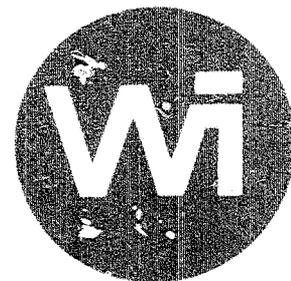


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**FINANCIAL ANALYSIS OF  
DIFFERENT TREE CROPS IN PAKISTAN**

by

***K.M. SIDDIQUI***

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## LIST OF ABBREVIATIONS

mm	millimeter(s)
cm	centimeter(s)
m	meter(s)
m <sup>3</sup>	cubic meter(s) foot
Rs.	Pakistan Rupees (1 US \$ = Rs.24.65 <sup>1</sup> )
e.g.	for example
etc.	etcetera
ha	hectare(s)
ac	acre(s)
IRR	internal rate of return
kg	kilogram(s)
km	kilometer(s)
%	percent
o	degree(s)
C	centigrade
Cv	Cultivated variety
annum	year

## EXECUTIVE SUMMARY

This report presents, among other things, results of financial analyses for 8 types of tree plantations in different parts of Pakistan. Financial analyses have been carried out for 5 multiple purpose tree species planted in the form of both linear and block plantations in the irrigated plains of the country on state as well as private farmlands. The plantations extend from Peshawar and Mardan districts in the extreme north to Hyderabad district in the extreme south. Therefore, physical, social and economic conditions vary considerably through out the tract dealt within this report.

The results of financial analyses indicate that benefit cost ratios of above plantations under the existing conditions depend upon the tree species, demand and marketability of forest produce and intensity of working. Generally, tree planting on farmlands, be it poplar, shisham or babul and irrespective of locality has a favourable impact from financial point of view. On the other hand, large block plantations on state land, with the exception of poplar in Changamanga, have low cost benefit ratio especially when rental value of the land (opportunity cost) is included in the analyses. This value is highly variable in different localities.

It would be inappropriate to conclude from the analyses of this report that large block plantations on the state land in the Punjab and Sindh provinces of Pakistan are not financially sound undertakings. Rather, the results point out the fact that management practices in these plantations have to be streamlined and intensified. This is especially needed in the riverain forests and plantations in Sindh province, wherein, present working is not intensive at all. Consequently, the economic investment and returns are very low. These forests and plantations represent a big economic resource and need to be developed on a sound basis to ensure not only economic benefit to provincial exchequer but also social benefits to population living in their vicinity.

Indirect or social benefits of the tree plantations to the people have only been briefly mentioned in the case of Changamanga plantation. Detailed social and economic analyses could not be done as these were beyond the scope of this report. However, these need to be undertaken urgently because future investment in forestry sector in a developing country like Pakistan depends upon their results. Local foresters, all too often, have been stressing the role of forestry in social and economic development without supporting it with adequate data base. The data in this regard are totally lacking. Studies should be carried out through local manpower resources with the financial assistance of international organizations such as FAO.

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## INTRODUCTION

### Physiography

The total area of Pakistan is 87.98 million hectares. It lies between 24-37° north latitude and 61.75° east longitude. The country can be divided into 3 distinct physical regions; the northern and north-western mountainous region, the Indus basin and the coastal region. The mountainous region is the termination of the great Himalayan Range and has a number of peaks well above 6000 m from sea level as well as an extensive sub-mountainous tract of valleys and plateaus. Further, more than 60% of land area is mountainous and sub-mountainous.

The Indus basin is the western part of the Indo-Genetic plain which is formed by alluvial deposition of river Indus and its tributaries. The culturable area of the plain is 31.82 million ha, of which 20.15 is cultivated. An extensive system of irrigation exists for cultivation of agricultural crops on 11 million ha. However, a substantial part of the irrigated plain has become waterlogged and/or saline due to poor drainage.

The coastal zone is a narrow fringe bordering the Arabian sea and consists of Indus delta, Runn of Kutch and the swamps.

### Climate

Pakistan has a variety of climatic conditions, ranging from marine tropical coastlands to alpine, due to its geographic position and physiography of terrain. However, arid climate prevails over more than 70% of area. This in turn also affects distribution of forest types in the country. These are; alpine and sub-alpine forests, dry and wet temperate forests, dry and wet sub-tropical forests, dry tropical forests and littoral and swamp forests. Some forests grow on river banks. A large number of plantations have been established in irrigated tracts of the Punjab and Sindh provinces. The area of individual irrigated plantation varies from few hundred ha to few thousand ha. On the whole, the

forest represent a small and dispersed wood resource.

### Forests of Pakistan

The forests cover only 4.27 million ha or 4.8% of the total area of Pakistan. For a population of 110.76 millions, the per capita forest area is only 0.04 ha. The proportion of production (commercial) forest is even smaller - 26.2% of the total forest area or 1.12 million ha. The biggest timber resource of Pakistan are the coniferous forests in the north and north-west hilly region. These forests are over an area of 1.93 million ha and about half of these are production forests. Other timber producing forest areas are in the plains; irrigated plantation, 0.2 million ha and riverain forests, 0.3 million ha. The non-productive forests in the hills and plains are the scrub forests (1.3 million ha) and coastal forests (0.35 million ha) respectively<sup>1</sup>.

### Forest Management

Significant forest extension has not occurred in Pakistan in more than four decades inspite of best intentions on the part of the government and people. This is mainly due to low priority of forestry sector in the national economy and concomitant resource constraint. The importance of forests especially for the protection of the watershed in the hilly regions is not generally recognized, though both agriculture productivity and power generation mostly depend upon their sustained water supplies in the rivers. At the same time the natural forests and plantations in the country have considerably depleted in growing stock over the years due to cutting for fuelwood and timber by increasing population. Developmental efforts to improve the situation have been meager,

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<sup>1</sup> Amjad, M. and Nadar Khan 1990. The State of Forestry in Pakistan. Forest Economics Branch, Pakistan Forest Institute, Peshawar. 77 pp.

scattered and patchy. However, there are some noteworthy exceptions to this situation. Most of the productive forests and plantations are managed through management plans by the locally trained manpower. Pilot programmes of intensification of management of natural coniferous forests, irrigated plantations and riverain forests have been started. Promotion of tree growth on farmlands in some localities has been successfully carried out through farm forestry programmes by the foresters and research scientists. This has gone a long way in meeting the timber and fuelwood requirements of a large section of total population.

### Timber Production

Timber production from the forest areas managed by the forest departments, was 482,00 m<sup>3</sup> during 1988-89. Of this 353,000 m<sup>3</sup> were coniferous and the rest 129,000 m<sup>3</sup> hardwood timber. The production of fuelwood was 234,000 m<sup>3</sup> during the same period; the major producers of fuelwood being irrigated plantations and riverain forests in the plains of Punjab and Sindh provinces. A number of minor forest products were also extracted from the forests. Their production during 1988-89 was; 3,818 tonnes of raw resin, 37,500 tonnes of Mazri (dwarf palm) leaves and 1,245 tonnes of Ephedra drug plant.

The production of timber and fuelwood from state-controlled forests is not sufficient to meet the needs of the entire population of Pakistan. The current annual consumption of timber is estimated to be 2.65 million m<sup>3</sup> on the basis of annual per capita timber consumption of 0.0239 m<sup>3</sup> and a population of 110.76 million. The demand is met from the following sources:

Source	Quantity (000 m <sup>3</sup> )	%
1. State forests	482	18.2
2. Imports	1,243	47.9
i. Timber round & sawn	158	
ii. Wood based pulp and paper and panel products (round wood equivalent)	1,085	
3. Farms & wasteland (by difference)	922	34.8
	2,647	100

During last seven years, the value of imports of wood and wood products have risen threefold from Rs.1387.0 to Rs.3284.2 millions (1 US \$ = Pak. Rs.25.0). About 93.0% of this amount was spent on import of pulp and paper. On the other hand, the value of exports of wood based products increased only modestly from Rs.315.0 to Rs.400.0 millions during this period. The sports goods accounted for 90% of the exported products.

On the basis of per capita consumption of 0.2 m<sup>3</sup>, the current annual demand for fuelwood is 22.15 million m<sup>3</sup>. The entire demand for fuelwood is met from indigenous sources, the recorded production from state controlled forests being only 0.4 million m<sup>3</sup> per annum. The balance of the supplies come from unrecorded sources including removals from farmlands and wastelands.

#### Wood Industries

In view of meager forest resource, wood-based industries are few and have limited production. These are sports goods,

chipboard, hardboard, veneer, plywood and safety matches. There is no pulp and paper manufacturing facility based on indigenous wood resource because of shortage and high cost of woody raw material. The sports goods manufacturing is a cottage industry and is export-oriented. There are only 50 factory scale manufacturing units. The average annual local production of chipboard is 36,230 tonnes, of hardboard 10,000 tonnes, of veneer 287,200 m<sup>2</sup>, of plywood 831,600 m<sup>2</sup>, of paper and board 65,457 tonnes, and 2,490.8 million boxes of safety matches.

## SILVICULTURAL CHARACTERISTICS OF TREE SPECIES

The reports deals with 5 economically important trees species which are commonly planted in Pakistan. Their characteristics are briefly described below:

1. Dalbergia sissoo, Roxb.

Family: Leguminosae, sub-family. Papilionaceae

Common names: Shisham, sissoo, tali.

Shisham is a large deciduous tree with a light crown. It has 1 to 1.4 cm thick grey and furrowed bark. In favourable localities, it reaches considerable dimensions. However, the stem growth is somewhat crooked and straight logs of any great length are difficult to obtain. Shisham furnishes one of the most important timbers in India and Pakistan and gives excellent fuel. The leaves are also used as fuel in rural areas when these are shed in late autumn. The heartwood is brown with darker streaks, very hard, strong and durable. Sapwood is whitish in colour and highly perishable and readily attacked by powder-post beetles. Heartwood is used for building, furniture, carts and carriages, carving and a large number of other purposes. It is extensively planted in Pakistan in the form of single tree, village woodlot, and linear and block plantations.

Distribution: Shisham is found throughout the sub-Himalayan tract from the Indus to Assam and in Himalayan valleys usually upto 1000 m elevation, but sometimes ascending to 1500 m elevation<sup>2</sup>. It descends the rivers for some distance into plains. It is extensively cultivated or self sown in plains of India and Pakistan. Shisham exhibits best growth on alluvial soil in river

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<sup>2</sup> Troup, R.S.1921. The Silviculture of Indian Trees. The Clarendon Press, Oxford, England. 294-318

beds throughout its natural range. In contrast, it grows in the form of straggling bush at an altitude of about 1500 m in northern districts of Pakistan. It is also found extensively in pure stands or with associates in Burma, Nepal, Afghanistan and Iraq. The species has also been grown in U.S.A. and Sudan, Nigeria and Gold Coast in Africa<sup>3</sup>.

Silvicultural characters: Shisham is a strong light demander; in the dense crops which it often forms the more vigorous trees tend to suppress and kill out the weaker ones. It is frost hardy. However, the leaves are sometimes affected by sever frost, but the tree is not seriously injured. The seedling are sensitive to drought, but in its natural state, the tree is fairly hardy. In irrigation plantation of Pakistan, the trees die if water supply is cut off for long length of time. It requires light and well-drained soil for its proper development. Of fungal pests, Fomes lucidus is the cause of much mortality in the plantations.

Shisham reproduces both naturally and artificially very easily through seed, coppice shoots and root suckers. The most common method of planting shisham is by root-shoot cuttings (stump). In the irrigated plantation of Pakistan, it is grown as a pure crop or mixed with mulberry. Stump planting is done to supplement coppice regeneration. On a rotation of 20-22 years with standards of 44 and 66 years age, the average annual yield was 6.5-13.0 m<sup>3</sup>/ha of timber and fuelwood<sup>3</sup> during early years<sup>3</sup>. Currently it is estimated to be only 0.35 m<sup>3</sup> of timber and 3.5 m<sup>3</sup> of fuelwood<sup>4, 5</sup>.

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<sup>3</sup> Haq, Riaz-ul-. 1985. Monograph on Dalbergia sissoo Roxb. (Shisham). Forest Education Division, Pakistan For. Inst. Peshawar.

<sup>4</sup> Siddiqui, K. M. et al. 1979. Results of 10 year old Eucalyptus camaldulensis Dehn. provenance study at Peshawar. Silvae Genetica, 28(1): 24-26

2. Morus alba, Linn. White mulberry.

Family: Moraceae

Common name: Tut.

A moderate-sized deciduous multipurpose tree. The leaves are very variable and there are many distinct varieties of the tree cultivated or growing naturally in different countries. Leaves are used for silkworm rearing in Pakistan and elsewhere in the world. It is also cultivated for its fruit which is white or red in colour. The wood is yellowish brown, of good quality and is used for boats, furniture, turnery articles, hockey sticks, and other sporting goods. Young branches are used for basket making.

**Distribution:** Mulberry is cultivated in Europe, western, central and far-eastern Asia, China and Japan. It is cultivated throughout Pakistan as a multipurpose tree by farmers. In the irrigated plantations of Punjab which have fair supply of water e.g. Changamanga and Daphar, the species has become invasive and constitutes upto 80% of growing stock. It is spread through birds and irrigation water.

**Silvicultural characters:** Mulberry grows best with a certain amount of shade as an under-storey of shisham in the irrigated plantations of Punjab. It is short-lived, growing rapidly but soon becoming hollow. It is also frost hardy. The trees are liable to be thrown by wind. When grown as a single tree in the open the tree tends to be short-boled and branchy.

As mentioned above, it has spread in irrigated plantation of Punjab through water and birds. The tree is also very easily raised by seed or cuttings. The tree coppices very well. The tree

is grown for variable number of years depending upon the ultimate use. For production of leaves, pollarding is started after 3 - 5 years of growth. Otherwise it is grown on a rotation of 20 years for timber. The average annual growth is 7-8.5 m<sup>3</sup>/ha in the irrigated plantation<sup>6</sup>.

### 3. Acacia nilotica Syn. Acacia arabica, Willd.

Family: Leguminosae, sub-family, Mimoseae.

Common names: Kikar, babul, babar.

A moderate-sized almost evergreen tree with a short trunk, a spreading crown, and feathery compound leaves. Its bark is dark brown. Stipular spines are present on branches. Three varieties of species are commonly recognized<sup>7</sup>; (1) The typical tree has spreading shady crown and moniliform pods. This is telia babul, the wood of which is much prized: this variety is economically important and extensively grown in natural forests and plantations. (2) Variety Kauria babul has a short bole and flat pods. The crown is more spreading. The wood is fit only for firewood and therefore, not grown commonly. (3) Variety cupressiformis or ramkanta babul or kabuli kikar. This variety is recognized by its broom-like (cupressiform) ascending branches: the stem is tall and the branches are thin.

Acacia nilotica is economically most important tree in dry plains of India and Pakistan. The sapwood is whitish and large: the heartwood is pink, turning reddish brown on exposure, hard and very durable if well seasoned. The wood is used for pit props, building, carts, agricultural implements, boat building, etc. It is

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<sup>6</sup> Nazir, M. and R. M. Zarif. 1974. Most efficient mixture of shisham and mulberry in irrigated plantation. Pakistan Jour. For. 24 (2): 374-382

<sup>7</sup> Siddiqui, K. M. 1975. Genetic improvement of babul Acacia arabica, Willd. for high growth rate and frost resistance. Pakistan Forest Institute, Peshawar.

an excellent fuel. The bark is extensively used for tanning leather. Pods, twigs and leaves constitute fodder for cattle, goats and sheep. Thorny branches make fencing material for farms. Lac is grown on trees in Sindh. It is truly a multipurpose tree.

