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Introduction

This paper endeavours to put the searchlight on and bring into focus a comparatively less studied subject and untrodden region of the pulp and paper industry, where policies have been guided more by ad-hocism, arbitrariness, emotions, platitudes and a good deal of verbiage than by any scientific, rational or intelligent study. Korthari's article on "Royalty on Pulpwood" published in the Economic Times of 7th February, 1971 which created quite a flutter in both the forestry and industrial circles, could be regarded as perhaps the first serious attempt at shedding new light on the question of royalty of pulpwood supplies to the pulp and paper industry.

That the question of raw material supply to the rapidly developing pulp andpaperindustries is of fundamental importance to a healthy growth of the industry cannot at all be disputed. This vital industrial sector has come a long way during the last two decades, and now stands at the cross

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Cash Flow and Cost-Benefit Studies of Plantation Forestry for Rationalizing Royalties of Pulpwood Supplies to Paper Mills

The pulp and paper industry is on the threshold of big developments. The question of providing adequate supplies of raw material to the industry would assume considerable importance. While there should be no fear of an impending raw material famine in the country in the years to come, there would be an imperative need for bringing about a revolution in thinking and evolving a rational and pragmatic policy of determining the royalties of pulpwood supplies

Plantation forestry aimed at creating man-made forests of fast-growing species is bound to play a big role in the coming years as regards pulpwood supplies. This activity would, however, require large investments, and to afford full justification for the allocation of scarce resources to it, the question of profitability will have to be ensured.

This paper emphasizes the need for working out a rational basis for arriving at norms of royalty based on cash flow studies and cost-benefit analysis of plantation models. Case studies of Eucalyptus and bamboo plantations have been presented with variable yields and the benefit/cost ratios and internal rates of return have been worked out for them. A strong plea has been made in the paper for relating royalties to the investments and the time frame in which raw material would be available. Plantation forestry should be able to stand on its own legs and there should be no need to use gimmicks or props to support it.

A far-sighted and dynamic policy regarding pricing of raw materials is the need of the day, and it has to be realized that subsidizing raw materials supplies would provide no long term solution. Unless industry is prepared to back its demands for bamboo and pulpwood from man-made forests with reasonable offers of royalty, it is questionable if the programme of establishing these could at all be justified.

roads. The growth of the industry and its future course would depend largely on how effectively and successfully the problem of raw material supply is tackled and solved. When the stakes for future planning are the attainment of self-sufficiency in the production of pulp, paper, board and newsprint (thereby removing the drain of sizable foreign exchange on imports) and at the same time, the capability of exporting products to needy countries, it would but be natural and reasonable to give this question of raw materials its due importance and put it in a proper frame.

The earlier confidence that the industry exhibited in the adequacy of raw material resources in the country when there were hardly 17 mills with

capacities ranging from 10 to 20 tonnes per day, is now giving place to a misgiving (though quite unjustified) of mounting raw material shortages and growing uncertainties of sustained supplies. Some experts, in their state of acute pessimism are even predicting an impending raw material famine. The authors, even at the risk of being called super optimists, have no hesitation in pointing out that there is no problem of any such impending famine in the coming years and that the existing forest resources and the new resources that are being created through the raising of extensive man-made forests would be quite adequate to meet the raw material requirements even in 1985 which, on an analysis of various projections made by experts and planners, could be taken as nearly 10 million tonnes for an anticipated production target of 4 million tonnes.

If anything, the problem is not so much about the adequacy of raw material supply as about systematic planning of units and capacities vis-avis location of resources, reorienting and intensifying management practices in the forestry sector, ensuring proper integration and evolving a pragmatic and rational pricing policy of raw material supply, based on wellrecognised economic principles.

PULP AND PAPER INDUSTRY IS AN ALLY OF FORESTRY SECTOR

The pulp and paper industry is the biggest ally of the forestry sector and the establishment of strong and cordial links between these two sectors which deal with two powerful tenets of economic and industrial growth,

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could make an effective contribution to national welfare. On the development and growth of the pulp and paper industry depends, in a large measure, the future of forestry, inasmuch as, a large proportion of the production of wood from the forests which at present has no economic use (this refers to the fuelwood or pulpwood component, which accounts for anything from 60 to 75 per cent of the growing stock in hardwood forests) could be utilized by the pulp and paper industry, thus giving meaning and value to forestry activities. Likewise, the health of the forestry sector and its ability to produce economically the raw material requirements of the pulp and paper industry will largely determine the future of this industry in the country in the years to come.

For bringing about this muchneeded integration it would be necessary for both the sectors to shed their isolation, and jointly and unitedly formulate plans for the future. A greater awareness of the problem of these two sectors would become necessary and it would also be necessary and desirable to include foresters in the highest echelons of planning, decision making and implementation. This question of having the highest expertise to deal with the vital question of organizing raw material supplies has not received the attention that it deserves. When the annual expenses on providing 10 million tonnes of raw material to the pulp and paper industry in 1985 amounting to Rs. 1200 to 1500 million are considered, it would need no argument to stress the need for entrusting the task to experts as against leaving it in the hands of amateurs or pseudoprofessionals,

NEED FOR ECONOMIC EVALUATION OF PLANTATION FORESTRY

Raw material supplies to the pulp and paper mills have so far mainly been based on naturally grown forests and, as such, there was a tendency to look upon raw material resources as a God-given gift, which required little human effort to produce. Besides, the main raw material for the industry, i.e. bamboo was for quite some time, regarded as an undesirable intrusion in the lower storey of forest crops which impeded the progress of natural regeneration of the valuable timber species. These considerations enabled the industry to obtain raw material supplies at nominal rates, and this accounts, to a large extent, for the indifference shown by it to the question of economic studies aimed at reducing costs of raw material procurement. It was also for this reason that the industry exhibited an utter disregard for siting units close to the sources of raw materials supply, because on account of the nominal royalty paid for raw material, it could afford to incur fairly heavy expenses on transporting raw material to mill sites.

With the passage of time and with the growth of the industry difficulties started to be felt with regard to raw material supplies. The cost-price squeeze began to be felt by the industry and it started dawning on it that in order to remain or even become more competitive, there was need for improving efficiency and keeping down costs.

It was on account of these considerations and also on account of the technological advances made in the pulping of hardwoods, that the idea

of raising man-made forests of fastgrowing species to provide raw material started gaining favour. Plantation forestry has made spectacular advances in recent decades and plantations of fast-growing pulpwood species could constitute important sources of raw material supply for the pulp and paper industry. Forestry genetics can assure high quality breeding material. With the use of selected seedlings, by tilling and fertilizing the soil, plantations can produce as much as ten times the growth of the natural forests. The shift to what are essentially agrotechnical methods presents many advantages, viz: convenient selection of species and rotation periods, a more homogeneous crop lending itself to mass production, removal and processing techniques, co-use of the land with agricultural crops in the first few years after establishment, reduction of supervision and transportation costs by concentration; and freedom to plan the sequence of age groups for orderly harvesting. An adoption of plantation forestry (now commonly called linear forestry) has evolved in a number of countries, and India is no exception. The plantation targets aimed at till the end of the Fourth Plan period are 560,500 hectares of fast-growing species and 906,500 hectares of economic species.

Granting that all future supplies of raw material to the pulp and paper industry could be made from plantations, then $2\frac{1}{2}$ million hectares of good quality productive forests, suitably sited with reference to the existing and proposed pulp and paper mills could meet the entire requirement of 10 million tonnes in the year 1985. The allocation of areas under the different types of raw material could be1 million hectares under bamboo, giving 2 tonnes yield per hectare per year.—2 mill. tonnes.

1 million hectares under fast-growing hardwood species, giving an annual yield of 5 tonnes per hectare per year.—5 mill. tonnes.

 $\frac{1}{2}$ million hectares under tropical pines giving an annual yield of 6 tonnes per hectare per year.—3 mill. tonnes.

Total $\frac{1}{2}$ million hectares, 10 mill. tonnes.

Five million tonnes could be the annual availability of long-fibre material and an equal quantity would be the short-fibre material. As for the total plantation area, it would constitute only 3.3% of the forest area of the country. Thus theoretically speaking there should be no difficulty in finding suitable areas and implementing the programme.

