Sub-study of the India country study of the international collaborative research project: Instruments for sustainable private sector forestry

INDIA COUNTRY SUB-STUDY

The second green revolution: Analysis of farm forestry experience in western *Tarai* region of Uttar Pradesh and coastal Andhra Pradesh

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Acronyms

AMC	Agricultural Market Committees
AP	Andhra Pradesh
APPM	Andhra Pradesh Paper Mills
DFO	Divisional Forest Officer
ETP	Entire Transplant of Poplar
FAO	Food and Agriculture Organisation
FD	Forest Department
GoAP	Government of Andhra Pradesh
GoI	Government of India
GoUP	Government of Uttar Pradesh
ha	Hectare
IIPO	Indian Institute of Public Opinion
ITC BPL	ITC Bhadrachalam Paperboards Limited
MoEF	Ministry of Environment and Forests
MRO	Mandal Revenue Officer
MT	Metric Tonne
NABARD	National Bank for Agricultural and Rural Development
NCA	National Commission on Agriculture
NCAER	National Council of Applied Economic Research
NGO	Non Government Organisation
NTFP	Non-timber Forest Produce
ODA	Overseas Development Administration
ORG	Operations Research Group
R&D	Research and Development
UP	Uttar Pradesh
USAID	United States Agency for International Development
WSL	Wimco Seedlings Limited

Preface

The present study is part of a wider international project titled 'Instruments for Sustainable Private Sector Forestry' being co-ordinated by the International Institute for Environment and Development (IIED), London. The overall aim of the project is to identify effective market and regulatory instruments that ensure private sector produces social and environmental benefits from forest management and to promote these instruments.*

In the first phase of the project, a **Global Review of Private Sector Participation in Sustainable Forest Management** was undertaken. This provided a snapshot of status and trends regarding private sector participation in sustainable forest management in 23 countries from all regions of the world.

In the second phase of the project, detailed country specific studies are being carried out in five countries *viz.* **Brazil, China, India, Papua New Guinea** and **South Africa.** The present study forms a part of the India Country Study, which is being co-ordinated by Ecotech Services (India) Pvt. Ltd. (ETS), New Delhi. These studies are being funded by the Department for International Development (DFID), India.

The broad objectives of the India Country Study are to understand

*In this project, the term 'private sector' is interpreted broadly such that it includes all those who engage in commercial activity concerning forest goods and services—be they individuals, community groups, informal sector groups or the large-scale corporate sector.

the current situation, trends and potentials with respect to private sector participation in sustainable forest management; to review the impact of sectoral and extra-sectoral policies on private sector participation; and to explore strategic options for the private sector to contribute to sustainable forest management in India. The India country study consisting of 6 sub-studies is divided into four broad themes: (1) baseline research; (2) emerging new private sector players; (3) policy provisions for private sector participation in sustainable forest management; and (4) market based instruments to encourage private sector's contribution to sustainable forest management. (See pages xi-xii for a list of the 6 sub-studies.)

The present study is part of the theme **Emerging new private sector players**, which analyses potential new sources of supply of forest goods, with a view to identifying a range of options to ensure future sustainable supplies. This theme focuses particularly on the potential of farm forestry, company-farmer partnerships and commercially productive Joint Forest Management (JFM) areas to supply forest goods. It also considers the contribution of the small-scale private sector both as a producer and consumer of such goods.

It is hoped that the insights gained from this study would help the policy makers to arrive at appropriate policy responses to further strengthen farm forestry in the country.

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R. P. Mattoo
Chief Technical Director
Ecotech Services (India) Pvt. Ltd.

Sub-studies under the India Country Study

The New Foresters: the role of private enterprise in the Indian forestry sector is the India country study prepared under the project **Instruments for sustainable private sector forestry**. This study derives from a series of sub-studies that were commissioned under the project. The sub-studies are:

1. *Policies affecting private sector participation in sustainable forest management*. Daman Singh. Ecotech Services (India) Pvt. Ltd. 2002.

   The private sector's participation in forestry activities is determined by policies at the central and state levels, not only those directly related to forests but also policies and legislation introduced for other sectors e.g. land ceiling on agriculture lands, export-import policies, tax laws etc. This study provides an overview of the policy environment for the private sector participation in forestry activities.

2. *Potential for commercial production from forests under Joint Forest Management*. Hema Arora, Anjali M. Bhatia and Snigdha Chakraborty. Ecotech Services (India) Pvt. Ltd. 2002.

   Around 15 per cent of India's forestland is already under joint forest management (JFM). Given the considerable area under JFM, these forests could well be important sources of raw material in future. This study examines the potential for commercial production from JFM forests by analysing the situation in Haryana and West Bengal—two states where the JFM programme first started and has reached a level of maturity.

3. *New hope for private forestry: Policy and practice of Lok Vaniki in Madhya Pradesh*. S. Raghavan and P. Srivastava. Ecotech Services (India) Pvt. Ltd. 2002.

   The state of Madhya Pradesh has recently introduced significant policy changes to encourage private sector participation in forestry. This study analyses the process of policy change and attempts to highlight the factors that made positive policy change possible.

4. *The ayurvedic medicine industry: Current status and sustainability.* Niraj Subrat, Meera Iyer and Ram Prasad. Ecotech Services (India) Pvt. Ltd. 2002.

Ayurvedic industry is an important forest-based industry, which uses a large quantum of medicinal plants that are mainly procured from the wild. The domestic market for ayurvedic formulations is expanding rapidly and the government is planning to substantially increase exports. There is danger of overexploitation of the medicinal plant resources if corrective steps involving the industry are not taken. This study examines the potential of application of certain market-based instruments to promote sustainable utilisation of these resources.

5. *Review of company-farmer partnerships for the supply of raw material to wood-based industry.* Sushil Saigal and Divya Kashyap. Ecotech Services (India) Pvt. Ltd. 2002.

   The national forest policy clearly indicates that forest-based industry should meet its raw material needs by establishing direct relationships with farmers. This study analyses the experience with partnership schemes started by four companies and provides suggestions for improvement.

6. *The second green revolution: Analysis of farm forestry experience in western Tarai region of Uttar Pradesh and coastal Andhra Pradesh*. Sushil Saigal and Divya Kashyap. Ecotech Services (India) Pvt. Ltd. 2002.

   Farm forestry was actively promoted by the government during the 1970s and 1980s, and farmers in several states planted trees on a large scale. Due to a variety of reasons, tree planting by farmers declined by the end of the 1980s. In recent years, farm forestry has again become popular among farmers. This study documents the farm forestry experience in the '70s and '80s and, through detailed case studies of two districts, analyses the reasons behind the popularity of farm forestry among local farmers.

These studies are available from Ecotech Services (India) Pvt. Ltd. and the Forestry and Land Use Programme of IIED (contact details are given behind the title page).

Executive summary

Farm forestry refers to tree planting on private land by farmers. Farm forestry first became popular in the 1970s when the government aggressively promoted it following recommendations of the National Commission on Agriculture. Farmers in several parts of the country (especially areas characterised by commercialised agriculture) adopted it enthusiastically. However, the popularity of farm forestry declined sharply after the mid 1980s as the farmers did not get expected returns on their investments.

In recent years, farm forestry has staged a comeback and has become quite popular in certain regions. Two such regions—western *tarai* of Uttar Pradesh and coastal Andhra Pradesh were studied to understand the reasons for this and to determine the lessons that may be applicable to other parts of the country. Within each region, one district was studied in detail *viz*. Uddham Singh Nagar in *tarai* and Prakasam in coastal Andhra Pradesh.

The study revealed that the main reasons for the popularity of farm forestry in these regions were:

(1) facilitative policy environment;

(2) enterprising farmers;

(3) suitable climatic and edaphic conditions;

(4) research and development (R&D) efforts of the private sector companies; and

(5) ready availability of market for the produce.

It emerges from the study that a facilitative policy environment is a necessary though not sufficient precondition for adoption of farm forestry by farmers. Cumbersome laws and procedures related to tree felling, transport and sale discourage farmers from taking up tree farming. While these restrictions have been imposed in many states with the objectives of preserving the environment and preventing pilferage from government forests, it is the relaxation of these restrictions that has helped in achieving these very objectives in many areas. Relaxation of restrictions encourages more farmers to plant trees, which in turn tends to reduce pressure on the government forests.

The other critical factor for the popularity of farm forestry has been the R&D effort of private sector companies. The main benefits of R&D have been the identification of locally suited species and development of high-yielding and disease resistant clones. The availability of suitable clones of trees has made farm forestry popular with farmers who were looking for avenues for higher or more assured returns.

The learning emerging from this study indicates that the availability of market and remunerative prices for farm forestry produce are likely to be major factors determining the future of farm forestry. The farmers' failure to get remunerative prices for their produce was the most significant factor that led to decline of farm forestry in several regions in the late 1980s. It has been observed that, in both the districts studied, farm forestry received setbacks in recent years mainly on account of the volatility of wood markets.

The farm forestry markets are affected by a number of factors including the government's policies e.g. those pertaining to raw

material supplies to industries from forest lands and export and import of wood-based materials.

In some states, the government continues to supply raw material to industry from forest lands (although there has been a general decline in the supply of such raw material), which affects the market of the farmers. For example, major wood-based industries in Uttar Pradesh are still supplied raw material by the government from eucalyptus and poplar plantations raised on government forest lands. Often, the rate charged is lower than the market rate.

The import of wood and wood products is now virtually unregulated and customs duty on these has been substantially reduced. While import of wood-based raw material has been liberalised and duties have been kept at the lowest level possible, the export of wood and wood products in the form of logs, timber, bark, pulp, charcoal etc. is banned. The low import duties on wood-based raw material along with the ban on export work together to depress domestic prices and thus adversely affects the domestic producers.

In spite of all the problems, the contribution of farm forestry towards meeting the demand for wood in the country is significant. It is estimated that Uddham Singh Nagar and Prakasam districts alone produce between 0.2–0.28 million tonnes and 0.65–0.7 million tonnes respectively of farm grown wood annually. In terms of value, it is estimated that wood worth Rs. 650 million and Rs. 560 million respectively is produced annually in Uddham Singh Nagar and Prakasam districts. Thus, just two districts (or rather parts of these districts) are producing nearly a million tonnes of wood valued at over Rs. 1,200 million annually. Overall, it is estimated that 50 per cent of the wood supply in the country is currently coming from non-forest sources.

However, development of farm forestry in the country is far below its potential. There is tremendous scope for increasing farm-based

contributions to forest products supply and of improving farmers' livelihoods. The following policy measures are recommended to help in this direction:

- There is a need for a nation-wide review of all laws and procedures constraining farm forestry.
- Rules and procedures for felling, transport and sale of major farm forestry species should be totally liberalised and the local *panchayati raj* institutions should be given powers to issue necessary passes with respect to less common farm forestry species.
- Existing policy of state monopoly on trade of most commercially important Non-timber Forest Products should be reviewed.
- Laws governing the management of private forests need to be liberalised.
- Incentives for tree farming, such as nationally tradable afforestation credits, should be introduced.
- The government may consider revoking the ban on exports of wood-based products and imposing a higher duty on import of wood-based raw material to safeguard the interests of domestic producers. Industry may be given some concessions in excise or sales tax.
- Policies such as state monopoly over certain forest products and supply of forest products at concessional rates to various users should be reviewed.
- Whether the government should continue to raise farm forestry species on forest lands that can be more easily and efficiently grown by the farmers on their farm lands should be reconsidered.

In certain regions, farm forestry has been given a significant boost by the R&D efforts of the corporate private sector. Research support for farm forestry could expand the range of commercially tradable

species, identify species appropriate for particular environments and extend the option of farm forestry to those for whom it has not been viable to date. The following research initiatives are recommended:

- Suitable farm forestry species for different areas should be identified and tree improvement work on promising indigenous species should be initiated.
- New uses for produce from popular farm forestry species should be developed.
- Government research institutes should focus on areas where the private sector is unlikely to take an interest, for example species and practices suitable for poorer farm foresters.
- Environmental impacts of taking up farm forestry on a large scale in a region should be studied by an independent body.
- The policy of supply of subsidised seedlings to the farmers should be reviewed and some of the resources devoted to providing subsidies should be reallocated for developing and producing better and higher yielding clones, which may be supplied in lesser numbers and at higher rates to farmers willing to invest in farm forestry.

Market information plays a crucial role in the development of farm forestry. The availability of market and remunerative prices are likely to be major factors in determining the future of farm forestry. Agricultural markets provide good experience upon which the forest sector could draw. In addition, the volatility of markets is a significant risk. It is recommended that:

- As more farmers take up farm forestry, a system of market regulation along the lines of agricultural markets needs to be put in place;
- A suitable market information system, again similar to that of

agricultural markets, should also be introduced to inform the farmers regarding major buyers, prevailing prices at different places, trends, procedures, etc.

Farm forestry is at a critical juncture in its development. Farmers of certain regions in the country have demonstrated that, given the right policy environment and incentives, they are willing and capable of raising tree crops on a large scale. However, available experience indicates that certain policy interventions are needed to sustain farm forestry in these regions and to promote it in others. Currently, there appears to be no comprehensive policy on this issue. Although the National Forest Policy mentions that forest-based industries should be encouraged to procure their raw material from farmers, the thrust of the policy seems to be towards encouraging tree planting by farmers for environmental reasons or for meeting their subsistence needs. There is a need to acknowledge the commercial nature of farm forestry and the potential for this to provide significant improvements to local livelihoods. If a comprehensive policy is developed to address various issues related to farm forestry and to sustain and further promote it, it is likely that within a relatively short period farmers could meet the entire industrial wood needs of the country.

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Mr. R P Mattoo, Chief Technical Director (ETS) and helped in improving its presentation.

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Authors

1. Introduction

1.1 Introduction to farm forestry

Farm forestry refers to tree planting on private land by farmers. Agro-forestry refers to production of short duration agriculture or fodder crops in combination with woody perennials on the same plot of land. In this report the term farm forestry refers to all types of tree planting by farmers on their lands including trees planted under agro-forestry system.

Farm forestry was promoted extensively by the government during the seventies and eighties. Farmers in several states planted trees on a large scale. However, due to a variety of reasons most farmers abandoned tree farming by the end of the eighties (details given in chapter 2). These constraints continue to hamper the revival and growth of farm forestry in most regions of the country. There are, however, some regions in the country where farm forestry either did not decline significantly or has picked up subsequently. This study focuses on two such regions of the country to understand the reasons for the same.

1.2 Objectives

The main objectives of the study are:

1. To document the process of growth of farm forestry in two regions of the country *viz.* western part of *Tarai* region of Uttar

Pradesh (UP) (which now lies in the newly constituted state of Uttaranchal) and coastal districts of Andhra Pradesh (AP), where farm forestry is currently very popular.

2. To investigate the reasons for the adoption of farm forestry by the farmers of these two regions and to determine the main factors impacting on farm forestry there.
3. To analyse the role of the various players (government as well as others) in promoting farm forestry in these two regions.
4. To identify the major impacts of farm forestry in these two regions.
5. To analyse the future trend of farm forestry in these regions and its potential to meet the requirements of the wood-based industries.
6. To identify the lessons learnt from the experience in these two regions for the rest of the country.

1.3 Methodology

The study is based mainly on primary research carried out through field visits to the two selected regions. Information gathered from the two regions has been supplemented through a secondary literature review and interviews with persons having knowledge of farm forestry.

The preliminary groundwork for the study was done during the scoping phase of the India country study. A number of interviews were conducted with the relevant officials of the Planning Commission, the Ministry of Environment and Forests, the Ministry of Industry and the state Forest Departments (FDs). Interviews were also conducted with officials of wood-based industries and industry associations, Non Government Organisations (NGOs) and experts active in the field of farm forestry. Some literature related to farm forestry was also collected during this time.

Information gathered during this time helped in gaining a general overview of the farm forestry situation in the country. It became clear that farm forestry is currently flourishing only in certain selected regions of the country. These include western Uttar Pradesh along with parts of Punjab and Haryana, coastal districts of Andhra Pradesh, parts of Karnataka, Kerala and north Bihar.

Of these regions, two were selected for detailed study where farm forestry was most popular and farmers were supplying their produce to the wood-based industry in significant quantities. These are the western *Tarai* region of Uttar Pradesh and coastal Andhra Pradesh.

Tarai is the name given to the flat belt of the country running along the foot of the southernmost range of the Himalayas. In the western part of Uttar Pradesh, *Tarai* region farmers have shown very positive response to farm forestry and are growing poplar (*Populus* spp.) trees on a large scale. Wimco Ltd., a leading match manufacturer in the country, has played a pioneering role in promoting poplar farming in the region. The region also has a number of other wood-based industries, such as plywood units, which have provided the farmers with assured market for their produce.

Coastal Andhra Pradesh is another region of the country where farm forestry is very popular and has been taken up by a large number of farmers. The main species being grown are subabul (*Leucaena leucocephala*), casuarina (*Casuarina equisitifolia*) and eucalyptus. Although some wood-based industries have played an important role in promoting tree farming in the region, the facilitative policy environment created by the state government has perhaps played a greater role.

Owing to the constraints of time and other resources, it was not possible to study the two regions in their entirety. Therefore, a representative district was selected in each of the two regions for an in-depth examination of the relevant issues. Based on discussions

with a number of experts and preliminary field visits to the regions, district Uddham Singh Nagar in Uttar Pradesh[1] (refer Figure 1, page 25) and district Prakasam in Andhra Pradesh (refer Figure 2, page 81) were selected for the study. Not only was farm forestry immensely popular with the farmers there, these two districts offered other important learning opportunities as well. District Uddham Singh Nagar has emerged as a major production centre of entire transplant of poplar (ETP) and the research and development (R&D) facilities of Wimco are also located there. District Prakasam has emerged as one of the largest pulpwood markets in the country and companies from all over India are procuring pulpwood from there.

After the selection of the districts, relevant information regarding farm forestry situation in both the areas was collected through secondary literature review and by interviewing persons having knowledge of farm forestry in these districts. Subsequent to this, checklists and questionnaires to be used in the field were prepared (Annex 1) and field visits made to both the districts. During the field visits, interviews were conducted with a cross section of farmers in both the districts. Farmers presently practising farm forestry as well as those who have either never adopted it or had abandoned it were interviewed. Initially, farmers were asked to respond to questionnaires. Later, this approach was replaced by a more informal, flexible and participatory approach as it was seen that several farmers felt uneasy about answering sensitive questions about their landholding size and income, especially when they were asked in the format of a questionnaire.

The interviews were either held individually or in small focus

[1] The district (Uddham Singh Nagar) selected for study in the *Tarai* region of Uttar Pradesh now lies in the newly constituted state of Uttaranchal. The state of Uttaranchal was carved out of the erstwhile state of Uttar Pradesh in May 2000, after the completion of the present study.

groups. Generally, group discussions were followed by intensive discussion-cum-interviews of a few farmers in the selected villages. An attempt was made to cover as many different categories of farmers as possible.

Apart from interviewing farmers, discussions were also held with other stakeholders. This included officials of the wood-based industries present in the area, officials of the Forest Department and Forest Development Corporations, officials of other government departments and banks and owners of private tree nurseries, etc. The specific detail of the field method used in the two districts is described in the respective chapters.

The information collected from the field was collated, analysed and put together in the form of a draft report. The preliminary findings of the study were shared with other members of the India country study team during a project workshop. The feedback received during and subsequent to the workshop was taken into consideration while finalising the present report.

1.4 Organisation of the report

The report is divided into five chapters. The first chapter introduces the study and delineates its objectives and methodology. The second chapter provides a brief overview of farm forestry development in the country. The third and fourth chapters contain the case studies of districts Uddham Singh Nagar and Prakasam, respectively. Conclusions and recommendations constitute the fifth and final chapter of the study, which is followed by the annexes and the references.

2. Farm forestry in India: A brief overview[2]

2.1 Origin of farm forestry

While farmers in India have been practising farm forestry for generations, concerted efforts to promote it on a large scale have started only in the past 20–25 years. The focus of this chapter is limited to these recent efforts and their results.

The origin of large-scale tree plantations on non-forest lands (social forestry) can be traced to the report of the National Commission on Agriculture (NCA), 1976. Although earlier there had been sporadic efforts in several states, social forestry evolved as a national programme only after the publication of the NCA report.

While social forestry was born as a result of the NCA report, it was not the central concern of the NCA. The main objective of the NCA was promotion of production forestry on state forest lands to meet industrial requirements. Social forestry was merely a subsidiary activity to help achieve the principal aim. The NCA wanted all forest land to be committed exclusively to production forestry. In its view, dependence of local communities on forests was a major cause of forest destruction and obstacle to production forestry. In order to free forest lands for production forestry, it suggested that the needs of local communities be met through a

[2] Adapted from Saigal 1998.

Box 2.1: Extract from the NCA report

'Production of industrial wood would have to be the *raison dé être* for the existence of forests. It should be project oriented and commercially feasible from the point of view of cost and return' (GoI 1976).

'Free supply of forest produce to the rural population and their rights and privileges have brought destruction to the forest and so it is necessary to reverse the process. The rural people have not contributed much towards the maintenance or regeneration of the forests. Having over-exploited the resources, they cannot in all fairness expect that somebody else will take the trouble of providing them with forest produce free of charge... One of the principal objectives of social forestry is to make it possible to meet these needs in full from readily accessible areas and thereby *lighten the burden on production forestry* (emphasis added). Such needs should be met by farm forestry, extension forestry and by rehabilitating scrub forests and degraded forests' (*ibid*.)

social forestry programme on non-forest lands such as village commons, government wastelands and farm lands (GoI 1976).

After the release of the NCA report, government support for plantations on non-forest lands increased substantially. Many states also formulated special projects and obtained financial assistance from international aid agencies. A large investment was made in social forestry through these internationally funded projects. Between 1981–82 and 1985–86, projects totalling Rs. 9.9 billion were initiated in 14 states (MoEF 1989) (refer Table 2.1).

Initially, the main focus was on common land plantations and farm forestry targets were kept modest. This was because the planners believed that farmers would plant only a few trees on homesteads or farm boundaries (Saxena and Ballabh 1995). Contrary to expectations, many farmers adopted farm forestry enthusiastically. But they did not plant trees to meet their fuelwood and fodder needs, as the planners had supposed. Instead, they planted trees on their farm lands for sale in the market. The popularity of farm forestry

Table 2.1: Details of externally aided social forestry projects started between 1981–82 and 1988–89

State	*Donor*	*Period*	*FF (ha)*	*FF %*	*CP (ha)*	*CP %*
Tamil Nadu	SIDA	81–82 to 87–88	85,165	37.94%	139,330	62.06%
West Bengal	WB	81–82 to 89–90	52,000	55.91%	41,000	44.09%
Haryana	WB/ DANIDA	82–83 to 89–90	30,000	44.78%	37,000	55.22%
Jammu and Kashmir	WB/ DANIDA	82–83 to 89–90	19,000	43.18%	25,000	56.82%
Maharashtra	USAID	82–83 to 89–90	44,035	54.36%	36,965	45.64%
Andhra Pradesh	CIDA	83–84 to	10,100	71.72%	42,625	28.28%
Karnataka	WB/ ODA	83–84 to 87–88	12,500	80.60%	29,000	19.40%
Orissa	SIDA	83–84 to 87–88	26,500	31.74%	57,000	68.26%
Bihar	SIDA	85–86 to 90–91	71,750	42.66%	96,450	57.34%
Gujarat	WB/ USAID	85–86 to 89–90	23,500	73.55%	82,900	26.45%
Himachal Pradesh	WB/ USAID	85–86 to 89–90	66,838	59.23%	46,000	40.77%
Kerala	WB	85–86 to 89–90	69,200	81.13%	16,100	18.87%

State	*Donor*	*Period*	*FF (ha)*	*FF %*	*CP (ha)*	*CP %*
Rajasthan	WB/ USAID	85–86 to 89–90	91,500	75.75%	29,300	24.25%
Uttar Pradesh	WB/ USAID	85–86 to 89–90	147,210	90.90%	14,740	9.10%
Orissa	SIDA	88–89 to 92–93	62,000	46.13%	72,400	53.87%
Tamil Nadu	SIDA	88–89 to 92–93	18,000	22.97%	60,380	77.03%
ALL			829,298	60.06%	826,190	39.94%

Source: MoEF, 1989

Abbreviations: SIDA: Swedish International Development Authority; WB: The World Bank; DANIDA: Danish International Development Agency; USAID: United States Agency for International Development; CIDA: Canadian International Development Agency; ODA: Overseas Development Administration (UK); FF: Farm Forestry; CP: Community Plantations.

in the eighties can be gauged from the fact that over nine billion trees were planted on private lands between 1980 and 1989 (Saxena and Ballabh 1995).