**Distribution:** It is probably indigenous to Sindh province in Pakistan and Central parts of India. Though the species is frost tender, still, it is cultivated or self sown in almost all drier region of Pakistan, including the northern districts where frost is quite severe and common. It does not extend into hills. The species is also found in many countries of West Asia and Africa.

**Silvicultural characters:** Babul is characteristic of dry regions but will not thrive without irrigation if the climate is too arid. In regions of low rainfall in Sindh, however, the existence of the tree is rendered possible only by river inundations. The two commonest types of soil on which the babul occurs are riverain alluvium subject to inundations and black cotton soil. The capacity of the babul to grow on saline soil appears to depend on the presence of a considerable amount of moisture in the soil.

Babul is a gregarious tree, forming crops which are pure or in which it is usually the prevalent species. It is a strong light demander and the crops come up in even-aged groups or patches of varying extent. It is naturally regenerated or cultivated easily by seed. The coppicing power of babul varies greatly. The species is fast growing and is worked on a rotation of varying number of years from 10 to 30 years depending upon the end use of the wood. The average annual growth is estimated at 12.1 m<sup>3</sup>/ha.

#### 4. Eucalyptus camaldulensis, Dehn.

Family: Myrtaceae

Common names: River red gum in Australia. Sufaida, Ilaichi in Pakistan.

It is native of Australia where it is most wide-spread on

the mainland. It is also one of the first species of eucalyptus to be planted overseas. Its introduction in Pakistan was in 1867<sup>8</sup>.

Euc. camaldulensis is very large evergreen tree, whose trunk is usually not straight. Its bark is red-gum type, thick, smooth and patchy. The wood of trees grown in Pakistan is light grey sapwood and reddish brown heartwood. It is lustrous, hard and heavy with twisted and interlocked grains, medium coarse and somewhat even textured<sup>9</sup>. It is the most important inland hardwood in Australia; valuable for purposes varying from honey production through shelterbelts, to sawn wood. It is also an important sleeper timber and produces excellent charcoal. Wood grown in Pakistan is good for pulp and paper, fence posts, fiberboard and particleboard, and after careful seasoning gives good house and office furniture, rural house construction, firewood and charcoal<sup>10</sup>.

Distribution: As mentioned above, it is the most wide spread species in its native habitat in Australia; found in all states except Tasmania within latitudinal range of 15.5 to 38° S. It has been introduced into many countries of Asia (including Pakistan), Africa, North and South Americas and Europe during second half of last century. Presently, it is widely planted and the area of plantations of Eucalyptus camaldulensis in these countries and wood production is more than that of its natural forests in Australia.

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<sup>8</sup> FAO. 1979. Eucalyptus for planting. FAO, Rome, Italy: 369-81

<sup>9</sup> Siddiqui, K. M. et al. 1986. Properties and uses of Pakistani timbers. For. Prod. Res. Div., Pakistan For. Inst. Peshawar, Pakistan: 47-8.

<sup>10</sup> Siddiqui, K. M. et al. 1984. Eucalyptus camaldulensis, Dehn., its growth properties and utilization. Bull. No.4 For. Prod. Res. Div., Pakistan For. Institute, Peshawar. 21 p.

**Silvicultural characters:** In its natural habitat, it grows under a variety of ecological conditions including in summer and winter rainfall areas as well as temperatures range of low to high. The species is almost confined to ecological situations associated with water courses, hence, the name of River red gum. Because of large natural range of distribution, it shows great deal of diversity in its morphological features<sup>11</sup>. This is partly due to interspecific hybridization in places in Australia where introgression of E. camaldulensis with other species has occurred in the past. It is also frost hardy and light demander. The best growth is observed in Pakistan on exposed and disturbed sites, especially during early years of planting.

The species is extensively planted in the form of linear and block plantations with or without artificial irrigation in arid plains of Pakistan. Generally, 6 months to one-year plants are raised in plastic containers in the nursery. Though it coppices very well, still, this method of regeneration is not practiced. Because of genetic diversity within the species and/or impurity of seed, the tree crop of the species is not uniform. The yield of the species is variously reported to be 15-20 m<sup>3</sup>/ha/annum.

5. Populus x euramericana, (Dodi) Guinier.

Family: Salicaceae.

Common names: Poplar, Safaida .

Populus x euramericana is the name given to cover all the hybrid cultivars derived from P. deltoides and P. nigra<sup>12</sup>. The hybrids of this group have been produced spontaneously ever since

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<sup>11</sup> Pryor, L.D. 1967. Past performance and future prospects for the use of Eucalyptus in Pakistan. Pakistan Forest Institute, Peshawar. 19 p.

<sup>12</sup> FAO. 1979. Poplars and willows in wood production and land use. FAO, Rome, Italy.

the American poplars were introduced into Europe in 1700s. Numerous clones of this group have been tested at Institute of Casale Monferrato in Italy and introduced in many countries of the world. One of the outstanding clone of this Institute e.g. Populus x euramericana Cv-I-214 has been successfully introduced over large areas in Pakistan since mid-sixties. The growth of this cultivar has been found to be quite high, especially in the northern districts. Later on, however, insect attack on poplar trees was observed. Amongst insects, attack of defoliator (Ichthyura anastomosis) and borer (Aegeria sp.) was quite common and serious. Therefore, attempts are currently being made to replace P. x euramericana planting with different clones of P. deltoides of North American origin which are not only non-susceptible to insect attack but can also withstand hot and dry climate.

No distinction is made in this report between different varieties or clones of exotic poplars which are presently planted in Pakistan. The major use of all poplar wood in the country is manufacture of matches<sup>13</sup>. Its other uses are packing cases, sports goods, rural construction, particleboard and fiberboard. The sapwood is almost white and thick, heartwood light grayish brown. Wood is lustrous, soft and light. Grain straight, fine and even-textured. The strength properties of P. deltoides are higher than those of P. x euramericana<sup>14</sup>.

Distribution: As stated above, P. x euramericana of Italian origin has been introduced in Pakistan. On the other hand, the natural range of P. deltoides, Marsh. extends from the Atlantic Ocean to the great plains of the west of North America with latitude of 30 to 50°N. It constitutes gallery forests on the

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<sup>13</sup> Sheikh, M. I. 1985. Poplars and willows in Pakistan. Pakistan Forest Institute, Peshawar. 97 p.

<sup>14</sup> Siddiqui, K. M. and J. A. Khan. 1984. Anatomical, physical and mechanical properties of exotic and indigenous poplars grown in Pakistan. Bull. No.6. For. Prod.Res.Div., Pakistan Forest Institute, Peshawar. 53 p.

alluvial flats of the valleys of the Mississippi river and its tributaries.

Silvicultural characters: Populus x euramericana Cv. I-214 has great adaptability to a variety of ecological conditions and exhibits extremely rapid growth. Because of fast rate of growth, it tends to develop big branches which have to be controlled by careful pruning. Though it is light demander, it is sensitive to influence of side light. It thrives on well-drained loamy soil with sufficient moisture supply. Unlike P. deltoides clones, it can be easily propagated by cuttings. The cultivar has well developed deep root system for efficient water uptake from the soil.

Plants for field planting are raised in two stages in the nurseries. In the first stage nursery, cuttings of one-year-old plants are planted at a spacing of 7.5 cms x 0.5-1 m for one year. The stock from first stage nursery is used for raising second stage nursery. The root-shoot cuttings and two cuttings from proximal end of the stem are made from one-year-old plants. Rest of the stem is made into cuttings for raising more of the first stage nursery. The spacing in second stage nursery is 1 m x 1 m. As several shoots are generally thrown out from each cutting, these are removed except the one which is most vigorous and sturdy. One-year-old plants of second stage nursery are used for field planting. Farmers in N.W.F.P. plant cuttings directly on their farm lands and grow trees for 5-8 years only. In irrigation plantation of Punjab, the rotation is 11 years. The average annual yield is estimated at 12.7 m<sup>3</sup>/ha.

## FINANCIAL ANALYSIS TOOLS IN FARM FORESTRY

The main role of an investor be it a farmer, forester or a businessman is decision making choosing among alternative courses of actions. Successful investors are usually those people who correctly identify relevant goals, issues and resource limitations and come up with alternative solutions that are workable and beneficial.

Virtually farm forestry actions involves investing in land, wood or some treatment and then waiting several years for all the benefits to be realized. Spending say Rs.1000/- per hectare to plant a 5 ha farm and then waiting for 10 years to harvest and sell the mature trees for say Rs.10,000/- per ha may be a good hypothetical example. Here two resources, Rs.1,000/- of capital and 5 ha of land are tied up and used for 10 years to produce the expected yield of Rs.50,000/-. It costs money to use such resources over time and the rent or price paid per unit time is measured by the interest rate or the price of money. This lead us to some form of economic/financial decision making.

Some people are born with a certain flair for business and appear to be able to make the right decision by instinct. Many of the most successful entrepreneurs can do this but they are only few such people. Most people need some sort of help and guidance in coming to the right decision to give them greater confidence. In making a decision it is helpful to have a "criterion" or "yardstick" against which to measure alternative courses of actions. Economist use financial tools to help them arrive at most possible right conclusions. The following paragraphs provide different techniques and how these could be used by interested users, farm foresters and students.

It is worth mentioning that correct decision making by using these tools solely depends upon correct available information: suspect information will provide suspect decisions. Extreme care has to be used in ensuring that only the best and most accurate information is used. These aids help to make a decision

but is not a decision in itself. It is the human judgement which counts in the long run.

## TECHNIQUES OF ANALYSING INVESTMENTS

Financial and economic analysis of investments requires the synthesis of many techniques. The primary process is the weighing of benefits against costs. The time stream of benefits and costs are considered and weighted in order to compare alternatives and to achieve given objectives. Various criteria are used to decide the investments e.g., Net Present Value, Benefit-Cost Ratio, and Internal Rate of Return.

Before discussing these criteria let us first discuss the idea behind the time value of money. A folk proverb, "a bird in hand is worth two in the bush", clearly recognizes that present values are better than the same value in future and earlier returns are better than later returns. This leads us to the time dimension in our evaluation through the use of discounting. Discounting is essentially a techniques by which one can reduce future benefits and costs to their present value. The computation requires specifying a discount rate from which a discount factor may be determined. A discount rate is a percentage rate (usually annual) which equates the present and the future value of a payment. A discount factor is a fraction of present worth of one monetary unit spent or received.

Establishing the discount rate is a theoretically complex and practically difficult chore. It may be based on the long term market interest rate on relatively safe investments. eg. government bonds or investment securities after taxes. It may also be estimated from the opportunity cost of capital say 'bank loans'. In most developing countries it is assumed to be between 8 and 15 percent. A 14% discount rate has been assumed in this report for the purpose of comparison. From academic point discount (interest) rate is composite of three elements:

1. Pure rate: This is the risk free cost of money over time or it is the long term cost of government borrowing through issue of bonds under full employment and no inflation.

2. Inflation rate: A rupee paid back in the future will not

buy as much as it will today so an inflation factor is added to rate charged.

3. Risk rate: Uncertain future carries financial insecurity. This could be variable and will depend upon type of investment venture.

Therefore the guiding rate is summation of pure rate, inflation and risk rate. A simple 14% rate may consist of 6% pure, 6% inflation and 2% risk rate. It may be pointed out that simple addition of discount (interest) rate is not exactly correct. They need to be multiplied as  $(1.06)(1.06)(1.02)=1.1461$  or 14.61%.

In forest investment the guiding rate is something debatable. It is a matter of policy and politics in public investment and plans set out by the Planning Commission. For businesses that must actually borrow money, the current market determines the rate and for individuals or small landowners using their own time and funds, the rate is determined by each person's time preference for money: how much they discount the future and their alternative uses of time and capital resources.

#### Net Present value

Net present value (NPV) measures investments, financial and economic viability in a cash flow analysis by taking into account a time preference for money and is determined from the discounted cash flows. Alternatively computing the difference of investments from discounted annual increment benefits and discounted annual incremental costs gives the net present value. It reduces benefits and costs occurring at different times to a comparable basis: the equivalent value to-day. This permits comparisons between alternatives and provides a decision rule for an investment entity. Mathematically it can be measured as follow

$$\sum_{t=1}^{t=n} \frac{B_t - C_t}{(1+i)^t}$$

where 'B<sub>t</sub>' is the benefit in each year and  
 'C<sub>t</sub>' is cost in each year,  
 't' goes from 1.2...n  
 n= number of year in the investment horizon.  
 i= Discount (interest) rate.

Economist are somewhat inconsistent in their terminology for this measure. It is often referred to as the net present worth (NPW). To calculate the net present value requires determination of the appropriate discount rate discussed earlier. The technique to calculate NPV alongwith other criteria has been illustrated from various examples of irrigated farm plantations in the country. A positive NPV will earn more than the guiding rate on invested funds and other things being equal, and would be an acceptable investment. If more than one investment alternatives are under consideration, then the one with the highest NPV would be the best choice.

#### Benefit-cost Ratio

It is the ratio of investment benefits to investment cost to evaluate the efficiency of resource utilization. It reduces the investment decision to a single number for ranking different investment alternative and choosing amongst them one with the highest ratio.

The benefit-cost ratio is an index that says something about the relative productivity of each rupee spent. Like NPV its calculation depends on knowing the appropriate guiding interest rate.

Mathematically it can be calculated as under:

$$\frac{\sum_{t=1}^{t=n} \frac{Bt}{(1+i)^t}}{\sum_{t=1}^{t=n} \frac{Ct}{(1+i)^t}}$$

where the symbols have the same meaning as before.

A benefit-cost ratio greater than one means that the investment benefits exceeds investment costs when discounted by the opportunity cost of capital. The size will reflect efficiency of investment. If the ratio is less than one then investment may not be carried out. Incidentally economists are again inconsistent in their use of benefit-cost ratio. Sometime they say 'Cost-Benefit Ratio'. However in present report the calculated ratio is benefit/cost.

#### Internal Rate of Return (IRR)

Internal rate of return is a criterion for analysing projects based on the percentage return on investments for evaluating the financial (and economic) advantages of a single investment. It is the discount rate at which the present value of the net incremental benefits is exactly zero. Since this cannot be solved analytically we are forced to resort to a systematic procedure of trial and error to find the discount rate which will make the net present value of the net incremental benefit stream equal zero. It can also be calculated by graphical method plotting discounted revenue both positive and negative against different discount rates.