The real difficulty would lie in earmarking large sums of money for implementing the programme. The requirement of funds for achieving the targets mentioned above would be to the tune of Rs. 3750 million. An exclusive plantation programme for the pulp and paper industry, if implemented, could solve many problems which are being faced today. But it will have to be realized both by the industrial and forestry sectors that when a claim is laid to scarce resources for investment, the profitability of the activity will have to be assured, or else money will not be forthcoming The question then becomes one of establishing the economic soundness of the investment proposal.

Unfortunately, even though extensive plantations of man-made forests have been raised so far and there is a clamour for more such plantations from industrialists and planners, there seems to be a pervasive indifference to the need of a rational pricing policy for raw material supplies from manmade forests. This naive approach to such an important matter, unless corrected in good time, would not bode well for the future. It may jeopardise the very future of the plantation programme and create insurmountable difficulties for the industry in the years to come.

It may not be out of place to mention here a few examples of the manner in which the question of royalties on pulpwood supplies is being dealt with. These are not meant as any sort of criticism, but on the contrary, they have been chosen with a view to derive useful lessons for the future. The examples chosen are three and they pertain to three important elements involved in plantation forestry.

(i) The Development Council for Pulp and Paper has been laying stress on the need for increasing the area under bamboo. This is an excellent suggestion, but then why is it that the idea has not been brought into force? The plain and simple answer is that it would cost around Rs. 80 per tonne (including a margin of profit to the grower) to produce bamboo in any sizable quantity from plantations. If industry is not prepared to pay this cost, then there would be very little point in recommending that bamboo plantations should be raised.

(ii) Many responsible persons representing both the public and private sectors often put forward the plea that profitability considerations should be overlooked when determining the royalties of plantation pulpwood,

because, according to them there would be other important benefits such as earnings by the exchequer from excise duty, sales tax, income tax etc. which could be quite substantial. Under this argument an overt claim is made for giving a special place under the sun to the pulp and paper industry. To say the least, this is a facile argument and it could do incalculable harm to the future of man-made forests. If the industry (whether it be in the public sector or private sector) is to pay Rs.10 to 15 per tonne as royalty of raw material which costs anything from Rs. 40 to 60 to grow, then it seems very doubtful if any justification could be given for investing huge sums on raising man-made forests.

(iii) Much stress is generally laid on the desirability of raising plantations of Fir and Spruce in the Himalayan forests for aug-menting long fibre pulpwood supplies. At a symposium held recently in Srinagar some enthusiastic forest officers averred that the technique of regenerating these species artificially had been mastered and, as such, extensive plantations of Fir and Spruce should be raised for meeting the requirements of the pulp and paper industry. This idea would sound excellent, but then, it has to be realized that the cost of growing one cubic metre of the species would range from Rs. 2,000 to Rs. 2,500, aussming the rotation period to be 100 years, cost of formation Rs. 1500 per hectare and rate of interest 8% per annum.

The three examples discussed above highlight the need for envolving new policies for plantation forestry based on the concepts of economic viability and keeping in mind the influence of time on the returns on investments.

The case for raising man-made forests for the pulp and paper industry has been ably put forward by the National Commission on Agriculture and it has stressed that "there must be an incentive for a changeover from the low-cost low-yielding forestry to a commercial high investment economic forestry. Accordingly, the price for the produce should be so fixed as to cover the cost of plantation and leave a profit". The Commission has also recommended that there has to be a rational pricing policy in future for bamboo and pulpwood, and that the pulp and paper industry should be in a position to pay higher royalty if uniformity of raw material is assured through plantations. The Commission goes on to say that industry should be prepared to pay still higher prices if the plantations are sited within a reasonable distance from the factory. If should, thus, be possible for both the forester and the factory to take a reasonable view in the matter and plan the programme of man-made forests to make it a profitable venture.

In this paper all the important elements of plantation forestry have been woven together into cash flow studies and cost/benefit analysis of Eucalyptus and bamboo plantations, in which the variables of yields have been taken into consideration. Other models for tropical pines and for intercropping with agricultural crops are also proposed to be worked out in order to present a broad-range picture. It is felt that an effective and pragmatic metod of evolving royalty patterns for pulpwood supplies to the pulp and paper industry from manmadeforests would be the drawing up of similarcash flow models and cost/ benefit analyses for a given set of costs, yields, interest rates and returns This would inject a new realism into the subject and help in evolving a rational method of determining royalties to the satisfaction of all concerned interests. This would go a long way in paving the way for a new era for the healthy growth of the pulp and paper industry in the country. But before dealing with the models that have been presented in this paper, it may be worthwhile discussing a few related matters which have an important bearing on the subject.

CONSIDERATION OF LOCA-TION OF INDUSTRIAL UNITS

One of the major factors affect ing the cost of production and the margin between costs and returns for any product is transport. As far as bamboo and pulpwood supplies are concerned. it has been estimated by the Indian Pulp and Paper Technical Association³ that the entire cost of supply to mill sites, on an average, constitutes 15 to 20 per cent of the total cost of production of paper per tonne. Some units, which are unfavourably sited, have to incur a cost as high as 30 per cent. Thus, if the cost of production of one tonne of paper is taken as Rs. 1500, the share of raw material cost would be in the range of Rs.225 to 300 as an average and Rs. 450/for unfavourable cases. These figures should be compared with raw material costs in Scandinavian countries and U.S.A. which range between 36 to 564. As for Japan, the raw material cost is reported to be as high as 50% of the cost of manufacturing a tonne of paper⁵.

The cost of transportation of raw material to mill sites on an average would amount from 60 to 70 per cent of the total cost of pulpwood

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delivery, and in unfavourable cases it would be as high as 80 per cent. When considered in relation to the cost of manufacturing one tonne of paper, the average would be in the range of 10 to 15 per cent and for unfavourable locations, it would be 25 per cent (whereas, the percentage share of present royalties would be less than 1 per cent of total cost).

The basic objective of choice of location of manufacturing plants, the design and layout of logging operations etc., should be to minimize the total cost of moving labour, materials and products from point to point along the production line. An important field of economics, termed "location theory" has therefore developed around this basic objective of minimizing transportation and transfer costs. The location aspect of industrial units would have an important bearing on the choice of suitable planting sites and species. Before leaving this item, it should suffice to stress here that the industry should be prepared to pay more for raw material if sizable savings in transportation costs are assured through the siting of manmade forests near the mills.

JUSTIFYING CLAIMS FOR IN-VESTMENT OF SCARCE RE-SOURCES

Any cost which is incurred in expectation of a deferred return is an investment. The criterion for investment analysis is, therefore, that an opportunity which shows a greater rate of return than another opportunity, is a more efficient use of capital. Thus, when it comes to a question of laying claim to large funds for raising man-made forests for the pulp and paper industry, a strong and convincing case will have to be made out in order to persuade government and financiers to chosen the purse strings. This could be possible when a clear-cut policy is formulated and the returns from the activity and the stream of other benefits are clearly and convincingly projected. The forestry and industries sectors should be prepared for the usual economic scrutiny which is made to determine the soundness of investment.

Strictly speaking, an activity should not be undertaken unless its total benefits will exceed its total costs. The comparison of costs and benefits provides a useful criterion for policy formulation. Benefit/cost analysis can be used not only to decide whether a policy is economically justified, but also in choosing between alternatives. In simple terms the choice should be to achieve an objective at a minimum cost or to obtain the maximum benefits from the use of limited resources. These considerations would apply to the creation of man-made forests for the pulp and paper industry. It should be the duty of the forestry sector to keep a strict check on costs and it should be he duty of the industry to create a situation whereby the benefits flowing from the activity could be maximized and shown to be equal to or better than many other alternatives.

IMPORTANCE OF TIME FACTOR

Capital is a result of the fact that production is not instantaneous. It therefore, represents in some respect time as an input in production. This is well reflected in the statement "capital is solidified time". Since time is the main input in timber production forestry, capital is likely to be a dominant cost and in fact as Fedkiw⁶ says, "the major cost of growing timber is the interest on capital". This is borne out by an analysis made by Leslie⁷ of the costs of growing *Pinus radiata* plantations in South Australia where the cost of —

establishment represents 12%of the total cost at 40 years. tending and annual maintenance represents 22% of the total cost at 40 years.

interest on the capital investment represents 66% of the total cost at 40 years.

Thus, time is an important factor in any project. Benefits of one rupee are more valuable to the economy the closer to the present they are earned. Similarly, the value of one rupee in costs diminishes the further in the future these costs are incurred. Costs and benefits occurring in different years are translated into equivalent (present) values by applying a discount rate. The higher, the rate of discount, the more important time becomes.

