are passed on to the cultured plants. The FDCM has under its consideration a project for establishing field laboratories for large-scale multiplication of teak seedlings through tissue culture.

One of the Guest Houses in Maharashtra

Annex 1

Forest Development Corporation of Maharashtra Ltd., Nagpur

Important features:

1. Total area earmarked from Government reserve forests		4,560.47 m^2
2. Area of reserve forests in Maharashtra		38,627.62 m^2
3. Year of establishment		1974
4. Total area of plantations raised to date:		
	Teak	79,800 ha
	Bamboo	1,460 ha
	Social forestry	350 ha
5. Annual Planting Target:		
	Commercial (teak)	12,500 ha
	Social forestry	860 ha
6. Forest Produce exploited annually:		
	Timber (teak)	50,000 m^3
	Timber (other)	100,000 m^3
	Poles (teak)	300,000
	Poles (other)	660,000
	Fuelwood	600,000 m^3 (piled)
	Bamboos	821,000
7. No. of Project Divisions		18
8. No. of Forest Workers employed:		
	Exploitation	15,600
	Plantation & other activities	24,000

Annex 2

Forest Development Corporation of Maharashtra Ltd., Nagpur

A Sample Sheet showing details of Logging and Transport Costs for a Typical Forest Project Division

Dahanu Forest Project Division
(1979-80)

Production:

Timber	17,012.696 m^3
Firewood	48,543,956 m^3 (piled vol.)

Total Area exploited: 936 ha

Yield per hectare:

Timber	18.18 m^3
Firewood	51.86 m^3 (piled)

Direct Logging and Transport Costs:

Activity	Total Cost (rupees)	Cost per ha (rupees)
1. Demarcation and marking	15,063.56	1.46
2. Internal roads, feeder and extraction paths	66,871.25	3.93
3. Felling and logging	303,712.07	17.85
4. Preparation of firewood stacks	234,948.76	4.84
5. Measurement of timber	31,861.27	1.87
6. Dragging of timber	259,536.65	15.26
7. Carting of firewood	231.669.52	4.77
8. i) by bullock carts	53,952.31	29.97
ii) by tractor	-	-
8. Miscellaneous, including fire protection	1,063,750.87	62.52
9. Transport to sale depot	876,997.04	57.65
	571,466.00	11.77
10. Sale depot expenses	210,986.98	12.40
	129,552.19	2.66
11. Any other relevant items of expenditure	56,169.59	3.30

Annex 3

Forest Development Corporation of Maharashtra Ltd., Nagpur

Annual Work Targets and Manpower Employed 1981-82

Activity	Target	Manpower employed (million mandays)
1. Exploitation (including logging)	12,500 ha	1.875
2. Nursery seedlings	40 million	0.62
3. Plantation	11,000 ha	1.925
4. Maintenance of Plantations	70,000 ha	1.19
5. Construction of Service Roads	64 km	0.238
6. Construction of Feeder Roads	330 km	0.594
7. Buildings	210 units	0.333
8. Social Forestry		
i) Rehabilitation of degraded forests	640 ha	0.31
ii) Rail, Road and Canal Bank Plantations	85 km	0.03
iii) Irrigated and Other Plantations	50 ha	0.056
Total manpower employed:		7,171 million mandays

Annex 4

Forest Development Corporation of Maharashtra Ltd., Nagpur

Financial Performance at a Glance

	1978-79	1979-80	1980-81
	(Rupees in millions - Pre-Audit A/c)		
1. Authorised Capital	150	150	150
2. Paid-up Capital	76	78	9
3. Network	71	72	71
4. Depreciation Reserve	11	14	16
5. Total Turn-over			
i) Sale of Forest Produce	166	180	232
ii) Other receipts (Bank interest and miscellaneous income)	4	5	5
6. Total Expenditure (including exploitation)	59 (44)	69 (53)	102 (63)
7. Total cost of exploitation per hectare (including overheads)	3806	4863	5576

8. Financial arrangement with Agriculture Refinance and Development Corporation (ARDC) for 1980-86, in million rupees.

Year	Total Reqt. (Cap.costs)	FDCM Contrib. (Internal source)	Equity Contrib.by Gov. of Maharashtra	ARDC Financial assistance (Bank loan)	ARDC Refinance (80% of Col.5)
1981-82	61	11	10	40	32
1982-83	64	5	13	47	37
1983-84	62	5	13	45	36
1984-85	65	-	13	53	42
1985-86	62	2	12	48	38
	314	23	61	233	185

Note: The capital cost excludes the interest on bank loans which will be paid by the FDCM from its internal resources. A moratorium for repayment of loans exists for the first five years.

The Development of Intermediate Technology for Timber Harvesting in South China

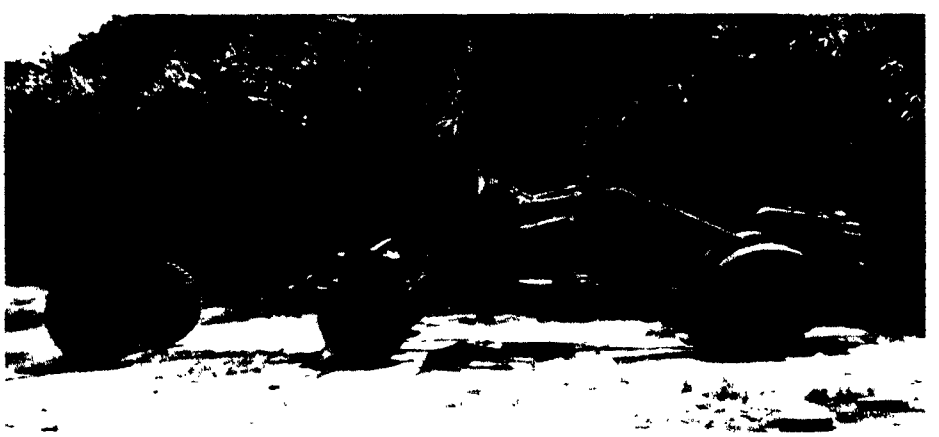
by

Professor Shi Mingzhang of the South Central China Forestry College

I. Introduction

Since the founding of the People's Republic of China in 1949 the demand for timber for construction has increased steadily. In order to raise production as quickly as possible we have tried to use machinery whenever we could,but we had to rely mainly on manpower and animals during the nineteen fifties. At the same time as striving to improve productivity, we have made every effort to reduce labour intensity and to guarantee the safety of the workers.

Together with the industrialization of the country, the capability to design and manufacture harvesting machines has been improving year after year. At the same time, we have imported technology and equipment so that mechanization has greatly increased, especially in hilly and mountainous areas. Overall mechanization is now about 70%. However, in some areas where forest land is scattered on steep slopes and crisscrossed with agricultural and forest crops, the work is carried on as a small and semi-mechanized operation and most of the logging operations are done by manpower. China is a developing country. Its national income per capita is low (today about US$200 per person per year) and funds are limited, but it is rich in human resources. In order to raise productivity and increase technical competence progressively in the rural areas, the Government has created more employment opportunities and protected the ecology's equilibrium. Small-size machines are considered more suitable to the practical conditions in the forest areas in China at present.



Small size walking tractor with trailer
Photo Shi Ming Zhang

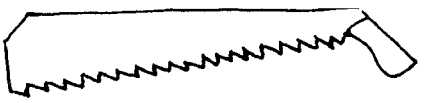
Although the term "intermediate technology" was not used by us in the past, would say that the small-size machines and the improved tools belong to this category.