Theoretically it is the discount rate (i) such that:

Where symbols have the same meaning as before

$$\sum_{t=1}^{t=n} \frac{Bt - Ct}{(1+i)^t} = 0$$

IRR is usually calculated by interpolation, iterative or formula method. The iterative is very tedious and laborious and only by luck one can reach at exact IRR. Formula method though simple has limited applicability. Most economists use interpolation wherein successive value of discount rate which will make NPV positive and negative are arrived at and IRR will lie somewhere in-between. Interpolated value is calculated by the followings formula:

$$\text{IRR} = \text{lower 'i'} + \frac{(\text{upper 'i'} - \text{lower 'i'}) \text{NPV at lower 'i'}}{\text{NPV at lower i} - \text{NPV at upper 'i'}}$$

Where 'i' is the assumed discount rate. When there are no intermediate costs and return it can also be calculated by the following formula.

$$\text{IRR} = \left( n \sqrt{\frac{\text{Revenue}}{\text{cost}}} - 1 \right) \times 100$$

However, in practice seldom there exist any project activity without interim revenue and expenditure over the whole life investment. It may also be noted that an internal rate of return of a series of values such as a cash flow can exist only when at least one value is negative. If all values are positive, no discount rate can make the NPV equals zero. No matter how high the discount rate, the net present value of a series would have to be positive if it include no negative number. Certain types of

agroforestry activities might fall into this category of investments.

## POPLAR PLANTING IN PESHAWAR AND MARDAN DISTRICTS

The districts of Peshawar, Charsadda and Mardan lie in the eastern part of N.W.F. Province of Pakistan. Their total area is 850,565 ha, of which, 46% or 391,725 ha are irrigated by a network of canals. The cultivated area is however, less than the irrigated area, e.g., 346,431 ha or 40% of the total area or 88.4% of the irrigated land.

The climate of the area varies from semi-arid to sub-humid. Annual rainfall ranges between 400 to 750 mm and mean annual temperature between 10.5 to 32.8°C. In the hottest months of June and July, the maximum temperature may rise to 40 to 44°C. December and January are the coldest months with minimum temperature of 1.7 to 2.8°C. Humidity is high during July and August.

The soil of these districts consists of fine alluvial deposit, which varies in depth in different localities. It is light, porous and composed of even mixture of clay and sand. Its pH is more than 8 and it is rich in calcium. Due to absence of adequate drainage, soil in parts of these districts has become waterlogged and saline.

The principal agricultural crops are sugarcane and maize during 'Kharif' season (May to October) and wheat, tobacco and sugarbeet during 'Rabi' season (November to May). Sugarcane, sugarbeet and tobacco are the leading cash crops, while, wheat and maize are the major food crops. Vegetables are comparatively of less importance, but are grown on fairly large area. Fruit orchards of apricot, plums, pears, peaches, etc., are also common in this region.

#### Poplar planting

Poplar planting on farmlands has been practised in these districts for centuries. Earlier, Populus nigra, Linn., was planted on fairly large scale by the farmers in this area for local use as fuelwood, and for rural construction. However, as mentioned before,

first exotic poplar cultivar Populus x euramericana I-214 in mid sixties and subsequently P. deltoides clones in late seventies were introduced in this region. A number of social and economic factors led to the widespread planting of these poplars by the farmers. Firstly, exotic poplars exhibited very good growth and their wood found ready market in the newly established match factories in Punjab and N.W.F.P. provinces. The farmers could grow it on short rotation of 5-8 years and sell a tree of 20-25 cms diameter for Rs.100. Further, the problems of land tenancy in the area in early seventies also boosted poplar planting. Hundreds of thousands poplar plants are grown by the farmers every year<sup>15</sup>. A recent survey shows that the number of trees growing on the farmland is 78-80/ha in irrigated areas and 33 trees/ha in rainfed areas<sup>16</sup>. Seventy percent of all trees are poplar.

#### Method of raising poplar trees

The farmer grows poplar trees on the boundaries of his farmland by directly planting shoot cuttings taken from existing trees, by letting coppice shoots of cut trees grow or by planting one-year-old whole nursery plants obtained from the nurseries of Forest Departments in these districts. About 200,000 plants are raised annually in these nurseries. In 1982, this figure was as high as one million. This indicates reduction in demand of poplar plants over a 5-year period. Farmers also raise their nursery plants whose number is estimated to be 5 times those produced in the nurseries of Forest Departments.

Both cuttings and whole plants are planted directly on the boundary of farmland in the form of a single row or multiple

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<sup>15</sup> Amin, R. 1985. Analysis of marketing of poplar wood in Peshawar and Mardan districts. Pakistan Forest Institute, Peshawar. 55 p.

<sup>16</sup> Amjad, M. 1991. Report on tree growth on farmlands of NWFP. Pakistan Forest Institute, Peshawar. 33 pp.

rows with half to one meter plant spacing. It is rather close spacing which does not provide enough growing space to old trees. In the case of water courses, the planting is done in the form of two rows which are one to three meters apart. The trees are often pruned to remove branches for fuel and facilitate quality wood production. The trees are harvested at the age of 6 to 7 years when they attain an average height of 12-15 meters and about 15 cms diameter at breast height.

#### Marketing of poplar wood

The trees are sold standing by the farmers to the petty contractors when these attain marketable size. The latter conduct the felling, conversion, transportation and sale of wood for different end uses. After felling, the tree is converted in billets of 1.3 to 1.5 meter length for supply to match factories in Punjab and N.W.F. provinces and sports goods industries in Sialkot (Punjab) as well as to local and outside packing cases manufacturers. Small size poles are used for shuttering in building construction industry. The annual export of poplar timber from Peshawar and Mardan districts is estimated at 51,000 metric tonnes. About 62,000 tonnes of poplar wood is also consumed every year locally for manufacture of packing cases, rural construction, construction of hutments for Afghan refugees, shuttering, and furniture manufacture. Small sized material is used as fuel. More trees are cut during winter months than during summer to meet increased demand of poplar wood.

ECONOMICS OF GROWING POPLAR ON FARMLANDS  
IN PESHAWAR AND MARDAN DISTRICTS

Data for economic analysis were obtained through interviews of farmers in the two districts. A proforma was prepared for this purpose, a copy of which is given as Appendix to this report. Since the farmers hardly ever keep any record of planting and harvesting costs and of income from sale of trees, therefore, the oral information given by them during interview was critically evaluated and translated into concrete data for economic analysis. In all 21 farmers were interviewed in two districts for this report. Further, not all trees are planted/harvested in one year by the farmer on his farmland, but only marketable trees growing on the farm at any time are sold and replaced by fresh planting by him. This process is repeated every year.

In this analysis, data on number of trees growing on the farmlands in the form of linear plantation were first converted to number of trees/ha. Subsequently all the costs of establishment and maintenance of the plantation, loss of agricultural crops as a result of growing of trees and income from sale of trees were computed on one hectare basis. The costs of establishment and maintenance was estimated on the basis of man days of work put in by the farmer and rate of daily wages of a semi-skilled farm worker e.g. Rs.30.00. The loss of income from agricultural crops due to presence of trees was determined from the oral information given by the farmers as well as through actual field measurement of farm area affected by tree growth. Farmer's income was found from sale of standing trees as revealed in field survey. He did not carry out any felling and conversion of the trees or marketing of wood because these operations were the responsibility of the petty contractors. In addition, the rotation age has been taken as 6 years as it was the reported age of sold trees. The details of basis of cost and income calculations are given in Appendix II.

## Statement of expenditure

Item	Mandays (No./ha)	Amount Rs./ha
<u>Ist year</u>		
1. Site preparation, levelling and dressing of water channels and berms.	9.6	288.00
2. Cost of saplings, preparation of cuttings and transportation to the site.	4	120.00
3. Planting, including digging of pits.	11.1	333.00
<u>Annual expenditure</u>		
1. Maintenance including weeding, pruning and fertilization.	1.3	39.00
2. Average loss in agriculture crop income	-	2499.87
(i) Ist-year, no loss	-	-
(ii) IInd year, 25% of Rs.4285.50/ha	-	1071.37
(iii) IIIrd year, 50% of Rs.4285.50/ha	-	2142.75
(iv) IVth year, 75% of Rs.4285.50/ha	-	3214.12
(v) Vth year, 100% of Rs.4285.50/ha	-	4285.50
(vi) VIth year, 100% of Rs.4285.50/ha	-	4285.50

## Statement of income

Item	Rate Rs./tree	Amount Rs./ha
Sale of 687 trees/ha	100.00	68700.00

Determination of discounted net cash flow for  
calculation of the internal rate of return

Year	Expenditure (negative)	Income (posit-	Net cash flows (C-B)=D	NPV at 76%(i) $\frac{1 \times D}{(1-76)^n \times}$	NPV at (i) $\frac{1 \times D}{(1-78)^n \times}$
A	B	C			
1 -	780	-	- 780	780.00	780.00
2 -	1340	-	-1340	761.36	752.81
3 -	2641	-	-2641	852.59	833.41
4 -	3942	-	-3942	723.07	698.97
5 -	5241	-	-5241	546.21	522.08
6 -	5241	68700	+63459	+3757.76	3551.35
Total	19185	68700		+ 94.53	- 35.92

$$IRR = i_1 + (i_2 - i_1) \times \frac{NPV_1}{(NPV_1 - NPV_2)} = 76 + (78 - 76) \times \frac{94.53}{94.53 - (-35.92)}$$

$$= 76 + 2 \times \frac{94.53}{130.45} = 76 + 1.45 = 77.45$$

$$NPV = \text{Discounted Revenue} = \text{Discounted costs}$$

$$= \text{Rs.}35724 - \text{Rs.}12491 = \text{Rs.}23233.00$$

Benefit cost analysis

Year	Amount Rs./ha	Discount rate 14%	Present value Rs./ha.
<u>Expenditure</u>			
1	780	1.00	780
2	1340	0.88	1179
3	2641	0.77	2034
4	3942	0.68	2681
5	5241	0.59	3092
6	5241	0.52	2725
			12491
<u>Income</u>			
6	68700	0.52	35724

$$\text{Benefit/cost ratio} = \frac{35724}{12491} = 1: 2.86$$

SHISHAM, MULBERRY AND POPLAR PLANTING IN  
CHANGAMANGA IRRIGATED PLANTATION

General

Changamanga plantation, the world's first irrigated forest plantation was started in 1866. Its total area is 5063 ha (12,510 acres). It is situated at a distance of about 75 km in the south west of Lahore - the capital of the Punjab, Pakistan. The total area of irrigated plantations in Punjab is 148,000 ha.

The entire area of the plantation is more or less flat with a general slop from north-east to south-west. Its soil is river alluvium laid down by Ravi and Sutlej rivers and formed under the combined action of climate. It is dark brown in colour, silty clay loam in texture, and highly porous with moderately slow permeability. The parent material consists of loess and calcareous sediments derived from igneous/metamorphic rocks through erosion of hills in the north.<sup>17</sup>

Climatically, Changamanga plantation is characterised by extreme of temperatures, low relative humidity, erratic and irregular rainfall. Average annual rainfall for 25 years (1946-1970) was 378 mm, mean maximum temperature 41.2°C and mean minimum temperature 5.4°C.

Initially, the plantation was established for supply of fuelwood to railways steam locomotives which were started in Punjab in 1880. Shisham (Dalbergia sissoo) was chosen for plantation with irrigation water on 10 years rotation because of its fast rate of growth and frost hardiness as well as for its wood of high calorific value. Mulberry (Morus alba) came up naturally in the plantation with irrigation water. The natural vegetation consisting of zerophytic species (Prosopis, Capparis, Acacia, etc.) were not thought fit for planting.

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<sup>17</sup> Ahmad, Faqir Ch. 1981. A note on Changamanga plantation and national park.

In 1888, coal was found in Punjab and fuelwood was replaced by coal in railway locomotives soon after. However, the planting programme at Changamanga was continued to meet fuelwood demand of rapidly growing nearby urban centers.

### Management

Under the latest working plan 4,065.6 ha or 80.3% of the area of the plantation is being managed for raising shisham and mulberry plantations and balance for growing poplar wood<sup>18</sup>. The former are worked on 22 year rotation with thinning at 6, 11 and 16 years age. The silvicultural system is coppice with standards. The poplar is worked on 11 year rotation.<sup>18</sup>

Since 1963, the plantation is also being managed as an outdoor recreation park. In order to provide mulberry leaves to the local population for rearing silkworms, 530.6 ha area have also been planted with pure mulberry crop since 1979-80 over a period of five years.

The plantation receives irrigation water from 15th April to 30th September at the rate of 12 cusecs (cubic feet per second) per 1000 acres (404.7 ha).

### Employment

The plantation provides employment of 0.15 million man days annually to semi-skilled and unskilled labour living inside and outside the plantation.

### Major Forest Produce

The major forest produce of the plantation are timber of various species and firewood. The average annual production of

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<sup>18</sup>

Bokhari, A.S. 1973. Revised Working Plan of Changa Manga Plantation 1972-73 to 1993-94.

these two commodities during last 11 years (\*1980-91) was as follows:

Timber	Quantity (m <sup>3</sup> )	Percentage of total
Shisham	4359	57
Mulberry	1347	18
Semal ( <i>Bombax ceiba</i> )	242	3
Poplar	1645	21
Others	59	1

#### Firewood

The average firewood yield during this period was 24692 m<sup>3</sup> (stacked volume). It is supplied to all major towns in Punjab province.

#### Minor Forest Produce

The minor produce of the plantation are; mulberry leaves, honey, chips, brushwood, stumps, grass and seed. An average annual income of Rs.965,294 is obtained from sale of this produce, which is consumed locally.

#### Income and Expenditure

The direct average annual income and expenditure over last 11 years (1980-91) is as follows:

Average income	=	Rs. 23,659,124
Average expenditure	=	Rs. 5,848,237
Indirect Income Estimated income to local villagers through silkworm rearing	=	Rs. 20 million

Estimated income as monetary  
equivalent of recreation = Rs. 10 million

1. Economics of raising Shisham and Mulberry  
Plantation at Changamanga

Shisham is planted in the form of root shoot cuttings (stumps) at 10'x6' (3 m x 1.8m) spacing, 1793 plants per ha. Mulberry comes naturally through irrigation water. The following economic analysis have been carried out from data collected from the Divisional Forest Officer at Changa Manga for the financial year 1981-91 (1st July, 1981 to 30th June, 1991). The analysis has been done with or without inclusion of land rent. Since the plantation grows on state land it is difficult to determine land rent. An amount of Rs. 1235.50 to Rs. 3000 per hectare has been used as land rent by different workers in the economic analysis of different irrigated planation of the Punjab<sup>19</sup>. These estimates are based on rental value of land for agricultural purpose by the farmers 'outside' the plantations. However, for the financial analysis presented below, net income from growing wheat in areas outside plantation was determined. This was found to be Rs. 2200.00 per hectare per annum. This value has been used as rental value of land (opportunity cost) in the economic analysis. Further, discounting factor of 14%, which is current bank rate of commercial banks has been employed for discounting. A rate of Rs. 30.00 per man day have also been used in the financial analysis.

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<sup>19</sup> Amjad. M. 1983. A appraisal of investment in Daphar irrigated plantation. Ann. Prog. Rep. 1982-83. Pakistan Forest Institute, Peshawar.