Interest rates on money borrowed are quite high, being in the neighbourhood of 8 to 9 per cent per annum. Such high rates would make it imperative to maximize production by locating plantations in the most productive areas, following intensive cultural methods and harvesting crops at an early age. It should be possible to identify the benefit stream from extra investments and industry should be prepared to pav adequately fo the benefits.

Management or investment decisions must ultimately be based on a comparison of the benefits expected

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with the cost likely to be incurred in establishing the type of forests in the most suitable locations for producing the sort and quantity of forest products and services expected to be saleable in the future. Such decisions should be made at the start of every plantation activity.

SUBSIDIZING RAW MATERIAL SUPPLIES IS NO SOLUTION

If the maximum price that pulp and paper industries can afford to pay for standing raw material is less than the cost of production of the crop, it is questionable whether there is any justification for growing the crop at all. Industry must be prepared to back its demands by paying royalties which would cover the costs of growing such raw material. The crucial point cannot be overlooked that if the price offered for a particular factor in a particular activity is lower than the rates that could be earned in other activities, the factor will tend to flow from the low income to the high income activity.

It would be seen from what has been stated above that the question of fixing reasonable scales of royalties for raw material supplies to the pulp and paper industry holds the key to the whole problem. It needs to be ensured that probjects in which the benefit/cost ratio could be really satisfactory, are not put in the red due to an unfavourable result brought about by the combination of artificially depressed royalties with costs inflated by in-efficient production methods.

Subsidizing raw material supplies over any length of time could never be a solution. A temporary subsidy may be justified, provided

it results in lower prices to the consumer. It may be quite likely that the subsidy would be absorbed by the manufacturers in the form of higher profits or lower efficiency. Perhaps a subsidy could only be justified as a means of assisting infant industries.

A commendable study has recently been brought out by the Forestry Commission of Great Britain⁸ in which the plantation policy has been reviewed on the basis of a cost-benefit analysis. This is a candid study and could serve as a model for any country which is desirous of evolving rational principles of investment. This study starts with the admission that plantation forestry in Great Britain gives a very low rate of return (3%) and, as such, the nation is entitled to have a satisfactory answer regarding the benefits it gets from investing money on this activity. No such gimmick has been adopted as the indirect returns from excise duty etc.

In India, and as for that, in the tropics, the situation would not be as bad as in U.K. from the returns point of view. Growth conditions are known to be good in several areas and it should be possible to obtain handsome yields and returns from plantations, if only industry could change its old approach and adopt a bold and dynamic outlook. For a plantation project in Kenya drawn up by the World Bank⁹ for a proposed pulp and paper mill, the internal rates of return from pine plantations (rotation 30 years) were expected to be --

-F	0.07
for timber supplies	- 8%
for pulpwood supplies	11%

The internal rates of return from Eucalyptus, pine and bamboo plantations in India could compare with the above rates and perhaps even exceed them, provided industry extends its whole-hearted cooperation by agreeing to pay reasonable royalties for pulpwood supplies. A forward-looking and long-range national plan is the need of the day and there seems no doubt that with better understanding of the issues involved and with wise leadership, such a programme would be evolved before long.

HIGHLIGHTS AND ANALYSIS OF THE CASH FLOW AND COST-BENEFIT STUDY MODELS

Considering the present level of technological advancement in the field of pulp and paper making in India, both long-fibre and shortfibre raw material will be used. At present bamboo is the predominant long-fibre component for most of the pulp and paper mills in India. On the other hand, there are extensive plantations of Eucalyptus raised during the last 10 years. According to the present pattern, bamboo forms 60% of the raw material and the rest 40% is hardwoods. Assuming that Eucalyptus is going to be the hardwood component of the furnish along with bamboos, economic models for raising these two species have been worked out, based on various scales of assumed royalties and yields.

Taking a 300 tonnes/day capacity paper mill as an economically viable unit, the total effective area under plantations to feed this mill with bamboos and Eucalyptus would come to nearly 1500 sq. kms. This area calculation is based on minimum yield of 50 tonnes/hectare at the end of 10 years, in case of Eucalyptus and 5 tonnes/hectare in case of bam-

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boo for a cutting cycle of 4 years. This area can, however, be reduced, if plantations could be located on better site quality areas which will give more production per hectare — (Ref. Annexure I).

To tackle such a large industrial raw material catchment, mechanization of various plantation operations, proper means of communication, adequate provision of accommodation for labour, staff and officers are essential. Keeping these points in view, a capital outlay of Rs. 3,725,000/- (or Rs. 25/hectare) is worked out as per details in Annexure — II.

To raise and manage 1500 sq. kms. of man-made forests, a pattern of establishment, which is considered as minimum requirement is tabulated (Ref. Annexure III) with an annual expenditure of Rs. 1,326,400/- (or Rs. 40/hectare). For arriving at these norms, both international and national experiences have been taken into consideration.

EUCALYPTUS MODEL

For Eucalyptus, a planting regime of 10 years is adopted so that after 10th year the required yield of raw material starts flowing every year till 50th year, assuming that 3 crops after the first one will be coppice However, for the sake of crops. this study, 1 hectare of plantation is considered every year for 10 years. Expenditure on various planting operations like raising of nursery, planting out in the field and other maintenance for first 3 years have been worked out (Ref: Annexure IV to XIII). Various forestry operations involved have been studied in detail based on the experience of a

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large number of foresters in various parts of the country. Since very little work has been done on proper work study for forestry operations, the norms adopted regarding the number of man-days for this study are mostly based on practical experience in the field. Also taken into consideration are the records on the expenditure of such plantation activities in various states. Today, the wage of an unskilled worker ranges from Rs. 2 to 3/- in different areas. but to make the study more realistic for 1980s an escalation factor has been provided for and a wage rate of Rs. 4/- per day has been taken.

Taking into consideration the various expenditures from 1st to 50th year, a cash chart of expenditure on raising 1 hectare of Eucalyptus plantation every year for 10 vears is worked out as per Annexure XIV. All the expenditures in a particular year have been discounted to their present values at different rates of interest (Ref: Annexure XV). Similarly, returns from 1 hectare every year after the 10th vear till 50th year have been discounted to present value at different rates of interest ranging from 8 to 18 per cent. For calculating returns 3 royalty rates have been considered i.e. Rs. 40, 50 and 60 per tonne, as tabulated in Annexure XVI. By comparing the present values of expenditures and returns, internal rates of return are calculated for various yield and royalty patterns and tabulated in Annexure XVII. An analysis of this Annexure clearly brings out that if production is 50 tonnes per hectare after 10 years and royalty rate is Rs. 50/- per tonne, the internal rate of return would

lie between 8 to 9 per cent. In case the money is borrowed from a Bank or any other financial institution at an interest rate of 8 to 9 per cent, then by selling the produce at Rs. 50/- per tonne, the expenditure is just balanced and there is no profit. If, however, the royalty is fixed at Rs. 60/- per tonne, a profit of 1 to 2 per cent is obtained after providing for an interest rate of 8 to 9 per cent. Similarly, for other yield patterns the internal rate of return is indicated for various royalty rates. Taking the most favourable model of yield of 100 tonnes per hectare, and a royalty of Rs. 60/- per tonne (which is considered as the maximum possibility for this mill) an internal rate of return of 14 to 15 per cent is possible. In other words, a profit of 5 to 6 per cent after allowing for 8 to 9 per cent rate of interest would be possible. It is felt that a minimum profit rate of 6 per cent should be aimed at by the forestry sector after paying interest on the money borrowed for investment. Accordingly, based on the production potential of a given site, the royalty rate should be fixed with reference to the table - at Annexure XVII.

The royalty rates considered inthis model are for standing trees at the stump site.

MODEL FOR BAMBOO

For bamboo, the area to be tackled is very large, considering the cutting cycle of 4 years. In other words, the whole area is to be planted in first 4 years and thereafter it has to be maintained for next 4 to 5 years before first yield is obtained. This may present certain management problems in the field. Two

models have, therefore, been worked out in case of bamboo, one based upon the assumption of raising the entire bamboo plantation in 4 years and the second based on the assumption that the whole area will be planted up in an annually phased programme of 16 years.

When the bamboo plantation is spread over a period of 16 years, it solves the management problems to a large extent and it also fits in with the possibility of a phased expansion programme of the capacity of the mill, as the yields in this case rise progressively. Annexure XXXII gives a graphic representation of the progressive yields for 16 year Model.