II. Intermediate Technology commonly used in the collectively owned forests

There are many intermediate technologies in China, but the most common are the following:

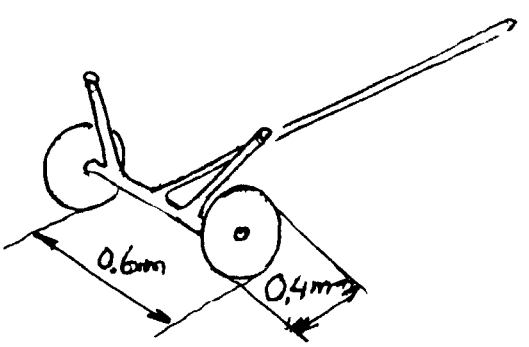
1. Curved handle saw. Felling and bucking are, to a large degree, carried out by the curved handle saw. Ordinary two-man and one-man saws are seldom used. As far as I know, the average production quota of felling is:

Ordinary saw	4.6 m^3/man-shift
Curved handle saw	7.3 m^3/man-shift
Chainsaw	22.5 m^3/man-shift.



Therefore, the ordinary saw has been gradually replaced by the curved handle saw. Probably the ordinary saw with both cutting and raking teeth was never used but the saws with both cutting and raking teeth should be more efficient than those with only cutting teeth. Although the productivity of the chainsaw is higher than the curved handle saw, the former is more expensive (about US$570, or even more per piece) compared with the curved handle saw, which is only about US$4.5 a piece. The chainsaw involves additional consumption of fuel and oil. The curved handle saw gives more than three times the employment opportunity of the chainsaw.

2. Hand dragged wooden cart. This is a hand skidding tool made of hardwood and used in a few forest areas. It has two wooden wheels with a diameter of about 40 cm connected by a wooden beam which is also used as an axle. The track is about 60 cm. The wooden shaft is about 180-220 cm long. (See drawing below).



The big end of the log is put on the axle and the small end on the ground. The loading capacity is about 0.2 m^3 with the down slope of about 17° (maximum 25°). Productivity is 0.5-0.8 m^3 per shift within 3 km of skidding distance. The average skidding cost is about US$2.1/$m^3$/km, including cost of road construction and maintenance. The skidding road

is only one meter wide. The down slopes, with the rear end of the log dragged on the ground working as a brake, would be easier for the loaded trip. The skidder can walk easily and smoke all along the way, so that the local people call this kind of slope a "smoking slope".

3. Rubber tyred cart (for short haul). This is made of wood or steel with two rubber tyres with a diameter of 67 cm and 90 cm apart from each other. The body of the cart is 130 cm long, with two shafts of 110 cm long. It costs about US$70. The load capacity is 0.6 m^3, twice as high as the hand dragged wooden cart. The road bed is 1.5-2.0 m. wide and the minimum diameter of the road is 3 m. The down slope is 1°-5°, with the maximum not larger than 10°. Cost of construction of the road is about US$570 per kilometre, but varies with local conditions. The cost of short haul by rubber tyred cart under the same condition is about US$0.6/$m^3$/km lower than the manpower and cable system. Therefore a short haul by rubber tyred cart is more popular in the southern part of China. Nevertheless, both hauling and return trip depends on manpower, as does loading and unloading. The problem remains one of labour intensity.

4. Walking tractor with trailer (for short haul). The price of a walking tractor is about US$2,300, of which the walking tractor is about US$1,700, and the trailer US$570.

The load capacity of the tractor with trailer is 1.5-2.5 m^3.

The width of the road bed for the tractor is 2.5-3.0 m; the width of the road surface is 2.0-2.5 m.; minimum curveture is 10 m. It is much better than the rubber tyred cart when the down slope is up to 15% (8°-9°) and the adverse slope is up to 10% (5°-6°). The cost of road construction varies with topographic and geologic conditions but is generally about US$3,400.

The hauling cost of the walking tractor with trailer is the lowest only when it is in the low mountainous region with an average slope of 15°, the average timber output of 65 m^3/ha and the average hauling distance of 0.85-7.2/km. If the average hauling distance is within 0.23-0.85 km, the hauling cost is just a bit higher than that of the rubber tyred cart. With an average hauling distance of 3 km it would be about US$0.85 m^3.

The walking tractor can be used in cultivating farmland, hauling timber and for transportation purposes in the rural areas, so that the farmers call the walking tractor a machine of multiple use.

5. Cable logging system. Cableways are generally used in steep slope forest areas. The most popular type is KJ-3, very similar to the Wyssen system used in Switzerland in the fifties.

However, the KJ-3 system is not so popularly used in some forest areas, for it costs more than US$17,000 and is very complicated to install and maintain its equipment. The KJ-3 cable system is more suitable for mountainous regions with an average slope of more than 30°, an average timber output of 20 m^3/ha, and yarding distance at 400-1,000 m. If the timber output is more than 100 m^3/ha, with the yarding distance at 600-800 m, the yarding cost would be very cheap, i.e. about US$2.3 - 3.4/$m^3$. Rubber tyred carts cannot haul long logs or poles, whereas cableways can. The price of long logs and poles is higher than that of short ones. Nevertheless, the hauling distance of the rubber tyred cart is more than twice that of the cableways.

In recent years the powerless cableways have been developed. Their yarding cost would be much lower than the powered cableways but the scope of operation is more limited. The man-dragged cableway is much simpler but it has been in use only with a few brigades, for its favourable slope is only 0°-5° (of which 2°-3° gives better results).

III. Conclusions

In China forest technology is constantly being developed, as can be seen from the above-mentioned five methods of production and use of machinery. It is clear that any appropriate intermediate technology would help the rural economy greatly, both from the point of view of manpower and rise in the level of mechanization. All machinery used is small and simple and these small machines can save a considerable amount of labour. A part of this saved labour could be engaged in subsidiary occupations, such as bamboo weaving. Incomes both collectively and individually would rise and the degree of mechanization of both agriculture and forestry would also be improved.

Under suitable conditions short distance transportation by walking tractor with trailer would be a better method. It could transport long logs which are most useful and could be sold at a higher price than the short ones. Nevertheless, it should be improved; for instance, the operation of the tractor with trailer is strenuous, the bunching of the logs from the stumps to the roadside depending wholly on manpower. If it were possible to do this by light yarder or powerless cableway, hand logging could be dispensed with. The loading operation should also be mechanized in future.

Train of S.K. Walking Tractors with Trailers for short distance transport.
Photo Shi Ming Zhang

COUNTRY REPORTS

sic Data from Country Reports

Country	Total land area 1,000 km^2	Forest & woodland area 1,000 km^2	Total population mill.	Ownership	Forestry Products			
					Fuelwood/ charcoal 1,000 m^3	Industrial roundwood 1,000 m^3	Sawnwood & panels m^3	Paper tons
Bangladesh	144	22	90		980	135	614	108
Bhutan	47	33	1	100% Gov.	18	69	-	-
Burma	677	388	31.8	" "	14,160	2,061	544	17
China	9,600	1,222	980	" "	-	-	10,000	-
Fiji Islands	1	1	.6	Tribal	200	228	102	-
India	3,288	748	622	96% "	15,372	11,108	8,440	937
Pakistan	878	43	83	60% "	300	400	-	-
Papua New Guinea	462	400	3	Clans & Tribes	6,000	1,022	71	-
Philippines	300	110	48	100% Gov.	94	6,400	2,742	296
Sarawak, Malaysia	124	93	1	" "	-	8,399	523	133
So.Korea	98	65	38	Gov.& Priv.	4,712	1,216	2,976	186
Sri Lanka	65	33	15	100% Gov.	315	231	22	-
Thailand	513	175	47	" "	869	5,205	2,448	459
Madhya Pradesh State India	442	155	52	" "	3,782	1,597	*	50

*Nearly 80% of fuelwood, charcoal and industrial roundwood converted into sawnwood.