## Financial Analysis

## Statement of year-wise expenditure

Item	Man days (No./ha)	Amount Rs./ha	Discounted amount (Rs.)
<u>Ist Year</u>	<u>123.7</u>	<u>3711.00</u>	<u>3711.00</u>
1. Jungle clearance	12.3	369.00	
2. Debris collection and burning	7.5	225.00	
3. Lay-out and 'dagh' bailing	5.0	150.00	
4. Levelling, 31.1 m <sup>3</sup> /ha earth work	1.6	48.00	
5. Earthwork, digging of khals slots and bunds, 356.6 m <sup>3</sup> /ha	63.0	1890.00	
6. Cost of 1793 stumps* @ Rs. 0.14/plant	8.5		255.00
7. Extraction and carriage charges of 1793 stumps	8.5		255.00
8. Planting of 1793 stumps	3.6		108.00
9. Irrigation, 9 No. @ Rs.12.33/ha	3.7		111.00
10. Weeding, 2 No.	10.0		300.00
<u>2nd Year</u>	<u>18.0</u>		<u>540.00 473.68</u>
1. Beating of failures, 25%, cost of 448 stumps	2.1		63.00
2. Extraction and carriage of stumps	2.1		63.00
3. Planting of failures @ Rs. 60/1000 plants	0.9		27.00
4. Irrigation, 7 No.	2.9		87.00

\* Details of expenditure for raising and maintenance of bed nurseries are given in Appendix III. The cost of stumps given in the analysis, which is actually booked in records, is slightly lower than actual cost.

5. Weeding, 1 No.	10.0	300.00	
<u>3rd Year</u>	<u>2.3</u>	<u>70.00</u>	<u>53.10</u>
1. Restocking, 5%, cost of plants	0.1	3.00	
2. Extraction and carriage of Plants	0.1	3.00	
3. Planting cost of failures @ Rs. 6000/1000 plants	-	1.00	
4. Irrigation, 5 No.	2.1	63.00	
<u>4th Year</u>	<u>1.6</u>	<u>48.00</u>	<u>36.95</u>
Irrigation, 4 No.	1.6	48.00	
<u>5th Year</u>	<u>1.6</u>	<u>48.00</u>	<u>28.43</u>
Same as 4th year	1.6	48.00	28.43
<u>6th Year</u>	<u>28.8</u>	<u>866.88</u>	<u>450.38</u>
1. Irrigation 3 No.	1.3	36.00	
2. Felling and conversion of fuelwood in 1st thinning 1 ha = 36.2 m <sup>3</sup> (stacked volume) fuelwood @ Rs. 16.95/m <sup>3</sup>	20.4	613.59	
3. Felling and conversion of timber in 1st thinning 1 ha = 0.1 m <sup>3</sup>	0.4	12.00	
4. Transportation charges of 0.1 m <sup>3</sup> timber @ Rs. 136.12/m <sup>3</sup>	0.4	13.61	
5. Transportation charges of fuelwood stacked 36.2 m <sup>3</sup> @ Rs. 5.29/m <sup>3</sup>	6.4	191.68	

<u>7th Year</u>	1.2	<u>36.00</u>	<u>16.79</u>
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Irrigation, 3 No.	1.2	36.00	
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8th Year

Same as 7th year	1.2	36.00	14.38
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9th Year

	<u>1.2</u>	<u>36.00</u>	<u>12.62</u>
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Same as 7th year	1.2	36.00	12.62
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10th Year

	<u>1.2</u>	<u>36.00</u>	<u>11.04</u>
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Same as 7th year	1.2	36.00	11.04
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11th Year

	31.6	949.90	256.30
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1. Irrigation, 3 No.	1.2	36.00	
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2. 2nd thinning, felling and conversion charges			
(a) Fuelwood 1 ha = 33.6 m <sup>3</sup> (stacked volume) at Rs. 16.95/m <sup>3</sup>	19.0	569.52	

(b) Timber 1 ha = 0.62 m <sup>3</sup> at Rs. 133.37/m <sup>3</sup>	2.7	82.07	
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3. Transportation charges			
(a) Fuelwood stacked 33.6 m <sup>3</sup> @ Rs. 5.29/m <sup>3</sup>	5.9	177.91	
(b) Timber 0.62 m <sup>3</sup> @ Rs. 136.12/m <sup>3</sup>	2.8	84.40	

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12th Year

	<u>0.8</u>	<u>24.00</u>	<u>5.68</u>
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Irrigation, 2 No.	0.8	24.00	
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<u>13th Year</u>	<u>0.8</u>	<u>24.00</u>	<u>4.98</u>
Same as 12th Year	0.8	24.00	4.98
<u>14th Year</u>	<u>0.8</u>	<u>24.00</u>	<u>4.37</u>
Same as 12th year	0.8	24.00	4.37
<u>15th Year</u>	<u>0.8</u>	<u>24.00</u>	<u>3.83</u>
Same as 12th year	0.8	24.00	3.83
<u>16th Year</u>	<u>48.8</u>	<u>1465.46</u>	<u>205.44</u>
1. Irrigation, 2 No.	0.8	24.00	
2. Third thinning, felling and conversion charges			
(A) Firewood, 27.16M <sup>3</sup> /ha (stacked volume) @ Rs. 16.37/m <sup>3</sup>	15.3	460.36	
(b) Timber, 3.1 m <sup>3</sup> /ha @ Rs. 133.37	13.8	415.45	
3. Transportation charges			
(a) Fuelwood stacked 27.16 m <sup>3</sup> @ Rs. 5.29/m <sup>3</sup>	4.8	143.68	
(b) Timber, 3.1 m <sup>3</sup> @ Rs. 136.12/m <sup>3</sup>	14.1	421.97	
<u>17th Year</u>	<u>0.8</u>	<u>24.00</u>	<u>2.94</u>
Irrigation, 2 No.	0.8	24.00	

<u>18th Year</u>	<u>0.8</u>	<u>24.00</u>	<u>2.58</u>
Same as 17th year	0.8	24.00	2.58
<u>19th Year</u>	<u>0.8</u>	<u>24.00</u>	<u>2.26</u>
Same as 17th year	0.8	24.00	2.26
<u>20th Year</u>	<u>0.8</u>	<u>24.00</u>	<u>1.98</u>
Same as 17th year	0.8	24.00	1.98
<u>21st Year</u>	<u>0.8</u>	<u>24.00</u>	<u>1.75</u>
Same as 17th year	0.8	24.00	1.75
<u>22nd Year</u>	<u>420.1</u>	<u>12601.94</u>	<u>804.57</u>
1. Felling and conversion charge in main felling			
(a) Fuelwood 90.5 m <sup>3</sup> /ha @ Rs. 16.95/m <sup>3</sup>	51.1	1534.01	
(b) Timber, 38.9 m <sup>3</sup> /ha @ Rs. 133.37/m <sup>3</sup>	176.5	5294.11	
2. Transportation charges			
(a) Fuelwood 90.5 m <sup>3</sup> @ Rs. 5.20/m <sup>3</sup>	16.0	478.75	
(b) Timber 38.9 m <sup>3</sup> @ RS. 136.12/m <sup>3</sup>	176.5	5295.07	

<u>Annual expenditure/ha</u>		<u>942.27</u>	<u>6300.78</u>
1. Water charges for irrigation	Rs.	9.88	
2. Silt clearance and repair of khals & bunds	Rs.	171.75	
3. Maintenance of roads	Rs.	19.62	
4. Kana stubbing	Rs.	49.99	
5. Repair of buildings	Rs.	31.59	
6. Salaries of staff	Rs.	695.44	
		<u>Grand total</u>	<u>12405.83</u>

#### Statement of yearwise revenue

<u>Item</u>	<u>Amount Rs/ha</u>	<u>Discounted amount Rs.</u>
<u>6th Year (Ist thinning)</u>	<u>4940.85</u>	<u>2566.93</u>
1. Sale of 36.2 m <sup>3</sup> (stacked) fuelwood	4686.09	
2. Sale of 0.1 m <sup>3</sup> of shisham timber	254.76	
<u>11th Year (IInd thinning)</u>	<u>5944.64</u>	<u>1604.02</u>
1. Sale of 33.6 m <sup>3</sup> (stacked) of fuelwood	4339.52	
2. Sale of 0.62 m <sup>3</sup> of shisham timber	1595.12	

\* Amount paid by the Forest Department to the Irrigation Department as the cost of irrigation water

<u>16th Year (IIIrd thinning)</u>	<u>11413.42</u>	<u>1599.47</u>
1. Sale of 27.16 m <sup>3</sup> (stacked)	3515.86	
2. Sale of 3.1 m <sup>3</sup> of shisham timber	7897.56	
<hr/>		
<u>22nd Year (Main felling)</u>	<u>110816.86</u>	<u>7075.16</u>
1. Sale of 90.5 m <sup>3</sup> (stacked) fuelwood	11715.22	
2. Sale of 29.7 m <sup>3</sup> of shisham timber	75663.72	
3. Sale of 9.2 m <sup>3</sup> of mulberry timber	23437.92	
<hr/>		
<u>Annual revenue/ha</u>	<u>334.68</u>	<u>2238.01</u>
1. Grazing/grass cutting	Rs. 1.50	
2. Mulberry leaves	Rs. 32.00	
3. Cultivation lease	Rs. 88.18	
4. Other sources*	Rs. 213.00	
<hr/>		
	<u>Grand Total</u>	<u>15083.59</u>

\* It includes sale of plants, mulberry twigs for basket making, fines, compensation, recreation, rent of buildings, honey, etc.

## Summary of expenditure and revenue

A. Year	Amount expen- diture Rs./ha	Discounted value at @		
		14%	16%	17%
1.	3,711.00	3,711.00	3711.00	3711.00
2.	540.00	473.68	465.52	461.54
3.	70.00	53.10	52.02	51.14
4.	48.00	36.95	30.75	29.97
5.	48.00	28.43	26.51	25.62
6.	866.88	450.38	412.39	395.39
7.	36.00	16.79	14.78	14.03
8.	36.00	14.38	12.73	11.99
9.	36.00	12.62	10.98	10.25
10.	36.00	11.04	9.46	8.76
11.	949.90	256.30	215.32	197.43
12.	24.00	5.68	4.79	4.27
13.	24.00	4.98	4.04	3.65
14.	24.00	4.37	3.48	3.12
15.	24.00	3.83	3.00	2.66
16.	1,465.46	205.44	158.17	139.06
17.	24.00	2.94	2.23	1.95
18.	24.00	2.58	1.92	1.66
19.	24.00	2.26	1.66	1.42
20.	24.00	1.98	1.43	1.22
21.	24.00	1.75	1.23	1.03
22.	12,601.94	804.57	558.26	466.15
Annual expenditure	942.27	6,300.78	5528.31	5337.73
Total expenditure		<u>12,405.83</u>	<u>11329.98</u>	<u>10881.04</u>
Land Rent/annum	2200			
Total including land rent			<u>14711.31</u>	<u>27117.14</u>
B. Yearly revenue				
6.	4,940.85	2,566.93	2352.57	2253.57
11.	5,944.64	1,604.02	1347.53	1236.72
16.	11,413.42	1,599.47	1231.85	1083.02
22.	110,816.86	7,075.16	4909.18	4099.12
Annual revenue	334.68	2,238.01	1999.09	1895.88
Total revenue		15,083.59	11840.22	10558.31

NPV	2,677.76	510.25	-312.73
With land rent =		-12627.72	

NPV

- NPV @ 14% excluding land rent = Rs.15083.59 - Rs.12405.83  
over the rotation period = Rs. 2677.76
- NPV @ 14% including land rent = Rs.15083.59 - Rs.27117.14  
over the rotation period = -Rs.12627.72

Cost benefit ratio

	<u>Rs./ha</u>
1. Discounted revenue over the rotation period	15,083.59
Discounted expenditure over the rotation period excluding land rent	12,405.83
cost benefit ratio	1 : 1.22
2. Discounted revenue over the rotation period	15,083.59
Land rent @ Rs.2200/annum/ha over the rotation period	14,711.31
Discounted expenditure over the rotation period including land rent @ Rs.2,200.00 ha	27,117.14
Cost benefit ratio	1 : 0.56

## IRR

## 1. IRR excluding land rent

$$= \text{Lower 'i'} + (\text{Upper 'i'} - \text{Lower 'i'}) \frac{\text{NPV at lower 'i'}}{(\text{NPV at lower 'i'} - \text{NPV at Upper 'i'})}$$

where 'i' is the assumed rate of interest

$$= 16 + (17-16) \frac{510.25}{(510.25) - (-312.73)} =$$

$$16 + \frac{1 \times 510.25}{822.98} = 16 + 0.62 = \underline{16.62}$$

2. IRR including land rent

$$\begin{aligned} &= 5 + (7-5) \times \frac{5719.85}{(5719.85) - (-55103.01)} \\ &= 5 + \frac{2 \times 5719.85}{10822.86} = 5 + 1.06 = \underline{6.06} \end{aligned}$$

## 2. Economics of raising Poplar Plantation at Changamanga

In the current working plan for Changamanga, a working circle for growing of poplar plantation was created in 1972-73 for the first time in place of shisham and mulberry over an area of about 1000 ha. This was done on the basis of decision made by the Punjab Agriculture Policy Committee to grow industrial woods in the irrigated plantations of province. Poplar was the obvious choice for this purpose because it had proven to grow faster than shisham and mulberry and its wood had ready market in match, plywood, particle board and sports goods industries. Only those areas were allotted to this working circle which had assured supply of sufficient irrigation water because water requirement of poplar trees were higher than those of shisham and mulberry.

As in the case of Peshawar and Mardan districts, early poplar planting consisted of Populus x euramericana Cv.I-214. In view of its susceptibility to insect and heat damage, currently only P. deltoides clones are planted.

For poplar planting, the existing crop of shisham and mulberry along with shisham standards in clear-felled. The area is leased for cultivation of agriculture crop for three years on yearly basis. After thorough ploughing and lay-out of irrigation system, one-year old plants of poplar from its second stage nursery are planted at 18' x 18' (5.5 x 5.5 m) spacing in the month of February. In between the tree rows, agricultural crops are grown by the lessees for three years. Turmeric and seasonal vegetables e.g. bitter gourd are raised during this period. Subsequent maintenance of the tree crop upto rotation age of 11 years is the responsibility of Forest Department. No thinnings are done during rotation period. The area of the working circle has completed one rotation and is being presently worked for second rotation.

The financial analysis of growing poplar in Changamanga is based on data collected from the office of Divisional Forest Officer as well as from the lessees. As for analysis of shisham and mulberry plantation, analysis of poplar planting has been done with or without rental value of the land at the rate of Rs.2200.00/ha/annum. Further, discounting factor of 14% and labour rate of Rs.30.00 per man day have also been used in the financial analysis.

Statement of yearwise expenditure

Item	Man days/ ha	Amount (Rs./ha)	Discounted value @ 14% (Rs.)
<u>Ist Year</u>	<u>89.6</u>	<u>2688.00</u>	<u>2688.00</u>
1. Jungle clearance	12.3	369.00	
2. Debris collection and burning	7.4	222.00	
3. Lay-out of irrigation system	4.9	147.00	
4. Earth work (108 m <sup>3</sup> ), khals & pits	47.1	1413.00	
5. Cost of raising of 330 plants @ Rs.0.14 per plant*	1.6	48.00	
6. Extraction and carriage of plants @ Rs.0.60 per plant	6.3	189.00	
7. Labour charges for planting @ Rs.0.30 per plant	3.8	114.00	
8. Labour charges for 6 irrigations @ Rs.12.00/irrigation	2.4	72.00	
9. Pressing hard of plants @ Rs.0.18/plant	1.9	57.00	
10. Straighting of plants @ Rs.0.18/plant	1.9	57.00	

\* Cost per ha of raising Ist and IInd stage poplar nurseries is given in Appendix IV.