Expenditures incurred for various operations for raising 1 hactare of bamboo plantation is detailed in Annexures from XIX to XXIII, based on the same labour rate and work norms as adopted for Eucalyptus. A cash flow chart showing the expenditure on raising 1 hectare of bamboo plantation every year for 4 years has been shown in Annexure XXIV. These plantations raised during the first 4 years will be maintained upto 40 to 44th year. The various expenditures incurred in different years as per the cash flow chart are discounted at different rates of interest to their present value as per Annexure XXV.

Similarly, the returns which are supposed to flow annually from 9th year onward till 44th year, are calculated based on 3 yield-patterns i.e. 5 tonnes per hectare, 8 tonnes per hectare and 10 tonnes per hectare in each cutting cycle. Also taken into consideration are 5 royalty patterns ranging from Rs.40 to 80/- per tonne. The royalties under all these variables are discounted to their present values at different rates of interest and tabulated in Annuexure XXVI.

An analysis of present worth of all the expenditures and returns (Annexure XXV & XXVI) will give various internal rates of return based on different royalty and yield patterns which are tabulated in Annexure XXVII. A perusal of Annexure XXVII, will indicate that at 5 tonne per hectare per cycle of 4 year production and royalty rate of Rs. 80 per tonne, the internal rate of return is 5 to 6 per cent. In other words, if the money is borrowed at 8 per cent for investment on plantation, the whole project so far as bamboo is concerned is uneconomic. Taking, however, the more favourable model of production of 10 tonnes per hectare per cycle of 4 years and a royalty of Rs. 80/- per tonne, an internal rate of return of 10 to 12 per cent is obtained, which means a profit of 2 to 3 per cent on investments after providing for interest rate of 8 per cent. In other words, in order to make bamboo plantations economic (to the extent of 2 to 3 per cent profit) at royalty rate of Rs. 80/- per tonne, these will have to be raised in best sites and fertilizing will have to be done to bring the production to 10 tonnes or more or else, royalty will have to be raised even beyond Rs. 80/- per tonnes to make the project viable.

Coming to a 16 year model of raising bamboo plantation, a cash flow chart is indicated at Annexure XXVIII and also the discounted values of both expenditures incurred and the returns obtained at various yields, and royalty and interest rates, are tabulated at Annexure XXIX

and XXX. A chart indicating internal rates of return for different rates of royalties and yield patterns appears at Annexure XXXI. From this Annexure, it is clear that if the plantation yields 5 tonnes per hectare per cycle of 4 years and the royalty is Rs. 80/- per tonne, the internal rate of return is only 4 to 5 per cent. In other words, the bamboo plantation is again uneconomic at Rs. 80/- per tonne royalty if the money is borrowed at 8 per cent for investment in such a project. For a 10 tonnes per hectare per cycle of 4 years production pattern and royalty rate of Rs. 80/- per tonne the internal rate of return is again of the order of 9 to 10 per cent. That means, it generates only 1 to 2 per cent of profit after providing for 8 per cent rate of interest.

The above study leads to the following inevitable conclusions :—

- 1. To make the plantation activity economically viable, it should generate profits on investment at anything from 3 to 6 per cent. This end can be achieved by locating plantations in the best available sites, intensive after-care, use of chemical fertilizers and introduction of better species and their provenances.
- 2. That the royalties have to be linked with the production as indicated in the various Annexures, dealing with the internal rate of return.

Since transportation cost accounts for very high percentage of total cost of raw material delivered at site a study has also been made to arrive at rational cost figures if airdry raw material is delivered at the mill

site. Different distance models ranging between 50 kms. to 150 kms. have been taken into consideration and transport cost worked out both for Eucalyptus and bamboo (Ref: Annexure XVIIIA, XVIIIB, XXXII and XXXIV).

An analysis of the transportation costs has been given in Annexure XXXII and XXXIII which shows that Eucalyptus can be delivered at the mill site at Rs. 86 to Rs. 156/per tonne, depending upon the different distances from the mill and various rates of royalties.

Similarly, for bamboo this rate varies from Rs. 100 to 180/- per tonne at the mill site. This cost includes the cost of felling, conversion, stacking, transporting to the road side and final haulage to the mill.

Benefit/cost ratio in case Eucalyptus range from 0.9 to 2.7 forh various yields and royalties, discounted at 8%. (Ref. Annexure XXXIV). Similarly, benefit/cost ratio in case of bamboo ranges from 0.38 to 1.50 in case of 4 year bamboo model and 0.35 to 1.28 in case of 16 year model, for various yields and royalties as given in Annexure XXXV and XXXVI.

For a 300 tonnes/day capacity mill, based on the above 3 models the present value of total nvestment for rasing Eucalyptus on a 10 year scheme works out to 100/-, and for bamboo, the present, value as computed by a 4 year model comes to Rs. 95,004,000/-. The corresponding value for bamboo on a 16 year model is Rs. 76,718,250/-. When a 10 year Eucalyptus model is integrated with a 4 year bamboo model, the present value (at 8 %) of total investment, works out to Rs. 118,316,100/- and when integrated with a 16 year bamboo model, it comes to Rs. 100,030,350/-.

CONCLUSION

The pulp and paper industry and the forestry sector are on the threshold of big developments. Huge investments are expected to be made on the expansion of existing units and the setting up of new ones for attaining self-sufficiency and meeting the export targets. This blue print places a heavy responsibility on the forestry sector for providing the raw material requirements of the industry at reasonable and economic costs. The creation of manmade forests would be a priority item, which could provide a longterm solution to the raw material situation. This would entail huge investments which would call for a radical reorganization of and reforms in the forestry sector.

The pulp and paper industry should also play the role of an active partner in bringing about a revolution in the country as regards rationalization of raw material allocations and supplies. The advantages of supplies from man-made forests to the industry itself would be far-reaching. There would be sizable savings on management, supervision, harvesting and transportation which, taken together, could service the plantation programme.

The other benefits to the nation, such as provision of much-needed employment to large masses in the rural sector, balanced regional development, spreading economic welfare in the backward areas and the development of infrastructure should not also be lost sight of.

In order to bring about a transformation in present thinking, it would be necessary to rationalize royalty structures and to link them up with enlightened cash flow and cost/benefit studies. This paper would have served its purpose if it could create a ferment in the minds of planners, industrailists and foresters.

REFERENCES

- 1. Kothari P.S.—Royalty On Pulpwood; Economic Times, 7th February, 1971.
- National Commission On Agriculture.—Interim Report on Production Forestry—Man-Made Forests, 1972.
- & 5. Indian Pulp and Paper Technical Association.—Report of the Technical Mission to Australia, Japan and Thailand, 1971.
- & 9. International Bank for Reconstruction and Development.—Forestry Plantation Project, Kenya, 1969.
- 6. Fedkiw J.—Yale University, School of Forestry, Bulletin No. 66.
- Leslie A.J.—Economic Problems in Tropical Forestry, F.A.O. Rome, 1971.
- 8. Forestry Commission, United Kingdom.—Forestry Policy, 1972.

ANNEXURE I

AREA REQUIREMENT

Total requirement of Eucalyptus wood per year	105,000 tonnes
Per hect. production after 10-years	50 "
Area under Eucalyptus for annual cut	2,100 hect.
Total area for 10 years	21,1000 hect.
Total requirement of bamboo per year	157,500 tonnes
Minimum production per hectevery 4 years	5 "
Area under bamboo for annual cut	31,500 hect.
Total Area for 4 years	126,000 hect.
Total effective plantation area for the whole Scheme:	147,000 hect.
Gross Area for the whole Scheme — 150,000 hect.	

Gross Area for the whole Scheme

1,500 Sq. Kms.

ANNEXURE II

Details of expenditure on capital outlay for raising pulp raw material to feed 300-tonne/day capacity paper mill

	Effective plantation area for 300-tonnes paper mill		147,000 ł	hect.
	Gross industrial plantation catchment for the 300-tonnes mill:		150,000 1	hect.
	Particulars of expenditure		Total estin cost Rs.	mated
1.	Tractors—@3 tractors per plantation division for 5 divisions.		750,000	
2.	Jeeps—@2 jeeps per plantation division for 5 divisions and one for C.F.		275,000	
3.	Motor cycles 20 (one for each ranger)		100,000	
4.	Buildings:			
	(a) One office building for each of the 5 divisions		500,000	
	(b) One building for circle office		100,000	
	(c) Inspection huts -2 for each plantation division for 5-divisions		200,000	
	(d) Store, tools and plants		100,000	
	(e) Residential quarters for officers & staff:		1,000,000	
5.	Telecommunication with 70 points		700,000	
		Grand total	3,725,000	

Capital outlay per hect $\frac{32,75,000}{147,000} = 25.4$ SAY Rs. 25/- per hect.