Forest Labour Force

Country	Permanent Workers: Age Min.	Av.	Max.	Days Per Year	Engaged in Felling	Hauling	Others	Total	Seasonal Workers: Age Min.	Av.	Max.	Days Per Year	Engaged in Felling	Hauling	Others	Total
Bangladesh	-	-	-	-	-	-	-	-	16	35	60	180	40,000	45,000	5,000	90,000
Bhutan	20	28	40	200	-	-	-	-	18	30	50	200	1,000	1,200	500	2,700
Burma	18	40	60	383	1,072	14,700	485	16,257	18	45	65	180	12,000	19,600	15,000	46,600
China	20	40	58	280	-	-	-	-	18	42	62	100	-	-	-	-
Fiji Is.	16	30	70	220	1,000	-	400	1,400	-	-	-	-	200	-	600	800
India	18	35	60	250	-	49,000	-	4,900	19	31	50	220	62,000	370,000	2,700,000	3,132,000
Pakistan	18	35	60	250	-	-	-	-	13	34	70	120	1.9 million mandays			
Papua N.Guinea	18	28	55	200	100	120	4,000	4,220	18	28	55	50-70	-	-	-	-
Philippines	18	25	60	250	-	-	-	-	18	25	50	150	-	-	-	-
Sarawak, Mal.	18	28	55	250	-	-	-	-	-	-	-	-	-	-	-	-
So.Korea	20	40	50	240	1,000	150		1,150	20	40	60	150	6,000	-	20,000	26,000
Sri Lanka	18	25	55	230	-	-	-	-	18	25	60	180	-	-	-	-
Thailand	18	30	60	280	-	-	-	-	18	30	50	120	-	-	-	-
Madhya Pradesh State	-	-	-	-	-	-	-	-	15	35	60	200	68.2 million mandays			

Organization of Logging

Percentage done by timber buyers, contractors or Government

Country	State Forests	Non-State Forests
Bangladash	5% State Corporations 95% Others	-
Bhutan	80% State Corporations 20% Timber buyers	-
Burma	100% State Corporations	-
China	100% State Corporations	(100% collective forests)
Fiji Islands		85% Timber buyer 10% Contractor 5% Forest Owner
India	20% Forest Dept. 30% State Corporations 45% Contractors 5% Forest Labourers Co-op.Societies	-
Pakistan	100% Contractors	100%Contractor
Papua New Guinea	75% Timber buyer 24% Contractor	80% Timber buyer 19% Contractor
Philippines	100% Private licences	-
Sarawak, Malaysia	100% Contractors or licencees	-
So. Korea	3% State Corporations 97% Timber buyer	100% Forest Owner
Sri Lanka	10% State Corporations 90% Contractor	-
Thailand	100% Contractor	-
Madhya Pradesh State India	100% State Corporations	-

Timber Haulage

Country	Approximate percentage moved and average distance					
	Short Distance Extraction			Long Distance Transportation		
	Men	Animals	Mechanical	River	Road	Railway
Bangladash	90% 2 km	5% 3 km	limited use	75% 120 km	20% 100 km	5% 300 km
Bhutan	78% 0.25 km	2% 0.35 km	18% 1 km	-	100% 180 km	-
Burma	-	95% 1.3 km	5% 1.3 km	80% 12 km	100% 50 km [1]	20% 360 km
China	30% 2.5 km	5% 1.5 km	65% 1.5 km	20% 350 km	60% 60 km	20% 70 km
Fiji Is.	5% -	4% -	91% -	1%	99% 35 km	-
India	18% 0.25 km	77% 4 km	5% 4 km	1½% 30 km	94½% 200 km	4% 500 km
Pakistan	20% 0.15 km	79% 12 km	1% 5 km	-	80% 500 km	20% 500 km
Papua N.Guinea	-	-	100% .8 km	-	100% 40 km	-
Philippines	10% 0.25 km	10% 0.1 km	80% 0.25 km	5% 40 km	95% 50 km	-
Sarawak, Mal.	20% 0.2 km	-	80% 0.3 km	100% 300 km [2]	-	-
So.Korea	95% 0.1 km	-	5% 0.3 km	-	40% 50 km	60% 150 km
Sri Lanka	10% 0.2 km	50% 4 km	40% 2 km	-	100% 150 km	-
Thailand	-	60% 0.5 km	40% 0.5 km	40% 0.5 km	20% 0.5 km	40% 0.6 km
Madhya Pradesh State	80% 0.5 km	18% 5 km	2% 10 km	-	100% 600 km	-

1/ Wood is transported to river on truck for approximately 40 km.
2/ Transport of log by road shows 100%, of which 20% is direct to industries and 80% to railway stations and rafting depots for further transport by water.

Tools used in felling (i) and crosscutting (ii)

Country		Hand Tools		Chainsaws	Models	Ownership
		Axes	Crosscut saws			
Bangladesh	(i)	95%	5%	-	Locally made	Workers.
	(ii)	60%	40%	-		
Bhutan	(i)	50%	40%	10%	Mostly Indian	Workers mostly. State owns heavy machines.
	(ii)	5%	80%	15%		
Burma	(i)	10%	80%	10%	Canada, U.S.A. Burma	State.
	(ii)	-	90%	10%		
China	(i)	-	30%	70%	Chinese	State. Collective forests: workers.
	(ii)	-	30%	70%		
Fiji Islands	(i)	-	1%	99%	Germany, Sweden, U.S.A., China, Australia, U.K.	Purchaser or Contractor. State has own tools.
	(ii)	-	1%	99%		
India	(i)	75%	20%	5%	Local and imported	Forest Dept. & Corporations.
	(ii)	7%	86%	7%		
Pakistan	(i)	80%	20%	-	Local	Contractors
	(ii)	40%	55%	5%		
Papua New Guinea	(i)	-	-	100%	Imported mostly from U.S.A., Australia	Timber companies or Contractors.
	(ii)	-	-	100%		
Philippines	(i)	46%	4%	50%	Imported. Axes & bolos locally made	Companies.
	(ii)	46%	4%	50%		
Sarawak, Malaysia	(i)	-	-	100%	German mostly guidebar 25-36"	Contractors or Licencee.
	(ii)	-	-	100%		
So.Korea	(i)	-	90%	10%	Local. Power tools imported from Japan, U.S.A.	State & private.
	(ii)	-	80%	20%		
Sri Lanka	(i)	60%	35%	5%	Local & imported: English, German, Swedish, etc.	State Corporations & Contractors.
	(ii)	1%	95%	4%		
Thailand	(i)	5%	55%	40%	Local. Power tools imported	State Corporations, Contractors.
	(ii)	-	60%	40%		
Madhya Pradesh State, India	(i)	85%	15%	-	Local. Power tools imported	State. Small tools privately owned.
	(ii)	5%	90%	5%		

SUMMARY OF ANSWERS TO QUESTIONNAIRE IN COUNTRY REPORTS

Participants were requested to prepare Country Reports according to specific guidelines. These were presented at the Consultation for discussion and a summary of them is given here.

BANGLADESH

General Forestry Policy: The national forestry policy of Bangladesh was reviewed in 1979. Its salient features are that:

all existing forest areas will be carefully conserved for qualitative improvement and managed scientifically.

all Government owned forests will be declared National Forest and such land shall not be used for any other purpose.

plant and timber wealth of the country will be increased by extensive plantations through mass participation and steps will be taken to extract more forest product to meet demand.

utilization of forest resources will be ensured by modern and appropriate technology.

steps will be taken to meet the need of raw materials of the existing forest-based industries from the national forest and new forest-based industries will be created.

arrangements will be made for forestry research, education and training to meet the scientific, technical and administrative need of the forestry sector.

forestry and the forestry sector of the economy will be managed by the forestry cadre service.

forest laws will be brought up to date in order that the forest policy may be implemented effectively. The Forestry sector will be reconstituted as a separate administrative unit of the Government.

measures for environment preservation and conservation of wildlife will be taken; also recreational facilities will be increased, always keeping in mind the conservation of forests.

Adequate measures will be taken to arouse public consciousness and civic responsibility towards the forest and technical assistance will be given to those interested in forestry activity.

Training: On-the-job training as well as short-term (1-2 weeks institutional training) is given to forestry workers.