2.2 Regional differences in adoption of farm forestry

The acceptance of farm forestry was not uniform throughout the country. Its popularity was largely limited to the regions characterised by commercial agriculture such as areas in north-west India. It failed to take off in the regions where agriculture was subsistence oriented such as Orissa, Bihar, eastern Uttar Pradesh and Madhya Pradesh. Similarly, farmers in the semi-arid millet growing regions of Maharashtra, Andhra Pradesh, Tamil Nadu and Karnataka did not take to tree planting in significant numbers, except in those

parts that had commercialised and in districts Kolar, Bangalore and parts of Tumkur (Saxena and Ballabh 1995).[3]

The difference between these regions manifest themselves in the number of farmers involved in tree plantation, total trees planted, survival rate and the place and purpose of planting. For instance, a study in subsistence oriented Orissa showed that only a few farmers were keen to plant trees on their land (ORG 1982). In contrast, a large proportion of farmers in the commercialised regions of south Gujarat and western Uttar Pradesh were inclined towards it (Saxena and Ballabh 1995).

In subsistence areas, trees were mainly grown for household use and to complement or supplement food crops (Arnold *et al.* 1987; Arnold *et al.* 1990a; USAID 1988). Consequently, a majority of the trees were planted on homesteads or farm bunds.[4] In some subsistence areas, the government subsidies offered rather than the returns from the tree produce were the main motivation for planting them (Arnold *et al.* 1990a). On the other hand, the main motivation for farmers in commercialised regions in north-west India was increased income through sale of tree produce (USAID 1988; FAO 1985).

The survival rates were also consistently lower in the subsistence areas. A survey carried out in Orissa in 1984–85 showed that the survival rate of the seedlings was only 11 to 17 per cent as against 71 per cent in Uttar Pradesh (IIPO 1988) and 65 per cent in Haryana (NCAER 1988).

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[3] Saxena and Ballabh have defined commercialised and subsistence agriculture regions in India at a macro level. Most commercialised regions are the wheat and cash-crop growing regions of north-west India, the Mahanadi, Godavari, Krishna and Kaveri deltas and other areas of intensive irrigation development as are found in the lowlands of Gujarat, Maharashtra and Tamil Nadu. Subsistence regions include the paddy-growing eastern India, the Himalayan uplands, other mountains and hills, the Chotanagpur plateau in south Bihar, much of the Deccan plateau and almost all tribal and heavily forested districts of central India (Saxena and Ballabh 1995).

[4] About 80 to 90 % of the total seedlings were planted on homesteads or farm bunds (GoO 1987).

Saxena and Ballabh (1995) have argued that the difference in response to farm forestry in the two types of agricultural regions were due to the inherently different agrarian structures prevailing there. Several factors such as small land holdings, heavy dependence on grain production, low monetisation of the economy and interlocked credit and produce markets limited the potential of market-oriented high intensity farm forestry in the subsistence agriculture regions. Farm forestry activities required spare land and knowledge of markets besides an entrepreneurial aptitude and outlook. Consequently, farmers in regions of subsistence agriculture adopted only such tree planting activities that were of low-risk and required only marginal adjustment to existing farming practices.

In the semi-arid millet growing region, water shortage was the major constraint. There had been very little research into developing suitable agro-forestry species for such regions. Farmers here were reluctant to grow the fast growing tree species that were being promoted as these would compete with the crops for the scarce moisture.

The prevailing agricultural practices in these regions also played an important part in restricting tree planting, even if farmers were interested. Most of the subsistence areas were rain fed and characterised by single cropping. After the harvest of the main monsoon crop the village livestock was let loose in the fields to graze on crop stubble and grass. Unlike in the cropping season, there was little or no supervision of the livestock. This made it impossible for farmers to protect their trees from grazing unless they invested in expensive fencing and carried out constant supervision. Hence, in these regions the actions of individual farmers depended largely on the actions of the community as a whole. The problem was much less in the irrigated, commercialised regions as farmers usually harvested two or three crops annually, and consequently livestock were rarely let out without supervision.

Pathak (1995) has tried to explain the differences between these regions, which he calls 'plain agriculture areas' and 'forest areas', in terms of the role of trees in the rural economy and 'subsistence ethics'. According to him, in 'forest areas' farmers did not perceive trees as having substantial market value due to their experience of selling firewood and small timber, usually pilfered from government forests, at low prices in the local markets. They also had strong 'subsistence ethics', implying that they placed greater value on production for self-consumption and did not like to sacrifice it by producing for the market. Other constraining factors in subsistence regions included isolation, lack of communication and transport facilities and distance from major urban centres.

The situation in the commercialised regions was quite different from the subsistence regions. Agriculture in these regions was geared to produce crops for the market and farmers were more oriented towards cash economy. These regions had witnessed regular migration to urban centres for education and employment leaving behind inadequate manpower to carry out agricultural operations. There were also several absentee landowners (Pathak 1995).

Consequently, many farmers in this region either raised crops with the help of hired labourers or leased out their land on fixed-rent or crop-share basis (Saxena and Srivastava 1995). Cropping with the help of hired labourers still required the landowner to invest considerable time and effort in supervision. Leasing, on the other hand, carried a risk of losing the land to the tenant due to various tenant-oriented land laws. Hence, farm forestry appeared an attractive option to these labour-constrained large farmers and absentee landowners. It involved low labour input and supervision costs and was considered more profitable (Vira 1995; ODA 1989). Absentee landowners found farm forestry a better option than leasing, as it was safer (less chance of encroachment), less troublesome and more

profitable (Bhalla 1983). Farm forestry was also attractive to urban people and businessmen as it offered tax benefits without the problem of close supervision as required for agriculture (Saxena and Srivastava 1995).[5] As a result, farm forestry became popular with relatively large farmers and absentee landowners in this region (Gupta 1986).

While the participation of large and absentee farmers in farm forestry was evident, the extent of participation of small farmers has been a subject of debate. According to Saxena and Ballabh (1995), although large farmers were the pioneers of farm forestry there was considerable participation of small farmers in the subsequent years. However, authors of some studies have argued that government records showing small farmer participation may be misleading as at several places large farmers had themselves classified as small farmers to corner benefits of government development programmes (Skutch 1987). Similarly, seedling distribution may not also correctly indicate the level of participation of different types of farmers. In some areas, small farmers might have taken free seedlings for resale to those who would pay for them rather than for planting themselves (Arnold *et al*. 1990b).[6]

2.3 The initial success

The main motivation for farmers to take up farm forestry was to earn cash income rather than to produce fuelwood and fodder or improve environmental conditions. Farmers planted commercial species for sale in the market. Eucalyptus was the main species in

[5] In India, tax benefits are available on agriculture and forestry income.

[6] Considering both income and farm size, the involvement of small farmers in farm forestry appeared to be high in West Bengal. A study showed that 67 per cent of the participants had annual income of less than INR 6000 and 84.3 per cent had less than 2 ha landholding each (Mukherji 1991).

the north-western region comprising Gujarat, Punjab, Haryana and western Uttar Pradesh (Pathak 1994). In the southern states, eucalyptus, casuarina and babul (*Acacia nilotica*) were the major species. On the whole, however, eucalyptus was by far the most popular.

The Forest Department reinforced the view of the farmers about profitability of tree planting by propagating it through billboards and radio. Extension workers also stressed the profitability factor to achieve their targets (Pathak 1994). Several incentives such as free or subsidised seedlings and soft loans were also provided to the farmers.[7]

The response of the farmers was overwhelming. In Haryana, for instance, area under trees on farm grew at a rate of 53 per cent per annum between 1975 and 1984 (NCAER 1988). Most of the planting was on agriculture land. Similarly, in Karnataka 63.3 per cent and 49.6 per cent of the area brought under farm forestry in districts Kolar and Bangalore respectively was agricultural land (Chandrashekhar *et al.* 1987).

Farm forestry targets were overachieved in most states. In Gujarat, for instance, 695.6 million saplings were distributed between 1980 and 1985 against a target of 150 million (GoG n.d.). Similarly, in Uttar Pradesh over 350 million seedlings were distributed during the project period against an initial target of a mere 8 million (World Bank 1989).

2.4 Decline of farm forestry

The success of farm forestry, even in commercialised regions, was short-lived. Farmers began to abandon it by the mid-eighties as

[7] Bank loans for eight years were available in Punjab with an interest rate of 10% for small farmers and 12.5% for other farmers (Kapur 1991).

they failed to get the kind of returns they had expected (Saxena and Ballabh 1995).[8] A study covering 45 tree farmers in Gujarat showed that only nine made relative profit, while the others would have done better by not giving up agriculture (Wilson and Trivedi 1987). Farmers in Punjab were unable to obtain even Rs. 15 for a seven to eight year old tree, whereas the Forest Department had earlier hinted at a price of Rs. 100 (Das 1988).

This led to a rapid decline in new planting. In Gujarat, eucalyptus seedling distribution fell from a peak of 134 million in 1984 to only 12 million in 1988 (GoG 1989). Similarly, in Haryana, the distribution of seedlings fell from a peak of 43 million in 1984 to a mere 4 million in 1988 (*Indian Express*, 1 November 1988, quoted in Saxena and Ballabh 1995). Similar decline was also observed in Punjab (Kapur 1991).

2.5 Reasons for the decline

2.5.1 Inappropriate silviculture

The farmers were poorly advised regarding silvicultural methods. Trees were planted at a close spacing and were harvested after 4–6 years (Saxena and Ballabh 1995). This led to very poor and small dimension output that was not suitable as timber and often only usable as fuelwood (Athreya 1989; IMRB 1989). The Forest Department encouraged farmers to plant with close spacing, as its objective was to increase fuelwood production for which close spacing was ideal. Another reason for promoting high density plantations were the huge targets Forest Department officials were given after the initial success of farm forestry (Saxena and Ballabh 1995). The quality of seedlings raised hastily in bulk by the Forest

[8] Saxena and Ballabh (1995) term 1986 as the watershed year after which farm forestry declined.

Department for supplying to farmers was also poor (World Bank 1988; Arnold *et al.* 1987). The farmers lacked experience of plantation forestry and believed that planting trees was enough. They neglected important silvicultural operations like soil working and proper weeding, leading to poor yields and low quality product (Arnold *et al.* 1989).

2.5.2 Marketing problems

Poles and timber

The initial eucalyptus crop was sold as poles for which there was demand from the construction industry. Eucalyptus poles replaced teak poles (Patel 1987) for erecting scaffolding and as roof supports (Saxena 1995). The farmers who got their produce to the market early got good returns. For instance, early producers in Punjab got Rs. 150 for a seven to eight year old tree (Das 1988). This raised the expectations of other farmers. The market for poles, however, was limited (NCAER 1987). It got saturated quickly and collapsed. In Gujarat, the price of eucalyptus poles of diameter range of 10–12 cm fell from Rs. 60 in 1986 to Rs. 23 in 1988 (Bhattacharjee 1988).

The eucalyptus crop grown at close spacing on very short rotation was not suitable for use as timber (Saxena and Ballabh 1995). Out of the projected 3 million cu.m of farm forestry wood output in Haryana during 1989–90, only 7 per cent was thick enough to be used as timber (NCAER 1987).

Even in the few cases in which the wood was of correct dimensions, other factors such as low density and unevenness reduced the farmers' returns. Traders too preferred to buy timber in bulk from government depots rather than to deal with a large number of scattered farmers. The timber available from the government depots was usually drier and there was scope for underhand deals

with the government officials (Saxena 1995). Thus, the farmers were at a disadvantage on this account.

Pulpwood

The produce of farm forestry was suitable as pulpwood, but paper mills were getting subsidised supply from the Forest Department.[9] They bought pulpwood from the farmers only if they could not get their full requirement (Saxena 1995). The mills preferred to buy pulpwood from the Forest Department as its supplies were much cheaper and available in bulk. For instance, in Uttar Pradesh, the Forest Department supplied eucalyptus to paper mills at Rs. 140 per metric tonne (MT) during 1983–86 while the market price was between Rs. 400 to 600 per MT.

There were three other major reasons why farmers could not fully tap this market. Firstly, many paper and pulp mills in India are designed for bamboo rather than wood. Secondly, most of the mills are situated in areas near the forests.[10] As wood is a bulky commodity, transport costs made it uneconomical for these mills to purchase wood being produced in the commercialised agriculture areas largely in north-west India (Saxena 1995). Thirdly, paper mills had been granted import concessions by the government and were getting cheap imports (Pathak 1995).

Collapse of wood markets

The combined effect of all these factors was to limit the market for the farmers and to depress the market price, which was often set by the subsidised supplies of the Forest Department and cheap imports. The glut faced by the north-western wood markets lowered

[9] In this section, the term Forest Department is used to denote all forest related government agencies including the Forest Corporation.

[10] There are only three paper mills in Uttar Pradesh and Haryana and none in Punjab (Saxena 1995).

the prices even further. Gujarat hit a low in 1984, Haryana in 1986 and Uttar Pradesh in 1987 (Pathak 1995). The price of eucalyptus wood was down to Rs. 300 per MT in Gujarat during 1984 (Bhattacharjee 1988). In the Yamuna Nagar market of Haryana, prices fell from Rs. 48 per quintal in 1987 to Rs. 28 per quintal in 1988 (Prabhakar 1988).[11] In Punjab, the price came down from Rs. 600–700 per MT in 1978 to Rs. 250–350 per MT in 1988 (Khare and Rao 1991).

Consequently, many farmers were forced to sell their produce as fuelwood. Even in the fuelwood markets, farmers faced the problem of competition from fuelwood headloaders who were collecting fuelwood free from the forests or other public lands. It is virtually impossible for fuelwood producers to compete with fuelwood collectors, as the only investment made by the latter is their labour. Furthermore, eucalyptus is not a preferred fuelwood as it gives out a lot of smoke. A study in Rajasthan showed that eucalyptus fetched a 15 to 20 per cent lower price than other fuelwood species (USAID 1990).

2.5.3 Disabling laws and policies

The cumbersome laws and procedures concerning tree felling, transport and sale also played an important role in reducing farmers' returns from, and enthusiasm for, farm forestry.

There are several restrictions on felling of trees standing on private land. The nature of restrictions varies in terms of species, regions, type of land holding and end use (Pathak 1995).[12] The procedure

[11] 1 quintal = 100 kilograms

[12] In Rajasthan, for instance, no trees could be harvested other than for one's own use. Hence no transit passes (to transport timber) were issued by the Forest Department (Mathur and Ghose 1991).

of seeking permission for felling is cumbersome and complicated. Permission is also required for transporting timber and every movement of timber has to be accompanied by a transit pass issued by a competent authority.

These rules are meant to safeguard the natural environment and to prevent pilferage from the government forests. In practice, however, they become sources of harassment and rent seeking by officials.[13] These act against the interest of the producers and bring in an element of uncertainty in the operation of sale transactions (Saxena and Ballabh 1995).

These irksome procedures and the resultant harassment of the producers affected farm forestry significantly. Even farmers with valid permits were often harassed by the police at road checkpoints on the pretext that either the permit was false or the quantity exceeded the amount indicated on the permit. This adversely affected the market of the farmers, as they could not take advantage of high prices prevailing in some other areas by transporting their produce there (Saxena 1995).[14]

In later years, several states lifted some of the restrictions on popular farm forestry species. Gujarat removed restrictions on eucalyptus and casuarina in 1984. Rajasthan, Uttar Pradesh, Tamil Nadu and Andhra Pradesh also relaxed regulations for the commercial species (Pathak 1994). To date, these procedures remain one of the main irritants for the farmers involved in tree planting in many parts of the country.

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[13] In Uttar Pradesh, for instance, the police have the power to apprehend a person for felling certain common species of trees standing on his or her land without permission (Pathak 1994).

[14] Farmers in western Uttar Pradesh could not benefit from high prices in eastern Uttar Pradesh due to this problem (Saxena 1995).

2.5.4 Loss of agricultural production

Another factor that led the farmers to abandon farm forestry was the unanticipated loss in agricultural yields (Pathak 1995). There has been a lot of heated, often acrimonious, debate on the question of use of fast growing exotics in farm forestry. The antagonists claim that these species reduce moisture availability for agriculture crops and reduce yields significantly (Bandopadhaya and Shiva 1985; Ahmed 1989). The proponents of fast growing exotics claim that species like eucalyptus are efficient water users if one considers biomass output per unit of water consumed.

Farmers had hoped to earn some extra income by planting trees on their farm boundaries but had not anticipated any loss in agriculture yields. Studies suggest that they started experiencing a drop in agricultural income from the third year onwards (see Figure 2.1).

Although the argument about water use efficiency of fast growing exotics may be valid, the farmers were more concerned about their annual water budget rather than the net result over a period of years. As a result, many of them stopped planting trees.

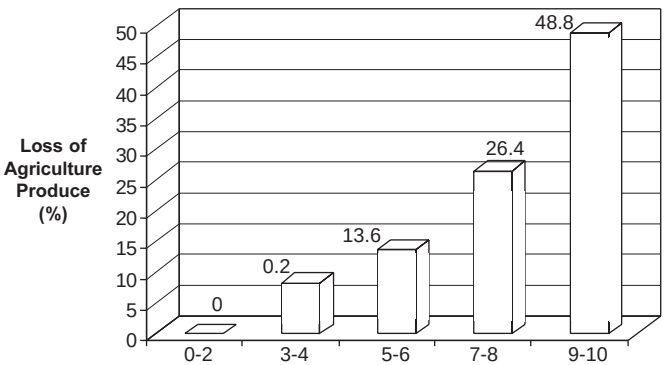

Figure 2.1: Progressive drop in agriculture yield in Haryana due to eucalyptus.

Source: Ahmed, 1989

2.6 Learning

The ambitious farm forestry programme launched by the government in the seventies and eighties failed to achieve the desired objectives of meeting local needs and improving private wastelands. Most farmers planted trees for sale in the market rather than for meeting local fuelwood and fodder needs. They continued to depend on government forests and community wastelands for their own supply of fuelwoods and fodder. Most of the planting also took place on agriculture lands in the agriculturally developed regions rather than on wastelands.

The programme failed to take-off in the subsistence agriculture oriented regions. Its success was short lived even in the commercialised agricultural regions where it rapidly declined after the mid-eighties. Most farmers were poorly advised about potential markets and returns. Consequently, they could not get good returns for their produce. There were no concerted efforts towards marketing and utilising the produce though the government was encouraging farmers to grow them. In addition, cumbersome procedures and government policies (e.g. subsidised raw material supplies to paper mills) further exacerbated the problems of the farmers.

The farm forestry programme therefore did not achieve the objectives of the government. But it demonstrated that given the right incentives and a remunerative price, farmers could easily meet most of the raw material needs of the wood-based industry.

2.7 New forest policy

The continuing degradation of state forests and failure of social forestry programmes to divert pressure from them forced the government to reconsider its forest policy. Then, in 1988, a new national forest policy was issued which completely reversed the

recommendation of NCA of raising industrial plantations on state forest lands and meeting community needs from non-forest lands. The new policy clearly stated that conservation and needs of local community should be the major objectives of forest management. Wood-based industries should meet their needs through farm forestry.

Box 2.2: Extracts from New Forest Policy

Para 2.2 'The principal aim of Forest Policy must be to ensure environmental stability and maintenance of ecological balance including atmospheric equilibrium which are vital for sustenance of all life forms, human, animal and plant. The derivation of *direct economic benefit* (emphasis added) must be subordinated to this principal aim' (GoI 1988).

Para 4.3 'The domestic requirements of fuelwood, fodder, minor forest produce and construction timber should be the first charge on forest produce.' (*ibid*.)

Para 4.9 'As far as possible, a forest based industry should raise the raw material needed for meeting its own requirements, preferably by establishment of direct relationship between the factory and the individuals who can grow the raw material ... the practice of supply of forest produce to industry at concessional prices should cease' (*ibid*.).

Consequent to this, farm forestry has become popular with farmers in certain regions of the country. Two such regions, district Uddham Singh Nagar, Uttar Pradesh and district Prakasam, Andhra Pradesh, have been taken up for detailed study in this report with the objective to understand the reasons for this.

3. Case study of Uddham Singh Nagar district

3.1.1 General

Uttar Pradesh, covering an area of 29.4 million ha, is the fourth largest state in the country in terms of area (before the constitution of the new state of Uttaranchal that has been carved out of the north-western regions of Uttar Pradesh). In terms of population, it is the largest state in the country. The state can be divided into three major physical regions:

- Himalayan and Siwalik hill region in the north-west
- Central Gangetic plain
- Vindhya region in the south-east

The Himalayan and Siwalik hill region is characterised by hills and high mountains reaching 8000 m broken by deep valleys. They form the source and catchment of many of the major river systems of India. At the foot of Himalayas, the Siwalik Hills form a band of low hills that slope down into an area of boulder beds, referred to as *Bhabhar*. This, in turn, merges into a more level terrain, the *Tarai,* which forms the transition area to the Gangetic plain covering most of the central part of the state (GoUP 1997a).

District Uddham Singh Nagar falls within the Himalayan and

Siwalik Hill region and is located in the *Bhabhar* and *Tarai* tracts.[15] The district has been recently (September 1995) carved out from the erstwhile districts of Nainital and Pithoragarh. It is divided into five *Tehsils* (administrative units) *viz.* Sitarganj, Bazpur, Gadarpur, Khatima and Kiccha. It is also divided into seven community development blocks *viz.* Jaspur, Kashipur, Bazpur, Gadarpur, Rudrapur, Sitarganj and Khatima. Rudrapur town is the headquarters of the district.

3.1.2 Physiographic conditions[16]

District Uddham Singh Nagar can be sub-divided into two types of physiographic/edaphic tracts *viz. Bhabhar* and *Tarai*. While the *Bhabhar* tract, marked by contour of 300 m, forms a part of the foothills of the southernmost range of the Himalayan mountain system, the *Tarai* tract succeeds the *Bhabhar* tract and forms a continuum with the great northern plains. The *Bhabhar* tract is characterised by dry surface soils called the *Bhabhar* soils, which are mostly coarse textured, sandy to gravelly, excessively well drained and are generally considered as infertile and poor. On the other hand, the *Tarai* tract possesses the *Tarai* soils that are noted for their rich clayey loam with some proportions of sand and humus. They are mildly calcareous and carry good amount of nitrogen.

The *Bhabhar* tract has low water table, falling as low as 35 m in April. The *Tarai* tract, on the other hand, has high water table that lies within 5 m even during the summer months. The water table rises further during the monsoon months and immediately thereafter.

Although the *Bhabhar* tract receives more rainfall than the *Tarai*

[15] The UP *Tarai* tract extends from district Saharanpur in the west to district Deoria in the east (GBPSSI 1987).

[16] Adapted from GBPSSI 1987.