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ANNEXURE III

C ·	No. Catagory	NIA of	Avera	ge cost/r	nonth (in]	Rs.)		-	
		posts	Pay Sca	le	Pay	D.A.	S.P.	Total	year Rs.
1.	Conservator of Forests	1	1300-18	00	1300	100	100	1400	16,800
2.	Divisional Forest Officers	5	700-1	250	700	120		820	49,200
3.	Asst. Conservator of Forests	5	400-9	50	400	150		550	33,000
4.	Range Officers	20	250-4	00	250	150		400	96,000
5.	Foresters	80	150-1	60	150	100		250	2,40,000
6.	Forest Guards	160	70-80)	70	80		150	2,68,000
7.	Watchers & Chowkidars	160	100					100	1,92,000
8.	Surveyhrs	5	120-2	00	120	80		200	12,000
9.	Accountants	6	150-3	00	150	100		250	18,000
10.	Stenographers	6	150-3	00	150	100		250	18,000
11.	Clerks	24	110-22	20	110	80		200	57,600
12.	Draftsmen	6	150-3	00	150	100		250	18,000
13.	Peons	43	150(C lidat	onso- ted)				150	77,400
14.	Jeep drivers	11	200	,,				200	26,700
15.	Tractor drivers	15	250	,,				250	45,000
16.	Mechanics	20	250	,,				250	60,000
17.	Asst. Foreman	10	400	"				400	48,000
18.	Foremen	5	600	,,				600	36,000
19.	Telephone mechanics	5	250	,,				250	15,000

Staff requirement for Plantation scheme to feed 300 tonne/day capacity paper mill and the cost thereof

Note:For booking annual expenditure for cash flow
study only maintenance cost@Rs. 10/- per
hect. is added after Rs. 40/- during the first
year of formation for each Hect.Total annual expenditure=Rs.
Annual area tackled=33,600 hect.
(Eucalyptus+bamboo)
.:13,26,400
Annual area tackled=33,600 hect.
(Eucalyptus+bamboo)
.:

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ANNEXURE---IV

Details of expenditure on planting up of 1 hect. area with Eucalyptus $2\frac{1}{2}m \times 2\frac{1}{2}m$ Spacement No. of plants per hect. 1600 No. of man days **Details of work** (1) Demarcation (2) Site clearance (3) Staking (4) Pitting (30 cm. \times 30 cm. \times 30 cm.) 54 ----- @30 pits per day per man (5) Transporting of plants in polythene tube to planting site over an average distance of 1 Km.-@60 plants per man per day in 3 trips. 25 (6) Re-filling of pits and mixing of fertilizer insecticide and planting-@100 pits 16 per day per man. (7) Casuality replacement (10% casualties)

- (8) Weeding @ 100 plants per man per day. 48 3 weedings during the year.
- 2 (9) Fencing up of the area

Total 156

Calculating @ Rs. 4/- as the wages of a worker per day, total expenditure on planting 1 hect.= $=156 \times 4 = 624/-.$

ANNEXURE V

1

5

3

2

Details of expenditure on raising Nursery for 1 hect	t.
of Eucalyptus plantation	

Spa	acement $2\frac{1}{2}m 2\frac{1}{2}m$	
No	of plants per hec. 1600	-
Fo	r 1 hec. of plantation, 1 standard nursery bed	will
be	sufficient.	
De	tails of work No. of man	days
1.	Site preparation and formation of one	•
•	standard bed.	2
2.	Preparation of one bed with made up soil	~
	and its sowing	2
.3.	Watering one bed ———(<i>a</i>) 30 beds per day	
-	per man. For 2 Months	2
4.	Filling up of 1600 polythene bags with	
	sieved, cleaned and mixed with manure,	5
_	soil@200 bags per man per day	8
5.	Pricking and transplanting of seeding	
	in 1600 polythene bags——@800 bags per	_
_	day per man	2
6.	Weeding of 1600 planted polythene bags	
	@1600 bags per man per day at an	_
	interval of 15 days, for 4 months	8
7.	Watering 1600 planted polythene bags	
	@48,000 plants per day per man. For	
	4 months.	4
8.	Erection of fencing, construction of tha-	
	ched shelters etc.	2
	Total	30
		<u> </u>

Calculating at the rate of Rs. 4/- as the wages of a worker per day, total Nursery expenditure on raising planting material for 1 hect. @Rs. 120/-.

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ANNEXURE VI

Details of the cost of raw material required during the first year, of raising 1 hect. of Eucalyptus plantation

Snacement :	$2\frac{1}{2}m \times 2\frac{1}{2}m$
No. of plants per hect.	1600 [~]

Details	of raw materials	Cost of N	/leteria	l (Rs.)
1.	Seed		Rs.	1/-
2.	Fencing material		Rs.	100/-
3.	Polythene bags		Rs.	18/-
4.	Cost of fertilizer @ Rs. 0.0)2		
	p	er plant—	· Rs.	32/-
5.	Miscellaneous		Rs.	5/-
	Total cost of raw material	4.	Rs.	156/-

ANNEXURE VII

Details of expenditure on the maintenance of 1 hect. of Eucalyptus plantation in the 2nd year

Spacement :	$2\frac{1}{2}m \times 2\frac{1}{2}m$
No. of plants per hect.	1600

Details of work No. of man days

- Weeding around the individual plant, application fertilizer & replacement of casualties (10%)—@150 plants per man, per day—weedings in the second year.
- Transportation of plants for casualty replacement—@60 plants per man per day in 3 trips.
 3

Total

- Calculating @ Rs. 4/- as the wages of a worker per day, the total labour $\cos t = 27 \times 4 =$ Rs. 108/-
- 3. Cost of fertilizer—Rs. 0.02 per plant = 32

Rs. 140/-

27

ANNEXURE VIII

Details of expenditure on the maintenance of 1 hect. Eucalyptus plantation during the 3rd Year

Spacement :	$2\frac{1}{2}m \times 2\frac{1}{2}m$
No. of plants per hect.	1600

Details of work

No. of man days

 Weeding around the individual plant, application of fertilizer & replacement of casualties (10%)——@150 plants per man, per day—One weeding during 3rd year 12

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Transportation of plants for casualty 2. replacement over an average distance of -@60 plants per man per day 1 Km.- $2\frac{1}{2}$ in 3 trips. Calculating @ Rs. 4/- as the wages of a worker per day, total expenditure= 1.58 $14\frac{1}{2} \times 4 =$ Add cost of fertilizer--@Rs. 0.02 per 3. 32 plant =

Grand Total Rs. 90/-

ANNEXURE IX

DETAIL OF EXPENDITURE ON CONSTRUCTION OF ROAD

For the purpose of this study the norm adopted is that for every 1 Sq. Km. of plantation area there will be 1 Km. of road. Average cost on construction of 1 Km. of temporary forest road in slightly undulating country is taken as Rs. 7,000/- or say Rs. 70/- per hact. of plantation area.

ANNEXURE X

For the purpose of this study it has been assumed that land for raising industrial plantations will be taken on lease at the rate of Rs. 10/- per hact. per year. That the land will be retained only during the currency of the planting and exploitation programme.

ANNEXURE XI

Road maintenance cost of temporary forest roads per kilometers is taken as Rs. 1,000/- or Rs. 10/- per hact of plantation.

ANNEXURE XII

The capital outlay on the project includes such items as tractors, workshops, vehicles and various types of buildings in various localities. The average depreciation rate for all these items taken together is taken as 12% and thus the whole capital outlay is depreciated over a period of 8 years. Working back per hact, the amount comes to Rs. 3/- which is added into the annual expenditure in the appropriate cash flow charts.

ANNEXURE XIII

CONTINGENCIES

A contingency expenditure of Rs. 15/- per hact. is provided to cover the charges like running of vehicles, their maintenance charges, purchase of office furniture, recruitment of temporary fire watchers and other sundry items. This amount is added in the annual expenditure for every hact. of area in the appropriate cash flow charts.