Special training facilities are available for chainsaw, tractor and other machine operators. Training is also given in operation of aerial ropeways, trucks and speed boats; also for maintenance and minor repairs of these machines and safety measures.

Managerial training in organizing and supervising workers is given to foremen (i.e. workers with responsibility for supervising small groups of workers).

Training is available for instructors and foremen in roadmaking, basic logging, forestry extension, maintenance and repair of machines and tools.

Work studies, productivity and wages: Work studies have been carried out in forest operation and especially in the field of logging, to ascertain the degree of wastage due to high stem cutting. Findings reveal that 5 percent wastage (i.e. loss of standing volume) takes place due to high stamp cutting. Workers are paid on a piece work basis by negotiation and the average wage for a forestry worker is US$1.25 per day.

Accommodation: One percent of forest workers live in forestry villages; 80 percent in logging camps; 19 percent in other accommodation.

Developments: No change is expected in the next ten years with regard to unskilled and semi-skilled labour but a shortage is expected in some categories, such as drivers and crane operators due to employment opportunities in the Middle East. Bangladesh forest operations are not considered to be over-mechanised.

BHUTAN

General Forestry Policy: Consistent with the preservation of the environment and without detriment to forest growth, to harvest the yield on a sustained basis. Due to the Himalayan terrain, renewability and conservation are the main criterion.

Training: Logging and training centres are organized by FAO for forestry workers. Training is given in roadmaking, management of cableways, etc. Similar training is given to operators of chainsaws, tractors and other machines and, in some places, on-the-job training is also given. Special training in centres and on-the-job training is available for foremen and instructors.

These possibilities seem to be sufficient but should be improved. An education centre is likely to be established with international assistance, which will include vocational training.

Work studies, productivity and wages: No work studies have been carried out. The average productivity of a forest operation is 30 to 40 per m^3/man/year. Workers are paid both on a time and on a piece work basis. The average wage is US$1.00 per day.

Accommodation: 40 percent of the workers are living in logging camps and 60 percent in other accommodation.

Developments: Availability of labour is not considered to be very good. Level of mechanization is low but efforts are being made to improve the situation. The Forestry Department is very young and has been dependent on officers seconded from India. Only in 1981 was self-sufficiency achieved. The Forest Industries side is being developed and a veneer and plywood factory will probably be constructed with FAO assistance.

Skidding in Burma with buffaloes

Photos by Myo Chit Nyo

BURMA

General Forestry Policy: To meet the annual sustained yield the policy was to protect forests, essential on climatic and physical grounds; to produce commercial forests for supply of valuable timber and establish local supply of forests for people's essential needs. Finally, to create reserves, sanctuaries and national parks.

Training: An in-service training school has been established for newly recruited officers, senior timber rangers and junior staff. At the above school there is training for chainsaw, tractor and loader operators, also for skidders and logging truck operators.

The school also provides refresher courses for head drivers, mechanics and training conducted according to a special training programme.

Training of instructors of workers and foremen is also provided.

Present training facilities are not adequate and should be improved with essential training aids for various forest operations.

Work studies, productivity and wages: Work studies have been carried out on the forest operations, resulting in the establishment of a workshop and training centre. The average productivity is 32.6 m^3/man/year. Workers are paid on a piece work basis and the average wage for a forestry worker is about US$1.00.

Accommodation: 5 percent of the workers live in forestry villages; 40 percent in logging camps and 55 percent in other accommodation.

Developments: Availability of labour is sufficient at present and may be so for ten years but it will be affected by improvements and developments in the industrial sector. Some shortcomings in the mechanization of logging operations are expected and it will be necessary to increase mechanization to offset shortage of labour.

CHINA

General Forestry Policy: All forestry activities are carried out on the basis of good silviculture methods and with sustained yield regeneration.

Training: Training courses are usually sponsored by provincial forestry departments or enterprises. Aim is to train all operators of machines, with a qualifying examination to be passed before being allowed to work.

Work studies, productivity and wages: Studies have been carried out on felling, delimbing, bucking and ground skidding. Average productivity is about 150 m^3/man/year. Workers are paid on a piece work basis and the average wage is about US$2.00 per day.

Accommodation: 70 percent of workers live in forestry villages and 30 percent in logging camps.

Developments: Availability of labour is sufficient at present, but by the end of this century there will probably be a shortage of good labour. There is 90 percent mechanization in North East China but less than 10 percent in the South. It is considered that some forest operations are over-mechanized but more attention will be paid to the socio-economic aspects of forest mechanization in future.

Skidding in Burma with buffaloes

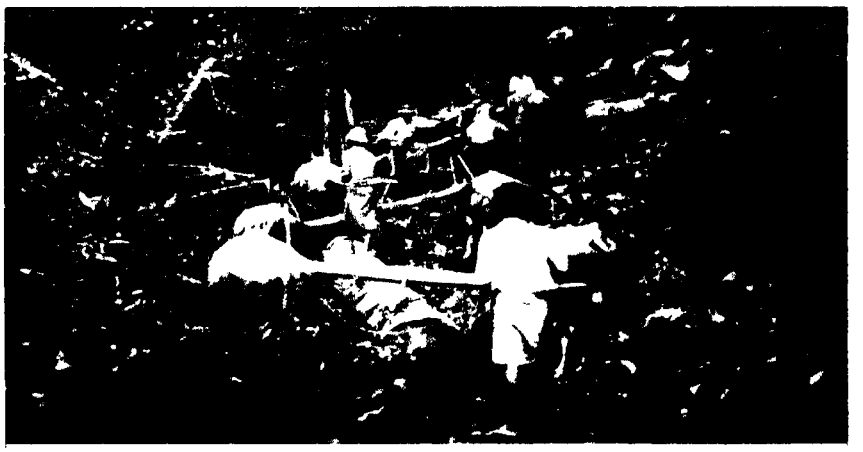


Photo by Myo Chit Nyo

Hauling in China with s.k. walking tractor

Photo by Shi Ming Zhang

FIJI ISLANDS

General Forestry Policy: To maintain and enhance environmental values of the existing forests and increase timber production for domestic and export markets by management of the natural forest and plantation development.

Training: For forestry workers, operators of chainsaws, tractors and other machines there is on-the-job instruction. For foremen there are basic training courses at the forestry training school. For foremen and instructors of workers training is given at the forestry training school or the government training centres. There is a forest workers' training scheme under preparation which will supplement the present facilities.

Work studies productivity, and wages: Some studies have been carried out on Pinus Carribea, the results of which are being applied in the logging and afforestation areas. Workers are normally paid on an hourly basis. There is some piece work on plantations. The average wage for a forestry worker is US$8.00 per day.

Accommodation: 10 percent of the workers live in forestry villages and 90 percent in other accommodation.

Developments: Labour availability is good and expected to continue. The level of mechanization is high.

INDIA

General Forestry Policy: The National Forest policy was enunciated in 1952 and has been reviewed from time to time. The following needs are kept in view when taking any policy decision connected with forests and forest lands:

Checking denudation and erosion in mountainous regions and catchments of rivers on which depend perennial stream flows.

Preventing erosion along treeless banks of rivers.

Maximizing forest productivity with a view to meeting the growing demand for industrial raw materials, timber and other forest produce.

Providing small timber and fuelwood requirements of the rural population.

Providing grass and grazing for livestock in forest areas, ensuring that it is not harmful to the forests.

Providing recreational and tourist opportunities in the forests without impairment of forest resources.

Creating blocks of forests interspersed with cultivation or by introducing trees in larger numbers in the ecosystem, after careful selection for maintaining a healthy relationship between soil, vegetation and animal life.

Training: Instructors and workers both receive training. Courses are held for staff at supervisory level dealing with chainsaws, tractors and other machines. There are basic logging courses to train supervisers and also for instructors of workers and foremen.