<u>2nd Year</u>	<u>5.3</u>	<u>231.11</u>	<u>202.74</u>
1. Cost of replacement of failures 83 plants @ Rs.0.14/plant	0.40	12.00	
2. Extraction and carriage cost of 83 plants @ Rs.0.60/plant	1.6	48.00	
3. Labour charges for planting for 83 plants @ Rs.0.36/plant	0.9	27.00	
4. Cost of 6 irrigation @ Rs.12.00/irrigation	2.4	72.00	
<u>3rd Year</u>	-	-	
<u>4th Year</u>	<u>18.2</u>	<u>546.00</u>	<u>368.55</u>
1. Labour charges for 4 irrigations @ Rs.12.75/irrigation	1.7	51.00	
2. Pruning of 330 plants @ Rs.1.5/plant	16.5	495.00	
<u>5th Year</u>			
Labour charges for 4 irrigations @ Rs.12.75/irrigation	<u>1.7</u>	<u>51.00</u>	<u>30.19</u>
<u>6th Year</u>			
Labour charges for 4 irrigations @ Rs.12.75/irrigation	<u>1.7</u>	<u>51.00</u>	<u>26.28</u>
<u>7th Year</u>			
Labour charges for 3 irrigations @ Rs.12.75/irrigation	<u>1.2</u>	<u>36.00</u>	<u>16.40</u>
<u>8th Year</u>			
Labour charges for 3 irrigations @ Rs.12.75/irrigation	<u>1.2</u>	<u>36.00</u>	<u>14.39</u>
<u>9th Year</u>			
Labour charges for 3 irrigations @ Rs.12.75/irrigation	<u>1.2</u>	<u>36.00</u>	<u>12.15</u>
<u>10th Year</u>			
Labour charges for 3 irrigations @ Rs.12.75/irrigation	<u>1.2</u>	<u>36.00</u>	<u>11.07</u>

<u>11th Year</u>	<u>421.4</u>	<u>12642.00</u>	<u>3410.12</u>
1. Enumeration and marking for 330 plants @ Rs.0.35/plant	3.9	117.00	
2. Felling and conversion charges for 52.28 m <sup>3</sup> of timber @ Rs.67.80/m <sup>3</sup>	118.1	3544.58	
3. Felling and conversion charges for 55.8 m <sup>3</sup> of firewood @ Rs.17.79/m <sup>3</sup> (stacked)	33.1	992.68	
4. Transportation charges for 52.28 m <sup>3</sup> of timber @ Rs.88.29 m <sup>3</sup>	230.8	6923.70	
5. Transportation charges for 55.8 m <sup>3</sup> of firewood @ Rs.12.71/m <sup>3</sup>	35.5	1063.83	

## Statement of revenue

<u>11th Year (main felling)</u>	<u>59166.2</u>	<u>15959.81</u>
1. Revenue from sale of 26.17 m <sup>3</sup> of above 29.1 cm of poplar timber @ Rs.1341.40/m <sup>3</sup>	35104.44	
2. Revenue from sale of 21.34 m <sup>3</sup> 19.4 cm to 28.3 cm of poplar timber @ Rs.670.7/m <sup>3</sup>	14312.74	
3. Revenue from sale of 4.77 m <sup>3</sup> of poplar under below 19.4 cm @ Rs.529.5/m <sup>3</sup>	2525.71	
4. Revenue from sale of 55.8 m <sup>3</sup> (stacked) of poplar firewood @ Rs.129.45/m <sup>3</sup> (stacked)	7223.31	

<u>Annual expenditure</u>	<u>942.27</u>	<u>4914.97</u>
1. Water charges for irrigation	9.88	
2. Silt clearance and repair of water channels	171.75	
3. Maintenance of roads	19.62	
4. Kana stubbing	49.99	
5. Repair of buildings	31.59	
6. Salaries of staff	695.44	

## Summary of expenditure and revenue

## A: Expenditure:

Year	Amount Rs./ha	Discounted value (Rs.)		
		14%	30%	32%
1.	2688.00	2688.00	2688.00	2688.00
2.	231.11	202.74	177.78	175.08
3.	-	-	-	-
4.	546.00	368.55	248.52	237.39
5.	51.00	30.19	17.86	16.80
6.	51.00	26.28	3.74	12.73
7.	36.00	16.40	7.46	6.81
8.	36.00	14.39	5.74	5.16
9.	36.00	12.50	4.41	3.91
10.	36.00	11.07	3.39	2.96
11.	12642.00	3410.12	917.03	787.18
Annual Expenditure	942.27	5857.24	3855.34	3703.59
Total	<u>17295.38</u>	<u>12637.48</u>	<u>7939.27</u>	<u>7639.53</u>

## B. Revenue

Ist* Year	5676.00	5676.00	5676.00	5676.00
2nd* "	1482.00	1299.60	1140.00	1122.73
3rd* "	889.20	684.00	526.15	510.33
11th "(woodsale)	59166.20	15959.81	4291.81	3684.13
Total	<u>67213.40</u>	<u>23619.41</u>	<u>11633.96</u>	<u>10993.19</u>

-NPV = Rs.23619.41 - Rs.12637.48 = Rs.10982.14

-NPV/including land rent of Rs.2200/ha/annum from 4th to 11th year.  
=Rs.23619.41 - Rs.20490.27 = Rs.3129.14

Cost benefit ratio Rs./ha

1. Discounted revenue over rotation period 23619.41

Discounted expenditure over the rotation period excluding land rent 12637.48

Cost benefit ratio  $\frac{23619.41}{12637.48} = 1:1.87$

\* Lease rate Rs/ha for agriculture during first three years of poplar planting.

2. Discounted expenditure over the 8 years (4th to 11th) period including land rent @ Rs.2200.00/ha/annum = 11695.21 + 6367.86 = 18063.07

Cost benefit ratio  $\frac{23619.41}{20490.27} = 1:1.15$

Since revenue in each year exceeds expenditure, calculation of IRR is not possible in such cases.

### 3. Growing of shisham on the farmlands

Shisham is most commonly planted on the farmlands in the irrigated tracts of the Punjab as it has a fairly high rate of growth and being deciduous, does minimal damage to agricultural crops especially to wheat crop in winter. Its wood is extensively used as fuelwood in rural and urban areas and the timber for furniture manufacture and rural construction. The trees are mostly grown in rows along the boundaries of farms, though, scattered trees within the farm are not uncommon. However, its growth is severely limited by lack of sufficient irrigation water supply and in waterlogged and saline areas. There is considerable variation in climate and soil in the irrigated areas of Punjab province.

#### Economics of growing trees on farmlands

The study was carried out in a number of villages in the vicinity of Changamanga plantation in Chunia tehsil of Kasur district. These are Kot Manga, Har Chowki, Jamshed Kalan, Gajan Singh, Kot Nawab, Moondaki and Kot Arjan Singh. Farmers were interviewed individually for collection of data. The soil in these villages is alluvial. It is dark brown in colour, silty loam texture and highly porous. The rainfall is meager and 60-70% of annual precipitation is received during summer months. Mean maximum temperature of the tract is plus 46°C and mean minimum temperature 0°C. The principal agricultural crops are wheat, cotton, rice, maize and sugarcane.

Shisham trees are grown by planting of root shoot cuttings on water channels and berms of farms. The rotation is 15 years. Cost of maintenance is low and only weeding and pruning of trees are carried out by the farmers. Trees are sold standing by the farmer and are converted into fuelwood and timber. Fuelwood is sold in nearby towns and timber is purchased by furniture manufacturers. Some timber is also used for rural construction within the locality. Basis of cost calculations are given in the Appendix. As in the case of shisham and mulberry planting in Changamanga, daily rates of semi-skilled labour was used as Rs.30.00. Since the trees are grown on farm boundary crop losses due to trees were included in the annual expenditure and the opportunity cost of land rent foregone (see Appendix V).

Statement of expenditure

Item	Man days (No./ha)	Amount Rs./ha
<u>Ist Year</u>		
Cost of site preparation	1.7	51.00
i) Dressing of water channels and berm		
ii) Digging of pits		
Cost of sapling	0.6	18.00
i) Cost of plants		
ii) Transportation charges		
Cost of planting	1.0	30.00
<u>Annual expenditure</u>		
Cost of maintenance	4.4	132.00
i) Weeding		
ii) Pruning		

Loss in Agriculture crop

5941.65

- i) 1st and 2nd year = nil  
 ii) 3rd and 4th year = 25%  
 iii) 5th and 6th year = 50%  
 iv) 7th and 8th year = 75%  
 v) 9th to 15th year = 100%

## Statement of income

Item	Rate Rs./tree	Amount Discounted at Rs./ha	14%
Sale of 30 trees/ha	806.10	24183.00	3862.27

Internal rate of return of shisham (*Dalbergia sissoo*)  
in Punjab.

Year	Expense (negative)	Income (positive)	Net cash flows (D) C-(B)= b	Discount factor at 14%	E	Net present value at 14% (F)=(D) x(E)	Discount factor at 16%	G	Net present value at 16% (DxG)=H	Net present value of 17% I
	231.00		- 231.00	1.0000		- 231.00	1.0000		- 231.00	- 231.00
	132.00		- 132.00	0.8772		- 115.79	.8621		- 113.80	- 112.82
	308.95		- 308.95	.7695		- 237.74	.7432		- 229.61	- 225.69
	308.95		- 308.95	.6750		- 208.54	.6407		- 197.94	- 192.90
	487.71		- 487.71	.5921		- 288.77	.5523		- 269.36	- 260.27
	487.71		- 487.71	.5194		- 253.32	.4761		- 232.20	- 222.45
	666.48		- 666.48	.4556		- 303.65	.4104		- 273.52	- 259.82
	666.48		- 666.48	.3996		- 265.98	.3538		- 235.80	- 220.07
	845.25		- 845.25	.3506		- 296.34	.3050		- 257.80	- 240.71
	845.25		- 845.25	.3075		- 259.91	.2630		- 222.30	- 205.73
	845.25		- 845.25	.2697		- 227.96	.2269		- 191.79	- 175.85
	845.25		- 845.25	.2366		- 199.99	.1954		- 165.16	- 150.29
	845.25		- 845.25	.2075		- 175.39	.1685		- 142.42	- 128.45
	845.25		- 845.25	.1821		- 153.92	.1452		- 122.73	- 109.79
	845.25	24183	+23337.75	.2597		+3727.04	.1252		+2921.88	+2590.95
					Total	+ 508.64	Total		- 194.55	- 144.88

$$\begin{aligned} \text{IRR} &= 16 + (17-16) \times \frac{36.45}{(36.45) - (-144.88)} \\ &= 16 + \frac{1 \times 36.45}{181.33} = 16 + 0.20 = 16.20 \end{aligned}$$

$$\text{NFV} = \text{Rs.}3862.27 - \text{Rs.}3353.65 = \text{Rs.} 509.27$$

Benefit cost analysis @ 14% (Rs.)

Discounted cost = Rs. 3353.65

Discounted revenue = Rs. 3862.27

B/c ration =  $\frac{3862.27}{3353.65} = 1:1.15$

NPV =  $3862.27 - 3353.65 = 509.27$

## BABUL PLANTING IN SINDH

## 1. Riverain Forests

Babul (Acacia nilotica) is the principal timber and fuelwood species in the province of Sindh, Pakistan. It is extensively grown in the riverain forests and irrigated forest plantations as well as on the farmlands in the province. The state-owned riverain forests occur on the banks of main stream of river Indus and are restricted to the areas between the protection embankments on both sides of the river. These forests are a several stage of Tropical Thorn Forest type and are subjected to flooding for 6 - 10 weeks in summer months by the river depending upon quantity of water flowing through it. They also undergo the constant process of erosion and deposition by the river.

The total area of riverain forests in Sindh is 241,000 ha. Babul grows only in those areas of riverain forests which receive sufficient inundation water during summer months. However, after construction of upstream reservoirs and downstream weirs on the river for development of irrigation facilities for agricultural land, the frequency and duration of inundation in riverain forests has presently reduced to considerable extent. This has adversely affected growth of babul in them, which cannot thrive in arid climate of the tract unless it regularly receives irrigation water during floods.

## Topography

The forests are situated in the vast alluvial plain of the river Indus and close to its banks. These are frequently intersected by the abandoned beds of river due to change in its course. The river flows on a ridge while the surrounding area is much lower than the river bed. Consequently, accretion and erosion

are constant features in this tract. On the whole, the area is generally flat with gentle slope towards south.

#### Geology and soil

The soil of riverain forests is rich alluvium, which is for the most part fertile loam containing varying proportion of clay and sand. The special feature of the forest areas is the formation of new land along the river banks due to accretion. Such areas are locally called 'Kachos' become stable and fit to sustain tree growth. Of course, the river simultaneously erodes some areas on the side opposite to the one on which accretion has occurred.

#### Climate

The climate of the region is of extreme arid nature. The rainfall is very scanty and may vary from 0 to 200 mm. The summer temperature goes as high as 46°C and the minimum temperature in winter is not less than 2-3°C. The summers are long and usually extend from March to October.

#### Management of riverain forests

The riverain forests are managed under the silvicultural system of clear felling with artificial regeneration on 15 year rotation. After felling and extraction of mature crop, seed of babul is broadcast sown during flood season in standing water in June-July with the help of a boat. Germination of seed starts soon after recession of flood water in the month of August. Cleaning and pruning is carried out during third year of sowing seed. Subsequently, only general maintenance of the roads and the tree crops are carried out.

## Marketing of forest produce

The major forest produce of riverain forests are timber, fuelwood and pit props. The felling and conversion of standing trees is carried manually by axe and two-man cross-cut saw. Depending upon the straightness of the stem, the log length varies from 2.4 to 3.6 m and the round timber is sold in stacked form in the depots near the forests. The timber along with fuelwood obtained during harvesting is supplied to major cities in Sindh province e.g. Karachi, Hyderabad, Sukkur, Nawabshah, Dadu etc. The timber is used for construction, furniture, agricultural implements and in coal mines of Sindh and Balochistan provinces. Pit props in round form vary in size; length 1.3 to 3.9 to 5 cm thickness and 10 to 15 cm width is also used in the mining industry. Charcoal is commonly made from fuelwood and supplied to the cities.

The riverain forests are source of a number of minor forest produce. This includes grass, forage (babul leaves and pods), honey and bark for tanning leather. Except for bark, other products are consumed locally. The former is supplied to leather factories in Hyderabad and Karachi.

## Economics of raising babul in riverain forests

This study was carried out in Rajri forest of Hyderabad Forest Division and data on cost of establishment and maintenance of the forest as well as revenue received during 1985-86 were collected from the office of the Divisional Forest Officer and updated in March, 1992. The area of Rajri forest is 6035.2 hectare and is situated at a distance of about 50 km from Hyderabad city. The management of Rajri forest is same as for other riverain forests described before. The size of a compartment is 16 ha. Babul is grown under silvicultural system of clear-felling with artificial regeneration by sowing of seed. The rotation of the tree crop is kept as 15 years.

Before the on-set of flood in summer, paths or 'pahies' are made in the existing jungle growth for movement of the boat in flood water for sowing seed. The seed is broadcast sown over the flood water, which germinates soon after flood water recedes. This is followed by sowing of seed by dibbling and in drills in areas where the germination is not satisfactory. These operations are repeated the following year as well to ensure complete regeneration of the area. Some cleaning and pruning is carried out in the 3rd year. Only maintenance of roads and lines is undertaken during subsequent years till the completion of rotation period.