	Cabi	O MOII	uadxa 1	anne c	UT FAISI		10 .19	Euca	smdkn	planta		GVEL	y year		IO NI	ņ	İ				
							Expen	diture	in Ru	pees ii	n diffe	rent	yrs.								1
Par	rticulars of work Years	Ι	7	ŝ	4	5	o l	~ ~	~	6	10		12 1	3 1	4 1.	5 16	<i>1</i>	18	51 8		50
-	Planting	780	780	780	780	780	780	780	780	780	780					-					
5.	Nursery raising	110	120	120	120	120	120	120	120	120	120										
з.	Weeding and fertilizing		140	230	230	230	230	230	230	230	230 2	230	90								
4.	Land rent	10	20	30	40	50	60	70	80	90	100 1	00 1	100 11	00 1()0 1()0 1C	10 IC	0 10	0 10	0 10	00
5.	Road construction	70	70	70	70	70	70	70	70	70	70										
6.	Road maintenance	10	20	30	40	50	60	70	80	06	100]	100	100 1	00 1(00 1(JO 1C	0 10	00 10	0 10	00 1(8
7.	Establishment	40	50	60	70	80	06	100	110	120	130 1	100]	100 1	00 1()0 J(30 1 C	0 10	0 10	0 10	00 10	00
<u></u>	Depreciation of machinery	ŝ	ŝ	ю	ŝ	e	ю	ŝ	Э												
9.	Contingencies	15	20	25	30	35	40	45	50	55	09	65	50	50	50	20	20	50	505	20	50
	Total	1048	1223	1348	1380	1418	1453	1488	1523	1555	1590	595	440 3	50 3	50 3	50 3.	50 3.	50 3;	50 3;	50 3	20

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ANNEXURE XIV

ANNE	XURE XIV-Conta																
	Particulars of work	Years	21	3	23	5	Expe	nditure	in Rs. 27	in dif	ferent	years 30	31	32	33	34	35
1.	Planting																
5.	Nursery raising																
3.	Weeding and fertiliz	sing															
4	Land rent		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
5.	Road construction																
6.	Road maintenance		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
.7.	Establishment		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
8.	Depreciation of may	chinery															
9.	Contingencies		50	50	50	50	50	50	50	50	50	50	50	50	20	50	50
		Total	350	350	350	350	350	350	350	350	350	350	350	350	350	350	350
							Expe	nditure	in Rs.	in dif	erent	/ears	1 1	 	Î Î Î	 . .	l
Pa	rticulars of work	Years	36	37	38	39	40	41	42	43	4	45	46	4	8	6 4	20
	Planting									_	-						
5	Nursery raising																
З.	Weeing and fertiliz	ing															
4.	Land rent		100	100	100	100	100	100	90	80	70	60	50	40	30	20	10
5.	Road construction																
6.	Road maintenance		100	100	100	100	100	100	90	80	70	60	50	40	30	20	10
7.	Establishment		100	100	100	100	100	100	90	80	70	60	50	40	30	20	10
8.	Depreciation of ma	chinery															
6	Contingencies		50	50	50	50	20	50	45	40	35	30	2:5	20	15	10	5
		Total	350	350	350	350	350	350	315	280	245	210	175	140	105	70	35
																	{

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ANNEXURE XV

Year	Expenditure	· · · · · · · · · · · · · · · · · · ·	Rate of interest				
	· ·	8%	10%	12%	14%	16%	18%
1 2 3 4 5 6 7	1048 1223 1348 1380 1418 1453 1488 1523	970 1048 1070 1014 965 916 868	948 1002 1013 943 880 820 764	945 975 959 877 805 736 601	919 941 910 817 736 620 595	903 909 864 762 675 526 526	888 878 820 712 620 530 467
9 10 11	1525 1555 1590 595	825 778 736 255	659 613 209	561 512 171	478 429 141	404 409 360 116	405 351 304
$ \begin{array}{c} 11\\ 12\\ 13\\ 14\\ 15\\ 16\\ 17\\ 18\\ 19\\ 20\\ 21\\ 22\\ 23\\ 24\\ 25\\ 26\\ 27\\ 28\\ 29\\ 20\\ 20\\ 21 $	393 440 350	1436	209 140 950	643	141 91 445	313	96 60 224
30 31 32 33 34 35 36 37 38 39 40 41 41 42 43 44 45 46 47 48 49 50	350 350 350 350 350 350 350 350 350 350	12 10 8 6 4 3 2 1 1	6 5 4 3 2 1 1	3 2 2 1 1 			
		11101	9673	8456	7658	6971	6363

Discounted values of expenditure for raising Eucalyptus plantations for 10 years @ 1 hect./year at different rates of interest

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ANNEXURE XVI

Yield	Royalty	Years	Returns	Disco	unted value	es at differ	ent rates	of interest	
		per annum -	8%	10%	12%	14%	16%	18%	
50	40	1 to 10 11 to 50	Nil 2000	10221	6846	4176	2784	1800	1200
50	50	1 to 10 11 to 50	Nil 2500	12914	8557	5220	3625	2250	1400
50	60	1 to 10 11 to 50	Nil 3000	15376	10269	6264	4350	2700	1690
60	40	1 to 10 11 to 50	Nil 2400	11651	8250	5011	4280	2160	1344
60	50	1 to 10 11 to 50	Nil 3000	15376	10269	6264	4350	2700	1680
60	60	1 to 10 11 to 50	Nil 3600	18452	12522	7617	5220	3240	2016
70	40	1 to 10 11 to 50	Nil 2800	14352	9584	5846	3625	2420	1568
70	50	1 to 10 11 to 50	Nil 3500	17939	11980	7308	5075	3150	1960
70	60	1 to 10 11 to 50	Nil 4200	21527	14367	8769	6090	3780	2350
100	40	1 to 10 11 to 50	Nil 4000	20502	13692	8352	5800	3600	2240
100	50	1 to 10 11 to 50	Nil 5000	25628	17115	10440	7250	6525	2800
100	60	1 to 10 11 to 50	Nil 6000	30702	20538	12528	8700	5400	3360

Discounted values of returns from Eucalyptus Plantation raised @ 1 hect./year for 10 years at different rates of yield and royalty

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ANNEXURE XVII

Internal rate of return from Eucalyptus plantations raised — @ 1 hect./yr. for 10-years for different rates of royalty and yield

	Royalty in Rs.						
Yield tonne/hect.		40)	ar G	50		60
50	- 7	to	8	.8 to	• 9	10 tc	11
60	8	to	9	10 to	11	11 to	12
70	9	to 1	0	11 to	12	12 to	13
100	11	to 1	2	13 to	14	14 to	15

ANNEXURE XVIII-A

Cost of Exploitation

Eucalyptus :---

1.	Felling, billeting, Collection and	
	stacking	Rs. 5.00/Ton
2.	Debarking	Rs. 5.00/Ton
3.	Loading and Unloading	Rs. 2.00/Ton
4.	Supervision charges	Rs. 3.00/Ton
5.	Tool etc.	Rs. 1.00/Ton
	Total	Rs.16.00/Ton

Transportation :--

Upto		10Km.	Rs. 1.00/Ton/Km.
;	11 to	20Km.	Rs. 0.70/Ton/Km.
	21 to	40Km.	Rs. 0.60/Ton/Km.
ana di t	41 to	60Km.	Rs. 0.50/Ton/Km.
· .	61 to	80Km.	Rs. 0.40/Ton/Km.
	- 81 to	100Km.	Rs. 0.35/Ton/Km.
11. <u>1</u>	101 to	120Km.	Rs. 0.40/Ton/Km.
	121 to	140Km.	Rs. 0.45/Ton/Km.
	141 to	160Km.	Rs. 0.50/Ton/Km.

Transportation charges vary from Rs. 10/- Ton to Rs. 70/-Ton depending upon the load

Bamboos :---

Cost of Exploitation :---

1.	Felling and bundling	Rs.	12.00/tonne
2.	Transportation loading point		
	and rebundling	Rs.	5.00/tonne
3.	Cost of String	Rs.	3.50/tonne

4.	Loading & Unloading	Rs.	2.50/tonne
5.	Cleaning of clumps	Rs.	3.00/tonne
6.	Handling and feeding	to	·
	chipper	Rs.	4.00/tonne
7.	Supervision charges	Rs.	7.00/tonne
8.	Sundry expenses	Rs.	3.00/tonne
A.,	ъ ,	Rs.	40.00/tonne

Transportation :---

By truck :							
20/-	upto	40K m	1.		Rs.	0.70/tonne	
30/-		41 to	80		Rs.	0.50/tonne	
40/-		81 to	120		Rs.	0.40/tonne	
60/-		121 to	160		Rs.	0.45/tonne	

Transportation rate varies from Rs. 7/- to Rs. 72/per tonne.