Present facilities could be improved by the organization of mobile training camps as and when required. Training in off-road transportation should be arranged by opening a new centre.

Work studies, productivity and wages: Work studies have been carried out in many states in India with very good results. An example of information furnished by work studies in 1979/80 is shown below:

Type of Operation	Productivity in m^3/man/year with 200 days/year
1. Felling, delimbing and cross-cutting	
Axe and hand saw	200 m^3
Peg toothed saw	350 "
Raker saw	400 "
Power chainsaw	1500 "*
Felling by uprooting	200 "
2. Debarking	
Axe	1200 "
Spade	1000 "
3. Off-road transportation in the hills	
Manual labour	80 "
4. Off-road transportation in plains	
Manual labour	80 "
5. Loading and Unloading	
Manual labour fuelwood operation	1200 "
6. Cutting, billeting and stacking by collection	400 "

* unit 150 days/year

Average wage for an unskilled worker varies from US$0.5 to US$1.00 per day but a skilled worker may earn up to eight times this on a piece work basis.

Accommodation: 15 percent of workers live in forestry villages; 30 percent in logging camps and 55 percent in other accommodation.

Developments: Timber and fuelwood harvesting and transport accounts for only 15 percent of the man/days employed in forestry operations annually. Owing to seasonal nature of logging and transport work trained workers are being lost to other occupations. To combat trend forestry workers should be trained in all aspects of forestry relevant to local situation and needs, in order to ensure round-the-year employment for the workers, at least where the annual worksites do not move too far apart.

PAKISTAN

General Forestry Policy: The Forestry Policy aims at conservation and protection of existing tree growth, intensification of forest management for increased production, and better utilization through harvesting on scientific lines and artificial regeneration, and popularising tree planting on private lands through public involvement in the form of motivation and co-operatives.

Training: For forestry workers, operators of chainsaws, tractors and other machines, and for foremen there is on-the-job training. There is, however, no training for instructors or workers and foremen. Improvement is contemplated by organization of training facilities supported by ongoing forest-assisted projects.

Work studies, productivity and wages: Work studies have been carried out. One dealt with the efficiency of the power chainsaw and hand tools in felling and conversion of trees. The result showed that the cost of production of timber per m^3 was Rs.8.18 with power chainsaws, while it was Rs.5.89 with hand tools. The difference was due to the high cost of fuel and lubricants and the difficulty of the terrain.

Average productivity is 1-5 m^3/man/day. Workers are paid by the hour or on a piece work basis. The average wage of a forestry worker is about US$2.5 per day.

Accommodation: 20 percent of workers live in forestry villages; 70 percent in logging camps and 10 percent in other forms of accommodation.

Developments: Labour is expected to become scarce. The level of mechanization is expected to remain low.

PAPUA NEW GUINEA

General Forestry Policy: The Papua New Guinea constitution requires that forest resources, as well as other national resources be conserved and used for the collective benefit and be replenished for the benefit of future generations. The forests are owned by clans and tribes and the Government must negotiate with them for the use of forest resources.

Training: Forestry workers can follow degree and diploma courses. There are courses for chainsaw operators. As yet no formal training for tractor and other machine operators. There are training seminars for foremen. No formal training is available for instructors who must go overseas. Training could be improved by the inclusion of training courses in logging and machine operation in the Timber Industry Training College syllabus.

Work studies, productivity and wages: No formal work studies have been done, only on an ad hoc basis. Average productivity is 200-300 m^3 / man/year. Almost all workers are paid on an hourly basis. The average wage is US$1.25 per hour.

Accommodation: 60 percent of workers live in logging camps; 40 in other accommodation.

Developments: Increasing cost of labour will mean more machines and less men required.

PHILIPPINES

General Forestry Policy: Multiple uses of forest lands oriented to the development and progress requirements of the country. Establishment of wood-processing plants to be encouraged and nationalized. Protection, development and rehabilitation of forest lands so as to ensure their continuity in productive condition. Land classification and survey to be systematized and hastened.

Training: Training is available for forestry workers, operators and foremen through the Demonstration of Improved Labour-intensive Technologies ILO/Field/Phil. project. Integrated training on a continuous basis should be introduced for workers, foremen and instructors. The present system depends for success on the supply of improved tools introduced by the BFD/ILO project.

Work studies, productivity and wages: Work studies introduced by the BFD/ILO project were carried out in some of the logging companies with the small chainsaw. This showed a trebled productivity. The use of the bow saw proved to be far more labour-intensive than the small chainsaw and its productivity was higher than that of the axe. There was increased productivity with the use of the debarking spade instead of the bolo. However, it used considerably more labour than the mechanical debarker. The brush hook for underbrush clearing was much more labour-intensive than a motorized clearing saw and its productivity was double that of the bolo, the existing manual technique. The oval blade planting hoe increased productivity over the manual technique using traditional planting tools. The work studies showed that felling and crosscutting with small chainsaw gave 18,150 m^3/man/year. The bow saw used for felling in plantation gave 18,150 stems/man/year. The debarking of pulpwood species with spade gave 3,030 m^3/man/year. The average wage for forestry workers in the government sector is US$2.85 per day and in the private sector US$4.20 per day.

Accommodation: 50 percent of workers live in forestry villages owned by the company; 15 percent in logging camps and 35 percent in other accommodation.

Developments: Employment in the forestry sector in future will depend on government policy and other circumstances, such as: main trends in the world timber industry: the changing of forest composition from old growth to young growth stands and man-made plantations: the constant or even declining real cost of Philippine forest labour, and the beginning of some imaginative social programmes in small-scale tree farming.

Difficult timber stand conditions are the main cause of the low level of labour. Use of less labour-intensive methods is due to low labour productivity because of inefficient working techniques. Worker productivity could be increased by training, by better tools and improved working techniques. Forest operations are over-mechanized at present.

SARAWAK MALAYSIA

General Forestry Policy: The diameter limit in the selection logging system in permanent forest/forest reserve is one of the main rules for the sustained yield goal. This sustained yield is based on a 25 year cutting cycle.

Training: Logging school was set up in 1980 which trains workers in topo survey, enumeration and tree identification. Permanent logging training under construction. There is training for forest guards. There are courses in sawdoctoring and sawmill maintenance for a period of six weeks. Degree and diploma courses are available at the universities. At present there is a lack of qualified instructors but facilities will increase when the permanent school is completed in 1982.

Work studies, productivity and wages: Work studies carried out by FAO, FD and STIDC. Workers are paid on a piece work basis. Average wage is US$7.50 per day.

Accommodation: Workers live in logging camps.

Developments: Shortage of skilled labour likely to occur due to competition from other industries. Labour turnover is high. Level of mechanization is high.

SOUTH KOREA

General Forestry Policy: Most of the wood needed is imported but the Korean forests are mainly built up on sustained yield basis.

Training: There is a two week technical training period for chainsaw, tractor and other machine operators. Instructors are college graduates, with three years' experience.

Work studies, productivity and wages: Work studies have been carried out on felling methods which will decrease accident rate. Average productivity is 250-280 m^3/man/year. Workers are paid about US$16 per day.

Accommodation: 80% of workers live in logging camps. 20 percent in other accommodation.

Developments: Increase in mechanization is expected.

SRI LANKA

General Forestry Policy: Felling, logging extraction for satisfactory supply of timber to Government departments, corporations and the public.

Training: State Timber Corporation train their machine operators on the job and there is in-service training for their operators of chainsaws, tractors and other machines. There are facilities for forestry field training at the Forest College directed by the Forest Department and the school of the State Timber Corporation. There is no training for instructors. Modern methods of training should be conducted by foreign personnel by means of classes and seminars.

Work studies, productivity and wages: No work studies have been carried out. Workers are paid on a hourly or piece work basis. The average wage is about US$1.00 per day.

Accommodation: 90 percent of the workers live in forestry villages; 10 percent in logging camps.