Daily rate of Rs.27.00 per man day has been used in this analysis. The rental value of land in the riverain forests was found to be very low, e.g., Rs.100.00/ha.

#### Financial analysis

##### Statement of yearwise expenditure

Item	Man days No./ha	Amount Rs/ha	Discounted amount (Rs.)
<u>Ist Year</u>	<u>5.1</u>	<u>137.70</u>	<u>137.70</u>
1. Cost of purchase of seed 10 kg/ha	0.7	18.90	
2. Cuttings of 'pahies'	0.1	2.70	
3. Broadcast sowing of seed	2.1	56.70	
4. Seed sowing by dibbling of seed (10%)	0.5	13.50	
5. Seed sowing in drills (10%)	0.7	18.90	
6. Hiring of boat	0.1	2.70	
7. Erection of brush wood fence	0.3	8.10	
8. Chowkidar	0.4	10.80	
9. Construction of fire lines	0.1	2.70	
10. Maintenance of compartment road	0.1	2.70	

<u>2nd Year</u>	<u>4.9</u>	<u>132.30</u>	<u>116.05</u>
1. Cost of purchase of seed 10 kg/ha	0.7	18.90	
2. Cutting of 'pahies'*	0.1	2.70	
3. Broadcast sowing of seed	2.1	56.70	
4. Hiring of boat	0.1	2.70	
5. Seed sowing by dibbling (10%)	0.5	13.50	
6. Seed sowing in drills (10%)	0.7	18.90	
7. Erection of brush wood fence	0.3	8.10	
8. Chowkidar	0.4	10.80	
<u>3rd Year</u>	<u>1.5</u>	<u>40.50</u>	<u>31.16</u>
1. Cleaning and pruning	1.2	32.40	
2. Cutting of new compartment lines	0.1	2.70	
3. Maintenance of compartment roads	0.1	2.70	
4. Maintenance of compartment lines	0.1	2.70	
<u>4th Year</u>			
Maintenance of compartment roads and lines	0.1	2.70	1.81
<u>5th Year</u>			
Maintenance of compartment roads and lines	0.1	2.70	1.60
<u>6th Year</u>			
Maintenance of compartment roads and lines	0.1	2.70	1.40
<u>7th Year</u>			
Maintenance of compartment roads and lines	0.1	2.70	1.22

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\* Paths made in brushwood for movement of boat for sowing of seed during flood season.

8th Year

Maintenance of compartment roads and lines	0.1	2.70	1.07
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9th Year

Maintenance of compartment roads and lines	0.1	2.70	0.94
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10th Year

Maintenance of compartment roads and lines	0.1	2.70	0.82
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11th Year

Maintenance of compartment roads and lines	0.1	2.70	0.72
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12th Year

Maintenance of compartment roads and lines	0.1	2.70	0.63
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13th Year

Maintenance of compartment roads and lines	0.1	2.70	0.55
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14th Year

Maintenance of compartment roads and lines	0.1	2.70	0.48
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15th Year

1. Felling and conversion charges of main felling	<u>278.3</u>	<u>7516.00</u>	<u>1200.33</u>
Firewood and timber 2.59 stacks @ Rs.912 per stack*	87.5	2362.08	
2. Sorting and stacking of 2.59 stacks @ Rs.96 per stack	9.2	248.64	
3. Transportation of 2.59 stacks @ Rs.1836 per stack	176.1	4755.24	

\* One stack of wood = 28.3 m<sup>3</sup> (1000 cft) stacked volume  
2.59 stacks of wood = 73.3 m<sup>3</sup>

4. Miscellaneous expenditure (Chowkidar, Munshi etc.) for 2.59 stacks @ Rs.57.93 per stack	5.5	150.04	
<u>Annual expenditure/ha</u>	<u>11.1</u>	<u>299.70</u>	<u>1798.82</u>
1. Repair of buildings	0.1	2.70	
2. Wages of staff	5.2	140.40	
3. Pay of officers etc.	5.8	156.60	
	Grand Total		3295.30

## Statement of revenue

Item	Amount Rs./ha	Discounted amount Rs.
<u>15th Year</u>		
Sale of 2.59 stacks @ Rs.6923.80 per stack	17932.64	2864.04
<u>Annual revenue/ha</u>	<u>35.31</u>	<u>216.87</u>
1. Grazing and grass cutting	2.00	
2. Minor forest produce	14.37	
3. Cultivation	8.94	
4. Other source*	10.06	

\* It includes compensations and damage recoveries.

## Summary of expenditure and revenue

A. Expenditure

Year	Amount Rs./ha	Discounted value @ 12%	Discounted @ 14% (Rs.)
1.	137.70	137.70	137.70
2.	132.30	118.12	116.05
3.	40.50	32.29	31.16
4.	2.70	1.92	1.81
5.	2.70	1.71	1.60
6.	2.70	1.53	1.40
7.	2.70	1.37	1.22
8.	2.70	1.22	1.07
9.	2.70	1.09	0.94
10.	2.70	0.97	0.82
11.	2.70	0.87	0.72
12.	2.70	0.77	0.63
13.	2.70	0.69	0.55
14.	2.70	0.62	0.49
15.	7516.00	1537.96	1200.45
Annual expenditure	299.70	1986.46	1798.82
Total	8155.90	3825.27	3295.30

B. Revenue

		Discounted		
		12%	14%	10%
15th year	17932.64	3669.37	2864.04	4722.20
Annual revenue	<u>35.31</u>	240.04	211.93	295.43
Total	17967.95	3903.41	3080.91	5017.63
		<u>3909.86</u>	<u>3111.28</u>	

Cost benefit ratioRs./ha

- Discounted revenue over the rotation period 3080.91
- Discounted expenditure over the rotation period excluding land rent 3295.30
- Cost benefit ratio 1: 0.93
- Discounted revenue over the rotation period 3080.91

Discounted expenditure over  
the rotation period including  
land rent @ Rs. 100.00/ha

3895.51

Cost benefit ratio 1: 0.79

NPV at 14% = 2098.52 - 3111.28 = - 1012.76

NPV at 12% = 3938.72 - 4124.97 = - 186.25

NPV at 10% = 5017.63 - 4792.62 = + 225.01

IRR = 10 + (12-10) x  $\frac{225.01}{225.01 - 186.25}$  = 10 + 1.09 = 11.09

= 12 +  $\frac{(2) (76.16)}{293.55}$  = 12+0.52 = 12.52

## 2. Irrigated forest plantations in Sindh

The provincial forest department of Sindh also manages a number of irrigated plantations in which babul and other species are raised in the form of plantation. The total area of these plantations is 82,000 ha. These lie outside the protective embankments of river Indus and are, consequently, provided irrigation water from canal network in the province. Originally, some canals were constructed for receiving flood water about 200 years ago. Later on, with the construction of weirs (barrages) on the river, perennial supply of irrigation water in the canals for agricultural crops was ensured. At the same time, the forest plantations were also started in selected areas to provide fuelwood and timber to the farming communities living in the newly canal-irrigated areas and wood fuel to railway steam locomotives.

In the early stages, the forest plantations of babul were grown through farmers by giving the land on lease to them for a short period of 3-5 years. The farmers grew rows of babul trees, about 10 m apart, and raised agricultural crops in between the rows of trees. This is still practiced in modified forms in some riverain forests and irrigated plantations of Sindh. The biggest advantage of this practice is that it involves minimal initial development expenditure on the part of Forest Department. However, currently more and more plantations are being grown without giving land on lease to farmers and instead, the pattern of raising plantations in the province of Punjab is being practiced.

### Economics of raising babul in irrigated plantation

The analysis was carried out in Miani Irrigated plantation. The total area of irrigated plantations in Hyderabad Forest Division is 2578.2 ha. The Miani plantation covers an area of 658.3 ha only. It is situated at a distance of about 11 km in the north west of the town of Hyderabad. It has general

characteristics of the tract as far as topography, climate and soil are concerned. However, patches of salt (Kallar) affected and waterlogged areas are extensively found in this plantation due to absence of proper drainage. The size of a compartment, which is a management unit, is 16 ha.

Babul is planted by sowing in trenches 3 m apart. Within trenches, the final spacing is 1.8 m. The sowing of seed is carried out during the months of May to July and fresh sowing to cover failures alongwith weeding are done in later part of year. Two weedings in the first year and one weeding and cleaning are undertaken in the plantation during 2nd and 3rd year of sowing seed. The rotation of the tree crop is 15 and produce is marketed as timber, pit props and fuelwood to the towns of Hyderabad, Karachi and Quetta. The rental value of the land was found to be Rs.1000.00 per hectare per annum. The daily rate of labour is Rs.27.00 per man day.

### Financial analysis

#### Statement of yearwise expenditure

	Man days No./ha	Amount Rs./ha	Discounted Amount Rs.
<u>Ist Year</u>	<u>82.1</u>	<u>2216.17</u>	<u>2216.17</u>
1. Jungle clearance	8.2	221.40	
2. Uprooting of stumps	5.5	148.50	
3. Earth work, digging of khals passils, trenches and bunds 279.9 m <sup>3</sup> /ha	49.4	1333.80	
4. Trial irrigation	1.4	37.80	
5. Cost of seed 10 kg	0.7	18.75	
6. Sowing of seed	3.4	91.80	
7. Irrigations 6 No. @ Rs.29.64/ha	6.6	178.20	

8. Weeding 2 No.	5.5	147.50	
9. Re-sowing	1.4	37.80	
<u>2nd Year</u>	<u>12.0</u>	<u>324.00</u>	<u>284.21</u>
1. Cost of seed 5 kg	0.3	8.10	
2. Re-sowing	0.7	18.90	
3. Irrigation 5 No. @ Rs.29.64/ha	5.5	148.50	
4. Weedings 2 No	5.5	148.50	
<u>3rd Year</u>	<u>14.8</u>	<u>399.90</u>	<u>307.71</u>
1. Cost of seed 5 kg	0.3	8.10	
2. Re-sowing	0.7	18.90	
3. Irrigation 4 No. @ Rs.29.64/ha	4.4	118.80	
4. Cleaning	6.7	180.90	
5. Weeding 1 No.	2.7	72.90	
<u>4th Year</u>	<u>14.0</u>	<u>378.00</u>	<u>255.13</u>
1. Irrigation 4 No. @ Rs.29.64/ha	4.4	118.80	
2. Weeding 1 No.	2.7	72.90	
3. Cleaning	6.9	186.30	
<u>5th Year</u>			
Irrigation 3 No. @ Rs.29.64/ha	<u>3.3</u>	<u>89.10</u>	<u>52.74</u>
<u>6th Year</u>			
Irrigation 3 No. @ Rs.29.64/ha	<u>3.3</u>	<u>89.10</u>	<u>46.26</u>
<u>7th Year</u>			
Irrigation 3 No. @ Rs.29.64/ha	<u>3.3</u>	<u>89.10</u>	<u>40.58</u>
<u>8th Year</u>			
Irrigation 2 No. @ Rs.29.64/ha	<u>2.2</u>	<u>59.40</u>	<u>23.73</u>

9th Year

Irrigation 2 No. @ Rs.29.64/ha	<u>2.2</u>	<u>59.40</u>	<u>20.82</u>
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10th Year

Irrigation 2 No. @ Rs.29.64/ha	<u>2.2</u>	<u>59.40</u>	<u>18.26</u>
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11th Year

Irrigation 2 No. @ Rs.29.64/ha	<u>2.2</u>	<u>59.40</u>	<u>16.02</u>
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12th Year

Irrigation 2 No. @ Rs.29.64/ha	<u>2.2</u>	<u>59.40</u>	<u>14.05</u>
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13th Year

Irrigation 2 No. @ Rs.29.64/ha	<u>2.2</u>	<u>59.40</u>	<u>12.32</u>
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14th Year

Irrigation 2 No. @ Rs.29.64/ha	<u>2.2</u>	<u>59.40</u>	<u>10.81</u>
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<u>15th Year</u>	<u>200.08</u>	<u>5404.17</u>	<u>863.09</u>
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- |   |       |         |  |
|---|-------|---------|--|
| 1. Felling and conversion charges of main felling. Firewood and timber 2.81* stacks @ Rs.637.86/stack | 66.38 | 1792.39 |  |
| 2. Sorting and stacking of 2.81 stacks @ Rs.132.60/stack  | 13.8  | 372.61  |  |
| 3. Transportation charges of 2.81 stacks @ Rs.1060.11/stack   | 110.3 | 2978.91 |  |
| 4. Depot charges for 2.81 stacks @ Rs.92.62/stack   | 9.6   | 260.26  |  |

<u>Annual expenditure/ha</u>	<u>220.62</u>		<u>1355.04</u>
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- |                             |       |  |  |
|-----------------------------|-------|--|--|
| 1. Water charges/irrigation | 53.72 |  |  |
| 2. Silt clearance           | 74.1  |  |  |
| 3. Kana stubbing            | 74.1  |  |  |
| 4. Maintenance road         | 7.5   |  |  |
| 5. Repair of buildings      | 0.2   |  |  |
| 6. Salaries of staff        | 11.0  |  |  |

Grand Total			<u>5537.47</u>
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\* One stack wood = 28.30 m<sup>3</sup> (1000 cft) stacked volume  
 2.81 stacks of wood = 79.52 m<sup>3</sup>

## Statement of revenue

Item	Amount Rs./ha	Discounted amount Rs.
<u>15th Year</u>		
Sale of 2.81 stacks @ Rs.6297.00/stack	<u>15805.47</u>	<u>2524.31</u>
<u>Annual revenue/ha</u>	32.85	201.76
1. Grazing and grass cutting	2.00	
2. Minor forest produce*	14.37	
3. Cultivation	8.94	
4. Other sources**	7.54	
	Grand Total	<u>2726.07</u>

## Summary of expenditure and revenue

A. Year expenditure	Amount Rs./ha	Discounted value @ (Rs.)		
		4%	6%	14%
1.	2216.70	2216.70	2216.70	2216.70
2.	324.00	311.54	305.66	284.21
3.	399.90	369.73	355.91	307.71
4.	378.00	336.04	317.38	255.13
5.	89.10	76.16	70.58	52.74
6.	89.10	73.23	66.58	46.26
7.	89.10	70.42	62.81	40.58
8.	59.40	45.14	39.50	23.73
9.	59.40	43.40	37.27	20.83
10.	59.40	41.73	35.16	18.26
11.	59.40	40.13	33.17	16.02
12.	59.40	38.58	31.29	14.05
13.	59.40	37.10	29.52	12.32
14.	59.40	35.67	27.85	10.81
15.	5404.17	3120.80	2390.26	863.09
Annual expenditure	220.62	2330.43	2050.66	1324.18
	<u>9626.49</u>	<u>9186.80</u>	<u>8070.33</u>	<u>5506.61</u>

\* It includes sale of pods as fodder

\*\* It includes compensations and damage recoveries

**B. Revenue**

15th Year	15805.47	9127.34	6990.75	2524.31
Annual revenue	32.85	379.85	338.19	179.17
	<hr/>	<hr/>	<hr/>	<hr/>
Total	<u>15838.32</u>	<u>9507.29</u>	<u>7329.94</u>	<u>2753.33</u>

**Cost benefit ratio****Rs./ha**

1. Discounted revenue over the rotation period 2725.07

Discounted expenditure over the rotation period excluding land rent 5537.47

Cost benefit ratio 1:0.49

2. Discounted revenue over the rotation period 2725.07

Discounted expenditure over the rotation period including land rent @ Rs.1000.00/ha 11935.72

Cost benefit ratio 1:0.23

- NPV @ 14% = 2753.33 - 5727.23 = - 2973.90

- NPV @ 14% including land rent = - 9210.65

- NPV @ 4% = 9507.29 - 9407.47 = 99.87

- NPV @ 6% = 7329.94 - 8290.95 = - 961.01

- IRR =  $4 + (6-4) \frac{99.87}{99.87 + 961.01} = 4.19$

=  $4 + 0.53 = \underline{4.53}$

**3. 'Hurries' plantations on the farmlands**

The practice of growing babul on farmlands in Sindh, Pakistan is more than one hundred years old. It was started in 1858, when the government decided to give 4 ha of state land free

to any farmer who would raise trees in the form of block plantations called 'Hurries'. This was done to provide adequate supply of fuelwood to the farming communities which were settling in the newly irrigated areas in this region. Further, it was expected that the tree growth in the dry tropical areas would help protect the farmlands from aridity. The farmers were provided additional facilities of free irrigation water from canals and remission of land revenue. These measures enabled a large number of farmers to grow tree plantations on their farmlands. Presently, 'hurries' planting is confined to three districts of Thatta, Sanghar and Hyderabad in the province. Further, now neither land nor irrigation water are provided free. The farmer has to pay water charges as well. Babul is the only tree species which is planted in these plantations<sup>20</sup>.