Figure 1

Location Map of Uddham Singh Nagar District

Source: www.thebharat.com

tract, water does not stay on the surface due to high porosity of the soils. Consequently, this tract faces water stress conditions during most parts of the year.[17]

3.1.3 Climatic characteristics

The district enjoys good climatic conditions with relatively mild temperatures and generous rainfall. The temperature in the *Tarai* tract varies from 0.5½C to 15½C in the month of January and from 32.5½C to 41.6½C in the month of May. The average annual rainfall received by the district ranges between 1,400 mm and 2,000 mm.

3.1.4 Socio-economic characteristics

Prior to the independence of the country (1947) the district was entirely covered with forests. It also had high incidence of malaria and human population was low. People living here belonged mainly to tribal communities such as Tharus and Bhuksas.

After Independence, in the mid 1950s large tracts of forests in the district were cleared for the purpose of agriculture and large land holdings were created under a colonisation scheme. Government allotted the land to retiring servicemen, freedom fighters and refugees who had arrived in India as a result of the partition of the country (Saxena 1994).

A number of communities *viz.* Punjabis, Jats, Paharis (from Uttar Pradesh hills), Thakurs (from western Uttar Pradesh) and *Bengalis* settled in the district. Between 1951 and 1961 the population of the district increased by as much as 73 per cent (GoUP 1997b). Later the process of agriculture and industrial development led to a second wave of immigration consisting of labourers who mainly came from

[17] Water stress conditions make *Bhabhar* tract unsuitable for growing agro forestry crops such as poplar (*Populus* spp.).

eastern Uttar Pradesh, Bengal and Bihar. The district has therefore experienced a rapid growth of population in the last few decades.

At present, the population of the district is a unique mix of different ethnic and linguistic groups rarely seen elsewhere in the country (refer Table 3.1).

Table 3.1: Mother tongue based population composition of the district (1981)

S.No.	*Mother Tongue*	*Percentage of Total Population*
1	Hindi	86.72%
2	Urdu	6.79%
3	Punjabi	4.54%
4	Bengali	1.71%
5	Others	0.24%
	Total	100.00%

Source: GoUP 1997b.

Scheduled Castes (SC) and Scheduled Tribes (ST) constitute over a quarter of the population of the district (refer Table 3.2).

Table 3.2: Block-wise percentage of SC and ST population in the district (1991)[18]

Name of Block	*Percentage of SC/ST Population*
Jaspur	18.4%
Kashipur	30.6%

[18] SC = Scheduled Caste and ST = Scheduled Tribe. These are socio-economic backward groups for whom the government is making special efforts for their upliftment.

Name of Block	*Percentage of SC/ST Population*
Bazpur	25.4%
Gadarpur	20.0 %
Rudrapur	15.2 %
Sitarganj	32.5 %
Khatima	43.2 %
Total	28.1 %

Source: GoUP 1997b

3.1.5 Agriculture

District Uddham Singh Nagar is considered to be one of the most economically developed districts of Uttar Pradesh. It is well endowed with fertile soils, water resources and good climatic conditions, which has favoured its agricultural development.

Prior to the 'green revolution' in the late sixties, the principal crops of the district were maize, *jowar* and mustard. During the 'green revolution' years of the sixties and seventies, irrigation facilities were developed and greater emphasis given to farm mechanisation and use of high yielding crop varieties.[19] The cropping cultivated in the *Tarai* tract consequently changed to the more remunerative high yielding crop varieties like sugarcane, wheat and paddy. Millets and coarse grain crops continued to be grown on *Bhabhar* soils. At present, sugarcane is the major cash crop of the district, which is

[19] Bore wells were introduced in the district in 1974–75, which led to the spread of green revolution as farmers now had easy access to irrigation water that was necessary for raising high yielding crop varieties (HYVs). This resulted in major advances in agriculture in the whole belt (personal communication, Mr. Rawat, a farmer from Fauji Matkota, Uddham Singh Nagar District).

sold to the sugar mills located in districts Uddham Singh Nagar and Nainital.

Agriculture in the district is characterised by large land holdings (refer Annex 2), secure means of irrigation (refer Table 3.3), and enterprising farmers who have high risk bearing capacity.[20] Most families residing in the district were allotted land by the government

Table 3.3 : Tehsil-wise land use pattern for the agriculture year 1406 (August 1998–July 1999)

(area in acres)

Tehsil	*Total Area*	*Area Unfit for Agri-culture*	*Forest Area*	*Cultu-rable Waste*	*Irriga-ted Agri-culture*	*Unirri-gated Agri-culture*	*Net Area Under Agri-culture*	*Gross Agri-culture Area*
Sitarganj	33,674	4,965	2,576	4,278	23,751 (97.2%)	680	24,431	44,246
Bazpur	28,980	3,428	1,326	2,044	23,007 (97.9%)	501	23,508	37,089
Gadarpur	23,069	2,991	16	963	19,006 (99.4%)	109	19,115	34,719
Khatima	32,221	4,275	1,549	1,524	23,642 (95.1%)	1,221	24,863	35,440
Kicchha	32,483	4,474	673	2,848	23,605 (93.8%)	1,555	25,160	40,283
Total	150,427	20,133	6,140	11,657	113,011	4,066	117,077	191,777

Source: Land Records/Revenue Department, District Uddham Singh Nagar

[20] Average land holding size in district Uddham Singh Nagar is 1.87 ha (refer Annex 2) as compared to only 0.93 ha in the state of Uttar Pradesh (CMIE 1994).

at the time of their resettlement. The size of the land allotted varied from 5 acres to 15 acres.[21] There are, however, some large farmers in the district who own hundreds and even thousands of acres of land. These are usually registered in the names of different persons in the official records to overcome land ceiling restrictions (personal communication, Dr. Joshi, Consultant, Wimco).

If the level of agricultural development in the district is analysed, it emerges that Gadarpur *Tehsil* (including Rudrapur and Gadarpur blocks) is the most developed followed by Kashipur, Bazpur and Kicchha while Khatima is the least developed among them (personal communication, Mr. Devender, Marketing Executive, Wimco). The reasons for this are the rather remote location of Khatima on the India Nepal border and the presence of predominantly tribal communities in the area (refer Table 3.2).

3.1.6 Forests

Presently, forests cover less than five per cent of the total area of district Uddham Singh Nagar. Forest cover in the district has declined over the years with the total area under forest decreasing from 10,098 acres in 1992–93 to 8,963 acres in 1995–96 (refer Annex 3). Blocks Sitarganj, Khatima and Bazpur contain the maximum forest areas. The main forest species is sal (*Shorea robusta*).

3.1.7 Industry

The district enjoys good industrial development. The agro and forest based industries present in the district include a paper mill (at Kiccha), ten plywood units, 70 rice mills and two sugar mills. Apart from the units located within its area, the district also supplies

[21] 1 acre = 0.404686 ha

agro and forest based raw material to units in other districts of the state and to other states of the country.

3.2 Methodology

During the field visit, discussions and interviews were conducted with farmers and agencies/persons who had been involved in promotion of farm forestry in the district either directly or indirectly. These included:

- Officials of Wimco, especially Wimco Seedlings Limited (WSL)
- Academicians/experts of Govind Ballabh Pant University of Agriculture and Technology, Pantnagar
- Divisional Forest Officer (DFO) of Haldwani Division of the Forest Department and staff of Uttar Pradesh Forest Corporation
- Local contractors and traders of timber of Rampur
- Owners of private poplar nurseries
- Owners/managers of wood-based industries

For holding discussions with farmers it was necessary that a representative cross-section of the district be selected. Hence, the district was divided into three zones, namely the region around Bazpur, the region along the highway between Rudrapur and Gadarpur and the region from Kicchha to Khatima (refer Figure 2). Demarcation of the zones was made on the basis of factors affecting adoption of farm forestry. These were:

- agro climatic/edaphic factors
- water logging and drainage problems
- extent of extension services
- quality of transport network

Villages from all the three zones were selected for holding discussions with the farmers. Although it had been decided to randomly select villages, finally only those were selected where the study team could gain introduction through either Wimco staff or others known to the villagers. In the absence of such an introduction it was not possible to secure the confidence of the farmers within a short time, especially for discussing sensitive issues related to land holding and income.

The study team was accompanied by a person known to the farmers at the time of their first visit to a village. This was usually a Wimco extension worker. However, conscious effort was made to revisit the villages later without the Wimco staff member.

Selection of the farmers to be interviewed was also guided by similar considerations as cited above. Care was taken to include farmers who had adopted farm forestry as well as those who had earlier attempted it but had given it up. Selection was also based on the economic status and land holding of the farmers to ensure the inclusion of all types of farmers such as marginal, small, medium and large farmers.

The questionnaire and checklist of questions used during the field visit is given in Annex 1.

3.3 History and present status of farm forestry in the region

The history of farm forestry development in the district can be broadly divided into two clear phases—eucalyptus phase and poplar phase.

The eucalyptus phase began in the seventies when the government started promoting farm forestry in a big way. Farmers of the district started planting eucalyptus (*E. tereticornis* hybrid) enthusiastically,

which was by far the most popular species.[22] The main reason for the popularity of eucalyptus was its perceived good market value as timber, poles and pulpwood. Additionally, it grows straight and has a small crown, which allows more trees to be planted per unit area and causes little shading when planted on field boundaries. The most common pattern of planting adopted by farmers was along farm boundaries with only some large farmers going in for block plantations. Trees were planted mainly to supplement crop production and were seen as a source of lump sum income to meet certain key household expenses like house construction, marriage, etc.

However, the enthusiasm of the farmers to plant eucalyptus trees declined after 1986 as it failed to generate the kind of returns that were expected from its sale. Another reason for this was the adverse effect of eucalyptus on agriculture crops that have been discussed in an earlier section.

The second phase of farm forestry in the district started in the mid eighties when poplar tree was introduced in the area and vigorously promoted by Wimco in order to secure its future raw material supplies. WSL, the research and development arm of Wimco, was instrumental in the development and promotion of various clones of poplar species among the farmers of the district.

Initially, the company distributed the propagules of poplar (called entire transplants or ETPs) free of cost to farmers along with technical guidance. Later, a project was launched with assistance from the National Bank for Agriculture and Rural Development (NABARD) to provide bank loans to farmers to take up poplar plantation. Between 1984 and 1994, more than 15 million poplar

[22] Previously E. hybrid was considered as hybrid of *E. tereticornis* and *E.camaldulensis.* But now it is considered as an unidentified provenance of *E.tereticornis* (Saxena 1994).

trees were planted by over 15,000 farmers in the poplar belt of UP, Punjab and Haryana under the Wimco-NABARD project. Nearly 14 million additional ETPs were retailed to farmers in these three states between 1993 and 2000 (Joshi and Chandra 2000).

Over the years, poplar became the most popular species with the farmers. This can be gauged from the fact that during the eighth five year plan farmers of Uttar Pradesh, Punjab and Haryana planted poplar over nearly 23,000 ha every year, which is almost equal to the total plantation efforts made by the government agencies (Joshi and Chandra 2000).

A number of private nurseries selling ETPs have also mushroomed in the region. Currently, Wimco is marketing about 15 lacs ETPs annually in Utttar Pradesh, 8 lacs in Punjab and 4 lacs in Haryana.[23] Other companies are marketing about 5 lacs ETPs annually in Uttar Pradesh, 7 lacs in Punjab and 2 lacs in Haryana. The total estimated supply of ETPs by the unorganised sector is estimated between 80 to 85 lacs ETPs annually. It is estimated that an area of about 30,000 acres in Uttar Pradesh, 17,500 acres in Punjab and 13,000 acres in Haryana are planted annually with poplars. An equal area is also harvested annually (Chandra 2000).

It is estimated that in district Uddham Singh Nagar 5–7 lac ETPs have been planted in the year 2000. This translates to an area of about 2,500 to 3,500 acres (personal communication, Dr. N.K. Joshi, Consultant, Wimco).

3.4 Pattern of spread of farm forestry

Farm forestry is not uniformly popular throughout the district. The variation in the spread of farm forestry in different parts of

[23] 1 lac = 100,000

the district is due to a number of reasons such as soil and moisture conditions, landholding size, ethnic composition, remoteness of area and so on.

Farm forestry is most popular in the region around Bazpur and from Bazpur to Kashipur. In this area, farm forestry has been adopted on a very large scale and extensive poplar plantations can be seen here. This is due to the availability of suitable soil, presence of a number of medium and large farmers, greater concentration of more enterprising ethnic groups and the extension efforts of Wimco staff members (refer Box 3.1).

Box 3.1: Impact of landholding size and ethnicity on the spread of farm forestry

In general, it has been observed that it is mostly large farmers who go in for block plantations of poplar trees in the district. As per the assessment of Wimco sales and extension officers, of the total farmers practising block plantations 70 per cent own landholdings measuring more than 5 ha. Consequently, farm forestry is most popular in areas with the greatest concentration of large farmers such as around Bazpur, Kashipur and Gadarpur. Ethnically, the earliest adopters of farm forestry in the district were Punjabis and Jats (from western UP) followed by the hill communities, Thakurs from eastern UP and lastly the tribals.

Farm forestry is virtually absent in the low-lying region around the highway between Rudrapur and Gadarpur towns (a distance of about 17 km) as it gets waterlogged during the monsoon season. Water logging is detrimental to poplar and as a consequence farmers of this region have not planted it on a large scale.

Poplar farming has also not been taken up in the other water logging prone areas of the district, which are spread in small pockets. These include low-lying areas that get waterlogged in the monsoon season, plots adjoining streams, areas around dams (a radius of about 2

km around the storage structure) and the belt around Sharda canal and its major distributors. A few farmers in these regions have planted trees but mainly on their plot boundaries to meet domestic fuelwood needs. The preferred species in such cases is usually eucalyptus, semal (*Bombax ceiba*), etc. rather than poplar.

In the region east of Rudrapur, beyond Kiccha and up to Khatima, farm forestry is again not very popular among farmers. This is due to a large extent on the edaphic and socio-economic conditions prevalent in the region. Large parts of the region fall under the *Bhabhar* tract and have porous soils and low water table that result in water stress conditions during most parts of the year. Poplar does not grow well in such a region as it is a shallow rooted tree that needs better moisture and soil conditions. This region is more suitable for deep-rooted species like khair (*Acacia catechu*), sal, shisham (*Dalbergia sissoo*), etc.

Apart from unsuitability of soil conditions, other factors that have affected spread of farm forestry in the region include remoteness, relatively higher proportion of forest land and the ethnic and socio-economic composition of the population. The region is remote and poorly connected to the rest of the district. Due to this, extension agencies such as Wimco have not been as active in this region as in villages around Rudrapur, Bazpur, Kashipur, Jaspur and Kicchha. As per district records, over 71 per cent of the total farmers of Khatima and Sitarganj blocks are small and marginal (up to 2 ha landholding), and 43.2 and 32.5 per cent respectively belong to SC and ST categories. Other dominant ethnic communities in the region include hill communities and Muslims from eastern Uttar Pradesh, who are also generally considered socio-economically backward. Due to the dominance of small and marginal farmers and socio-economically backward ethnic community farm forestry has not been adopted on a large scale in the region.

3.4.1 Planting patterns

During the eucalyptus phase of farm forestry there was not much difference in the planting pattern adopted by the farmers. Most farmers of the district limited tree planting to field boundaries. However, after the introduction of poplar many farmers started raising block plantations as they could continue to grow agriculture crops under poplar trees, which was not possible with eucalyptus.

It was observed during the field visits that the pattern of planting adopted by the farmers depended primarily on their economic status and size of landholding. While large and medium farmers combined block and boundary plantation, small and marginal farmers usually confined themselves to boundary plantation.

In block plantation poplar trees are planted at a wide spacing to allow inter-

Box 3.2 Sugarcane cultivation

Sugarcane can be sold either to cooperative sugar mills or in the open market where it is mainly purchased by the crushing units that produce molasses and jaggery. Farmers prefer to sell to the cooperative sugar mills as they pay a much higher price (Rs. 85–90 per quintal) than the open market (Rs. 30–40 per quintal). However, to do so the farmer has to be registered with the mill and obtain a permit (locally called slip) from it for raising and supplying a specified amount of sugarcane. The slip is issued in the name of the landowner. Due to the large difference in the price of the mill and the open market and certain other facilities provided by the former (such as loans and planting stock at concessional rates) the slips issued are of great value. Many farmers who have gone in for poplar plantation continue to show that they are growing sugarcane in the records. They often buy sugarcane from the open market at low prices to supply their allotted quota to the mills. This is done by manipulating the records in connivance with some mill officials. The reason for this is the apprehension among the farmers that if they show discontinuity in sugarcane cultivation the mill may not issue them slips in later years when they resume sugarcane cultivation. Another reason is that by getting fake slips issued, they can make a good profit without having to raise the crop (personal communication, Mr. Gandhi, R&D Manager, Wimco).

cropping of agriculture crops. The most common spacing adopted is 5m x 4m.[24] However, many farmers use slightly different spacings such as 6m x 3.5m, 6m x 4m, 7m x 3.5m or 8m x 3m depending on their own experience and observation. The orientation of the plantation is decided on the basis of the shape of the farm, direction of the wind and location of the sun so as to maximise production of agriculture crops (e.g. north-south orientation of tree rows minimises the effect of shade on agriculture crop).

The most common rotation period for poplar is six years.[25] Under the most common inter-cropping pattern, poplar ETPs are planted in January-February and a crop of sugarcane is raised as an intercrop. In the next year, a second sugarcane crop is raised through ratoons. After this, sugarcane is discontinued due to increasing shade of trees during summer months. Most farmers do not grow any crop during the summer season from the third year onwards. Instead, the farmers shift to growing crops in the *rabi* (winter) season alone. The most preferred *rabi* crop is wheat. Although it is possible to raise some shade crops under poplar in the summer season, these are not very popular with the farmers. Wimco has suggested turmeric as a suitable crop but farmers haven't shown much enthusiasm for it as it is a year-long crop and does not have a well-developed local market.

While the above is the most common inter-cropping sequence being followed under poplar, official records may not always reflect this as some farmers submit false records to show that they are continuing to cultivate sugarcane on their land (refer Box 3.2).

Apart from the above-mentioned plantation patterns, there are

[24] This is also the spacing recommended by Wimco.

[25] Wimco, however, recommends a rotation of eight years.

also some other interesting but uncommon practices which are being tried out by the farmers.

Some farmers raise ETP nurseries instead of agriculture crops in the initial years of poplar plantations. This pattern is suited to those farmers who either cannot devote adequate time or labour for raising agriculture inter-crops or are interested in producing ETPs for sale. A few farmers have planted poplar trees in strips. One farmer who was interviewed had planted poplars in strips of a few rows each, the area of each strip being 3.6m x 1.8m and the distance between the strips 20–25 metres. In this pattern, the emphasis is more on agricultural production, with trees acting as windbreaks and providing supplemental income.

As far as boundary plantations are concerned it was observed that there was no standard pattern or spacing followed by the farmers, though the most common range of tree-to-tree distance followed by farmers is 1.5m to 2.5m. It was also observed that several neighbouring farmers sharing a common farm boundary had planted rows of trees on either side of the boundary at a distance of about half a metre. Due to such close spacing these boundary plantations are unlikely to do very well. The reasons for this pattern, some farmers explained, was that in most cases one farmer had planted first while the other was forced to follow suit due to fears that with the increase in girth of trees the neighbour would claim part of his land. Also, as the trees planted on bunds by a neighbouring farmer were going to cast shade and take away some nutrients from his land, it was better to follow suit and plant trees to derive some benefit.

Most of the farmers planting trees do so on their own land as landowners in the district are reluctant to give land on long-term lease. The usual practice is to give land on lease only for a particular cropping season and not even for a year. This is to prevent the

tenant from encroaching upon the land. However, a few cases of poplar plantations raised on leased land were found in the district by the study team during its field visit (refer Box 3.3).

Box 3.3: Poplar plantations on leased land

Mr. Anil, a resident of village Khanpur II and owner of Saraswati Poplar Nursery, has planted a total of 18,000 poplar trees out of which some trees have been planted on land that he has taken on a six years' lease. He has paid the entire lease rent as an advance to the landowner. The income from inter-cropping is also retained by Mr. Anil.

At the same time he has also planted 10,000 trees on *batai* (share cropping) with another farmer. In this case Mr. Anil has planted trees on the bunds of the land of the other farmer. While all expenses on the trees are being borne by Mr. Anil, the income from the sale of trees will be shared equally by the two.

He has also taken on lease about 0.5 acre of land along the main road for Rs. 8,000 to raise poplar nursery. The normal lease rent is about Rs. 4,000 to Rs. 5,000 per acre per year.

3.4.2 Preferred poplar clones

There are several clones of poplar that have been introduced in the district. The earliest two clones introduced were G3 and G48. Subsequently, many others have also been introduced. The popularity of the various clones has changed over time. The main criteria used by the farmers for selecting clones are:

a. suitability to their land
b. good form (less taper, thin branches, etc.)
c. fast growth
d. time of leaf fall and leaf re-emergence
e. resistance to diseases

Currently, the most popular clone is G48. G3 is not much preferred

now as it has become susceptible to a wilt disease caused by *Bipolaris maydis* pathogen. Other popular clones include Stoneville clones S7C8 and S7C15 and Lalkuan[26] clones L13, L34 and L49. New clones developed by Wimco that are gaining popularity include *Udai*, *Bahar*, *Kranti,* WSL22 and WSL32.

While knowledgeable farmers make their selection on the basis of the inherent genetic qualities of the clones, some farmers choose the tallest and the thickest ETPs at the time of purchase due to an erroneous perception that these will perform best in the field.

3.4.3 Reasons for the emerging planting pattern

It was observed that wherever physical conditions permit and farmers are reasonably aware, poplar is planted on farm bunds and vacant plots by all categories of farmers. The following are the main reasons for the popularity of boundary plantations:

- tree on farm boundary help in demarcating the boundary and thus reduce boundary disputes with neighbours;
- they provide an additional source of income without affecting agricultural production;
- the trees can be felled at any time to meet emergency expenses (farmers view these trees as bank deposits);
- the trees on the boundary also act as windbreaks and thus help agricultural crop growth.

It was observed that while boundary plantations are raised by all categories of farmers, block plantations are limited only to large farmers. The main reasons for unpopularity of block plantations among small and marginal farmers were:

[26] The Forest Department developed the Lalkuan clones at their nursery located in Lalkuan.

- *Food security*: The first objective of small farmers is to ensure their family's food security. Thus, they prefer to grow food crops rather than cash crops. They do not go in for block plantations as they will have to forego the *kharif* (summer) crop (usually paddy) for 4–5 years, forcing them to buy food grains from the market.
- *Rotation*: Small farmers are unable to forego the annual returns received from agricultural crops such as paddy and wait for six or more years to receive the returns from poplar trees.
- *Risk taking capacity*: Small farmers do not have the capacity to take risks associated with poplar farming due to fluctuations in the prices of poplar wood. For example, while a large farmer may be able to wait for a year or two if the wood market is in slump, the small farmer may be forced to sell his produce at low prices due to his inability to wait for any length of time. A small farmer is unable to adjust easily to market fluctuations while a large farmer can. Thus, it is important for small farmers to keep a part of their land under conventional agricultural crops.

The importance of food security and cash flow for farmers can be gauged from the fact that almost all farmers interviewed reported that they kept aside at least some of their land for agricultural crop production with trees planted on only the boundaries. Even in those parts of the district where farm forestry is popular, farmers were of the opinion that those with less than 5 to 10 acres holding should not opt for block plantation but confine themselves to boundary plantations unless they had some other source of income.[27]

Block plantations are mainly raised by medium and large farmers who are economically better off. Apart from the fact that these

[27] Experience gathered over the years shows that farmers with less than 2 ha land resorting to block planting of poplars are unable to eke out a comfortable living from the third year onwards. This is because agricultural incomes from this time onwards are not sufficient to meet the family needs (Joshi and Chandra 2000).

farmers do not face the same constraints as the small and marginal farmers, they also have specific reasons for preferring block plantations.