Developments: Permanent labour villages will be established in remote forestry operation areas. There is low level of mechanization due to high cost of machinery and fuels and there is a serious spare part problem.

THAILAND

General Forestry Policy: 40 percent (20.7 mill.ha) of total area of country to be reserved as forest area owned by State.

Training: Practical training carried out at operational sites. The F.I.O. requires its new recruits to have a four week training period. For operators of chainsaws, tractors and other machines the Forest Department provides a short training programme. There is a short course at the Forestry Training School for foremen. A short course is sometimes given for instructors.

Work studies, productivity and wages: Some work studies have been made. One result showed that chainsaws are five times more economical and 17 times faster than crosscut saws. Average productivity in felling, crosscutting and bunching is 500 m^3/ men/year. Short and long distance transport: 16 m^3/2 men/day. Workers are paid on a piece work basis in the private sector and wages for the F.I.O. Average wage is US$2.50 per day.

Accommodation: 50 percent in logging camps and 50 percent in other accommodation.

Developments: No labour shortage is expected. Possibly there will be less mechanization.

GROUP WORK

A. Observations of the various groups of participants during the logging equipment demonstration at Antagarh

1. **Basic Logging**

i) **Felling**

Felling by axe alone is a very wasteful method, besides being slow and time-consuming. It should therefore be totally discouraged in favour of other methods.

Felling by crosscut saws and a combination of axe and crosscut saw should be the general method utilized in all countries where abundant labour supply is available.

Felling by power chain saw should be employed where there is a shortage of labour and where adoption of this technology would not result in throwing labour out of employment. This method may also be applied where bigger logging jobs, under adverse local conditions, are to be accomplished within a short period of time and where high labour wages make the labour-intensive method uneconomic.

ii) **Debranching**

Smaller branches which can be chopped off by few strokes may be delimbed with an axe.

Bigger branches which would yield timber, pulpwood and fuelwood should be delimbed by other methods, the adoption of which will depend on the availability of labour and level of technology prevailing in a country.

iii) **Crosscutting**

Crosscutting by axe should be totally replaced by crosscut saws. Power chain-saws may be employed under conditions mentioned above.

The tree should be converted into the appropriate log length or multiple thereof, according to the country's conventional use.

iv) **Debarking**

Up to now in debarking each country follows its own convenience by using tools such as axe, hammer, crowbar, matchet, debarking spud etc. Of these the debarking spud and crowbar appear to be the most suitable tools and are recommended for use. However, development of appropriate tools should continue.

v) **Utilization of Logging Waste**

Logging waste such as small timber, poor quality and otherwise uneconomic timber, fuelwood and thinnings, which are uneconomic to extract, may be economically harvested as charcoal.

2. Transportation

i) Movement of Logs by Men

Instead of carrying a log directly on their shoulders, as traditionally practised here in India, an easier method could be introduced. Employment of pairs of tongs and strings is one of them. Trolley and wheelbarrow may also be used for short wood such as fuelwood.

ii) Transportation by Bullcart

Wooden wheels may be replaced by pneumatic tyre wheels, together with bearings. Proper harnesses should be used in order to improve the pulling capacity of the bulls. Elephants can also be used for terrain transport, provided that food and water is available at the logging site.

(iii)Loading

From the safety point of view, the manual loading method with the aid of two ropes should be improved by replacing the wooden stakes with piling jacks or spiked stakes.

The loading method being adopted in Thailand using "A" framed crane trucks and the truck with semi-trailer may be experimented with in India. Another loading method using a square wooden framed truck can also be tried.

iv) Farm Tractors.

Chokers should be used for hooking the load to be skidded. Other kinds of attachment, such as self loading arch and skidding tongues for three point linkage can be used.

v) Trailers

Unloading operations could be undertaken in a more efficient way if a tipping system were incorporated.

vi) Forwarder

The forwarder is a very sophisticated and efficient machine. The high cost of acquisition, problems regarding maintenance and availability of spare parts makes its introduction to India inadvisable.

vii)Skidder

Its employment may be needed in difficult terrain conditions.

3. Tool Manufacture and Organization of Logging

i) India was considered to be fortunate in having started local manufacture of tools according to forestry requirements.

ii) The Khesla Workshop would be meeting these requirements if a quality check of products could be undertaken on a regular basis, with special emphasis on the steel used, as well as shape and finish of tools following clearly established standards.

iii) In addition to saws, the manufacture of improved axes and maintenance tools would prove to be important.

iv) Considering the workshop layout certain improvements should be introduced, i.e. levelling of floor, protection of transmission, proper working height and illumination of the premises where the saw sharpener is working.

v) For saw sharpening, filing grids and angle gauges should be provided.

vi) The distribution of tools as well as their testing might be easier through a co-operative organization of which State Forest Departments and Forest Corporations could be members.

vii) It is estimated that the percentage of industrial timber being cut in India at present is distributed as follows:

Contractors	45%
Corporations	30%
Forest Departments	20%
Forest Labourers' Co-op. Societies	5%
Total	100%

viii) There seems to be a certain reluctance towards further expansion of logging through Corporations and Forest Labourers' Co-operative Societies. The former are working rather efficiently and the latter are doing reasonably well on the whole, though for both training appears to be a key issues. The staff of Corporations require management training and the necessary institutions are being established. The Forest Labourers' Co-operative Societies need training in organization, administration, tools and techniques.

ix) In India the transfer of logging operations to Corporations and Co-operatives seems to have had a beneficial effect on the social conditions of the labourer, without reducing working efficiency. It should, therefore, be further encouraged.

4. Social Conditions (condensed)

Notwithstanding the present status enjoyed by the forest labourers in the countries under consideration, the following suggestions are made in order to draw attention to the great need to increase the socio-economic status of forest workers to a level comparable and competitive to other workers.

i) Wage security, taking into account a form of minimal wage or guaranteed income, should be introduced and the maximum working period should not exceed 7-8 working hours per day.

ii) The management should take the initiative in providing wage saving facilities for all workers. A certain percentage of their income should be deducted and transferred to a bank or other saving facility, in order to make provision for times of hardship.

iii) Training should be provided on a continuing basis.

iv) Safety awareness must be implanted in the minds of all the workers and consequently provision for safety equipment has to be made.

v) Medical facilities are necessary, such as a dispensary and a trained nurse.

vi) As most of the workers live fairly far from the working site, transport facilities should be provided by the management at no extra cost to the worker.

vii) Educational facilities, including adult education, should be provided.

viii) Family planning programmes should be established and conducted at forestry villages.

ix) Training of forest workers and/or their dependents in trades other than forestry should be foreseen. This would be one of the ways in which management could increase the earning capacity of the families, at the same time providing for employment on an annual basis.

x) Adequate amenities at forestry villages should be supplied, such as radio, newspapers, sport facilities, to mention a few.

xi) There appears to be considerable scope to increase World Food Programme support to forest workers.

B. Summarizing Views expressed during Group Work on Employment in Forestry

1. The governments of most of the countries represented at the Consultation are aware of the economic, social and ecological potential of forestry as a catalyst for rural development. This is, for example, expressed through policies aiming at the introduction of intensive forest management, such as reforestation, as well as the establishment of wood processing industries in rural areas. However, there is room for improvement in the implementation of such policies.

2. There is an obvious need to supplement forest resource planning with human resource planning, aiming at the improvement of the quality of employment, and in order to increase its quantity in regions where unemployment or under-employment is a problem.

3. As regards the incorporation of employment conditions and objectives into concession agreements, there are considerable differences between countries. In the case of large-scale and long-term concessions, employment conditions and objectives are usually defined in some detail but in the case of small-scale and short-term contracts, they may be largely missing. In all countries there is a lack of qualified staff and of resources to control employment aspects of concession agreements.