#### Economics of growing babul in 'Hurries' plantations

For the purpose of this study, data on the cost of establishment and revenue for growing babul in 'Hurries' plantations were collected from two villages namely, Sekhat and Kheber which are situated at a distance of about 30-35 km north of Hyderabad town. These villages are typical of rural Sindh. The entire cropped area is artificially irrigated by canal water or tubewells because of scanty rainfall. Majority of farms are small in size and 76% farms are below 5 ha. The subsistence farming is way of life in this tract. Major agricultural crops are wheat, cotton and sugar cane. The babul trees are grown in conjunction with agricultural crops for one year only, in the form of block plantation in these villages.

The farmers procure babul seed from the market or from

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<sup>20</sup> Sheikh, M. I. 1986. A case study on Hurries Acacia nilotica block plantations for wood production in Pakistan. Pakistan For. Inst. Peshawar, Pakistan.

provincial forest department. Land is ploughed and levelled to ensure even spread of irrigation water. Seed of babul is broad-cast sown or sown in drills alongwith cotton seed in the month of April in blocks of 20 x 20 m. Cleaning and pruning are carried out during 3rd and 4th year. Standing trees are sold by the farmers to the contractors after they have grown for 7 years. The trees are converted in pit props for coal mines within the province, small size timber for house construction and fuelwood and supplied to the town of Hyderabad.

The following analyses have been carried out separately for canal irrigated and tubewell irrigated 'Hurries' plantations because water rates differ in them. The land rent in these villages is Rs.1500.00 per ha and daily rate of unskilled worker is Rs.30.00. A discount factor of 14% has been used in the analyses.

#### Financial analysis

##### Statement of yearwise expenditure of 'Hurries' plantation irrigated by tubewell water.

Item	Man days No./ha	Amount Rs./ha	Discounted amount Rs.
<u>Ist Year</u>	81.8	2,454.00	2,454.00
1. Cost of purchase of seed, 25 kg/ha	3.1	93.00	
2. Ploughing of land	18.5	555.00	
3. Seed sowing in drills	1.8	54.00	
4. Tubewell water expenditure for irrigation 6 No. @ Rs.86.45/ha	25.9	777.00	
5. Irrigation 6 No. @ Rs. 9.88 per irrigation	2.9	87.00	

	69		
6. Chowkidar	29.6	888.00	
<u>2nd Year</u>	<u>58.4</u>	<u>1752.00</u>	<u>1348.10</u>
1. Tubewell water expenditure for irrigation 6 No. @ Rs. 129.50/ha	25.9	777.00	
2. Irrigation 6 No. @ Rs. 14.50/ha	2.9	87.00	
3. Chowkidar	29.6	888.00	
<u>3rd Year</u>	<u>83.1</u>	<u>2493.00</u>	<u>1917.38</u>
1. Cleaning and pruning	24.7	741.00	
2. Tubewell water expenditure for irrigation 6 No. @ Rs.129.50/ha	25.9	777.00	
3. Irrigation 6 No. @ Rs.14.50/ha	2.9	87.00	
4. Chowkidar	29.6	888.00	
<u>4th Year</u>	<u>76.9</u>	<u>2307.00</u>	<u>1557.20</u>
1. Cleaning and pruning	18.5	555.00	
2. Tubewell water expenditure for irrigation 6 No. @ Rs.129.50/ha	25.9	777.00	
3. Irrigation 6 No. @ Rs.14.50/ha	2.9	87.00	
4. Chowkidar	29.6	888.00	
<u>5th Year</u>	<u>58.4</u>	<u>1752.00</u>	<u>1037.29</u>
1. Tubewell water expenditure for irrigation 6 No. @ Rs.129.50/ha	25.9	777.00	
2. Irrigation 6 No. @ Rs.14.50/ha	2.9	87.00	
3. Chowkidar	29.6	888.00	
<u>6th Year</u>	<u>58.4</u>	<u>1752.00</u>	<u>910.54</u>

1. Tubewell water expenditure for irrigation 6 No. @ Rs.129.50/ha	25.9	777.00	
2. Irrigation 6 No. @ Rs.14.50/ha	2.9	87.00	
3. Chowkidar	29.6	888.00	
<u>7th Year</u>	<u>58.4</u>	<u>1752.00</u>	<u>798.17</u>
1. Tubewell water expenditure for irrigation 6 No. @ Rs.129.50/ha	25.9	777.00	
2. Irrigation 6 No. @ Rs.14.50/ha	2.9	87.00	
3. Chowkidar	29.6	888.00	
Annual expenditure/ha Land revenue tax	<u>37.05</u>		<u>158.87</u>
	Grand Total		10181.55

## Statement of yearwise revenue

Item	Amount Rs./ha	Discounted amount Rs.
<u>4th Year</u>		
Sale of pods	741.00	499.71
<u>5th Year</u>		
Sale of pods	815.10	482.58
<u>6th Year</u>		
Sale of pods	815.10	423.33

7th Year

Sale of crops	44460.00	20255.12
		-----
Grand Total		21660.74
		-----

## Summary of expenditure and revenue

A. Expenditure

<u>Year</u>	Amount Rs./ha	Discounted value in Rs. @		
		<u>14%</u>	<u>38%</u>	<u>40%</u>
1	2454.00	2454.00	2454.00	2454.00
2	1752.00	1348.10	1269.00	1251.42
3	2493.00	1917.38	1309.00	1271.94
4	2307.00	1557.20	877.83	840.74
5	1752.00	1037.29	483.08	456.06
6	1752.00	910.54	350.06	325.75
7	1752.00	798.17	253.66	232.68
Annual expenditure	<u>37.05</u>	<u>158.87</u>	<u>83.38</u>	<u>80.32</u>
Total	<u>14299.05</u>	<u>10181.55</u>	<u>7080.01</u>	<u>6912.91</u>

B. Revenue

4	741.00	499.71	281.00	270.04
5	815.10	482.58	224.72	212.15
6	815.10	423.33	162.84	151.54
7	<u>44460.00</u>	<u>20255.12</u>	<u>6726.74</u>	<u>6170.37</u>
Total	46831.20	21660.74	7395.30	6804.10

Net Present Value

$$\text{NPV @ 14\%} = 21660.74 - 10181.55 = \underline{11479.15}$$

$$\text{NPV @ 14\% including land rent of Rs.1500/ha} = 21660.74 - 16614.00 = \underline{5046.74}$$

## Cost benefit ratio

1. Discounted expenditure over the rotation period excluding land rent	Rs./ha 10181.55
Cost benefit ratio	1: 2.13
2. Discounted revenue over the rotation period	21660.74

Discounted expenditure over the

rotation period including land  
rent @ Rs. 1500/ha (Rs. 6432.45 + 10181.55) 16614.00

Cost benefit ratio 1:1.30

IRR

NPV @ 38% = + 315.29

NP @ 40% = - 108.81

IRR =  $38 + (40-38) \times \frac{315.29}{315.29+108.81} = 38 + (2) \frac{(315.29)}{424.10}$

= 38 + 1.49 = 39.49

Financial analysis

Statement of yearwise expenditure of 'Hurries'  
plantation irrigated by canal water.

Item	Man days No./ha	Amount Rs./ha	Discounted Amount Rs.
<u>Ist Year</u>	<u>55.9</u>	<u>1677.00</u>	<u>1677.00</u>
1. Cost of purchase of seed, 25 kg/ha	3.1	93.00	
2. Ploughing of land	18.5	555.00	
3. Seed sowing in drills	1.8	54.00	
4. Irrigation 6 No. @ Rs. 14.50	2.9	81.00	
5. Chowkidar	29.6	888.00	
<u>2nd Year</u>	<u>32.5</u>	<u>975.00</u>	<u>855.26</u>
1. Irrigation 6 No. @ Rs. 14.50/ha	2.9	87.00	
2. Chowkidar	29.6	888.00	
<u>3rd Year</u>	<u>57.2</u>	<u>1716.00</u>	<u>1320.40</u>
1. Cleaning and pruning	24.7	741.00	
2. Irrigation 6 No. @ Rs. 14.50/ha	2.9	87.00	
3. Chowkidar	29.6	975.00	
<u>4th Year</u>	<u>51.0</u>	<u>1530.00</u>	<u>1032.73</u>
1. Cleaning and pruning	18.5	555.00	
2. Irrigation 6 No. @ Rs. 14.50/ha	2.9	87.00	
3. Chowkidar	29.6	975.00	

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<u>5th Year</u>	<u>32.5</u>	<u>975.00</u>	<u>577.25</u>
1. Irrigation 6 No. @ Rs.14.55	2.9	87.00	
2. Chowkidar	29.6	975.00	
<u>6th Year</u>	<u>32.5</u>	<u>975.00</u>	<u>506.38</u>
1. Irrigation 6 No. @ Rs.14.50/ha	2.9	87.00	
2. Chowkidar	29.6	975.00	
Annual expenditure/ha		<u>72.05</u>	<u>280.20</u>
1. Water charges for irrigation		35.00	
2. Land revenue		37.05	
		Grand Total	<u>6249.22</u>

## Statement of yearwise revenue

Item	Amount Rs./ha	Discounted amount Rs.
<u>4th Year</u>		
Sale of pods	741.00	499.71
<u>5th Year</u>		
Sale of pods	815.10	482.58
<u>6th Year</u>		
Sale of crop	17435.29	9055.40
	Grand Total	<u>10037.69</u>

## Summary of expenditure and revenue

A. Expenditure

<u>Year</u>	Amount Rs./ha	<u>Discounted value @ (Rs.)</u>		
		14%	32%	34%
1	1677.00	1677.00	1677.00	1677.00
2	975.00	855.26	738.64	727.12
3	1716.00	1320.40	984.85	955.67
4	1530.00	1032.73	665.23	635.88

5	975.00	677.25	321.15	302.40
6	975.00	506.36	243.29	202.02
Annual expenditure	72.05	280.20	168.97	162.86
<b>Total</b>	<u>7920.00</u>	<u>6249.22</u>	<u>4799.13</u>	<u>4662.95</u>

**B. Revenue**

Year				
4	741.00	499.71	322.18	307.97
5	815.10	482.58	268.48	252.81
6	17435.29	9055.40	4350.70	4035.57
<b>Total</b>	<u>18991.39</u>	<u>10037.69</u>	<u>4941.36</u>	<u>4596.35</u>

**NPV**

NPV @ 14% = Rs.10037.69 - Rs.6249.22 = Rs.3788.47

NPV @ 14% including = Rs.10037.69 - 12082.22 = Rs.2044.54  
land rent

**Cost benefit ratio**

Rs./ha

1. Discounted revenue over rotation period	10037.69
Discounted expenditure over rotation period excluding land rent	6249.22
2. Discounted revenue over rotation period	10037.69
Discounted expenditure over rotation period excluding land rent Rs. 1500/ha	12082.22

**Cost benefit ratio**

1. Excluding Land Rent	=	1:1.61
2. Including Land Rent	=	1:0.83

IRR

$$\text{NPV @ 32\%} = + 142.23$$

$$\text{NPV @ 34\%} = - 66.60$$

$$\text{IRR} = 32 + (34-32) \frac{142.23}{142.23+66.60} = 32+1.36 = \underline{33.36}$$

EUCALYPTUS CAMALDULENSIS PLANTING  
IN KHIPRO PLANTATION, SINDH

Khipro plantation covering an area of 9232.4 ha is situated on both bank of Nara canal near Khipro town of Sanghar district in Sindh. It is in the form of two narrow strips of land along the two banks of canal. Before the commissioning of Sukkur Barrage and the present Nara canal, the area was receiving flood water from river Indus through Dhorro Naro, and a riverain forest of babul was growing on it. In later part of eighteenth century, the river changed its course and tree crop deteriorated due to aridity. The forest was mainly used as game reserve by the then rulers of the tract. The plantation was established in 1891 and managed by Revenue Department upto 1947 when its management was transferred to the Forest Department, Sindh.

The plantation is situated in the marginal tract of the Indus valley adjoining Thar desert. For its greater part, the ground is flat with a gentle slope towards south. At places flat ground is cut up by old abandoned beds of Dhorro Naro which used to meander in the area in the past. Large sand dunes, upto 120-150 ha in area and about 30 m in height, are also found scattered all along the border of the plantation with the desert. The geology, soil and climate of Khipro plantation are same as those of riverain forest in Sindh. However, due to artificial irrigation, the plantation has developed salinity and waterlogging at some places.

The planting of Eucalyptus camaldulensis was started in this plantation in 1973 under a special project to provide industrial raw material to pulp and paper, chipboard and furniture industries. To-date, about 3500 ha area has been planted with this species.

1. Economics of growing Eucalyptus camaldulensis in Khipro plantation

One year old plants of Eucalyptus camaldulensis are raised in polythene containers in the nursery. These are planted at 1.5 x 1.5 m spacing in trenches during the months of February and March. The restocking of failures is carried out in 2nd and 3rd year of planting. Two weedings in 1st year and one weeding in each of 2nd, 3rd and 4th year are undertaken in the plantation. The rotation of crop is fixed at 8 years and trees are sold standing through open auction. The trees are converted into poles and fuelwood which are marked in Sanghar, Mirpur Khas, Hyderabad and Karachi. Some wood is also converted into sawn timber for use in boat manufacture in Karachi. However, the plantation is located at a large distance from major centres of consumption. Hence, the economic returns are rather low. The rental value of the land was also found to be low e.g., Rs.400.00 per hectare per annum. This is due to salinity and water logging in the area. The daily rates of labour are only Rs.18.00 per man day.