- *Labour Constraints*: There is an increasing shortage of agricultural labour in the district due to an overall decline in the available workforce and shifting of some of the workforce to the industrial sector (refer Annex 4). In some parts of the district daily paid labourers are available only for a short duration during the year. As a result, both large and medium farmers are shifting over to farm forestry, which is much less labour intensive than agriculture. This is also true for those households where the members are engaged in secondary and tertiary sector jobs and hence have fewer hands available for cultivating the land. In such cases the landowners often opt for block plantations with inter-cropping given either on lease or on share cropping.

Box 3.4: Case study of a poplar planter and nursery owner

A real estate developer in Rudrapur area has not only planted poplar trees on his 40 acres land but also runs a poplar nursery on leased land. His primary reason for planting trees is his inability to devote time to take care of the agricultural crops. He does not wish to leave his land vacant, as it can be encroached upon. He also takes advantage of the plantation to reduce his tax liabilities.

- *Land Security:* A number of absentee landowners prefer farm forestry to giving their land on lease for agriculture as they feel that this is a more secure option (refer Box 3.4).
- *Tax Benefits:* Some of the large landowners also adopt farm forestry to evade taxes on income earned through other business pursuits. As agricultural income is free of income tax a number of people grow poplar as a way of laundering money made elsewhere. They find it easier to show high income from trees as compared to conventional agricultural crops.

3.5 Role of different agencies in popularising farm forestry

3.5.1 Wimco Limited

Wimco Limited is the leading safety match manufacturing company in India. The company has a total annual manufacturing capacity of 5,000 million boxes (50 sticks each) of safety matches and consumes about 75,000 cu.m of wood annually (Joshi and Chandra 2000).[28]

The company has several subsidiaries and sister concerns. R&D related to farm forestry as well as production and sale of poplar ETPs is carried out by its subsidiary WSL that has its research facility at Bagwala near Rudrapur. WSL was set up in the 1980s and has played a key role in developing and promoting various clones of poplar species among farmers of Punjab, Haryana and UP *Tarai* tract. WSL also maintains a research farm measuring 60 ha at Chandain near Rudrapur. Wimco Greenbelts Limited is another subsidiary of Wimco Limited that is involved in raising commercial plantations. Pavan Poplar Limited is a subsidiary of WSL and has been floated for the management of some land taken on lease for raising poplar plantations. In 1995 the four above companies formed an 'Association of Persons' named Wimco Greens, which floated an investment scheme for raising plantations on 746 ha of land[29] sub-leased from Pavan Poplars Limited.[30]

Wimco has made significant contribution to farm forestry through the development of new clones of poplar (*Populus deltoides*), their

[28] Consumption in 1997–98 and 1998–99 was 76,163.226 cu.m and 747,94.903 cu.m, respectively.

[29] They have managed to bypass the land ceiling restrictions by sub-leasing this land from a family that was given 5,000 acres of land on 99 year lease in 1933 (personal communication, Dr. J.P.Chandra, Executive Director, WSL)

[30] Subsequently, in the report the term 'Wimco' is used for any or all of these companies.

multiplication and sale on commercial basis and popularising their planting among farmers of UP *Tarai*, Punjab and Haryana through its network of extension officers and field personnel.

The company started to focus on poplar farming only after it started facing shortages of semal (*Bombax ceiba*) wood, its main raw material for making match splints then. Earlier, the company was receiving semal wood from government forests. However, continuous exploitation of the tree led to its depletion in the forests of the area. At first, the company attempted to procure semal wood from places as far off as Nepal. But increasing shortage of the wood forced the company to look for alternatives. After screening several potential species it found poplar most suitable and decided to promote its planting among farmers. The company found that two clones—G3 and G48—did particularly well in the area and thus concentrated its efforts in propagating them. Simultaneously, it also started its own R&D efforts to develop other suitable clones.

The company started its extension efforts in the late sixties. It distributed ETPs free to farmers and even took some land on lease to set up demonstration plots. Full time efforts at promoting tree farming, however, started from 1976 in Punjab and 1981 in Uttar Pradesh. The initial efforts in Uttar Pradesh were concentrated around its factory site in Bareilly. A nursery was set up near the factory and planting stock was transported from there to various locations and distributed free of cost to the farmers. There was, however, a very high rate of failure due to delay in planting and lack of adequate care taken by the farmers. The survival rate of seedlings was reported to be a mere 56 per cent in 1981.

In 1982 the company decided to stop free supply of seedlings and ETPs and started charging a nominal price for them. It also stopped delivering the plants and asked farmers to arrange for their own transport. The cost of transport was subsequently reimbursed by

the company. Further, seedlings were supplied only after the pits had been dug by the farmers. The survival rate went up to 85 per cent in 1982 and 90 per cent in 1983 when the cost per seedling and ETP was increased to Rs. 2.

In 1983 the company prepared a project for poplar planting under the agro forestry system for Uttar Pradesh, Punjab and Haryana and submitted it to NABARD for financing (personal communication, Dr. J.P. Chandra, Executive Director, WSL). The project, which was started in 1984, played a key role in popularising poplar farming, not only in UP *Tarai* but also in parts of Punjab and Haryana. Under the project farmers were provided loan for taking up poplar plantations through local banks, which was refinanced by NABARD. Wimco provided high quality planting stock and technical assistance to the farmers and also an assured market for their produce through a buy-back offer at a predetermined price. The loan was to be repaid after eight years or harvesting of trees, whichever came earlier. The project ended in 1994. During the project period 15,831 farmers of three states of Uttar Pradesh, Punjab and Haryana planted over 15 million ETPs (Joshi and Chandra 2000).

After the end of the Wimco-NABARD project, the company has concentrated on production and sale of ETPs on a commercial basis. It has also developed some new clones (such as *Udai*, *Bahar* and *Kranti*) that have become very popular. It has sold 14 million ETPs to farmers in Uttar Pradesh, Punjab and Haryana between 1993 and 2000 (Joshi and Chandra 2000). The year-wise details of ETPs sold by Wimco in UP and UP *Tarai* region are provided in Table 3.4.

Wimco invests between five and six million rupees annually on research and development of poplar clones (personal communication, Dr. J.P. Chandra, Executive Director, WSL). The company

Table 3.4: Year-wise detail of poplar plantations raised through Wimco

Year	*UP Total*		*Tarai belt of UP*	
	ETPs (in lacs)	*No. of farmers*	*ETPs (in lacs)*	*No. of farmers*
1984	1.90	316	0.50	67
1985	2.50	374	0.65	84
1986	3.85	703	1.05	190
1987	5.05	918	1.77	236
1988	12.85	1992	2.57	321
1989	12.51	1768	2.75	323
1990	14.38	2231	1.44	141
1991	14.79	2347	2.22	271
1992	16.61	2966	1.99	329
1993	14.05	2195	2.11	324
1994	7.86	1209	0.94	135
1995	4.50	1005	1.13	189
1996	9.13	1826	2.36	315
1997	13.91	2598	4.46	460
1998	17.74	3608	5.79	667
1999	20.00	4000	5.30	510
2000*	13.85	–	–	–
Total	171.63*	30,056	37.03	4,562

Source: Wimco

* Data for the year 2000 is not included in the totals.

is also carrying out field trials by varying spacing and combinations of inter-crops to develop the most profitable combinations.

In addition to the sale of ETPs, Wimco also provides technical guidance to farmers in selection of suitable clones, proper spacing, planting technique, time of watering, protection against pests, proper pruning methods, etc. Due to the better quality of ETPs and technical backup provided by the company, many farmers prefer to purchase ETPs from Wimco even at a relatively higher price though several private nurseries that have come up in the district sell ETPs at a much lower price.[31]

Experts from Wimco give advice on poplar growing, maintenance and pruning to tree growers through radio programmes broadcast from the local radio station. This is another way that Wimco has contributed towards promoting farm forestry in the district.

Apart from promotion of poplar through sale of ETPs and extension services, at one time Wimco was also seen as the major buyer of poplar wood produced in the district. The buy-back guarantee offered by Wimco in the early years was largely responsible for attracting farmers in the district towards farm forestry. Hence, Wimco provided the farmers in the district with a ready market. This was later supplemented by several plywood industries that opened in the area. At present, however, plywood industries are the main purchasers of raw material from the farmers, while Wimco purchases bulk of its raw material from the Forest Corporation.[32]

[31] The WImco prices for poplar ETPs in 2000 was Rs. 18. In case a customer booked his order in advance, i.e. in the month of June–July, he was offered a discount price of Rs. 12 per ETP. The private nurseries sold ETPs at a much lower rate of Rs. 5 to 8.

[32] At present Wimco purchases about 90% of the required raw material from the Forest Corporation and only the remaining 10% is purchased from local farmers (personal communication, Mr. Bansal, Wimco).

3.5.2 Forest Department and Forest Corporation

The Forest Department (FD) was the main promoter of farm forestry in the district during the earlier eucalyptus phase. Even in case of poplar, the Forest Department has played an important role in introducing it in the district and in developing new clones.

The Forest Department has its own research centre that has been carrying out R&D work independent of the efforts made by Wimco. It has developed a number of suitable clones of poplar, called Lalkuan clones (*viz.* L13, L49, L34, etc.). It is also working on the improvement of eucalyptus. In fact, the work of the Forest Department in the district pre-dates that of Wimco, which obtained much of its earlier genetic material from FD plantations.

Apart from undertaking research, the Forest Department also supplies poplar ETPs and eucalyptus seedlings to farmers. The FD supplies poplar ETPs at much lower price than Wimco (about Rs. 3 per ETP). The FD has also been carrying out extension activities to promote farm forestry. It has prepared and distributed literature on raising and caring for poplar plantations. However, farmers met during the course of the field work maintained that extension efforts of the FD are not of the same level or quality as that of Wimco.

The Forest Department is also raising poplar and eucalyptus plantations on forest land. For instance, the Afforestation Division at Haldwani annually raises about 250 ha of poplar plantations and 350 to 400 ha of eucalyptus plantations. Approximately, the same amount of area is harvested each year. The rotation followed for poplar is 12 years and that for eucalyptus is 8 years. The total size of the Poplar Working Circle is 3,445 ha and that of the Eucalyptus Working Circle is 7,475 ha (personal communication, Mr. R.R. Jamwar, Divisional Forest Officer, Afforestation Division, Haldwani). Hence, the Forest Department is a major producer and

supplier of poplar and eucalyptus. Last year the Forest Department earned between Rs. 100 to Rs. 120 million from the sale of these trees.

Earlier the Forest Department gave the local farmers poplar plantations on short-term lease for raising agricultural inter-crops.[33] This practice was later stopped as the Forest Department feared that its land would be encroached upon and the plantations might be used by Punjab based militant groups. Subsequently, inter-cropping was carried out by the Forest Corporation, which also does the harvesting and marketing of wood produced by the Forest Department. However, the Forest Corporation incurred heavy loss as it did not have any experience of agricultural operations. Due to this and also as the threat of militancy has subsided, the Forest Department has again started giving leases to local farmers for inter-cropping from the year 2000.

Most of the eucalyptus and poplar wood marketed by the Forest Corporation is sold to large industries. About three-fourth of the eucalyptus wood is sold to the two main paper mills in the state *viz.* Century Paper Mills and Star Paper Mills and the balance is sold to other buyers. Similarly, all poplar wood above 46 cm girth (of grade A) is sold to Wimco while some allotment is made for the Artificial Limb Centre at Kanpur. The balance is auctioned in the open market. The price and other modalities for supplying wood to industries are decided at the head office of the Forest Department in Lucknow. Although the poplar and the eucalyptus wood produced by the Forest Department scarcely enter the local market, it indirectly affects the marketing prospects of the farmers growing trees on their fields.

[33] Inter-cropping with sugarcane is not allowed. Crops such as soyabean and *urad* are usually grown during the *kharif* season in the initial years.

The Forest Corporation also raises and sells poplar ETPs. In 1999 it raised 1 lac ETPs out of which only 25,000 were sold, mainly to the Forest Departments of Punjab and Haryana, as they had fixed a price of Rs. 15 per ETP.

Theoretically, the Forest Corporation can also procure wood from farmers. But it does not do so as it believes that farmers often do not have all their papers in order. Besides, the Logging Division of the Forest Corporation is not keen to harvest and collect wood from scattered sources.

Overall, while the effort of the Forest Department (and the Forest Corporation) in R&D, production and sale of ETPs and extension activities has had a positive impact on the growth of farm forestry in the district, growing of poplar and eucalyptus on forest land by the Forest Department has affected the market for the farmers' produce negatively.

3.5.3 Private nurseries

In recent years a number of private nurseries have come up in the district, which produce and sell poplar ETPs. These are mostly concentrated around Rudrapur-Kiccha road and Dineshpur area. While these include a few large nurseries most of them are operated by farmers, even landless farmers, who take one or two acres of land on lease for raising the nursery. Many of these nurseries are run by Bengalis, who learnt the method by working as labourers in the nurseries of Wimco.

One reason behind mushrooming of poplar nurseries is that raising ETPs is fairly simple. The nursery owners either obtain branches of some good poplar trees or purchase a few ETPs from Wimco or the Forest Department. These are then cut into small pieces and planted closely at about 8,000 to 10,000 pieces per acre. The cuttings root easily and are ready for transplanting in about a year's time.

These nurseries have come up either near roads or have a tie up with a roadside shop owner, who works as an agent and books ETP orders on their behalf. Some take up small parcels of land along the road to set up demonstration nurseries while their main nursery is located in the interior. A few large nursery owners also advertise their nursery through distribution of pamphlets and by putting up posters and banners (refer Box 3.5).

The private nurseries have also significantly contributed to the growth of farm forestry in the district by supplying ETPs to farmers at a lower price as compared to Wimco. While Wimco charges Rs. 18 per ETP these nurseries supply them at prices ranging from Rs. 5 to Rs. 8.

Earlier, Wimco had a monopoly in the sale of ETPs in the entire district. Since the last few years Wimco's share in the total sale of ETPs in the district has declined sharply with more and more ETPs being raised and sold by private nurseries. Currently, Wimco is annually marketing about 15 lac ETPs in Uttar Pradesh, 8 lacs in Punjab and 4 lacs in Haryana. Other companies are annually marketing about 5 lac ETPs in Uttar Pradesh, 7 lacs in Punjab and 2 lacs in Haryana. The total supply of ETPs from private nurseries is estimated at 80 to 85 lacs annually (Chandra 2000).

It is estimated that 5 to 7 lac ETPs have been planted in the year 2000 in district Uddham Singh Nagar. Out of these only 20 per cent were purchased from Wimco (personal communication, Dr. N.K.Joshi, Consultant, Wimco).

District Uddham Singh Nagar has emerged as an important centre for production and supply of ETPs to other areas as well.[34] It

[34] Currently, the production of ETPs in district Uddham Singh Nagar is estimated to be 20 to 25 lacs, out of which only 5 to7 lacs are planted in the district while the rest are sent to other areas.

Box 3.5: Case study of a large private nursery

Name: Purnagiri Poplar Nursery
Location: Jafarpur Village
Block: Rudrapur

This was the first private poplar nursery to come up in the district. The owner, inspired by the success of Wimco, set up the nursery on 2 acres of his agricultural land in 1993. Since then he has slowly increased the area under the nursery.

Total land owned: 30 acres
Number of ETPs planted per acre: 10,000 to 11,000
ETP production per acre: About 8,000
Nursery period: One year

Costing per ETP

Land lease rent: Re 1
Other production costs: Rs. 1.50
Cost of uprooting and loading: Re. 0.25
Total cost per ETP: Rs. 2.75

The growth pattern of his nursery and the sale price obtained over various years is given in the following table:

Year	*No. of Acres under Nursery*	*Sale Price per ETP*
1993	2	12
1994	4	15
1995	8	12
1996	16	10
1997	20	8
1998	20	7
1999	10	5 to 7
2000	5	2

Initially, the owner had to advertise his nursery but later on sales were mostly based on word of mouth publicity. Apart from local sale, since 1997 his buyers have been coming from as far off as Kashipur, Lakhimpur, Shahjahanpur, Hapur, Ghaziabad, Pilibhit and Moradabad. The location of the nursery on the highway has been of great advantage. An appreciable percentage of buyers are those passing through the area and stop on seeing the ETPs displayed on the roadside. According to him, about a quarter of his sale could be attributed to the location advantage he enjoys.

is estimated that private nurseries and farmers now produce nearly 80 per cent of ETPs in the district while only a decade ago almost the entire production of ETPs was by Wimco (personal communication, Mr. Srivastava, Raw Material Manager, Wimco).

The private nurseries do not produce all types of clones as farmers demand only particular ones. Earlier G3, G48 and S7C8 were the most popular clones in the district but now G48 and *Udai* are the most popular. Many farmers, as stated earlier, select their ETPs on the basis of their thickness and height at the time of purchase rather than on their genetic characteristics.

Wimco has developed a colour-banding pattern for its various clones which makes it easy for the farmers to identify them. For instance, G48 is marked with a blue band. The private nursery owners have adopted the same colouring pattern, which is used to mislead gullible farmers.

Most of the sale of ETPs by private nurseries in the district is to middlemen who then supply it to farmers in various areas. For example, 90 per cent of the sale of ETPs by Saraswati Nursery owned by Mr. Anil of Khanpur II village is to middlemen and only 10 per cent is sold directly to the farmers. Many traders take the ETPs to far off places such as Dehradun, Pilibhit etc.

The main reason for this growth in the number of private nurseries is the increasing demand for ETPs in district Uddham Singh Nagar and elsewhere. The growth of nurseries, in turn, further fuelled the demand as farmers got easy access to ETPs at low rates. However, spurt in the number of nurseries, on the one hand, and fall in demand for ETPs on the other, due to sudden reduction in the prices of poplar wood, have resulted in many of them incurring loss in the last two years (see Section 3.7.3). ETP prices came down to as low as Rs. 2 in 2000.

As far as future trends are concerned, the nursery owners feel

that the market for ETPs is likely to improve in the next two years during which time a large number of plantations will mature and be harvested. However, farmers will replant their farms with poplar only if there is an increase in the prices of poplar wood in the market.

3.5.4 Govind Ballabh Pant University

Govind Ballabh Pant University of Agriculture and Technology is a major agriculture university of the country, which is located in the area. This university has played a crucial role in the spread of 'green revolution' in the district through introduction of high yielding crop varieties and better farm management techniques.

The university has indirectly influenced the spread of farm forestry in the district in a number of ways. First, the 'green revolution' has made farmers of the district more market oriented. Hence, when they received higher returns from poplar farming they quickly shifted to it. Second, proximity to the university has made farmers more receptive to new ideas. The university also holds a fair for farmers twice a year through which new ideas are disseminated to them. The university is also carrying out some agro forestry trials though its contribution to R&D in farm forestry is insignificant.

3.6 Impacts of farm forestry

The most notable impact of farm forestry in the district has been in the increase in production of wood and a consequent establishment of a number of wood-based industries. Since the mid eighties about 15 plywood and plyboard factories have been set up in the area.

3.6.1 Agriculture

The impact of spread of farm forestry on agriculture in the district was discussed with farmers and experts of Govind Ballabh

Pant University. Most farmers said that while there was a marked reduction in production of agricultural crops near the field boundaries (1 to 2 m) planted with eucalyptus, adverse effect of poplar was much less. Experts of the university mentioned that on an average there is about 12 per cent reduction in the yield of paddy due to boundary plantation of eucalyptus trees (personal communication, Dr. O.P.S.Bana, Department of Agro Forestry, Govind Ballabh Pant University). This, of course, also depends on the orientation of the trees.

Poplar has less adverse impact than eucalyptus as it remains leafless for several months and hence not only casts less shade but also uses less water due to minimal transpiration losses. There is, of course, decline in the yield of inter crops planted under poplar as the trees mature. Most farmers grow sugarcane in the first two years and wheat in the subsequent four years during the six-year rotation of poplar trees. This is because from the third year onwards farmers have to leave the field fallow during the *kharif* (monsoon) season as the shade of the trees makes it impossible to grow any crop. Only when the trees shed their leaves in winter a *rabi* crop such as wheat can be grown. Moreover, paddy, the most popular *kharif* crop, cannot be grown with poplar as it requires standing water, which would kill the trees.

The rate of decline in production of sugarcane and wheat crops under poplar as reported by the farmers is given in Table 3.5.

Some people feel that even this loss can be avoided if the cropping pattern is suitably altered and farmers are encouraged to grow shade-loving crops like ginger and turmeric. However, turmeric planting has not picked up in the district as it is a yearlong crop and farmers planting it would have to forego wheat for that year, which they are not willing to do. These shade-loving crops also pose other problems for the farmers such as non-availability of seeds

Table 3.5: Change in the productivity of crops while inter-cropping with poplar trees

Crop	*Year*	*Average yield of crop in mono-culture (in quintals/acre)*	*Average yield while inter-cropping with poplar (in quintals/acre)*	*Percentage decline*
Sugarcane	1	350	300	14.28%
Sugarcane (Ratoon)	2	250 to 275	150	45.45%
Wheat	3	16 to 17	15	11.76%
Wheat	4	16 to 17	12	29.41%
Wheat	5	16 to 17	10	41.18%
Wheat	6	16 to 17	8	52.94%
Wheat	Average	16 to 17	11.25	33.82%

Source: Primary Survey

and shortage of labour required for cultivating them. But the biggest constraint is the lack of marketing opportunity for these. Currently, Wimco is screening other species, including pineapple, pacholi (an oil yielding crop), lettuce, beetroot and yams, for inter-cropping with poplar trees.

Thus, the major impact of farm forestry on agriculture in the district has been decrease to some extent in cultivation of sugarcane and paddy.

3.6.2 Other impacts

Farmers of the district perceive no adverse impact of farm forestry on the water table or soils of the area. The opinion of the experts of Govind Ballabh Pant University is also the same. They claim

that poplar farming is actually good for the soils of the region as the trees extract nutrients from deeper layers and return some of these to the surface through humus.

One positive impact of poplar farming in the district has been reduction in dependence of farmers on moneylenders for loans. Most farmers treat their poplar trees as fixed deposits and often harvest some of them, especially those on the boundary, to meet their cash needs. Thus, farmers are able to avoid borrowing money at high interest rates of 3 per cent compounded per month from local moneylenders.

The lump sum money obtained from the sale of plantations is often used to purchase durable assets or to meet major family expenses like marriage, house construction, etc.

3.7 Markets and marketing arrangements

3.7.1 Main markets

In the initial years, the main market for poplar wood produced in the district was provided by Wimco through a buy-back agreement with the farmers. In the mid-eighties a number of plywood and plyboard factories came up in the area. These then became major purchasers of poplar wood grown in the district. Currently, the plywood and plyboard factories along with sawmills that produce strips for flush doors etc. are the main markets for poplar wood produced in the district. Century Paper Mills of Lalkuan and the sawmills of Rampur provide the main market for eucalyptus wood produced in the district.

At present, there are about 15 plywood and plyboard factories operating around Rudrapur, Ramnagar and Bilaspur towns in the area. Although the first unit in the district was established in 1975 (it mainly used mango and semal wood as raw material), most other

units were established during two periods in mid-eighties and mid-nineties *viz.* 1986–87 and 1994–95.[35] These factories mainly use poplar grown in the district to make core veneers while the face veneers are imported from South-East Asian countries. It is estimated that each factory needs about 2.5 trucks or about 375 quintals of raw material per day. Thus, the total daily demand of all the factories is 5,625 quintals, which is equal to the output of seven acres of poplar plantations.

The largest concentration of sawmills in the region is in Rampur town, headquarters of the neighbouring district of Rampur. Rampur town has eighty-six sawmills of which only 29 have valid licences while the others are operating illegally. The capacity of these sawmills vary and most of them make packing cases, mainly for mango fruits, and strips, locally called *fantees,* for supply to ply board and flush door factories located in New Delhi and Bareilly[36] (personal communication of a timber trader at Rampur).