4. In some countries communal and agro-forestry systems play an important role in providing food, wood, employment and additional income, in settling shifting cultivators and in successfully regenerating cut-over areas. There appears to be considerable scope for the expansion of such activities. However, there are also instances where it is difficult to control agro-forestry systems and, as a result, forests might be turned over to agriculture. In such cases agro-forestry tends to be restricted or discouraged.

5. To promote appropriate technologies, activities on a national level such as the SIDA/India logging training project and the ILO/Finland/Philippine project on technology in forestry are recommended, as is also exchange of experience at a regional level. Work study, local availability of appropriate tools and training are the most important factors to be considered.

6. In those countries where unemployment in rural areas is a major concern, forestry offers opportunities for unemployment relief through activities such as reforestation, erosion control, charcoal production and road construction. There is much scope to expand these activities by providing funds from local Governments, FAO, World Food Programme and ILO's public works programme.

7. In most countries there is no formal representation of forest workers, such as trade unions or work councils to collaborate in employment problems. Trade unions will only gradually develop. Workers' education is needed to ensure that they become a qualified partner representing the workers' interests. Where trade unions do not exist it was found that forest labourers' co-operatives can also be a good means of taking care of the workers' employment problem.

C. Ergonomics aspects of intermediate technologies discussed by the Groups

1. Whereas in primitive traditional technology ergonomic aspects are often ignored, intermediate technologies can only be considered as appropriate if basic ergonomic requirements are respected.

2. With regard to safety features the overall situation is largely unsatisfactory. Only few countries have adequate safety regulations concerning the forestry sector in order to provide personal protection equipment and keep accident records. When new tools, equipment, techniques and methods are introduced, safety requirements tend to be overlooked.

3. Forestry work is usually a heavy physical work; in addition, the worker is often exposed to heat stress. This is why adequate nutrition and rest periods should correspond to these conditions. In several countries, food is subsidised to meet the workers' requirements. The World Food Programme has also helped to improve nutrition of forest workers. There are many ways by which physical efforts can be reduced, e.g. minimising manual transport of loads, using well maintained tools, transporting workers to and from work sites. The widest possible use should be made of these possibilities.

4. Good collaboration between Government authorities, employers as well as workers is necessary in order to improve the ergonomic situation in the forestry sector, and to ensure that technological progress develops in line with ergonomic requirements. The Government authorities should be particularly concerned in issuing adequate safety regulations and in carrying out safety inspections. Employers should provide basic safety instructions and safety equipment (e.g. boots, gloves, hard helmets, first-aid material) and respect well defined safety standards regarding work organisation. Trade unions or safety committees would be helpful to support accident prevention programmes.

5. Manufacturers of forest tools and equipment, jointly with relevant research institutes and users of such equipment, should pay attention to ergonomic features and consider them in tool development and testing. Protective covers should be supplied for cutting tools.

6. There is need for inclusion of ergonomics in the curriculum of foresters' training programmes and to give it prominence in forest workers' training.

7. A checklist on ergonomics and safety which was presented during the Consultation appears to be a useful exercise in analysing different technologies applied in forest operations. Indications were given on how to improve this list.

8. There is obviously need for further collaboration amongst Asian countries on ergonomics related to forestry. The international organisations concerned (in particular ILO, FAO and IUFRO) but also bilateral donors are requested to help organise seminars and to provide teaching materials and expertise on the subject. This should also be a special concern of all technical cooperation projects in which operational activities are involved.

D. Summarized views of the Groups on Training for Intermediate Technologies

1. Training at worker level is crucial to introduce new technologies. It is required on a continuing basis. There is a definite need for training for improved labour-intensive forest operations.

2. A key problem in training is the availability of qualified and motivated instructors with a good practical background. Initially external assistance may be needed to train them. Instructors must be well selected. They should receive pay and promotion incentives and remain at least for five years on full-time training assignments.

3. First priority should be given to foreman training, especially in cases where the foreman is in charge of an unstable labour force and newly recruited workers receive initial instructions from him on working techniques and safety.

4. Worker training should be carried out close to the working site. Trained workers should receive a certificate and be able to earn more money. A pre-requisite for successful worker training is a largely stabilized work force, the provision of adequate employment conditions, and access to efficient tools and equipment.

5. Training as an ongoing activity requires institutional support at all levels. To gain support, the benefits of training must be clearly explained during introductory seminars for forest managers. To build up a well functioning training system a long-term effort and the active pacticipation of qualified and dynamic foresters is indispensible.

6. Where workers are employed by contractors or concessionaires a training tax may be introduced to cover the expenses for worker training.

J. Singh, P. Patnaik, F. Werner, U Phyo Mauk

E. The Groups' Observations on Environmental and Social Considerations

1. The main objectives of appropriate technology in forestry were summarised as follows:

- to meet community demands for forest products
- to reduce wastage and improve productivity and utilization
- to create more employment opportunities
- to increase earning capacity and quality of life of workers
- to preserve the environment
- to economise on cost of production.

2. The constraints/problems in the successful implementation of appropriate technology were discussed in the Groups and are summarised below:

- inadequate organization to propagate the technology
- financial constraints
- shortage of technical know-how (in some countries)
- non-availability of improved tools indigenously
- lack of coordination among concerned agencies
- local traditions and desire to stick to old methods and customs.

3. Action to be taken at different levels to overcome the above constraints:-

Local level

- educate the local people on forestry operations and intermediate technology
- develop organization to pursue the process of improvement of methods
- choose proper methods suiting local conditions.

National level

- lay down policy regarding employment
- build up organization to implement policy
- help development of tools and ensure quality control
- organize seminars at national level
- train new entrants and hold refresher courses for in-service officers.

International level

- provide support to allied organizations in developing countries
- organize seminars/training courses at regional levels
- distribute publications.

4. Relations between environment and technology were discussed. All the Groups felt that due attention must be given to conservation of environment while adopting any technology in forest operations. It was felt that the higher the level of technology, the more adverse is the effect on the environment.

F. Summarized views on energy technologies given by the Groups

1. Most of the countries present at the Consultation suffer from woodfuel shortage in rural areas and are therefore trying to move the villagers out of fuelwood plantations. In addition, some countries are considering the possibility to establish industrial energy plantations. Most of the work, however, is still in the initial stages and requires expansion. Seedlings, subsidies or food aid are provided in many cases as incentives to local people. Efficient manual techniques, good organisation and regular control of grazing are essential. There is a large scope for the creation of employment opportunities through woodfuel plantations.

2. Fuelwood harvesting should be done with saws as much as possible. Wedges and hammers may be needed to break down larger diameters. Special building equipment is helpful to compact small branches and to assemble a marketable commodity of standardised size. Wheelbarrows may be useful for off-road transport to loading points. Bullock carts are recommended for short distance road transport. Fuelwood harvesting should be done as efficiently as industrial wood harvesting.

3. For charcoal making traditional earth kilns are still commonly used. In some countries brick kilns are also employed, e.g. for carbonising fuelwood from mangrove forests. Portable steel kilns are already successfully operating in several countries of the region. There is considerable interest in introducing them in further countries as a means to utilise wood from logging waste, unmerchantable thinning or plantation and land clearing which cannot be utilised as fuelwood because of excessive transport costs. Studies on briquetting and pelleting of charcoal powder are under way. There appears to be a large potential to manufacture charcoal in wood surplus areas for consumption in wood deficit areas while at the same time providing a considerable amount of employment.

4. Forestry services should actively engage in disseminating fuel-saving stoves for wood and charcoal. Up to now little progress has been made in this field although a great deal of studies and trials have been and are being carried out. One way of supporting this work would consist in introducing fuel-saving stoves in forestry villages.

5. Regional and interregional exchanges on energy technologies are desirable for the promotion of appropriate tools, techniques and methods. If efficient contribution is made both to improve the rural energy supply and to provide employment under favourable economic and social conditions, woodfuel programmes will undoubtedly gain increased Government support.