(See Annexure XVIII B on Page No. 206) ANNEXURE XIX

Details of expenditure on planing up of 1 hect. area with Bamboo

Spacing :	$4\frac{1}{2}m \times 4\frac{1}{2}m$
No. of plants/hect :	500

Details of works No. of man days 1. Demarcation 1 2. Site clearance 5 3. Staking 1 4. Pitting $(30 \text{ cm} \times 30 \text{ cm} \times 30 \text{ cm})$ @ 30 pits 17 per day, per man Transporting plants in polythene bags 5. to planting site over an average distance of 1 km. — @60 plants per man, per day 8 in 3 trips. Re-filling up of pits, mixing of fertilizer, 3. insecticide and planting------@100 pits/ day man 6 Casualty replacement (10% casualities) 1 7. Weeding _____ @100 plants/day/man _____ 8. 3 weedings during first year. 15 9. Fencing up of the area 2

Calculating @ Rs. 4/- as wages of a worker per day, total expenditure on planting 1 hect.= $56 \times 4=224$.

Total

56

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ANNEXURE XX

ANNEXURE XXII

Details of	expenditure on raising Nursery	per	1 hect.
	of bamboo plantation		

Spacement		$4\frac{1}{2}m \times 4\frac{1}{2}m.$
No. of plants/hect.		500
	,	

For 1 hect. of plantation 1 standard nursery bed will be sufficient.

Details of works

No. of man days

2

2

2

2

1

13

2

30

- 1. Site clearance and formation of 1 standard bed
- 2. Preparation of one bed with made up soil and its sowing
- 3. Watering one bed——@30 beds per day, per man for 2 months
- 4. Filling up of 500 polythene bags with seived cleaned and mixed with manure soil——@200 bags per man day.
- 5. Pricking and transplanting of seedling in 500 polythene bags
- 6. Weeding of 500 planted polythene bags ——@1600 bags per man per day at an interval of 15 days for 10 months.
- 8. Erection of fencing, construction of shelters etc.

Calculating @ Rs. 4/- as the wages of a worker per day total nursery expenditure on raising planting material for 1 hect.= 30×4 =Rs. 120/-.

ANNEXURE XXI

Details of first yea	the cost of raw 1 ar of raising 1 he	naterial required durin ct. of bamboo plantat	ig the
Spacing		$5m \times 5m$	
No. o	f plants/Hect.	500	
ے ا Details of ra	w material	Cost of raw materia	als (Rs.)
1. See	d		1
2. Pol	ythene bags		5
3. Fen	cing material		100
4. Cos	t of fertilizer		10
		Total	116

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Detail of expenditure on the maintenance of 1 hect. of bamboo plantation during the 2nd year

Spacking	$4\frac{1}{2}m \times 4\frac{1}{2}m$	
No. of plants/hect.	500	•

No. of man days Detail of work Weeding around the individual plant and 1. replacement of casualty @ 100 plants/ 10 man/day. Two weeding during 2nd year Application of fertilizer 71 2. 11 man days 3. Calculating = Rs. 4/man/day total =Rs..44 labour cost .20 =Rs.Cost of Fertilizer G.T. Rs. .64 (Two applications)

ANNEXURE-XXIII

Details of expenditure on the maintenance of 1 hect. of bamboo plantation during the 3rd year

Spa	acking	$4\frac{1}{2}m\times 4\frac{1}{2}m.$	
No	of plants per hect 500,	· · ·	
Detail	of work	No. of man	days
1.	Weeding the individual pla	nts @100 plants/	
2.	cay/man (only one weeding Application of fertilizer	;)	5
۰ ۱	Calculating @ Rs. 4/man/c labour cost	ay—total =Rs.	24

G. Total

(Only one application)

Cost of Fertilizer

201

10

34

=Rs.

Rs.

202 ANNEXURE XXVI

Cash flow of expenditure on raising 1 hect. of Bamboo Plantation every year-for 4 years

								-	-														ļ
•								Ĥ	kpend	liture	ii	Rup	ees i	n di	fferei	ut ye	ars				. 1		1
Pai	ticulars of work	Years		2	e	4	5	9	-	8	6				1	1 15	16	1	18	6	50	21	2
1	Planting		340 3	40 3	4 %	9	ŀ					ļ			ĺ								
3	Nursery raising	÷	120 1	20]	20 1	20																	
÷.	Weeding & Fertilizing		1	64	86	8	86	34				•											
4.	Land rent		10	23	30	4	4	6	4 0	ю Ф	4	4	4	4	4	6	4	4	\$	40	40	4	6
Ċ,	Road Construction		02	20	2	20																	
9	Road maintenance		10	20	30	40	40	4 ,	1	7 0	50	0	0 4	4	0 4	6 6	4	4	4	6	4	4	4
۲.	Establishment		40	50	60	2	40	40	1 0	1 0	ю 4	0	0	4	0 4	6	4	4	4	40	40	6	40
%	Depreciation of Machinery	1	e	ŝ	ŝ	ŝ	ŝ	e	ŝ	e								-					
9.	Contingencies		15	20	25	20	20	50	0 2	0	0	0	Б 0	Р О	0	50	20	20	20	20	20	20	50
			608 7	07 7	76 8	11 2	 	1 17	13 14	13 14	0 14	0 14	0 14	14	14	140	5	14	<u>4</u>	[<u></u> 4	140	140	1 1
								Ì	Ĥ	kpene	liture	i i	Inpee	s in	differ	ent y	ears	ĺ		Ì			
ra	rticulars of work	Y cars	33	54	25	2	5	88	6	0	1	8	e S	4	3	37	8	39	4	4	4	4	4
	Planting									1													ļ .
4	Nursery raising																						
ω.	Weeding & Fertilizing																						
4.	Land rent		4	4	4	Q	4	40	40 4	ю 4	0 4	4	0 4	4	4	6	4	6	4	4	30	50	10
5.	Road Construction																						
6.	Road maintenance		4	4	6	4	6	4	4 0	4 10	Ó 4	4	4	4	4	6	4	4	4	4	30	50	10
7.	Establishment		6	4	4	1	,	40	4 0	10.4	0 4	4	4	4	4	6	4	4	6	6	30	50	10
<u></u> %	Depreciation of machinery	r																					
9.	Contingencies		50	20	20	20	20	50	20	50	2	2	8	0	000	5 0	я О	к О	й О	х 0	15	10	ŝ
			6	401	40 1	100	1 1 1	t0 17	10 14	14	0 14	14	0 14	14	0 14(14	14	5	5	[]	18	8	35
															•								
	х Х																						

ANNEXURE XXV

			- 70	• /0	♥/0	10
1	608	596	587	574	563	553
2	707	679	654	629	606	584
3	776	731	690	652	616	583
4	811	749	693	642	596	554
5	241	218	198	180	164	150
6	177	157	170	100	110	150
0 7	1/7	137	140	125	112	99
0	143	124	109	95	83	73
8	143	122	104	90	77	67
9	140		• •	х		
10	140					
12	140					
13	140					
14	140					
15	140	•		•		
10 17	140					
18	140			• •		
19	140					
20	140 ——	2748	1758	1167	801	566
21	140					
22	140					- 4
24	140	<u>.</u>		К. ш.		
25	140	,				
26	140					
27	140					
20	140					
30	140					
31	140			1		
32	140					
33	140					
35	140					
36	140					
37	140					
38	140					· · ·
39	140					
40	140)	1				
41	140	62	28	13	6	3
42	105	46	20	9	4	2
43	70	30	13	6	- 3	1
44	35	15	6	3	1	1

Discounted values of expenditure for raising bamboo plantations for 4 years--1ha./yr. at different

rates of interest

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ANNEXURE XXVI

 Discounted values of returns from bamboo plantations raised for 4 years—@ 1 ha./year—at different rates of interests