Another major market for farm forestry wood is located at Yamuna Nagar, Haryana. Although a few large farmers at times take their produce to that market, generally very little wood from district Uddham Singh Nagar is sold there. This is primarily due to the high transportation costs involved and the fact that this market receives a lot of wood from Punjab and Haryana, which is considered to be of better quality on account of lower moisture content. Consequently, lower price is paid for wood arriving from the *Tarai.*

Wimco is no longer the main market for poplar in the district as it receives the bulk of its raw material from government plantations.

[35] These factories were set up in the district due to the availability of raw material, backward area benefits and good power supply situation.

[36] Some material is also supplied to local units.

In 1999, however, it procured about 1600 cu.m of wood from the area for its Calcutta factory (personal communication, Mr. Srivastava, Raw Material Manager, Wimco).[37]

3.7.2 Marketing arrangements

Tree harvesting and transport rules in the state have been simplified in recent years. In case of several farm forestry species, including poplar and eucalyptus, no felling permit is needed.[38] There is no need for a transit permit (for transporting wood) also in case of districts without any reserve forest. Although a transit permit is needed in Uddham Singh Nagar, it can be easily obtained.

Wood is sold through four main systems in the district:

- sale of standing trees to middlemen;
- sale of standing trees to a factory;
- sale of harvested wood at the factory gate;
- sale of harvested wood in the wood market.

The most preferred system is sale of standing trees to middlemen who then harvest the trees and cart them to the factories or at times to the wood market at Rampur. Only sometimes a few large farmers harvest trees on their own and take them either directly to the factories or to the wood markets of Rampur and Yamuna Nagar. The bulk of the wood sale, however, takes place through middlemen. These middlemen are mostly traders from Rampur who have been in the wood trade for several years and have been operating wood depots (*tals*) and sawmills.

[37] 1 cu.m of poplar wood is roughly equal to 13 to 14.5 quintals.

[38] 16 species of trees were exempted from the purview of the Uttar Pradesh Protection of Trees in Rural and Hill Areas Act, 1976 in 1982 (vide notification no. 86/XIV-3–377–76 dated 20th January 1982). By 1991 the exemption had been increased to 18 species (*Financial Express* dated 19.09.1991).

The main reasons for the farmers to prefer the middlemen system of sale of wood are as follows:

- The middlemen purchase standing trees from the farmer and arrange for their felling and conversion into logs of various sizes. They make a lump sum payment to the farmers. This saves the farmers the effort of arranging for labourers, supervising the harvesting operation and sorting the logs by their size.
- Each tree yields material of different sizes, which have their own markets and price. It is difficult for the farmers to reach the various markets to sell the different sized material and roots that they have whereas the middlemen are aware of the whereabouts of these markets.
- Often farmers do not have a full trolley or truckload of wood, especially in the case of boundary plantations, which becomes uneconomical to transport as the charges for a truck or a trolley are for full load. Middlemen, on the other hand, pool the produce of more than one farmer to make a full trolley or truckload.
- Farmers often face harassment and demand for bribes at various checkpoints while transporting the material for sale themselves. Middlemen, on the other hand, have fixed 'arrangements' with the officials manning the various checkpoints and hence sales through middlemen save the farmers a lot of headache. Middlemen get all the paperwork done and take the responsibility to transport the wood.[39]
- Farmers often face the problem of rejection of some of their produce and reduction in price on the issue of quality when they sell directly to the factories.

[39] For example, as per rules tractor trolleys are not allowed to carry more than 40 quintals of materials. But often these are used to carry up to 100 quintals. While the officials harass individual farmers, middlemen usually have an understanding with them and thus are able to operate freely.

- Middlemen often make payment in advance to the farmers while factories take 15 or more days to release the payment.

Although local factories accept standing crop as well as wood brought to the factory gate, they too prefer to procure wood through fixed suppliers (middlemen), who, in turn, purchase the wood from the farmers.

3.7.3 Price trends

In the past several years, timber price in the country has risen at a higher rate than agricultural commodities. For example, since 1982 timber price has risen at an annual rate of 9 to 13.5 per cent as compared to 7.5 per cent for rice, 7 per cent for wheat and 9.5 per cent for oilseeds during the same period (MoEF 1999).

While there is a general upward trend in price, wood markets are highly volatile and local prices fluctuate widely due to changes in the demand and supply situation. Around district Uddham Singh Nagar too the market prices of woods fluctuate almost daily. But over the years it has been observed that wood prices are highest during the months of June and July (monsoon months) and lowest during the months of October and November. This is because maximum harvesting of trees is undertaken during the months of October and November after the harvest of *kharif* crop and least during the monsoon months.

This skewed pattern of supply presents problems for both the farmers as well as the purchasers. Farmers face the problem of fall in price as a large quantity of wood enters the market in a short span of time, while purchasers have to buy their annual requirement within this short period of time and maintain stocks for the rest of the year. This results in additional cost for them.

The price of wood is determined by its size and quality. The peelable logs (girth above 90 cm) are commonly called 'oversize', while logs

with girth between 30 and 90 cm are called 'undersize'. Any materials smaller than 30 cm girth as well as all material having knots or other deformities are called *sokta*. The maximum price is for the 'oversize' material while the lowest for *sokta* and roots.

In recent years the price of poplar wood has declined sharply. There was a sharp fall in the price of poplar wood in1998. The price picked up slightly in 1999 but declined sharply again in 2000 (refer Table 3.6).[40]

The decline in the price of poplar wood can be attributed to a

Table 3.6: Year-wise fluctuations in the market price of wood in Rampur (Rs./quintal)

Year	*Poplar*		*Eucalyptus*		*Mango*	*Fuelwood*
	Oversize	*Undersize*	*Oversize*	*Undersize*		
1990–93	100 to 150	45 to 50	28			
1994–95	200 to 250					
1996–97	450 to 480				160 to 170	
1998*	340 to 385	190 to 225			80 to 90	
1999	385	210 to 225	120 to 140	110	160 to 170	
2000	280 to 310	165	110 to 140	110	120 to 150	36

Source: Timber Trader in Rampur

[40] The price of eucalyptus wood, however, has not seen any such sharp decline.

number of factors. The rise in price in the year before the crash was reportedly due to a gap in planting of poplar trees during 1992–93 and harvesting of immature trees by several farmers in the earlier years to pay off their bank loans. Consequently, very little oversized material entered the market during 1997 leading to sharp increase in price.

In 1998 the government lifted the ban on felling of mango trees and consequently a large numbers of old mango orchards were felled by the farmers. The supply of large quantities of mango wood in the market depressed the price of poplar trees as mango wood is also good for making plywood, plyboard and packing cases.[41]

Another reason for the fall in price in 1998 was the decrease in demand for wood due to closure of several sawmills on account of a Supreme Court judgement. Many sawmills in the district were operating illegally on the basis of temporary licenses issued to them. The Supreme Court issued an order in December 1996 for the closure of all such units. By the time these instructions reached the local level temporary licenses of several sawmills had already been renewed for the year 1997. The real impact of this order was, therefore, felt only in 1998 and it was a contributing factor in reducing the demand for wood and the consequent fall in the price of poplar wood.

While the supply of poplar wood has been increasing steadily, the demand for wood by the plywood and ply board industry has either stagnated or has started decreasing in recent years. Plywood factories in the region have started facing stiff competition from imported plywood and ply board and consequently their sales have dropped. At the same time, it has also become easier for wood-

[41] The excess supply also resulted in fall in price of mango wood. However, the price of mango wood again picked up in 1999 after the ban was re-imposed.

based industries to import cheaper raw material from outside the country. These have also contributed to the lowering of demand for poplar wood and the consequent slump in its price.[42]

Another important factor affecting wood markets in the district is the supply of wood to industries from government forests. As mentioned earlier, Forest Corporation supplies wood to the large wood-based industries of the region thereby reducing the demand for wood grown on farms.[43]

This can be illustrated through the case of Wimco, one of the largest consumers of poplar wood in the district which receives the bulk of its supplies from the Forest Corporation. The wood is supplied to Wimco at less than the market price as can be seen from Table 3.7. During the past seven years, the average price at which Wimco

Table 3.7: Year-wise price paid for poplar wood by Wimco to the Forest Corporation and the farmers (Rs./cu.m)

Year	*Farmers*	*Forest Corporation*
1987–88	800	950
1988–89	950	1,044
1989–90	1,000	1,199
1990–91	1,125	1,510
1991–92	1,150	1,510

[42] The customs duty on imported logs has been reduced from 60% in 1990–91 to 5% in 2000. Customs duty on finished products such as plywood, particleboard etc. has also come down from 60% in 1990–91 to 35% in 2000 (Singh 2000).

[43] Some illicitly felled wood from forest land, especially undersized wood, also enter the market, which too negatively affects the market for the farmers. However, illicit felling is most prevalent for khair, sal, teak, shisham etc., which are more expensive woods. Poplar is rarely illicitly felled and sold as it is a relatively cheap wood.

Year	*Farmers*	*Forest Corporation*
1992–93	1,200	1,510
1993–94	1,445	1,685
1994–95	2,000	1,665
1995–96	2,800	2,306
1996–97	3,900	2,767
1997–98	4,000	3,459
1998–99	5,000	4,151
1999–2000	6,000	4,982
2000–2001	6,900	5,730

Source: Wimco Purchase Department.

has procured wood from the Forest Corporation is only about 80 per cent of the market price.

The actual quantities procured by Wimco from the Forest Corporation and the farmers are given in Table 3.8. It can be seen that while in 1997–98 Wimco procured 32 per cent of its raw material from the farmers, it procured only 2 per cent the next year when the price collapsed. The re-entry of Wimco in the market in 1999–2000 helped somewhat to stabilise the market price.[44]

Another reason for the sharp decline in the price of wood in 1998 was the alleged formation of a cartel by the local plywood and panel industries after they had paid high prices in 1997. According

[44] Out of 3,450 cu.m wood procured from the farmers by Wimco in 1999–2000 about 1,600 cu.m was procured from district Uddham Singh Nagar alone.

Table 3.8: Year-wise procurement of wood by Wimco's Bareilly unit (hoppus cu.m)

Year	*UP Forest Corporation*		*Farmers*		*Total*
	Quantity	*Percentage*	*Quantity*	*Percentage*	
1986–87	3,834	63%	1,609	37%	4,443
1987–88	13,875	81%	3,217	19%	17,092
1988–89	6,769	66%	3,556	34%	10,325
1989–90	4,548	44%	5,800	56%	10,348
1990–91	13,428	68%	6,150	32%	19,578
1991–92	12,484	65%	6,792	35%	19,276
1992–93	12,515	57%	18,715	33%	31,225
1993–94	11,997	36%	20,897	64%	32,894
1994–95	6,500	20%	26,514	80%	33,014
1995–96	15,641	43%	20,263	57%	35,904
1996–97	11,303	53%	9,974	47%	21,277
1997–98	19,475	68%	5,794	32%	18,269
1998–99	11,165	98%	191	2%	11,356
1999–2000	12,600	78%	3,450	22%	16,050

Source: Joshi and Chandra 2000

to Wimco officials, they were also approached to join the cartel but they declined. The cartel was able to lower the price effectively in 1998 when Wimco did not purchase much wood from the farmers. But the arrangement did not work the following year when Wimco decided to re-enter the market.

Apart from supplies from the Forest Corporation, procurement from farmers by Wimco is also dictated by the situation in the safety match market. The total wood procurement by Wimco has fallen from a peak of nearly 36,000 cu.m in 1995–96 to mere 16,000 cu.m in 2000. Wimco matches sales have fallen in recent years due to increase in competition from match makers from south India, who sell their product at about half the price of Wimco. According to Wimco officials, this is possible because of the subsidies enjoyed by these factories from their respective state governments. Presently, the market share of Wimco has declined to about 12 per cent. Because of the decline in sales Wimco had a lot of residual stock in store in 1998–99, as a result of which it did not procure much timber from the open market during that year.

Wood price is also affected by production of crops such as mango that require wooden packing cases. In case the mango crop fails the demand for packing cases fall, resulting in a slump in the price. This is cited as one of the reasons for the slump in the price of wood in 2000.

It is evident from the above that the wood market in the district is highly volatile and is affected by a number of factors. The future of farm forestry in the district, therefore, will be determined by the trend in the wood market, especially with respect to poplar wood.

3.8 Reasons for spread of farm forestry in the district

In the last few years farm forestry, especially poplar farming, has become extremely popular in the district and it has now become a major land use category. The main reasons behind the spread of farm forestry in the district are as follows:

- Climatic and edaphic factors**:** The district has a good combination of conducive climate and nutrient rich soil in its *Tarai*

tract, which makes it one of the most fertile areas of the country. The climate is suitable for growing a wide variety of crops. The area was under dense forest until a few decades ago and has very fertile soil. The soil is mostly loamy and sandy loam, which is most suitable for growing agricultural and tree crops like poplar. The district by and large also has excellent drainage and high water table allowing easy availability of irrigation water. All these factors have made adoption of cash crops like sugarcane and paddy and subsequently poplar trees profitable for the farmers. Only some northern parts of the district, which fall under the *Bhabhar* tract, have poor, nutrient deficient sandy soil in which trees do not grow well.

- Appropriateness of poplar**:** Apart from conducive climatic and edaphic factors, the most important reason for the growth of farm forestry in the district is the availability of a suitable fast growing tree species—poplar (*Populus deltoides*) that fitted perfectly with the cropping pattern of the area (refer Box 3.6).

Box 3.6: Poplar

There are six indigenous poplar species, namely *Populus ciliata*, *Populus alurifolia*, *Populus gamblei*, *Populus euphratica*, *Populus alba* and *Populus jaucuemontiana*, which are widely distributed in different parts of Himalayas (Joshi and Chandra 2000). In addition, the Forest Department has been trying to introduce several other exotic species of poplar. The initial provenances were obtained from the Casale Institute, Italy and were tried out in the hills. These provenances, however, did not grow very well and were found to be highly susceptible to insect attack. These were also tried out in the *Tarai* region but here too their performance was found to be poor.

In 1969, a Dr. Pryor from Australia, while on a visit to Wimco advised them to try out clones from provenances that were growing at similar latitudes (around 28^0 N) in the Mississippi Valley of the United States of America. Subsequently, he sent cuttings of two clones called G3 and G48 from the area. These clones were tried out by Wimco and were found to be suitable for the local conditions. They were then multiplied on a large scale by Wimco and the Forest Department

and supplied to the farmers. The main reasons for spread of farm forestry in the district using these clones are as follows:

1. These clones are fast growing and disease resistant. The rotation for these trees is only six years and farmers easily get about four quintals of saleable wood per tree at rotation age.

2. The phenology of poplar clones makes it possible for the farmer to continue taking inter-crops all through the rotation. These clones are deciduous in nature and completely shed their leaves in autumn unlike some other provenances/ varieties of poplar that retain some leaves even during autumn. In addition to the complete leaf fall, its timing also exactly matches with the cycle of the main *rabi* (winter) crop—wheat. Generally, the leaf fall takes place before the wheat crop is sown and many farmers plough these fallen leaves into the field. These leaves act as green manure and add to the fertility of soil. The trees are totally leafless and dormant during the period in which the wheat crop is grown. This eliminates competition for water and nutrients between the tree and wheat. The leaves reappear only in late March or early April and by that time the wheat crop is almost ready. This almost perfect match of the phenology of the introduced poplar clones and requirements of the most popular agriculture crop has resulted in its wide acceptance in the region.

3. The greatest advantage with poplar is that it can be easily and rapidly multiplied through vegetative propagation methods. There is no need for any special technology, equipment or infrastructure (mist chambers etc.). The tree cuttings root so easily under the local climatic conditions that farmers are themselves able to prepare their nurseries from cuttings. It is thus extremely easy to maintain the superior genetic characteristics of the clones in future generations. If the multiplication was through the sexual mode or the vegetative propagation needed some specialised skills or equipment (e.g. tissue culture, plant hormone treatment etc.), poplar farming may not have become so popular among the farmers of the region.

4. Poplar is not a tree for the wastelands. It needs mild climate, deep fertile soils, good drainage and assured irrigation, at least in the first two years. The *Tarai* offers all these conditions and hence poplar thrives here.

5. The versatility of poplar wood and its multiple uses in match, plywood, plyboard, chipboard, packing and several other industries has ensured that the farmers have a good market for their produce.

Poplar is a deciduous tree that sheds its leaves completely during the autumn season. This allows the farmers to continue cultivating crops like wheat under the trees without much loss in the yield. This is not possible with other trees such as eucalyptus as apart from retaining leaves, these reportedly cause water stress in agricultural crops. Consequently, in the earlier eucalyptus phase, farmers planted eucalyptus trees only on farm boundaries and even these were ultimately replaced with poplar. Another positive aspect of poplar is that it has a very short rotation period of five to six years, while seed route eucalyptus takes between eight to ten years to mature. The suitability of poplar to local climatic and edaphic conditions, its near perfect match with the prevailing crops, its high productivity[45] and short rotation are the major reasons for its immense popularity among the farmers of the district.

- Enterprising farmers: The enterprising nature of the farmers is another reason for the success of farm forestry in the district. For the past several years, farmers of the district have been raising crops such as sugarcane, soyabean, paddy and wheat mainly for the market rather than for home consumption. Due to this market orientation and enterprising nature, farmers of this district are willing to try out new crops and combinations if they perceive them to more profitable. The presence of a large agricultural university in the area has also contributed to this openness towards new crops and farming methods. The enterprising nature of the farmers is evident from the case of mentha cultivation in the district. A few years ago, farmers of the district took up cultivation of mentha on a large scale, as they were able to get good returns from the sale of mentha oil. A number of farmers also set up mentha oil distillation plants.

[45] The average mean annual increment of poplar plantations under agro-forestry system is about 25 cu.m per ha per year.

However, they discontinued its cultivation as soon as the price of mentha oil crashed.[46]

- Increased profitability: The increase in profit margins through poplar farming has significantly contributed to its popularity among the farmers. In the past years due to increasing costs of inputs like fertilisers, diesel, pesticides, etc. the incomes of farmers in conventional agriculture have either stagnated or decreased in real terms. There is also very little scope for further increasing the yield of agricultural crops as they are already being cultivated intensively. However, by adopting poplar farming farmers can increase their incomes significantly without investing much effort (refer Box 3.7). A number of inputs provided to the agricultural crops like irrigation, fertilisers, etc. help the trees in growing and hence not much extra care is needed.
- Lump sum income: Even more than the increase in income, it is actually the availability of lump sum money after harvest that has actually attracted a

Box 3.7: Increased profitability under poplar

- Approximate net average returns per acre from major cash crops:

  Sugarcane: Rs. 15,000
  Wheat: Rs. 5,000
  Paddy: Rs. 8,000

- Approximate returns per acre from poplar:

  Number of trees per acre: 200
  Rotation: 6 years
  Average expenditure over rotation: Rs. 10,000

  Average net return: Rs. 150,000
  Average return per year: Rs.25,000
  Average loss of agricultural income over rotation (loss of paddy crop for four years as well as loss in production of sugarcane and wheat): Rs. 47,625

  Net benefit from poplar: Rs. 102,375
  Net benefit per year: Rs. 17,062

Source: Primary survey

[46] Mentha oil sold for Rs. 2,100 per kg in 1997–98. But in 2000 the price had come down to as low as Rs. 400 per kg.

large number of farmers to farm forestry. In fact, many farmers mentioned this as the main benefit of farm forestry. Farmers find it difficult to save from their agricultural income and usually all the money is spent. The lack of savings poses difficulty for them when they have to incur large expenses such as on wedding, purchase of land or agricultural machinery, house construction, etc. Through farm forestry farmers can earn lump sum money after six years and are able to use it for meeting these expenses. During the field visit the team came across a number of such farmers who had constructed new houses, bought land or purchased trucks and tractors with the money they had earned through the sale of trees. They all felt that they would not have been able do so by saving from their agricultural income.

- Risks associated with alternative crops: Agricultural crops carry risks, which, according to the farmers, has increased considerably in recent years due to erratic weather and emergence of new pests.[47] Farmers cannot be certain about the return they will get from agricultural crops until they actually sell them as rain during the harvest season either ruins the crops or reduces its grade significantly. Tree crops, on the other hand, are comparatively less risky. Firstly, trees are not so easily damaged and secondly, these can be retained on the farm in case market price falls. Even if trees fall during a storm, the farmer can still get some return by selling the wood, whereas agricultural crops would be completely damaged. Hence, farmers prefer to grow a combination of trees and agricultural crops.
- Role of Wimco: Apart from all the above reasons, one factor

[47] During field visits several farmers mentioned that agriculture has become risky due to changes in weather such as increased irregularity of rainfall and increase in both summer and winter temperatures. Cultivation of some crops (e.g. soyabean) has been discontinued due to widespread pest attack.

that has been instrumental in promotion of farm forestry, especially poplar farming, in the district is the role played by Wimco. The contribution of Wimco has been discussed in an earlier section. It can be said with certainty that in the absence of Wimco, poplar farming would not have been so popular in the district.

- Demonstration effect[48]: Demonstration effect has played an important role in popularising poplar planting in the district. For instance, many farmers of villages Haripura and Harshan, Bazpur Block, started poplar farming only after a farmer in the nearby village Chanakpur sold 1,100 poplar trees for Rs. 6 lacs in 1995. In village Fauji Matkota, Kiccha *Tehsil*, poplar was first planted in 1981 by a farmer on farm bunds. Wimco provided the ETPs and technical advice free to the farmer. Some of the trees were harvested in 1985. After seeing the profit made by the farmer others also started planting poplar (refer Box 3.8).

Box 3.8: Demonstration effect

Lacchhi Singh is a Bhuksa tribal living in village Chanakapur, Bazpur *Tehsil*. He is considered to be one of the pioneers of poplar planting in the area. He first planted 1,100 poplar ETPs in 1988 and then again 400 ETPs in 1989. But it is only since 1996 that he has been planting ETPs every year. The money earned by him from his first trees, which he used for making a house, buying more land and agricultural implements, is the reason for his continued planting of more ETPs. Seeing his case, many other farmers of the area, including several Bhuksa, Tharu and other backward community farmers, have adopted farm forestry.

- Availability of market: A major cause for the popularity of farm forestry in the district is also the ready availability of market for poplar and eucalyptus wood in the area owing to presence of a

[48] 'Demonstration effect' refers to adoption of a particular tree species by a farmer after seeing good results obtained by another farmer.

number of plywood factories and paper mills. Some of these were established to take advantage of certain incentives offered by the government while some shifted to the area after restrictions were imposed on wood-based industries operating in the North-East. This has also been responsible for creating a demand for farm forestry produce in the area favouring adoption of farm forestry by farmers of the district.[49]

- Facilitative policies: Adoption of farm forestry in the district has received a boost with the removal of legal restrictions on felling and transport of major farm forestry species. The state government has exempted 18 species from felling permit requirements under the Uttar Pradesh Rural and Hill Area Tree Conservation Act, 1976. The species exempted include poplar, babool, eucalyptus, jamun, mulberry, jangal jalebi, vilayati babul, dhak, kathber, saijan, agasi, aru, casuarina, fares, robinia, siris, subabul and paper mulberry (*Financial Express* dated 19.9.1991). The requirement for felling permit has also been removed in 37 'non forest' districts of the state.

3.9 Future trend

The future of farm forestry in the district will largely depend on the trends in local wood markets, especially those for poplar. Farmers of the district will continue with poplar farming only if they are able to get reasonable returns.