G. The Groups' suggestions for future action in the Asian Region related to the introduction of appropriate technologies in Forestry

General Discussion

1. To promote appropriate technologies in forestry an integral approach is needed combining development of tools, equipment, techniques and methods, with training at all levels, including worker level. Such activities should include logging, silviculture, community forestry and agro-forestry. They should be in line with environmental requirements and be based on adequate working and living conditions provided for the forest workers.

2. Emphasis should be placed on national initiative aiming at strengthening, expanding or introducing the necessary research and training facilities. If necessary, regulations should be issued to ensure the application of appropriate technology.

3. Technical co-operation between developing countries should increase regional exchanges for the promotion of appropriate technology in forestry. In addition, international organizations and donors of bilateral aid are invited to reinforce national and regional activities for appropriate technologies in forestry. It would be appreciated if FAO and ILO would pursue their collaboration in this field for the benefit of the Asian countries.

4. Furthermore, it is recommended that the international organizations concerned continue their efforts to pool international expertise on appropriate technologies in forestry at the inter-regional level and make it available to member countries, without copyright restriction, through reports and training manuals for wide distribution in their official languages, with a layout which would facilitate translation into local languages.

PROGRAMME

First week

SUNDAY 18 OCTOBER	Registration of participants at Ashoka Hotel, New Delhi
MONDAY 19 OCTOBER	
10.00 - 12.00	Welcome statement by Inspector General of Forests, Mr. N.D. Bachkheti
	Address by Secretary, Ministry of Agriculture, Mr. S.P. Mukherjee
	Inauguration by Minister of Agriculture, Mr. Rao Birendra Singh
	Vote of thanks by FAO Representative, Dr. Rumeau
	Return by bus to Ashoka Hotel
	General introduction to the Consultation by Mr. G. Segerström, Director of the meeting, FAO, Rome
13.30 - 14.30	Man and Technology: N. Chatterjee
14.30 - 15.30	Management Trends in Modern Forestry: Floyd Werner
15.30 - 17.00	Panel discussion
19.00	Dinner reception offered by Minister of Agriculture, Government of India
TUESDAY 20 OCTOBER	
09.00 - 12.00	Participants' Country Reports
13.30 - 17.00	Participants' Country Reports (continued)
WEDNESDAY 21 OCTOBER	
09.00 - 12.00	Relations between Technology and Forestry Planning Systems - Examples from India and Sweden: P. Patnaik and C.G. Mossberg
14.00	Departure from Ashoka Hotel by bus to Airport
15.00	Flight IC 516 Delhi-Nagpur
	Introduction to field demonstrations on arrival
	Overnight in Nagpur
THURSDAY 22 OCTOBER	
08.00 - 18.00	Trip by bus Nagpur-Bhilai. En route field demonstration by G.M. Bedekar (basic logging)
	Overnight at Hotel Bhilai
FRIDAY 23 OCTOBER	
All day	Field visit to Antagarh and back to Bhilai. Presentation by T. Degerlund and V.K. Wadhwa
	Overnight in Bhilai

SATURDAY 24 OCTOBER

All day	Trip by bus to Bhilai-Nagpur. En route visit to logging areas in Maharashtra.
	Overnight in Nagpur

Second week

SUNDAY 25 OCTOBER

10.00 - 11.30	Study visit to Khosla Engineering Industries, Nagpur
	Afternoon free
19.30	Departure by bus to Airport
20.50	Flight IC 515 Nagpur-Delhi
22.30	By bus Delhi-Dehra Dun

MONDAY 26 OCTOBER

09.00	Participants' arrival and hotel accommodation in Dehra Dun
11.00 - 12.00	India/SIDA Logging Training Centres Project (LTCP) Background presented by Chief Executive Officer: K.C. Thapliyal Ongoing activities illustrated by Project Coordinator: Carl Mossberg Future planning outlined by Chief Executive Officer: K.C. Thapliyal
13.30 - 17.00	Group work I and II (social, economic and technical constraints in forestry)

TUESDAY 27 OCTOBER

09.00 - 12.00	FAO/SIDA Handbook on Basic Technology for Forestry presented by G. Segerström
13.30 - 17.00	Group work III (What is the right level of mechanization?)

WEDNESDAY 28 OCTOBER

09.00 - 12.00	Employment in Forestry: B. Strehlke
13.30 - 17.00	Group work IV (employment)

THURSDAY 29 OCTOBER

09.00 - 10.30	Man-Tool-Technique-Training: B. Strehlke
10.30 - 12.00	Aspects of Ergonomics and Safety to be Considered in Choice of Technology: B. Frykman
13.30 - 17.00	Group work V

FRIDAY 30 OCTOBER

09.00 - 10.00	Environment and Technology: Gurmal Singh, Forest Research Institute (FRI), Dehra Dun
10.00 - 11.00	Socio-economic Aspects on Technology Levels: B. Ohlsson
11.00 - 12.00	Workers' Training - a Socio-economic Study: N. Basu
13.30 - 17.00	Group work VI (environment and social considerations)

SUNDAY 31 OCTOBER

09.00 - 12.00	Energy-Technology: B.P. Srivastava
13.30 - 17.00	Group work VII

Third week

SUNDAY 1 NOVEMBER	Optional excursions and sightseeing
	Additional participants arriving in New Delhi, Ashoka Hotel
	Night train to Dehra Dun for the last group of participants
MONDAY 2 NOVEMBER	Arrival of last 15 participants to Dehra Dun
09.00 - 11.00	Finalisation of preparations for presentation of group works, etc., for additional group
11.00 - 12.00	Introduction to Consultation of additional group by G. Segerström and K.C. Thapliyal
13.30 - 16.30	Presentation of Group works I to VII by Group leaders
16.30 - 17.00	Introduction to field trip by Chief Executive Officer and Project Coordinator

TUESDAY 3 NOVEMBER

All day	Field demonstration of basic logging tools: G. Skarner
	In situ conversion

WEDNESDAY 4 NOVEMBER

09.00 - 12.00	The Development Process: play by the participants : Jöran Fries
15.00	Departure by bus from hotel for New Delhi, Ashoka Hotel
21.00	Dinner

THURSDAY 5 NOVEMBER

09.00 - 12.00	Summary of experiences
13.30 - 17.00	Drafting of Report and Recommendations

FRIDAY 6 NOVEMBER	
09.00 - 12.00	Adoption of Recommendations Evaluation of the Consultation by participants
13.30	Closing session
19.30	Farewell dinner
SATURDAY 7 NOVEMBER	Departure of participants from New Delhi

Photo Gunnar Segerström

ANNEX

SECRETARIAT

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Co-Director	Mr. Floyd Werner, SIDA, New Delhi
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APPROPRIATE TECHNOLOGY

Text by Bengt Frykman
Melody "Over the Mountains, Over the Sea"

1. We came from North
And we came from South.
We came from mountains
And over the sea.
Just to discuss a technology
Appropriate to our needs.

Refrain: Appropriate logging is our way.
With this kind of technique
We want to stay.
This is the way we solve the things.
This is so good for us.

2. In India's land
We went out for a trip.
To look in the field
At the use of "equip"
Much what we saw gave us a kick.
Now we want more of that!

Refrain: repeat

3. At Madhuban Hotel
We have spent a week.
And discussed together
Much more than technique.
Hopefully all of us now know
What we have talked about.

Refrain: repeat

4. On Sunday we won
Our football game.
And started on Monday
Again with the same.
Presented our work to seniors.
Tried to convince them all that ...

Refrain: repeat

5. On Tuesday we went
To the woods to see
Pitsawing, tools and biomass energy.
Gunnar, he told us we could swim
And that became true for us.

Refrain: Over the water and over the ground
We took a walk to the raining sound
By jeep, foot and tractor,
We reached the bus.
This was the best for us.

6. Soon we'll go back to
Our countries again.
Sorry to leave
All our new friends,
But we'll keep them in memory,
Which is the best for us.

Repeat first Refrain.

Photo Jöran Fries

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