 Yield
 Royalty
 Years
 Returns
 2%
 4%
 6%
 8%
 10%

 rate
 per annum
 10%
 10%
 10%
 10%

····	rate		per annum	· · · · ·	· · · · · ·		<u> </u>	_ <u></u>
5-tons	Rs. 40/-	1 to 8 9 to 44	Rs. 200/-	 4250	2655	1728	1170	 971
	R s. 50/-	1 to 8 9 to 44	Rs. 250/-	5313	3319	2160	1463	1128
	Rs. 60/-	1 to 8 9 to 44	R s. 300/-	6375	3983	2592	 1756	1354
	R s. 70/-	1 to 8 9 to 44	R s. 350/-	 7431	 4645	2024	1948	1300
,	Rs. 80/-	1 to 8 9 to 44	Rs. 400/-	8501	5311	3456	2341	1942
8-tons	Rs. 40/-	1 to 8 9 to 44	Rs. 320/-	 6801	4249	2765	 1872	 1444
	Rs. 50/-	1 to 8 9 to 44	Rs. 400/-	8501	5311	3456	2341	1942
	Rs. 60/-	1 to 8 9 to 44	 Rs. 480/-	10201	6373	<u> </u>	2809	2166
	Rs. 70/-	1 to 8 9 to 44	Rs. 560/-	11901	7436	 4838	3277	2526
	Rs. 80/-	1 to 8 9 to 44	R s. 640/-	13602	8498	5530	3744	2888
10-tons	Rs. 40/-	1 to 8 9 to 44	Rs. 400/-		5311	 3456	2341	 1942
	Rs. 50/-	1 to 8 9 to 44	Rs. 500/-	 10626	 6639	4320	2926	2256
	Rs. 60/-	1 to 8 9 to 44	Rs. 600/-	12750	7966	5184	3511	2708
	Rs. 70/-	1 to 8 9 to 44	 Rs. 700/-	 14862	9290	 4048	3896	2600
	Rs. 80/-	1 to 8 9 to 44	Rs. 800/-	17002	10622	6912	4682	3884

ANNEXURE XXVII

Internal rate of returns from bamboo plantations raised-@1 hect./

year for 4-years

Yield	Royalty	Rs. 40/-	Rs. 50/-	Rs. 60/-	Rs.70/-	Rs.80/-
5 to 20			·	1 to 2	3 to 4	5 to 6
o-tons 8-tons		1 to 2	3 to 4	5 to 6	7 to 8	9 to 10
10-tons	a na an a	3 to 4	5 to 6	7 to 8	9 to 10	10 to 11

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ANNEXURE XXVIII

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ANNEXURE XXVIII contd.



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	· · · · · · · · · · · · · · · · · · ·		<u> </u>	R	ates of inter	est	
Year	Expenditure_		2%	4%	6%	8%	10%
1	608		596	585	574	563	553
2	707		679	537	629	606	583
3	776		731	698	652	616	583
4	811		749	693	642	596	554
5	846		766	695	632	576	525
6	881		782	6 9 6	621	555	497
$\overline{7}$	916		797	696	609	534	470
8	9 51		812	695	597	514	444
9	983		823	691	582	492	417
10	1018		835	688	568	472	392
11	1053	1. S. S.	847	684	555	452	369
12 miles	1088		858	680	541	432	347
13	1128	200	868	6/4	526	413	325
14	1108		8/8	009 657	512	394	305
15	1183		8/9	662	494	3/3	283
16	1248		909 470	229	491 244	504 170	130
10 IV	504		416	203	208	140	107
10	560		-10	275	200	147	107
20	560						
20	560					Т. Т.	
$\frac{1}{22}$	560						
$\overline{23}$	560						
24	560						
25	560						
26 1 1 1 1	560						·· ·
27	560				<i></i>		
28	560	•	7020	20.40	0077	1246	017
29	560		- 7038	3949	2211	1540	015
50 31	560						
32	560						
33	560						
34	560				-		
35	560						
a x x a 36 a a a x x x	560						
37	560						
38	560						
39	560						
40	560						
41 42	525		229	101	45	21	10
42	490		209	91	40	18	8
44	455		190	81	35	15	7
45	420		172	72	31	13	6
46	385		155	63	26	11	5
47	350		138	55	23	9	4
48	315		122	48	19	8	3
49	280		106 -	41	10	0	· · · · · · · · · · · · · · · · · · ·
50	245		91 76	<i>3</i> 4 20	15	5 1	ے 1
51	210		/0 62	28 23	11 8	4	1
52 53	140		<u>4</u> 9	23 17	6	2	
55	105		36	13	4	$\overline{1}$	
55	70		24	8	2	1	_
56	35		12	4	1		
	· · · · · ·		22404	.15960	12234	9742	8019

ANNEXURE XXIX	
Discounted values of expenditure for raising bamboo plantations for 16 years @	1 ha./year at different rates of interest.

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ANNEXURE XXX

Yield	Royalty rate	2%	4%	6%	8%	10 %
	Rs. 40/ton	15191	3898	4995	3120	1992
	Rs. 50/ton	18988	10496	6244	3902	2491
5 tons/ha.	R s. 60/ton	22785	1 259 7	7491	4682	2989
	R s. 70/ton	26584	1 469 6	8741	5460	3846
- - -	R s. 80/ton	30381	167 9 5	999 0	6243	3 9 88
· · · · · · · · · · · · · · · · · · ·	- - -	- 		<u></u>		
•	Rs. 40/ton	24304	13437	7 99 1	4995	3187
	Rs. 50/ton	30381	1 679 6	9990	6243	3988
8 tons/ha.	Rs. 60/ton	36456	20154	11988	7514	4784
	Rs. 70/ton	42538	23511	13986	8740	5579
	R s. 80/ton	48608	26874	1 59 82	9 99 0	6374
	R s. 40/ton	30382	1 679 6	999 0	6240	3988
1	Rs. 50/ton	37976	20992	12488	7804	4982
10 tons/ha.	Rs. 60/ton	45570	25194	14982	9364	5978
	Rs. 70/ton	53168	29392	17482	10920	6972
	R s. 80/ton	60762	33592	1 99 80	12486	7 9 76

Discounted values of returns from Bamboo Plantations raised for 16 years @ 1 ha./year at different rates of interests

ANNEXURE XXXI

Internal rate of return from Bamboo Plantations raised at 1 hect./year for 16 years.

		Royalty/	on			
	Yield Tons	Rs. 40/-	Rs. 50/-	Rs. 60/-	Rs. 70/-	Rs. 80 /-
						
	5	· · · · · ·		1 to 2	3 to 4	4 to 5
	8	2 to 3	4 to 5	5 to 6	6 to 7	8 to 9
	10	4 to 5	5 to 6	6 to 7	8 to 9	9 to 10

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ANNEXURE XXXII

Total delivery cost to mill site for different royalties and heads. Eucalyptus

Distance 50 Km. 75 Km. 100 Km. 125 Km. 150 Km Royalty 40 86 88 104 112 136 50 96 98 114 122 146 60 106 108 124 132 156

ANNEXURE XXXIII

Total delivery cost to mill site for different royalties and leads. Bamboo

Distance in Rs. Royalty	50 Km.	75 Km.	100 Km.	125 Km.	150 Km.
40	100	110	120	140	140
50	110	120	130	150	150
60	120	130	130	160	160
70	130	140	150	170	170
80	140	150	10	180	. 180

YieldRoyaltyBenefit/Cost
Ratio40.3850.485-tons60.58

	50	.48
5-tons	60	.58
	70	.64
	80	.75
n	40	.62
м	50	.75
8-tons	60	.93
	70	1.08
	80	
	40	.76
	50	.96
10-tons	60	1.16
	70	1.28
	80	1.50

ANNEXURE XXXVI

Yield

ANNEXURE XXXIV

Benefit-Cost Ratio for different yields and royalties for Eucalyptus Model at 8% discount rate. Benefit-Cost Ratio for different yields and royalties for a 16-year Bamboo Model at 8% discount rate.

Royalty

					Ratio
Yield	Royalty	Benefit-Cost	· · · · · · · · · · · · · · · · · · ·	40	.35
		Ratio	· ·	50	.40
50-tons	40	0	5-tons	60	.48
	50	.9		70	.56
	60	1.1		80	.70
60-tons	40	1.04	• • • • • • • • • • • • • • • • • •	40	.51
	40 50	1.04	8-tons	50	.70
	50	1.5		60	.76
	60	1.0		70	.89
70-tons	40	1.3		80	1.02
	50	1.6		40	.70
	60	1. 9		50	.80
100-tons	40	1.8	10-tons	60	.90
	50	2.2		70	1.12
	60	2.7		80	1.28

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Ben fit/Cost

ANNEXURE XXXV

Benefit-Cost ratio for different yields and royalties for 4-year Bamboo Model at 8% discount rate.