The price of poplar wood has declined sharply from Rs. 450 to 480 per quintal in 1997 to Rs. 280 to 310 per quintal in 2000. The

[49] On December 12, 1996, the Supreme Court banned felling of trees in all natural forests (not applicable to minor forest produce including bamboo), except those under state working plans, because the country had suffered heavy loss due to illegal felling of trees. A complete ban was imposed on the movement of timber and cut trees from the seven North-East states, except for the purpose of defence and railways (CSE 1999).

rapid decline in the price of poplar wood since 1998 has dampened the enthusiasm of farmers and many have stopped fresh planting. Some are contemplating planting eucalyptus on farm boundaries as they feel that there will be excessive production of poplar in the coming years. This would lead to further decline in the price of wood. Some enterprising farmers have also started taking interest in other tree species such as kadamb (*Anthocephalus cadamba*), semal (*Bombax ceiba*) and teak though their numbers are limited at the moment. In any case, these species can be planted only on farm boundaries as inter-cropping is not possible under them.

The fall in fresh planting during the last couple of years has also resulted in a sharp decrease in the area under poplar nurseries in the district. During this time many private nursery owners have not been able to sell ETPs produced by them. The selling price per ETP came down to as low as Rs. 2 in 1999–2000 and many nursery owners have decided against raising new nurseries in 2000–2001.

While the market trend in the future will depend on a number of factors, Wimco is unlikely to contribute much to the demand for farm forestry produce. It has got a lease of 746 ha of land through Wimco Greens and Pavan Poplars Limited out of which 644 ha has been planted with poplar. Harvesting of the trees would commence on a selective basis in 2001. Once harvesting starts, Wimco would probably not need to procure any wood from farmers. In fact, Wimco might even end up having surplus wood.

There is currently also a ban on setting up new plywood factories and sawmills in the state.[50] No new licences for sawmills have been issued since 1989 (personal communication, Mr. Jamwar, Divisional Forest Officer, Afforestation Division, Haldwani). The

[50] The sawmills are regulated under the Uttar Pradesh Establishment and Regulation of Sawmills Rules, 1978

Photo: Sushil Saigal

A farmer's clonal eucalyptus plantation in Prakasam district, Andhra Prasesh. ITC Bhadrachalam Paperboards Limited has played a key role in popularising clonal eucalyptus in Andhra Pradesh.

Photo: Sushil Saigal

A roadside banner of a poplar tree nursery. Uddham Singh Nagar has emerged as a major production centre for poplar ETPs.

Photo: Sushil Saigal

A eucalyptus tree being harvested in Prakasam district, Andhra Pradesh.

Photo: Sushil Saigal

A sawmill in Rampur, Uttar Pradesh. Ready availability of market for tree crops has encouraged many farmers in Uddham Singh Nagar to take up farm forestry.

Photo: Sushil Saigal

A train being loaded with pulpwood at Prakasam District. Prakasam now supplies pulpwood to eleven companies located all over the country.

Photo: Sushil Saigal

Farmers in Prakasam are replacing tobacco (foreground) with clonal eucalyptus (background). The volatility of tobacco market has encouraged farmers to opt for tree farming with a view to higher and more secure returns.

Photo: Sushil Saigal

A highway tea stall with banners of a poplar nursery. Many highway tea stall owners act as booking agents' double of poplar nurseries.

Photo: Sushil Saigal

Poplar log being peeled in a local plywood factory in Uddham Singh Nagar.

purpose behind the ban is to prevent illicit felling of government forests. However, considering the importance of farm forestry in the district, if this ban is removed in the future, the market for farm forestry produce is likely to improve considerably.

Many wood traders, met during the field visit, were of the opinion that poplar price was likely to stabilise at the current level i.e. around Rs. 300 per quintal. If that happens, farm forestry situation in the district is likely to stabilise and farmers would continue to plant poplar, as its farming would still be profitable. It is pertinent to mention here that although fall in poplar wood price has resulted in a decline in fresh planting, there are many farmers who continue to plant it. An estimated 2,500 to 3,500 acres were planted with poplars in district Uddham Singh Nagar in 2000. In fact, one such farmer said that, as per his calculations, even if poplar wood sold at the price of fuelwood, growing poplar would be profitable for him. Hence, it is likely that some farmers would continue to plant poplar even if its market fell further. However, overall there is likely to be a significant reduction in the area under farm forestry in the district.

Another issue that is likely to affect the future of farm forestry is the future performance of the various poplar clones. All clones are likely to become susceptible to diseases sooner or later as they lack genetic variability. Already, out of the two initial clones—G3—has become susceptible to a fungal disease and farmers have stopped planting it. Thus, the future of farm forestry will depend on the development of new clones of poplar on a regular basis.

Wimco is likely to play an important role in this regard. It is now planning to focus most of its attention on R&D and reduce its extension activities as farmers of the area have now become well versed in the technical aspects of raising poplar trees. The Forest Department is also likely to develop new clones through its R&D

facilities. However, one issue that needs to be tackled with respect to this is that of intellectual property rights. Currently, Wimco faces tough competition from private nurseries, which multiply the clones developed by Wimco and sell them at a much lower price affecting the earnings of Wimco. Regulation through patenting of clones and registration of plant nurseries would have to be seriously considered to enable Wimco and other private sector companies to play a meaningful role in forestry R&D.

Agricultural policies of the future will also affect farm forestry. There are a number of subsidies available in the agricultural sector such as those on fertilisers, irrigation and electricity, which impact on the cropping pattern. In case these are reduced or removed, farm forestry is likely to become more popular as it does not require as much inputs as agriculture.

Farmers of district Uddham Singh Nagar and other parts of the poplar belt have demonstrated that they are able and willing to raise farm forestry crops on a large scale if they receive good returns for their produce. Private sector companies such as Wimco have also demonstrated that they can help in popularising farm and agro-forestry among farmers. However, the sharp decline in the price of poplar wood in the past couple of years and the problems being faced by Wimco in their nursery programme have highlighted the need for regulation of farm forestry markets and certain other policy interventions. Unless this is done, the future of farm forestry in the district and the region would never be secure.

4. Case study of Prakasam district

4.1 Introduction to the study area

4.1.1 General

Andhra Pradesh, which covers an area of 27.5 million ha, is the fifth largest state in the country in terms of geographical area (GoAP 1996–97). The state is made up of 23 districts which can be broadly divided into three regions namely Telangana, coastal Andhra and Rayalseema (refer Table 4.1).

Prakasam is the largest district in the coastal Andhra region covering an area of 17,626 square kilometres. At the time of 1991 census the total population of the district was 27.59 lacs, which gave it a population density of 157 (GoAP 1999). Around 83 per cent of the

Table 4.1: Region-wise distribution of area in Andhra Pradesh

S.No	*Name of the Region*	*Geographical Area (Sq. Kms.)*	*Number of Districts*
1.	Telangana	114,863	10
2.	Coastal Andhra	92,906	9
3.	Rayalseema	67,299	4
	Total	275,068	23

Source: GoAP 1996–97 and GoAP 1999

population of the district reside in rural areas. The district was formed by carving out areas from the erstwhile districts of Kurnool, Guntur and Nellore (Shukla and Nanda 1994). It is bounded in the north by district Guntur, in the west by district Kurnool, in the north-west by district Mahabubnagar and on the south by districts Nellore and Cuddapah (refer Figure 2). Its eastern side is flanked by the Bay of Bengal. The main rivers flowing through the district are Gundlakamma, Manneru, Paleru and Musi. The district is divided into three Revenue Divisions *viz.* Ongole, Kandukur and Markapur. These have 20, 24 and 12 *Mandals*, respectively (Shukla and Nanda 1994).

4.1.2 Climatic and edaphic factors

District Prakasam is one of the eight districts in the state that are covered under the Drought Prone Area Programme. The average rainfall in the district is only 752 mm, which is received during both south-west and north-east monsoon (GoAP 1999). The coastal parts of the district receive rainfall through the north-east monsoon from October to December while the interior parts receive rainfall through south-west monsoon from June to September. The maximum temperature during summers goes above 40½C while the lowest temperature during winter falls to about 20½C.

The main types of soil in the district are red loamy, black cotton and sandy loam covering 51 per cent, 41 per cent and 6 per cent of the total land area respectively (Shukla and Nanda 1994). The district can be broadly divided into eastern and western regions based on the types of soil. In the eastern region, while the soil near the coast is sandy the predominant soil type is black cotton soil, which is mostly highly saline and alkaline with pH ranging from 7.5 to 9.5 and going up to even 11 in extreme cases. The groundwater in the region is also often saline and unfit for irrigation or human consumption. Soil in the western region is primarily lighter red

Figure 2. Location Map of Prakasam District

Source: www.thebharat.com

loamy soil, which normally has a pH ranging between 6.5 and 7.5 (personal communication, D. Ramamurthy, Chemist, Natural Resource Development Cooperative Society, Ongole; Shukla and Nanda 1994).

4.1.3 Land use

Forests and agriculture are the two major land uses in the district covering about two-thirds of the total area of the district. The detailed classification of the geographical area of the district is given in Table 4.2.

4.2: Classification of geographical area in the district (1996-97)

Category	*Area (in ha)*	*Area (in Percentage)*
Forests	442,499	25.82%
Barren and unculturable land	149,727	8.73%
Land put to non-agricultural use	146,830	8.57%
Cultivable waste	65,777	3.84%
Permanent pastures and other grazing lands	69,319	4.04%
Land under miscellaneous tree crops and groves not included in the net area sown	10,328	0.60%
Current fallow	109,739	6.40%
Other fallow land	145,789	8.50%
Net area sown	574,054	33.50%
Geographical area by village papers	171,4062	100.00%

Source: Directorate of Economics and Statistics, Andhra Pradesh quoted in GoAP 1999.

Forests are mainly located in the western part of the district and occupy over a quarter of the total geographical area. There are two territorial Forest Divisions in the district with headquarters at Markapur and Giddalur respectively.

Agriculture is the main land use in the district covering about two-fifths of the total geographical area. Agriculture is also the main occupation of the people in the district with 79.44 per cent of the work force engaged in it or allied activities.[51] About two-thirds of the agriculture in the district is rainfed. Irrigation facility is available to the balance one-third land mainly through canals, tanks and wells (refer Table 4.3). The canals in the district mostly originate from Nagarjuna Sagar dam. Tanks are the traditional irrigation source and the district has about 200 major and 584 minor irrigation tanks (Shukla and Nanda 1994).

Table 4.3: Net area irrigated by different sources in the district (1996–97)

Source	*Area (ha.)*	*Area (%)*
Canals	77,271	38.42
Tanks	32,864	16.34
Tube wells	32,923	16.37
Other wells	33,790	16.80
Other sources	24,276	12.07
Total	201,124	100.00

Source: Directorate of Economics and Statistics, Andhra Pradesh quoted in GoAP 1999.

[51] While the average land holding size is 1.67 ha, half the farmers in the district own less than one ha of land (refer Annex 5).

The main crops in the district are paddy, tobacco, cotton, *arhar*, chillies, *jowar*, maize and sesame. About a quarter of the area is cropped with paddy (source: AP Government website www.andhrapradesh.com). The type of soil, season and amount of rainfall and the availability of irrigation facility are the main factors determining the cropping pattern. The cropping pattern in the district can be predominantly divided into the following categories:

- In areas where there is assured irrigation facility and soil is suitable paddy is the most preferred crop though other crops such as chillies are also grown. This covers most parts of the district that fall under the command area of the canals from the Nagarjuna Sagar dam.
- In red loamy soil areas without irrigation facility, covering central and western parts of the district, mostly dryland crops such as *ragi*, *bajra* and red gram are grown. In some parts there are also citrus fruit orchards. In the south-eastern part of the district, around Singarayakond, there are mango orchards.
- In the sandy soil of the coastal belt many farmers have been growing casuarina trees for several decades to sell as poles, firewood and later as pulpwood. In recent years, aquaculture has also picked up in the coastal belt but most of the farmers practising it are outsiders who take land on lease from the local people.
- The main crops in the black cotton soil are tobacco and cotton. It is primarily in this area that the farmers are shifting towards tree farming owing to the fluctuation in the price of tobacco and problems of pests in cotton.

4.2 Methodology

Selection of the district was made after discussions with the representatives of a few wood-based industries in New Delhi and

Hyderabad. Prakasam district was chosen for the study as in recent years it has emerged as a major source of raw material for several wood-based industries located in Andhra Pradesh and other states.

In the initial phase of the study meetings were held at Hyderabad with officials of the Forest Department and ITC Bhadrachalam Paperboards Limited (ITC BPL), since the company is not only procuring raw material from the district but is also actively promoting tree farming there. The meetings helped in gaining an understanding of the general situation of farm forestry in the district and the broad policy framework for it. Secondary data and published literature related to farm forestry in district Prakasam was also obtained during this initial phase.

A second round of meetings were held in the district with key informants such as representatives of companies purchasing raw material from the district, forestry extension staff of ITC BPL, pulpwood traders, local NGO staff, Tobacco Board officials and FD officials.

These discussions brought out the fact that farm forestry was not spread uniformly throughout the district but was limited to a particular belt in its eastern part. It was decided to concentrate on this part and nine villages were selected for field visits. Three villages on the fringes of this belt, where farm forestry was currently not popular, were also selected for field visits.[52] These villages were selected in consultation with the local extension and seedlings

[52] Names of villages visited:

(A) Within the farm forestry belt: T. Naidupalem (Tangturu *Mandal*), Vengamukapalan, Karavadi (Ongole *Mandal*), Lingamgunta (Maddipadu *Mandal*), Nallaturru (Maddipadu *Mandal*), Gundlapally (Maddipadu *Mandal*), M.Nidamanuru (Tangturu *Mandal*), Thimmanapalem (Medarmetla *Mandal*) and Therovagunta (Ongole *Mandal*).

(B) Outside the farm forestry belt: Nandanamarella (Kanigiri *Mandal*), Inkollu (Inkollu *Mandal*) and Alluru Kottapatnam.

marketing officers of ITC BPL. Checklist aided interviews were held in these villages with the farmers either individually or in small groups. The selection of the villages and farmers was made in such a manner that all three important farm forestry species in the district *viz.* subabul, casuarina and eucalyptus were covered.

Discussions were held with farmers in the villages outside the farm forestry belt, either individually or in small groups, to understand their reasons for not planting trees. All farmer interviews were facilitated by an interpreter.

4.3 History and present status of farm forestry in the district

Spread of farm forestry in the coastal region of Andhra Pradesh can be traced back to the historic shift of cropping pattern from subsistence crops like millets to cash crops such as tobacco during the British rule. Hence, farming system in the region had become cash oriented a long time ago.

The first tree species to be cultivated on a large scale in the district was casuarina. The Forest Department planted it extensively for raising shelterbelts. Farmers found it to be more profitable on the coastal sandy soil than agricultural crops and shifted to it. They initially grew it for sale as poles and firewood but in later years it was also sold as pulpwood as the market developed.

While farmers have been growing casuarina for several decades, the other two main farm forestry species *viz.* subabul (*Leucaena leucocephala*) and eucalyptus have become popular only in the past 15 to 20 years. The spread of these two species can be directly linked to problems being faced by farmers in the other cash crops, especially tobacco. Fluctuations in the tobacco market have played

a crucial role in forcing the farmers to shift to alternatives such as subabul and eucalyptus.

4.3.1 Growth of farm forestry in tobacco growing areas[53]

Tobacco is a cash crop whose production is regulated by the Tobacco Board. The board was set up in 1975 under the Ministry of Commerce. The Tobacco Board estimates the requirement of tobacco each year and then distributes production quota among its registered farmers, who are mainly located in Andhra Pradesh and Karnataka. There are about 40,000 registered barns[54] in Andhra Pradesh, out of which 18,000 are in district Prakasam alone. In addition, there are 6,000 unregistered barns of which half are in district Prakasam.

As is evident from the above, district Prakasam is an important tobacco producing area in the country. Tobacco has been the preferred crop in the district for several decades, especially in the non-irrigated areas as it does not require much irrigation.

The main reason for the popularity of tobacco was the limited choice available for alternate crops due to salinity and alkalinity of soil, lack of irrigation, problem of wild boars,[55] reasonably good return on investment in tobacco, fewer labour problems and easy availability of crop loans.

However, in recent years many farmers have decided to shift from tobacco to other crops due to risks associated with its farming.

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[53] This section is based on a discussion held with the Tobacco Board officials at Ongole.

[54] The unit of regulation of tobacco is a barn, where tobacco is cured. These barns have to be registered with the Tobacco Board. For each barn, farmers are allowed to raise 30 quintals of tobacco, which may work out to 5 to 6 acres depending on the productivity of the field.

[55] In some parts of the district, threat of damage by wild boars limits the choice to non-food crops.

Certain features of tobacco make it a risky crop. As the crop is totally dependent on the vagaries of the weather, there is wide fluctuation in quantity as well as quality of the produce. The quantity can fluctuate from two to seven quintals per acre while the quality can vary from first grade, which sold for Rs. 4,900 per quintal in 1999, to the low grade, which sold for less than Rs.1,000 per quintal.

While the uncertainty in production is not a new phenomenon, the level of risk has been compounded in recent years by the highly volatile market situation.[56] Although the government announces a minimum support price, it is usually unrealistically low and does not cover even the cost of production. For example, the minimum support price in 1999 was only Rs. 2,600 per quintal whereas farmers received Rs. 4,900 for first grade tobacco in auctions.

One reason for the increase in market fluctuation in recent years is overproduction. Traders exploit this situation as farmers cannot store their produce for long due to loss of quality as well as in quantity as a result of loss of moisture. They are also required to sell only to registered dealers.[57] Another reason is the decline in demand due to falling exports and lack of adequate procurement by the domestic tobacco companies.[58]

Although farmers were able to get good returns from tobacco in some years, they incurred losses in others. This was one of the main reasons why several farmers shifted from tobacco to cotton and chillies in the eighties. However, due to problems of marketing and pests such as white fly, the farmers suffered heavy losses in cotton and chillies too.

[56] Tobacco is sold through auction platforms run by the Tobacco Board and prices may fluctuate within the same day.

[57] There is overproduction as several unregistered farmers also grow tobacco and many registered farmers plant more than their allotted quota.

[58] This is on account of presence of carryover stocks lying with the tobacco companies and increase in excise duty on mini cigarettes.

Hence, many farmers, who were looking for some alternative to tobacco, adopted farm forestry, mainly subabul and eucalyptus, when the option was made available to them.[59]

4.3.2 Present status of farm forestry

In recent years, district Prakasam has emerged as a major source of farm produced pulpwood for industries. It is estimated that over one lac acres of farmland is under tree crops and the district is supplying between 6.5 to 7 lac MT of pulpwood annually to various wood-based industries (FD n.d.a).

The main tree species are subabul, casuarina and eucalyptus. The most popular tree species is subabul, with 54.3 per cent of the area under farm forestry devoted to it. Casuarina and eucalyptus follow with 26.4 per cent and 19.3 per cent respectively. The current production of these trees is estimated at around 3.8 lac MT for subabul, 1.10 lac MT for casuarina and 1.50 lac MT for eucalyptus (FD n.d.a).

4.4 Pattern of spread of farm forestry

Farm forestry is not uniformly popular in the entire district and is limited to only certain *Mandals*. It is most popular in one particular belt in the eastern part of the district and is almost totally absent in the western Markapur Division of the district. Also, the farm forestry areas of the district can be divided into broadly distinct regions according to the prevalence of the tree species (subabul, eucalyptus and casuarina) there. The choice of the species is determined by the edaphic factors of the area, availability of irrigation, economic condition of the farmer and 'demonstration effect' (refer Box 4.1).

[59] Tobacco farmers have been so adversely affected by the fluctuations in the tobacco market that they have demanded a crop holiday in the year 2000 from the government i.e. they do not want any farmer to grow tobacco for one year.

Box 4.1: Demonstration effect

Mr. Ravi is a farmer residing in village Nandanamarella in Kanigiri *Mandal*, which is located about 60 km west of Ongole. It is a dry area where the main crops are red gram, bajra and ragi. Farmers of this area do not practice farm forestry.

Mr. Ravi is the first and so far the only person in the area to plant trees on his field. He has raised a clonal eucalyptus plantation over 50 acres of his land by investing about Rs. 525,000.

While no other farmer in the area is planting trees, Mr. Ravi has made such a huge investment because he has seen very good results of clonal plantations in Kottagudem area, where he was posted as a school teacher before his retirement.

It is likely that in future other farmers in the area will also start planting eucalyptus after seeing good results obtained by Mr. Ravi.

Out of the three main farm forestry species, farmers of the district have been growing casuarina for over 50 years. Casuarina is grown on sandy soils in the coastal regions as farmers find it more profitable than any alternate agricultural crops. However, as it needs irrigation in the initial years, it is grown only in areas with assured irrigation.[60] In earlier years, casuarina was grown chiefly for poles and firewood, but these days it is mainly sold as pulpwood.

Of the remaining two species, while eucalyptus (seed-route) has been planted for several years, subabul was introduced in the district only about 20 years ago. It is generally believed that seeds of subabul came to the district from Pune where Bharatiya Agro Industries Foundation (commonly known as BAIF) has been working to popularise subabul planting for many years.

Planting of subabul and seed-route eucalyptus has picked up only

[60] In districts Visakapatnam and Srikakulum, however, farmers grow casuarina even in non-irrigated areas.

in the past 15 to 20 years. These have become popular with farmers who were looking for an alternative to crops such as tobacco and cotton. These species are mainly being grown in areas where soils have problems of salinity and alkalinity and irrigation facility is either not available or is limited.

While the areas where these two species are grown overlap, subabul is more popular as it can grow in highly saline-alkaline soils while eucalyptus can tolerate only mild alkalinity. Further, subabul requires lesser investment, needs less care as compared to eucalyptus, has a shorter rotation period, is perceived to enhance soil productivity and is less risky due to low failure rate.

Since 1996, clonal eucalyptus introduced by ITC BPL has also gained popularity in the district. By 2000, 516 ha farm land was already under clonal eucalyptus plantations (refer Box 4.2). It is only planted by large, better-off farmers as the initial investment required for raising these plantations is very high. The cost of planting stock is about Rs. 15,000 per ha. In addition, the clonal plantations need further annual investments in fertilisers, pesticides, ploughing, inter-cultivation and irrigation until the rotation age. The high initial and recurring cost has put it beyond the reach of small and marginal farmers. It is mainly large tobacco farmers and tobacco traders with land, who have planted clonal eucalyptus. Clonal eucalyptus offers higher returns as compared to tobacco and other alternative crops (refer Box 4.3). This is due to considerably higher productivity of clonal plants and their resistance to diseases. As per the promotional literature of ITC BPL, clonal plantations yield, on an average, 20 cu.m per ha per year under rainfed conditions, which is considerably higher than the yield of normal seed route plantations. Under irrigated conditions, yields up to 50 MT per ha per year have been reported.

Many farmers grow eucalyptus over only a part of their land while

Box 4.2: Growth of clonal eucalyptus plantations

ITC BPL introduced clonal eucalyptus on a commercial scale in 1992. It spread slowly in the initial years but is now picking up at a rapid speed. For instance, in the seven years between 1992 and 1999, farmers in the state raised 3,430 ha of clonal eucalyptus plantations with supplies from ITC BPL. Moreover, an additional 1,500 ha is likely to be planted during the year 2000. It is not only the number of farmers but also the average plantation size per farmer that is increasing. An analysis of the state level sales record maintained by ITC BPL shows that up to 1996-97 the average plantation size per farmer was less than one ha, but increased to over 3 ha in 1998-99.