Financial Analysis

Statement of year-wise expenditure

Item	Man days (No./ha)	Amount Rs./ha	Discounted amount (Rs.)
<u>Ist Year</u>	<u>313.9</u>	<u>5650.20</u>	<u>5650.20</u>
1. Jungle clearance	11.5	101.00	
2. Lay out of irrigation	4.1	73.80	
3. Earth work, digging of khalls, passels, trenches 419.8 m <sup>3</sup> /ha	69.1	1243.80	
4. Trial irrigation	2.0	36.00	
5. Cost of 4303 plants @ Rs. 0.75 per plant	8.5	255.00	
6. Carriage charges of 4303 plants @ Rs.0.06 per plant	14.3	257.40	

	78		
7. Planting of 4303 plants at Rs.0.09 per plant	23.30	419.40	
8. Irrigation 6 No. @ Rs.18.52/ha	6.2	111.60	
9. Weedings 2 No.	4.1	73.80	
<u>2nd Year</u>	<u>73.3</u>	<u>1319.40</u>	<u>1157.76</u>
1. Cost of replacement of failure (30%) 1291 plants @ Rs. 0.75 per plant	53.8	968.40	
2. Carriage charges of 1291 plants	4.3	77.40	
3. Planting of 1291 plants	7.0	126.00	
4. Irrigation 6 No. @ Rs. 18.52/ha	6.2	111.60	
5. Weeding 1 No.	2.0	36.00	
<u>3rd Year</u>	<u>11.1</u>	<u>199.80</u>	<u>154.27</u>
1. Restocking 1.5% cost of plants, planting cost of failures at 0.75 per plant	2.7	48.60	
2 Carriage charges 1.5% of failures	0.2	3.60	
3. Irrigation 6 No. @ Rs. 18.52/ha	6.2	111.60	
4. Weeding 1 No.	2.0	36.00	
<u>4th Year</u>	<u>8.2</u>	<u>147.60</u>	<u>100.03</u>
1. Irrigation 6 No. @ Rs. 18.52/ha	6.2	111.60	
4. Weeding 1 No.	2.0	36.00	
<u>5th Year</u>			
1. Irrigation 4 No. @ Rs. 18.52/ha	<u>4.1</u>	<u>73.80</u>	<u>43.96</u>

79

6th Year

1. Irrigation 4 No. @  
Rs. 18.52/ha

12.3

221.40

115.45

4.1

73.80

4. Cleaning and pruning

8.2

147.60

7th Year

1. Irrigation 4 No. @  
Rs. 18.52/ha

4.1

73.80

33.75

8th Year

1. Irrigation 4 No. @  
Rs. 18.52/ha

4.1

73.80

29.61

Annual expenditure/ha

334.16

1550.66

1. Water charges for irrigation

53.72

2. Silt clearance

74.10

3. Kana stubbing

74.10

4. Repair of buildings

0.26

5. Salaries of staff

131.98

Grand Total

8835.09

## Statement of revenue

Item	Amount Rs/ha	Discounted amount Rs.
<b>8th Year</b>		
Revenue from the sale of 3.35 stacks (94.80 m <sup>3</sup> )@ 1985.62 per stack	6651.84	2658.29
<b>Annual revenue/ha</b>	<b>49.83</b>	<b>231.16</b>
1. Grazing/grass cutting	Rs. 0.89	
2. Cultivation of cotton	Rs. 22.86	
3. Minor forest produce*	Rs. 9.79	
4. Other sources**	Rs. 16.29	
<b>Grand Total</b>		<b>2813.88</b>

## Summary of expenditure and revenue

A. Year expenditure	Amount Rs./ha.	Discounted value @ 14% (Rs.)
1.	5,650.20	5,650.20
2.	1,319.40	1,157.76
3.	199.80	154.27
4.	147.60	100.03
5.	73.80	43.86
6.	221.40	115.45
7.	73.80	33.75
8.	73.80	29.61
Annual expenditure	334.16	1,550.16
<b>Total</b>	<b>8,093.96</b>	<b>8,835.09</b>

\* It includes sale of pods.

\*\* It includes dead, dying tree, sale of plants and compensations.

**B. revenue**

3th year	6,651.84	2,658.29
Annual revenue	49.83	231.16
	-----	-----
Total	6,701.67	2,889.45
	-----	-----

**NPV**

$$= \text{Rs.}2889.45 - \text{Rs.}8835.09 = \underline{\underline{-5945.6}}$$

$$\text{NPV including land rent of Rs.}247.00/\text{ha} = \text{Rs.}2889.45 - \text{Rs.}10837.32 = \underline{\underline{-7947.87}}$$

**COST BENEFIT RATIO**

	<u>Rs./ha</u>
1. Discounted revenue over the rotation period	2,889.45
Discounted expenditure over the rotation period excluding land rent	8,835.09
cost benefit ratio	<u>1 : 0.33</u>
2. Discounted revenue over the rotation period	2,889.45
Discounted expenditure over the rotation period including land rent @ Rs.247.00/ha	10,837.32
Cost benefit ratio	<u>1 : 0.27</u>

**IRR** Since expenditures exceed revenue without considering time value of money, there is no need of IRR calculation

## Summary of Financial Results of certain tree crops in Pakistan

S. No	Locality	Tree Crop	Rotation	NPV at 14 % discounted rate		B/C ratio		Internal rate of Return (IRR)
				Excluding land rent	Including land rent(Rs)	Excluding land rent(Rs)	Including land rent	
1.	Peshawar-Mardan (Farm Lands)	Poplar	6 years	..	23233.00	..	2.86	77.45
2.	Changa Manga Irrigated Plantation	Shisham Mulberry	22 years	2677.76	-12627.72	1.22	0.56	16.06
3.	"	Poplar	11 years	10981.93	3129.14	1.87	1.15	..
4.	Farm Land (Punjab)	Shisham	15 years	..	509.27	..	1.15	16.20
5.	Riverain Forests (Sindh)	<u>Acacia nilotica</u> (Babul)	15 years	- 484.02	- 1103.73	0.93	0.72	11.09
6.	Irrigated plantation (Sindh)	<u>Acacia nilotica</u> (Babul)	15 years	- 2973.90	-9975.97	0.49	0.22	4.19
7.	Hurri plantation on farm lands in Sindh Tubewell irrigated Canal irrigated	<u>Acacia nilotica</u> (Babul)	7 years	11479.15	5046.74	2.13	1.30	39.49
			6 years	3788.47	-2044.54	1.61	0.83	33.36
8.	Khipro (Sindh)	<u>Eucalyptus camaldulensis</u>	8 years	-5945.64	-7947.87	0.33	0.27	..

PROFORMA FOR POPLAR TREES DATA COLLECTION  
FROM FARMERS IN PESHAWAR AND MARDAN DISTRICTS

1. Name of the Farmer
2. Address
3. Occupancy status
  - i) Owner
  - ii) Tenant
  - iii) Owner cum tenant
4. Size of land holding (ha/ac)
  - i) Irrigated
  - ii) Non-irrigated
  - iii) Semi-irrigated
5. Objective of planting trees
  - i) Commercial
  - ii) Self consumption
  - iii) For intangible benefits
6. Type of tree growth
  - i) compact
  - ii) Linear
  - iii) Scattered
7. Tree growing cost
  - i) Source of sapling
  - ii) Site preparation cost (man-days)
  - iii) Cost of sapling (cost of plants + transportation charges)
  - iv) Planting cost (man-days)
  - v) Maintenance cost (weeding, cleaning etc)
8. Cost of irrigation
  - i) Man-days required for irrigation
  - ii) Local labour rate
9. Average number of trees harvested/sold each year.
10. Harvesting age
11. Cost of harvesting
12. Method of marketing
  - i) Standing sale
  - ii) Sale after felling on the farm after conversion
  - iii) Felling and conversion cost
  - iv) Transportation cost, if any
13. Income
  - i) By volume
  - ii) By weight
  - iii) Per tree

BASIS OF COST AND INCOME CALCULATIONS FOR POPLAR  
PLANTING IN PESHAWAR AND MARDAN DISTRICTS

1. Cost of site preparation in the analysis including levelling and dressing of the water channels and berms. The farmer spends 9.6 mandays per hectare for this purpose.
2. Cost of sapling in the analysis includes only cost of preparation of cutting and transportation charges to the planting site. For this operation 4 man days are required per hectare annually.
3. Cost of planting includes digging of pits and planting and 11 man days/hectare/annum are needed for this operation.
4. Maintenance cost comprises weeding, cleaning and fertilizat.on. For this 1.3 mandays/hectare/annum are required. Cost of irrigation have not been taken into account for analysis because in any case the farmer has to irrigate agriculture crops with or without trees and the rate/number if irrigation remain constant.
5. Loss in agriculture crop due to introduction of trees on farm lands was calculated on the basis of total loss reported by the farmer for sugarcane and wheat and maize crops per hectare per annum. The agricultural productivity has been estimated as follows

a.	Sugarcane production 387 maunds/ha/annum @ Rs.15.00 per maund	Rs. 5805.00
b.	Wheat maize, 12.35 + 10.7 maunds/ha/annum @ Rs. 120/- per maund	<u>Rs. 2766.00</u>
	Total Rs.	8571.00
	Average Rs.	4285.50/ha/annum

The loss was about 25% in second year of planting, 50% in 3rd year, 75% in 4th year and 100% in 5th and 6th year. On the average it comes to approximately Rs.2499.87 per hectare per annum.

6. The rotation age has been fixed according to the reported age of the sold trees. The average age was calculated as 5.5 years against which full 6 years were taken as rotation age for financial analysis.
7. Income per tree per annum has been calculated on the basis of average number of trees sold per annum by the farmer and average price per tree received by him. To arrive at income per tree weighted averages were calculated for each sample unit, which comes to Rs.100.00 per tree.

COST PER HA OF RAISING AND MAINTENANCE  
OF SHISHAM BED NURSERY WITH 1.52 m APART  
TRENCHES IN CHANGAMANGA PLANTATION

<u>Ist Year</u>	<u>Mandays</u>
1. Site clearance	7.4
2. Levelling (minor)	7.4
3. Ploughing 3 times and planting with Sohaga	7.4
4. Pricking of grass after ploughing	4.9
5. Layout and dag bailing	1.2
6. Construction of mains and khals	9.9
7. Making of beds, passels and trenches	74.1
8. Sowing	37.0
9. Resowing to cover failures	4.9
10. Price and packing of seed including carriage to the site	37.0
11. Irrigation/watering	37.0
12. Weeding	64.2
13. Silt clearance, noke safai/repair of khals and mains	3.7
14. Unforeseen/misc.	<u>4.9</u>
Total	301 mandays
@ Rs.30 per manday Rs.9030 per ha.	

Maintenance of bed nursery during 2nd year (Rs.per ha)

1. Extraction and packing etc. of 50,000 stumps @ Rs.60 per 1000	= Rs.3000
2. Fertilization, weeding, irrigation and maintenance of beds/trenches and watercourses	= Rs.1000
Total	= <u>Rs.4000 per ha</u>

Maintenance of bed nursery during 3rd year

1. Extraction and packing etc. of 50,000 stumps @ Rs.60 per 1000 plants	Rs.3000
2. Irrigation, weeding and fertilizer	<u>Rs. 500</u> Rs.3500 per ha

## APPENDIX-IV

COST PER HA OF RAISING 1ST AND IIND STAGE  
POPLAR NURSERIES IN CHANGAMANGA PLANTATION

<u>Ist stage 7.5 cm x 1 m planting</u>	<u>Qty/No.</u>	<u>Rate</u>	<u>Amount</u>
1. Uprooting of stumps	247	Rs.1.50	Rs.370.50
2. Collection and burning of debris	1 ha	Rs.74.10	Rs. 74.10
3. Irrigation before ploughing	1	Rs. 5.56 per irrigation	Rs. 5.56
4. Ploughing with mould board plough	4 No.	Rs.64.83 per ploughing	Rs.259.32
5. Levelling with scraper/roller	3 No.	Rs.37.05 each	Rs.111.15
6. Digging of main and khals	1 ha	Rs.129.67 per ha	Rs.129.67
7. Layout of lines 1 m apart	10,931 m length	Rs.0.75 per 305 m length	Rs. 26.88
8. Preparation and planting of cuttings	143,458 No.	Rs.13.50 per 1000	Rs.1936.68
9. Irrigation 18 No.	18 No.	Rs. 3.70 each	Rs. 66.69
10. Hoeing by manual labour once in a month from March to September	7 No.	Rs.148.2 each	Rs.1037.40
11. Application of fertilizer	5 bags	Rs.105/-each	Rs.525.00
12. Water rate charges	1/ha	Rs.42.60 per ha	Rs. 42.60
		Total	<u>Rs.4585.55</u>

2nd stage poplar nursery 1 m x 1 m

	<u>Qty/No.</u>	<u>Rate</u>	<u>Amount</u>
1. Uprooting	247 No.	Rs. 1.50 each	Rs. 70.50
2. Collection	1 ha	Rs.74.10 per ha	Rs. 74.10
3. Irrigation	1 No.	Rs. 5.56 per ha	Rs. 5.56
4. Ploughing	4 No.	Rs.64.83	Rs. 259.32
5. Levelling	3 No.	Rs.37.05	Rs. 111.15
6. Digging	1 ha.	Rs.129.67	Rs. 129.67
7. Layout	10,931 m length	Rs. 0.75 per 305 m length	Rs. 26.88
8. Preparation and planting of cuttings	11,960	Rs.13.50/1000	Rs. 161.46
9. Irrigation	18	Rs. 3.70/each	Rs. 66.69
10. Hoeing	7 No.	Rs.148.2/each	Rs.1037.40
11. Fertilizer application	5 bags	Rs.105/each	Rs. 525.00
12. Water rate charges	1/ha	Rs.42.60/ha	Rs. 42.60
		Total	<u>Rs.2810.33</u>

BASIS OF COST AND INCOME CALCULATIONS FOR  
SHISHAM PLANTING ON FARMLANDS IN PUNJAB

1. Cost of site preparation includes dressing of water channel and berms on levelling in case of linear planting and digging of pits in case of scattered planting. For this purpose 1.7 man days per hectare have been calculated.
2. Cost of sapling comprises purchase of stumps and transportation charges from forest nursery to the planting site. For this about 0.64 man days per hectare are required.
3. Cost of maintenance includes weeding and pruning etc. About 4.4 man days are required per hectare annually for these operations.
4. The tree density per hectare was computed on the basis of total number of trees standing in the farmlands of all sample units. This came to be about 30 trees per hectare. Out of 30 trees/ha at the rotation age.
5. The reported harvesting age of trees varied from 10 to 22 years. The rotation age was calculated by averaging the harvesting age of all the sample units, which was about 15.3 years. Therefore, the rotation age was fixed as 15 years for analysis.
6. The sale price of tree was calculated on the basis of weighted averages of the total income earned by sample farmers, which was Rs.537.40 per tree.
7. Total revenue was determined on the basis of amount received by the farmer by selling 30 trees at the end of rotation period.
8. Loss in agriculture crop due to shisham trees was calculated on the basis of average loss incurred while growing various crops. This was found to be Rs.396.18 per hectare. Thus total loss during rotation period was Rs.5941.65. The total loss was distributed amongst various age classes of trees. It was observed that upto 2 year of age of trees did not contribute to loss of agricultural crops. However, during 3rd and 4th year the loss was estimated as 25%, 5th and 6th year the loss was 50%, 7th and 8th year was 75% and 100% for the rest of the growth period of the trees.