The trend of growth is similar in district Prakasam also as is evident from the table below:

Year	*Number of clonal plants sold*
1992	4,000
1993	7,000
1994	14,000
1995	56,000
1996	125,000
1997	187,000
1998	220,000
1999	386,771

Source: Junior Manager (Plantations), ITC BPL, Ongole

continuing with agricultural crops over the remaining land. This is done to spread the risk as well as to get some annual income. In some cases, farmers have raised clonal eucalyptus plantations on their own land while they have grown agricultural crops on additional land taken on lease. One such farmer is Mr. Sanjiv Reddy

Box 4.3: Economics of clonal eucalyptus plantation

Cost per ha:

Year	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*Total*
Cost (Rs.)	28,138	4,180	4,611	3,886	4,273	4,697	5,166	54,950

Returns per ha:

Output of pulpwood: 150 tons of debarked wood under rainfed conditions (it will be much higher if the plantation is irrigated)
Support price declared by ITC BPL: Rs. 1,900 per ton of debarked wood
Gross returns: Rs. 285,000
Returns from the second rotation are likely to be much higher.

Source: ITC BPL.

of village Nellaturru, Maddipaddu *Mandal*, who has raised clonal eucalyptus plantations over 15 acres of his own land and planted tobacco on the balance 10 acres of his land and an additional 20 acres that he has taken on lease.

The pattern of spread of different farm forestry species can be illustrated by the case village M.Nidamanuru, which is presented in Box 4.4. While the main factors determining spread of farm forestry over a longer term are the economics of farm forestry and the alternative agricultural crops, planting of trees in any particular year is also greatly influenced by the amount of rainfall in that year. For instance, there was considerable drop in planting in 1999–2000 as there was very little rainfall that year.[61]

[61] Lack of rainfall also affects harvesting pattern of the trees as failure of agricultural crops force farmers to harvest even immature plantations to cope with economic hardship.

Box 4.4: Pattern of adoption of farm forestry in the M. Nidamanuru village

Farmers of village M.Nidamanuru are currently growing all the three farm forestry species *viz.* casuarina, eucalyptus and subabul.

Casuarina was the first farm forestry species to be introduced in the village over 50 years ago. Several farmers have been regularly raising casuarina for over 25 years now. Casuarina is planted only in the sandy soil near the bank of river Musi, which flows near the village. Casuarina grown in the village is sold mainly as poles and firewood. Farmers owning fields with sandy soils shifted to casuarina as they found it to be more profitable than the alternate agricultural crops that they could grow on that land. Casuarina poles fetch a much higher price (about Rs. 1,300 per tonne) than subabul or eucalyptus, but only a few farmers in the village have planted it due to lack of suitable soil and assured irrigation, which is necessary for growing it in the area.

Subabul was first introduced in a neighbouring village in 1981. A person from outside the area brought the tree. Seeing the success of his plantation, people of the surrounding villages including M. Nidamanuru started planting subabul by replacing part of their tobacco or cotton crop. The main reason for shifting from tobacco and cotton was the low and uncertain returns received from tobacco due to fluctuations in the market and pest attacks on cotton. The farmer pioneering subabul in the area also placed advertisements in the local papers and sold seeds from his plantation to other farmers. Over the next few years, subabul planting spread rapidly in the village and in 2000 most farmers had some part of their land under it. Subabul was initially sold as firewood to tobacco curing barns, but subsequently the pulpwood market developed and farmers began growing it to sell it to the pulpwood industry.

About 15 to 20 years ago some farmers in the village had also tried seed-route eucalyptus plantations. But due to poor growth of eucalyptus as well as its longer rotation most farmers later shifted to subabul. The reason cited for the poor growth of eucalyptus was unsuitability of local soil conditions. However, in recent years some farmers have planted clonal eucalyptus plants supplied by ITC BPL due to their higher yields and the buy-back guarantee offered by the company.

4.5 Cultural practices

The general practices adopted by farmers for the major farm forestry species are briefly discussed in this section.

4.5.1 Eucalyptus

There are two types of eucalyptus plantations in the district, the clonal variety and the seed-route origin variety. There is a vast difference in the silvicultural practices adopted by the farmers in the two cases.

Clonal eucalyptus

The clonal planting stock is supplied by ITC BPL who has also developed a package of practices for the farmers (refer Annex 8). The spacing recommended by ITC BPL is 3m x 2m, which is usually adhered to by the farmers. The ITC BPL staff arranges for the soil test and suggests the most appropriate clones to the farmers. The farmers are supplied two or more clones to spread the risk in case of mismatch of clones to the site. The most popular clones in the district are clones number 3, 7, 10 and 27.

Eucalyptus is not as tolerant of salinity and alkalinity as subabul and consequently it is planted in less refractory soils. Most farmers growing clonal eucalyptus use pesticides and fertilisers and intercultivate the plantation twice a year, once in September before the rains to retain the rainwater and next after the rains around January. Farmers having irrigation facility water their plantations two to three times a year. Many farmers also take an agricultural crop such as tobacco in the first year of plantation.

The rotation suggested by ITC BPL is seven years but farmers usually harvest the trees in 4 to 5 years. Depending on the growth, one or two coppice crops are also taken. ITC BPL estimates the average yield of clonal plantations after seven years as 150 MT per ha.

Seed-route eucalyptus

Farmers obtain seed-route seedlings either from private nurseries or government agencies. They are normally planted at close spacing of around 1.5m x 1.5m. Some farmers occasionally irrigate the plantation though ploughing or intercultivation is rarely done. Tobacco is sometimes planted as an inter-crop with eucalyptus in the first year.

The trees are harvested in 4 to 6 years depending on their growth. One or two coppice crops are also taken. The yields of these plantations vary widely, depending upon the site and management of the plantations. However, farmers mentioned that they usually get between 40 and 60 MT per ha over the rotation period.

4.5.2 Casuarina

Casuarina is primarily planted in the sandy soils of the coastal belt. Farmers mentioned that they plant casuarina at a close spacing of 1.25m x 1.25m to compensate for mortality losses. The seedlings are procured either from private nurseries or from the Forest Department.

The plot for the plantation is prepared by ploughing it and the seedlings are planted in pits. In the first two years, fertiliser and irrigation is provided to the plantation. The rotation followed is three years after which a crop is harvested and the stumps removed from the field. The field is either immediately replanted with casuarina or some other crop like *jowar* is cultivated for a year after which casuarina is replanted.

The average yield of casuarina in a three to four year rotation is in the range of 50 MT per ha. The fallen leaves of casuarina are sold as fuel.

4.5.3 Subabul

Subabul seeds initially came to the region from Maharashtra. After planting of several subabul plantations in the district they are now abundantly available locally. The farmers either collect the seeds from local plantations or buy them. Alternately they also collect wildlings or get planting stock from either the Forest Department or Andhra Pradesh Paper Mills (APPM).

The seedlings are normally planted at a close spacing of 1m x 1m to 1.25m x 1.25m. In the first year, some agricultural crop such as tobacco is intercultivated.

Ploughing and providing inputs such as fertiliser and irrigation to the plantation depends upon the farmer and there is no particular trend. Usually, farmers collectively appoint a watchman to guard the plantations spread over a large area. Each farmer contributes towards the salary of the watchman in proportion to the area of his plantation. The current rate of payment in village M. Nidamanuru is Rs. 20 per acre.

The rotation followed for the tree is between three to five years with the three years rotation period being most common. In general, the yield of pulpwood with bark from subabul over a rotation period of three years ranges between 20 to 30 MT per acre with the average being around 25 MT (about 20 MT per ha per year).[62] After harvesting, at least one and commonly two coppice crops are taken with the same rotation of three years. Many farmers retain two coppice shoots per stool in the coppice crop. At the time of harvest, after which no further coppice crop is planned, the trees are cut at a sufficient height above the ground level to allow for easy uprooting of the stumps.

[62] The rotation age as well as yield is significantly altered if the plantation is regularly irrigated.

The tree crops sold as pulpwood are mainly harvested between November and March. During this period the moisture content of the trees are good due to the rains and it benefits the farmers as it weighs more. Furthermore, the coppice crop grows well during and after the rains and also harvesting operations is easier due to less heat.

4.6 Role of different agencies in promoting farm forestry

4.6.1 Wood-based industries

Wood-based industries have played an important role in promoting farm forestry in the district. Apart from providing a ready market for farm forestry produce,[63] which has been the most important incentive for the farmers to take up this activity, some of these industries have also promoted tree plantation among the farmers.

Two companies that have had significant contribution to farm forestry in district Prakasam are ITC Bhadrachalam Paperboards Limited (ITC BPL) and Andhra Pradesh Paper Mills (APPM). Their roles are briefly discussed in the sections below.

ITC Bhadrachalam Paperboards Limited

ITC Bhadrachalam Paperboards Limited has an integrated pulp and paper mill located at Sarapaka in district Khammam, Andhra Pradesh. This mill was established in the year 1979 and currently produces 65,000 MT of pulp and 182,500 MT of paperboards

[63] A large number of wood-based industries located in Andhra Pradesh and elsewhere are procuring pulpwood from the district. Major industries procuring farm forestry wood from district Prakasam are APPM, Rajahmundry; Sirpur Paper Mills, Sirpur; AP Rayons, Kamalapuram; ITC Bhadrachalam Paperboards Limited, Sarapaka; Nagarjuna Cement, Huzur Nagar; West Coast Paper Mills, Dandeli, Karnataka; JK Paper Mills, Rayagada, Orissa; Ballarpur Paper Mills, Ballarshah, Maharashtra; Orient Paper Mills, Amlai, Madhya Pradesh; Mahendra Pulp and Paper Limited, Vapi, Gujarat and BILT Sewa Unit, Jeypore, Orissa.

and paper per year. The company requires nearly 2.6 lac MT of freshly felled pulpwood annually as raw material (Lal 2000).

In earlier years, the company was receiving its raw material from government forests. But as the supplies from this source started dwindling, the company started exploring alternate sources. The company was keen to raise its own captive plantations, but due to land ceiling laws and restrictions on leasing of forest lands it was unable to do so.[64] Faced with declining supplies from government forests and bleak prospects of raising its own captive plantations, the company decided to promote farm forestry among farmers to procure its future raw material supplies.

ITC BPL has performed the main role in promoting eucalyptus farming in district Prakasam and in several other districts of the state. But it has not had much contribution in promoting either subabul or casuarina, both of which cover larger areas than eucalyptus in the district.[65]

ITC BPL started its social forestry programme in 1982 under which it began distributing eucalyptus seedlings free of cost. The programme continued until 1986 and during this period, 4.67 million eucalyptus seedlings were distributed free of cost to farmers (Lal *et al*. 1997).

In 1987, the company started its farm forestry programme and developed a package of high quality nursery stock, technical extension services, buy-back guarantee and financial assistance for raising and maintenance of plantations. A detailed project was submitted to NABARD, which envisaged technical and financial

[64] The land ceiling limit for the worst category of land in Andhra Pradesh both for farmers as well as corporate entities is 54 acres (Reddy and Reddy 1995 in Lal 1999).

[65] The company started a casuarina improvement programme in 1994, but it has not yet started producing casuarina clones on a commercial scale (Lal 1999).

assistance to farmers for raising eucalyptus plantations over marginal lands in five districts in AP (Lal *et al.* 1997).[66]

The company created a separate Plantations Department[67] to manage the project, which ran until 1995. During the period of the project, 17.4 million seedlings were planted by 6,185 farmers over an area of 7,441 ha in 1,138 villages of districts Khammam, Guntur, Krishna, West Godavari, Nalgonda, Warangal, Nellore and Prakasam (Lal *et al.* 1997).

Although this in itself was no mean achievement, it was far less than what had been envisaged at the beginning of the farm forestry project. The company felt that one of the main reasons for the lack of enthusiasm among farmers towards eucalyptus farming was the low yield and hence profit of seed route plantations, which ranged between 6 to 10 cu.m per ha per year (Lal 1999; Lal 2000).

With the objective of improving the yield and profit of plantations and making farm forestry more attractive to farmers, the company started an R&D project in 1989. The main focus of the project was genetic improvement of planting stock and improvement of the package of practices.[68]

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[66] The project was sanctioned in 1989.

[67] The Plantation Department of the company carries out R&D as well as marketing/extension activities. A senior officer of the rank of Vice President heads the department. At present, the total staff strength of the Plantation Department is 26, out of which 10 Junior Managers are based in the field to carry out marketing and extension activities. There is one Junior Manager posted in district Prakasam.

[68] The company has made considerable investments in R&D and extension activities. During the period 1986–87 to 1997–98, the company spent Rs. 31.9 million on promotion of farm forestry plantations and providing technical extension services. Similarly, during the period 1989–90 to 1997–98, the company spent Rs. 15 million towards capital expenses and Rs. 28.8 million towards operational and administrative expenses related to its forestry R&D work and production of clonal planting stock. Until 1997–98, the company had only recovered Rs. 23.6 million through the sale of clonal seedlings. However, with rising sale of its clonal seedlings, the company hopes that the Plantation Department will not only be able to survive without subsidy but also generate profits (Lal 1999).

As a result of the R&D project, the company has developed 11 high yielding and disease resistant clones that have a yield ranging from 20 to 44 cu.m per ha per year under rainfed conditions. These are now multiplied on a commercial scale and supplied to farmers (Lal 1999).

The first clonal demonstration plantation of the company was set up in 1991. Later on it established some more covering an area of 15 ha in three districts (Lal 1999). The supply of clonal eucalyptus plants, termed Bhadrachalam Clones, started in 1992. They were initially sold at a subsidised price of Rs. 4.50 per plant. Between 1992 and 1996, the company continued to sell both seed route as well as clonal plants, but since 1996 it is promoting only the clonal variety. Currently, it supplies clonal plants at the price of Rs. 8 per seedling. The company also provides technical guidance to the farmers for proper site selection and clone matching. It further offers a buy-back guarantee at an agreed upon price to the farmers. Between 1997 and 1999, the buy-back price offered at the mill gate for debarked wood of eucalyptus was Rs. 1,900 per MT. However, since 2000, the company has decided to buy back the produce at the prevailing market price, as it is difficult to fix the price for a future date (personal communication, Mr. Piare Lal, Vice President, Plantations, ITC BPL).

The field staff members of the company carry out extension activities through one-to-one meetings with the farmers, group meetings and arranging exposure visits for potential tree farmers to good plantation sites. In the initial years, the company had advertised in the local farming magazine *Annadaata*. Now, many farmers themselves contact the ITC BPL field staff after seeing the good results of plantations of other farmers. A few farmers have also written articles on tree farming in district level newspapers which has helped to promote a positive attitude towards farm forestry (personal communication, Mr. Piare Lal, Vice President, Plantations, ITC BPL).

The Indian Leaf Tobacco Division of ITC has also been supporting farm forestry in some districts of Andhra Pradesh by providing subsidies to farmers. The details of financial support provided in recent years to the farmers for taking up plantation activity is provided in Table 4.4.

Table 4.4: Total subsidy offered to the farmers in the period 1995–1999

Year	*Number of farmers*	*Number of saplings planted*	*Area (ha)*	*Subsidy (Rs.)*
1995	86	138,611	75.42	323,640
1996	117	209,172	120.64	732,102
1997	108	212,695	122.85	744,433
1998	114	280,422	171.37	981,477
1999	155	324,605	201.51	1,291,545
Total	580	1,165,505	691.79	4,073,197

Source: Note on 'Technology Based Plantations' dated 29.3.2000 by Mr. Piare Lal, Vice President (Plantations), ITC BPL

As a result of the efforts of ITC BPL and its sister concerns, 516 ha of clonal eucalyptus plantations have been raised in the district.

Andhra Pradesh Paper Mills

Andhra Pradesh Paper Mills (APPM) currently produces about 95,000 MT of paper annually at its factory located at Rajahmundry, district East Godavari, Andhra Pradesh. Its annual requirement of cellulosic raw material is about 3.5 lac MT, which is being met entirely from within the state (Naidu 2000).

Although APPM initiated its farm forestry scheme in 1977, it gained momentum only in 1989. APPM is encouraging farm forestry

among the farmers of the coastal districts of Andhra Pradesh through the supply of casuarina and subabul seedlings at a heavily subsidised price. The naked seedlings of subabul are supplied at only 2 paise per seedling while the bagged seedlings are priced at 5 paise (personal communication, Mr. Brahmanudu, Raw Material Manager, APPM, Ongole).

The mill has set up 153 nurseries for raising seedlings for supply to the farmers (CSE 1999). Currently, about 20 million seedlings of casuarina and subabul are being distributed in the coastal districts every year (Naidu 2000). In district Prakasam alone, APPM has been distributing three to four million seedlings of subabul annually. During 1998, the company also distributed one lac seedlings of casuarina, but due to poor response from the farmers, this has been discontinued.[69]

In addition to the supply of subsidised seedlings, APPM field staff members visit the fields of farmers and provide them with technical guidance. APPM also organises meetings with farmers in their demonstration plots to explain better techniques of raising pulpwood plantations to them (Naidu 2000).

4.6.2 Forest Department

The Forest Department of Andhra Pradesh, like those of other states, has been actively promoting tree planting on non-forest lands through its social forestry programme. It is estimated that since 1985, on an average 10 to 15 million seedlings are being distributed annually in each district. These seedlings are distributed either free of cost or at a highly subsidised price, as per the decision of

[69] The main reason for the poor response was the climatic and edaphic conditions of district Prakasam, which are not very well suited for raising good quality casuarina poles. Consequently, the growth of the tree is not very good and they also have many knots, which reduces their market value as poles (personal communication, Mr. Brahmanudu, Raw Material Manager, APPM, Ongole).

the District Forestry Committee. About 70 to 80 per cent of these seedlings are provided for farm forestry plantations with the most common species being casuarina, subabul, eucalyptus and bamboo (personal communication, Mr. Padmanabha Reddy, DFO Mahboobnagar).

In district Prakasam, the Planning and Extension Division of the Forest Department, with its headquarters at Ongole, mainly carries out social and farm forestry related extension and seedling distribution work.

The Forest Department provides subsidised seedlings to the farmers through its nurseries. The available figures indicate that since 1995, on an average, the Forest Department has been distributing over 11 million seedlings annually in the district. The distribution has been highest in the last two years (refer Table 4.5).

Nominal price is charged for these seedlings. The prices fixed by the District Forestry Committee for 1999 were 15 and 20 paise for seedlings in smaller bags and Rs. 4 for seedlings in bigger bags.

Table 4.5: Year-wise seedling distribution by the Forest Department in the district

Year	*Number of seedlings distributed (in million)*
1995	10.97
1996	5.24
1997	4.13
1998	22.37
1999	15.84
Total	58.55

Source: Planning and Extension Division, Ongole.

Since 1996, the Forest Department has also been promoting farm forestry under the World Bank supported Andhra Pradesh Forestry Project (Treatment Practice 11). Under the scheme, groups of marginal farmers are selected in such a way in each locality that the total area is at least 20 ha. The area is deep ploughed and inputs like planting stock, fertilisers, pesticides, legume seed etc. are provided to the farmers. The farmers are free to choose the species of the seedlings they wish to plant. In the first year, a maintenance incentive of Re. 1 per plant up to a maximum of Rs. 1,100 per ha is given to the farmer. In the second year, the maintenance incentive increases to Rs. 1.50 per plant up to a maximum of Rs. 1,650 per ha. These incentives are, however, paid only if the survival percentage of the plants is more than 75 per cent. The entire income from the sale of trees from the plantations, at the rotation age, is to be retained by the farmers themselves. Between 1996 and 2000, under the scheme 3,253 ha of farm forestry plantations was raised in the district (refer Table 4.6). This scheme has now ended.

In addition to the distribution of seedlings, the Forest Department has also been promoting plantation on common lands. Available figures indicate that since 1985, 4,928 ha of plantation on common lands has been raised in the district (refer Annex 6).

Table 4.6: Area covered under the Andhra Pradesh Forestry Project

Year	*Area covered under the scheme (ha)*
1996–97	382
1997–98	580
1998–99	1,186
1999–2000	1,105

Source: Planning and Extension Division, Ongole

Under the Andhra Pradesh Forestry Project, the Forest Department has also set up a research cum demonstration plot in the district. The plot is located on a 15 ha patch of forest land in Chevuru, Guluru *Mandal*, which is about 55 kilometres from Ongole town. The Forest Department is also carrying out field trials of casuarina clones and spacing trials of eucalyptus. In addition, some inter-cropping trials with plants such as aloe are also under way. A small arboretum and medicinal plants garden is also being developed for demonstration purpose.

4.7 Impacts of farm forestry

The major impact of farm forestry has, of course, been the increase in availability of raw material for wood-based industries. In addition, there have been other impacts, which are discussed below briefly.

4.7.1 Climate

Several persons reported during discussions in the district that after the spread of farm forestry the maximum temperature during summers has come down and the rainfall has become more regular, except in 1999 when there was very little rain. However, this still needs to be scientifically validated.

4.7.2 Dairy industry

Subabul plantations have had a positive impact on the dairy industry. The manager of the milk collection depot of village Nidamanuru informed that milk production in the village had increased from 50 to 60 litres per day to 900–1,000 litres per day after subabul plantations came up in the village.[70] This was primarily due to

[70] Although the number of milch animals has gone up as a result of spread of farm forestry, the number of bulls, especially the famous breed of Ongole bull, which is used for ploughing, has gone down.

increased availability of fodder in the form of subabul leaves. The fat content of the milk has also reportedly increased. The main benefit has gone to landless and marginal farmers, who now have to purchase less fodder from the market. One such dairy farmer of village M. Nidamanuru, who owns three buffaloes, estimated that currently he is spending less than Rs. 10 per day on fodder, whereas in the absence of subabul plantations he was spending around Rs. 30 per day. These days he has to put in less labour to make his ends meet and he is even thinking of leasing a small plot of land to cultivate *jowar*. The flip side of this is the damage caused to the subabul plantations through lopping and grazing. However, the subabul farmers do not perceive it as a major problem and most of them do not object to this.

4.7.3 Ground water

The major negative impact of farm forestry as perceived by the farmers of the district is the depletion of the ground water reserves. Several farmers in village M.Nidamanuru mentioned that the ground water level had dropped after tree plantations were raised in the village. One farmer mentioned that he has a well in his field that dried up after he planted subabul, but got recharged after he harvested his plantation. Another farmer, Mr. Keshav Murthy, who had over 30 acres under subabul, has now decided to stop farming it and shift to other crops as he feels that subabul has resulted in lowering of the ground water table. He mentioned that several farmers were worried on this account and might stop planting trees in the future. Farmers of other villages have also voiced similar concern. For example Mr. Raghu, a farmer from village Thimmanapalem, Medermetla *Mandal* stated that ground water depletion in his and a neighbouring village was due to eucalyptus farming. Farmers also informed that village Santanutalapadu, Cheemakurthy *Mandal* was facing acute scarcity of water due to

depletion of ground water as a result of eucalyptus plantations. However, there has not yet been any scientific study in the district on the impact of plantations on ground water. Consequently, the promoters of farm forestry such as ITC BPL dispute these claims of adverse impact of plantations on the ground water.

4.8 Markets and marketing arrangements

In district Prakasam, there are no restrictions on felling and transport of several farm forestry species including subabul, eucalyptus and casuarina. These have been exempted from the purview of the Andhra Pradesh Forest Produce Transit Rules, 1970. While casuarina was exempted from the transit restrictions in the seventies, subabul and eucalyptus were granted exemption in 1984. A farmer is only required to obtain a 'cultivation certificate' from the Mandal Revenue Officer (MRO) stating that he has grown the farm forestry produce on the land cultivated by him. The MRO issues this 'cultivation certificate' based on the recommendation of the Village Administrative Officer. After obtaining the 'cultivation certificate' the farmer is free to sell his produce.

4.8.1 Evolution of the pulpwood market

The main market for farm forestry produce in the district is provided by wood-based industries, which procure their pulpwood from the district. Some of these are located within the state while others have their mills located in other states.

The first company to start procuring raw material on a regular basis from district Prakasam was West Coast Paper Mills (WCPM), which opened its first depot in the district in 1989 to procure raw material for its unit in Dandeli, Karnataka. WCPM was facing problems in obtaining its supplies from the Forest Department sources. It was also facing stiff competition from South India Viscose

Limited for procuring eucalyptus locally. Due to these problems, it decided to look for alternatives and hence started procuring casuarina and subabul wood from district Prakasam. From 1988–89 to 1990–91, WCPM purchased mainly casuarina for its mill, but after that subabul became the main species. During 1998–99, the company procured about 91,000 MT of pulpwood from the district, out of which 55,000 MT was subabul and 36,000 MT was casuarina. Details of the raw material procurement by WCPM since 1988–89 are given in Annex 7 (personal communication, Mr. Venugopal, Assistant Manager, Raw Material, West Coast Paper Mills).

APPM was the second company to open its depot in district Prakasam and it started procuring pulpwood from 1992. Since then, it has been procuring around 1 lac MT of pulpwood, out of which about 80,000 MT is green subabul wood and the rest casuarina and eucalyptus (personal communication, Mr. Brahmanudu, Raw Material Manager, APPM, Ongole).

Subsequently, several other companies also started procuring wood from the district. At present, the following companies are procuring wood from there.

A. Andhra Pradesh based companies
    1. Andhra Pradesh Paper Mills, Rajahmundry
    2. Sirpur Paper Mills, Sirpur
    3. AP Rayons, Kamalapuram
    4. ITC Bhadrachalam Paperboards Limited, Sarapak
    5. Nagarjuna Cement, Huzur Nagar

B. Companies located outside Andhra Pradesh
    1. West Coast Paper Mills, Dandeli, Karnataka
    2. JK Paper Mills, Rayagada, Orissa
    3. Ballarpur Paper Mills, Ballarshah, Maharashtra

Box 4.5: Economics of pulpwood transport

It is interesting to note that many mills located at a considerable distance from district Prakasam are procuring pulpwood from there even though they have to incur heavy transportation costs. For instance, WCPM that procures nearly 1 lac MT of pulpwood from district Praksam, spends Rs. 430 per tonne in transporting the wood from the district to its mill site in Karnataka (personal communication Mr. Venugopal, Assistant Manager, Raw Material, West Coast Paper Mills). Even ITC BPL, which is located within Andhra Pradesh, incurs a cost of about Rs. 400 per tonne in transporting the wood from district Prakasam to its mill site in district Khammam. Although these companies are spending about one-third of their total raw material procurement cost only on transportation, they continue to procure raw material from the district due to non-availability of adequate quantity of raw material in the vicinity of their mills.

4. Orient Paper Mills, Amlai, Madhya Pradesh
5. Mahendra Pulp and Paper Limited, Vapi, Gujarat
6. BILT Sewa Unit, Jeypore, Orissa

It is estimated that presently these companies procure between 6.5 to 7 lac MT of wood worth around Rs. 560 million annually from the district (FD n.d.a). Some of these companies have permanently posted officers in the district for procurement of pulpwood. These include APPM, ITC BPL, AP Rayons, WCPM and Sirpur Paper Mills. Others procure mainly through agents.

Many companies such as WCPM and APPM maintain depots, where the wood is first stored before being despatched to the mill, while others such as ITC BPL directly despatch the wood from the site of purchase to the mill.[71]

[71] The advantage of keeping the material in depot for some time is that due to moisture loss from the timber, the quantity to be transported is less and consequently transport costs are less. However, on the other hand the company has to incur the costs in operating the depot and there is a danger of deterioration of wood. Subabul wood is particularly susceptible to borer attack.

These companies are procuring all the three main farm forestry species *viz.* subabul, eucalyptus and casuarina. Depending on the requirements of the pulping and manufacturing process, the wood is purchased with or without bark.

4.8.2 Mode of procurement

At present, these companies are purchasing wood from the district through three systems:

1. Procurement through suppliers
2. Direct purchase from farmers
3. Purchase from farmers through the Agriculture Market Committees (AMCs)

Procurement through suppliers

This was the most common system of procurement until 1999. Under this system, the companies enter into contract with suppliers for the supply of a specific quantity of wood at their depots or mill site within a given time period, usually six months to one year. The type of wood (for example debarked eucalyptus, subabul with bark, etc.) and other specifications such as minimum acceptable girth and the size of billets are also specified in the contract. The suppliers, in turn, procure the wood from the farmers, often through sub-suppliers.

This system is advantageous to the companies as it avoids having to deal with a large number of scattered farmers producing small amounts of wood. The mills are also able to get wood at competitive prices as the supply contracts are decided through tenders. Furthermore, it is the suppliers rather than the company who invest their money initially, which is also to the company's advantage.

Many farmers also prefer this system for the convenience it offers to them. The suppliers usually purchase standing trees and arrange

for harvesting, billeting and transportation. This saves the farmers considerable trouble. The negative aspect of this system for the farmers is the lower price that they receive and the delay in payment as the money comes to the farmers from the company through the suppliers.

Direct purchase from farmers

Apart from the reasons mentioned before, until 1999 there was yet another important reason for the companies to prefer supplier system over direct purchase from the farmers. This was due to a provision in the Sales/Purchase Tax rules that charged 4% tax on wood purchased from a supplier registered with the Commercial Tax Department and 10% on that purchased from an unregistered supplier.[72] While all the companies' suppliers were registered, farmers were treated as unregistered suppliers and higher rate of tax was charged. This acted as a disincentive for the companies to purchase wood directly from the farmers.

Nevertheless, in some cases companies purchased directly from the farmers and continue to do so. For instance, ITC BPL has buy-back arrangement with some farmers and buys wood directly from them. In such cases the company arranges for harvesting, billeting and transport of material. Alternately, farmers can themselves harvest and supply pulpwood at company depots or at mill site. However, the total quantity procured directly from the farmers by the companies is insignificant.

Companies do not prefer this system due to additional costs involved in dealing with a large number of scattered farmers. Furthermore, they have to block their own money for procuring wood and their administrative work also increases. Most farmers also do not prefer

[72] The sale tax rate for unregistered dealers has now come down to 8% due to the implementation of uniform sale tax structure by various states.

to harvest their own plantations as it involves arranging labourers for harvesting and billeting of wood, as per the specifications of different companies, and then arranging transport to the depot or mill site. They find it easier to sell their plantations on acreage basis, and the harvesting, conversion and transport operations are carried out by the middlemen. Middlemen have their own labour gangs and also have good understanding with the transport companies, which makes it is easier for them to carry out these operations.

Purchase through Agricultural Market Committees

The third method of procurement is through the Agricultural Market Committees (AMCs). This system was introduced only in 1999, after farmers agitated on account of sudden reduction in price of subabul in 1998–99. Until that time the various mills, operating through their suppliers, were paying different prices for procurement of wood.

There was a sharp fall in subabul wood price from Rs. 910 per MT in 1996 to Rs. 740 per MT in 1999 (refer Box 4.6). This led to an agitation by the farmers, who organised themselves under the banner of *Akhilapaksha Porato Samiti*. They made representation to the district administration and demanded a minimum support price of Rs. 920 per MT. The farmers also demanded that the companies purchase subabul directly from them through AMCs, that the companies should make spot payment for the produce and the farmers should get sales tax exemption when they make direct sale to the companies. Instead, the AMC could charge a cess from them. The district administration tried to resolve the issue by organising meetings between the representatives of the companies and the leaders of the farmers in March and April, 1999. However, the matter could not be resolved as the farmers insisted on a minimum support price of Rs. 920 per MT against the prevailing market price of Rs. 800 per MT.

Box 4.6: Collapse of subabul market

Sirpur Paper Mills started procuring wood from the district in 1996. As they urgently needed the wood, they offered a high price of Rs. 910 per MT against the prevailing price of Rs. 850 per MT. Subsequently they realised their mistake and asked their suppliers to lower the price. They procured at lower price next year and by March 1999 their suppliers had reduced the procurement price to Rs. 740 per MT. The details of the prices paid by the major purchasers of subabul at the local depots are given in the table below:

Name of the Paper Mill	*Procurement Price per MT in different years (Rs.)*			
	1995-96	*1996-97*	*1997-98*	*1998-99*
Andhra Pradesh Paper Mills	766 to 846	846 to 898	865 to 830	800
West Coast Paper Mills	840	830	820	810
Sirpur Paper Mills	No procu-ement	890 to 910	825 to 835	795 to 800 Lowest: 740 in March 1999

Source: Forest Department, n.d.a

The matter finally reached the office of the Chief Minister, who called a meeting of all the concerned parties on 27th April, 1999 to resolve the issue. In the meeting with the Chief Minister, the representatives of both companies and farmers agreed on a price of subabul wood, which was fixed at Rs. 860 per MT, inclusive of taxes on subabul wood with bark, delivered at the depot. The companies also agreed to procure subabul wood through AMCs, avoiding the middlemen. This system became operational from 5 May, 1999.

Subsequently, the government issued a Government Order (G.O. Ms. No. dated 10 June, 1999) declaring subabul, eucalyptus and

casuarina to be *Agricultural Produce* under the Agriculture Group as per the provisions of the Andhra Pradesh (Agricultural Produce and Livestock) Markets Act, 1966 and included these in the Schedule II for the purposes of the said Act. These species can now only be traded through AMCs.

The Government also issued a Government Order (G.O. Ms. No. 370 dated 3 May, 1999 under the Andhra Pradesh General Sales Tax Act, 1957) granting exemption to the paper mills located within the state, which purchased subabul, eucalyptus and casuarina poles through the AMCs from payment of sales tax until 31 May, 1999. However, this G.O. only mentioned exemption from sales tax and not from the purchase tax, which the companies were liable to pay at 10%. Three Andhra Pradesh based companies made a representation to the Government on this issue on 27 July, 1999. Subsequently, another G.O. (G.O. Ms. No. 742 dated 20 October, 1999) was issued and exemption was granted from purchase tax with retroactive effect from 3 May, 1999. After lobbying by mills located outside the state, through the issuance of another G.O. (G.O. Rc. No. 73 dated 9 February, 2000), the exemption from the sales and purchase taxes was extended to all paper mills, including those located outside the state.

4.8.3 Current marketing arrangements and prices

Although all the three major farm forestry species in the district *viz.* subabul, eucalyptus and casuarina have been declared 'agricultural produce' and as such can only be traded through AMCs, so far only subabul (with bark) wood is being traded through AMCs. Eucalyptus, casuarina and subabul (debarked) wood continue to be procured as earlier.

The existence of an agreement on the purchase price of only subabul (with bark) wood, for Rs. 860 per MT, is the main reason

Box 4.7: System for procurement of subabul (with bark) wood through AMCs

While the system for procurement of eucalyptus and casuarina continues as before, subabul (with bark) wood is being procured by the companies since 5 May, 1999 through AMCs. There are 14 AMCs in the district, which run 36 Market Yards. The arrangements for the purchase of subabul (with bark) wood have been made at AMCs which cover Singarayakonda, Tangutur, Ongole, Throvagunta, Chimakurthy, Medarmetla, Cumbum and Markapur, where depots of various companies are located. The AMCs covering these places are Ongole (Ongole, Throvagunta and Tangutur), Kondepi (Singarayakonda), Addanki (Medarmetla), Maddipadu (Chimakurthy), Cumbum and Markapur. The companies have to get registered with the AMC by paying the prescribed licence fee and open a depot near the AMC, if they already do not have one.

In order to sell his or her produce to the AMC, a farmer has to first obtain a photo identity card, which has been introduced since 15 July, 1999 to eliminate middlemen. Subsequently, s/he has to get the 'cultivation certificate' from the MRO. The farmer then has to take the certificate, along with the photo identity card, to the concerned AMC to obtain a token, which mentions the amount of wood and the date on which it is be supplied to the AMC. The AMC issues the tokens to the farmers on a first come-first served basis, depending on the purchase orders it receives from the various companies. The companies give the AMCs their requirement (purchase order) for the coming month by the last date of the previous month.

Farmers have to harvest and transport the wood to the AMC themselves. They take their produce to the designated weigh-bridge on the appointed day and get it weighed in the presence of the representatives of AMC and the procuring company. The farmer pays the weighing charge and a weight slip and sale notice, signed by the farmer as well as representatives of AMC and the company, is prepared. The wood is then unloaded in the depot of the company. In case a mill requests, the wood can be stored free of cost for short duration in the market yard. Payment to the farmer for the produce is made by the AMC, which in turn recovers it from the purchasing company within five days through a crossed cheque. The AMC charges a cess of 1 per cent of

the total selling price for its services, which is deducted from the total amount payable to the farmer.

The company transports the purchased wood to its mill site by road or rail. A transit permit is issued to the transporting vehicles by the AMC as per the provisions of the Andhra Pradesh (Agricultural Produce and Livestock) Markets Act, 1966.

for continuing with the old middleman system in case of eucalyptus, casuarina and subabul (debarked) wood.

Even in the case of subabul (with bark) wood traded through the AMCs, middlemen have not been totally eliminated. In fact, according to estimates made by a supplier and raw material manager of a paper mill, bulk of wood reaching AMCs is actually supplied by middlemen and only 25 to 30 per cent is supplied directly by the farmers. It is only farmers located near an 'active' AMC that are supplying wood directly to them, while the rest prefer to deal through middlemen for reasons discussed earlier.

There are currently two systems in vogue. A farmer either gets the 'cultivation certificate' from the MRO issued in his name and pays only a commission to the middleman for carrying out harvesting, billeting and transport or takes a lump sum payment from the middleman, who then 'arranges' a 'cultivation certificate' in his or his close relatives' name. The latter system is preferred by the farmers as the chances of cheating are much less. In case of sale by weight, the middlemen often show less weight of produce and are also careless about harvesting; often harvesting trees at a higher level rather than cutting them close to the ground.

However, irrespective of the system of sale, the price paid through AMC is taken as the reference price for calculating the amount payable to the farmer. The current price being paid through AMC

is Rs. 860 per MT. After payment of market cess and weighing charges, it comes to approximately Rs. 850 per MT. The farmer has to incur expenditure of about Rs.100 per MT on felling and billeting and on an average another Rs. 100 per MT on transportation. Therefore, the net amount obtained by the farmer is about Rs. 650 per MT.

The farmers are in general satisfied with the AMC system. The main advantages of this system are assured remunerative price and prompt payment. The latter, as all the farmers talked to agreed, is the greatest advantage of the new system. Now they receive their payment within five days while earlier they had to sometimes wait for months.

Eucalyptus, casuarina and subabul (debarked) wood is not traded through the AMCs and is usually purchased directly by the companies through their suppliers. The companies buy these species as pulpwood. However, there is also a market for eucalyptus and casuarina poles and some farmers sell their produce as poles as this fetches them much higher prices. The price obtained for casuarina and eucalyptus poles at stump site is between Rs.1,200 to Rs.1,800 per MT. The additional advantage with poles is that the farmer also gets paid for the bark, which constitutes about 15 per cent of the total weight. However, due to more stringent quality requirements for poles, only a limited quantity of the produce from district Prakasam is sold as poles. The quality requirements for the poles are often not met with by the produce due to the difficult climatic and edaphic conditions of the district. The main markets for poles are in Hyderabad, Nagpur and Anantpur.

The market price for subabul (debarked) wood is proportionately higher than subabul (with bark) wood, considering the loss of weight and the labour invested in debarking it. AP Rayons and ITC BPL are the only companies purchasing subabul (debarked) wood

as they cannot use subabul (with bark) wood in their mills due to technical reasons. During 1998–99, the material cost, exclusive of taxes and transportation charges, incurred by ITC BPL for subabul (debarked) wood was Rs. 1,030 per MT, while that of subabul (with bark) wood was Rs. 680 per MT (source: ITC BPL records). However, farmers prefer to sell subabul wood with bark and only if that option is not available due to distance from AMC, they sell subabul (debarked) wood. The main reasons for this preference are higher labour requirement, moisture loss, and quality problems due to some bark remaining on the billets.

The current market price for eucalyptus (debarked) wood and casuarina (debarked) wood delivered at depot site is Rs. 1,000 and 1,100 per MT, respectively. The average cost incurred on felling, debarking and billeting is about Rs. 200 per MT. While transportation cost depends on the distance of the plantation from the depot, on an average, it comes to about Rs. 100 per MT. So, the net price obtained by the farmer is about Rs. 700 and Rs. 800 per MT, respectively. At present, the two main procurers of eucalyptus wood are AP Rayons and ITC BPL.

4.9 Role of District Administration[73]

The District Administration has played a positive and proactive role in improving the marketing of farm forestry produce in the district. The District Collector of district Prakasam and *Zilla Parishad* Chairman have taken personal interest in the matter and have held a large number of meetings with district officials, representatives of companies and farmers to sort out various operational problems.

In order to make the marketing system more farmer-friendly, the

[73] This section is based on interviews with various persons of the district connected with farm forestry and the minutes of meetings held in the district on the subject.

District Collector has asked the companies to open depots at various AMC locations and also to provide necessary bank guarantees to the AMCs. He also requested them to procure more wood from the farmers. When some of the companies expressed their inability to procure more material due to difficulties in getting lorries, he requested the Regional Transport Officer to provide 50 lorries for transporting subabul wood.

In order to streamline operations at the AMC level and to remove the bottlenecks, he contacted the Director of Marketing at Hyderabad to get additional staff posted at the AMCs. This was to ensure that there were no delays at the time of weighing of the produce or issuance of payment cheques to the farmers. He allowed hiring of additional assistants at the subabul purchase point on contractual basis, pending receipt of orders from the Director of Marketing, Hyderabad.

He has also issued instructions to all AMCs to start the token system so that farmers do not harvest and bring in more produce than is needed by the companies. This way they do not have to wait for days to get their trolleys unloaded.

As casuarina and eucalyptus have also been declared 'agricultural produce' and can only be purchased through the AMCs, in a meeting held on 21 June 1999, the District Collector issued instructions to the companies to start procuring these species through AMCs with effect from 1 July, 1999. He had requested the Assistant Manager of ITC BPL to come up with an action plan, but so far this system has not become operational.

4.10 Reasons for spread of farm forestry in the district

In recent years farm forestry has emerged as a major land use in district Prakasam. It is, however, not uniformly popular across the

district but is limited to a certain belt on the eastern side of the district. The main reasons for spread of farm forestry in the district are briefly discussed below:

- Facilitative government policies: Facilitative government policies have played a crucial role in encouraging and sustaining farm forestry in the district. This has been done in two ways:
  (1) By reducing supply of raw material to the industries from government forests.
  (2) By removing bottlenecks in the way of tree farming by farmers.

  The state government has steadily reduced the supply of hardwoods and bamboos from the forests to the industries. This has forced the companies to purchase farm-grown wood and has also prompted some of them to invest in R&D and extension activities. The government has greatly helped tree farming by exempting important farm forestry species from the purview of transit rules. The government has further facilitated the growth of farm forestry by declaring subabul, eucalyptus and casuarina as 'agricultural produce'. It has also abolished sale and purchase tax on purchase of wood by paper mills through the AMCs. The importance the state government attaches to farm forestry can be gauged from the fact that the Chief Minister himself intervened to resolve the imbroglio over subabul marketing in the district.
- Enterprising farmers and risks associated with alternative crops: The farmers of this district have been growing cash crops such as tobacco, cotton and chillies for a number of years. Hence, farmers were already operating in a cash economy and understood the functioning of markets. It was therefore easier for them to shift to tree crops once they started facing problems with the traditional cash crops.

- Climatic/edaphic conditions and lack of irrigation: Farm forestry is popular only in those parts of the district where the combination of low rainfall, saline-alkaline soils and saline groundwater have limited the choice of crops available to the farmers. The ability of trees like subabul to grow on such refractory soils under low rainfall conditions without needing much investment or care has made them an attractive option for the farmers. Several farmers owning wastelands, on which they were not cultivating any crop, have also started tree cultivation on them. However, wherever climatic and edaphic conditions are better and/or irrigation facility is available, farmers prefer to grow other crops. In irrigated areas, the preferred crop is paddy as it gives higher return. According to farmers of village Nandanamarella, one could easily earn Rs. 12,000 per acre from paddy even if irrigation is provided only in critical periods. In dry land areas with red soils, farmers grow crops such as red gram, *ragi* and *bajra* due to the very low investment required and little risk associated with them.[74]
- Availability of ready market and market infrastructure**:** One of the most important reasons for the farmers to adopt tree farming is the ready availability of market for farm forestry produce. Large-scale purchase of farm grown wood by various companies from the area since early nineties had a direct positive impact on the growth of farm forestry in the district. There is also a good market infrastructure in the district due to the presence of several weigh bridges, company depots, rail-side depots, loading facilities and AMC market yards. As has been mentioned earlier, 11 companies located in Andhra Pradesh and

[74] For instance, in certain areas where termite problem is present, red gram is a much safer crop than trees. The investment needed for *ragi* and *bajra* (excluding land rent) is only about Rs. 1,125 per ha and one gets the returns within three months.

elsewhere are procuring about 6.5 to 7 lac MT of wood annually from the district. The size of wood market is estimated to be about Rs. 560 million per year.

- Role of District Administration: The District Administration of district Prakasam has played an important role in sustaining and popularising farm forestry in the district. It is quite likely that but for the timely intervention of district officials, farm forestry would have received a severe setback when the subabul prices crashed in 1999. All through the subabul-marketing crisis, the District Administration had taken a very supportive approach and attempted to resolve the issue by getting the farmers and companies to talk to each other. The local political leadership too was involved in the process and a number of innovative ideas were put forward. Even after an agreement was reached between farmers and companies, district officials continued to work on this issue to sort out various operational aspects related to the new system. The significance of the role of the District Administration can be ascertained from the fact that while the G.O. declaring subabul, eucalyptus and casuarina as 'agricultural produce' is applicable to the entire state, the AMC system is being followed only in district Prakasam.
- R&D and extension effort by the companies: The biggest contribution of the companies to the promotion of farm forestry in the district is, of course, provision of a ready market for the produce. In addition, companies such as ITC BPL and APPM have been involved in directly promoting farm forestry. ITC BPL has invested considerable effort and money in developing high yielding and disease resistant eucalyptus clones suited to various climatic and edaphic conditions. These high yielding clones have made farm forestry an attractive option for large farmers who have the ability to make the large investment needed to

raise clonal plantations. About 520 ha of clonal eucalyptus plantations in the district can be attributed directly to the efforts of ITC BPL. APPM has also been playing an important role by supplying subsidised subabul seedlings. The subabul seedlings supplied by it every year are enough to cover 400 ha.[75]

- Role of Forest Department: The key role of Forest Department has been in supplying subsidised seedlings and other inputs. The Forest Department has been supplying on an average around 11 million seedlings since 1995. Even assuming a close spacing of 1m x 1m and a survival percentage of only 33 per cent, the area planted comes to over 350 ha every year. In addition, the Forest Department has helped farmers in raising farm forestry plantations over 3,253 ha between 1996–97 and 1999–2000 under the World Bank aided Andhra Pradesh Forestry Project.
- Demonstration effect: In addition to factors such as suitability of climate and soils, lack of alternatives and extension efforts by companies and Forest Department, the 'demonstration effect' has also played an important role in adoption of tree farming by farmers. This is perhaps the primary reason, other than soils and availability of irrigation, for the greater popularity of farm forestry in certain *Mandals*. Even the pioneering farmers of an area were the ones who have seen the good results of farm forestry in some other areas.

4.11 Future trend

The future of farm forestry in the district will primarily depend on the situation of the pulpwood market and the economics of alternative crops such as tobacco and cotton. The farmers are likely

[75] It could not be reliably ascertained how much area is actually planted every year with seedlings supplied by APPM.

to continue to raise tree crops if they can get reasonable assured returns. However, if they do not get adequate returns, they are likely to shift to some other crops. This trend was clearly seen at the time of the crash of subabul prices when few farmers raised new subabul plantations.

In the immediate future, however, the area under farm forestry is likely to increase due to increasing demand for pulpwood. Most of the additional demand is likely to be for subabul, as more and more companies are shifting to it. According to the estimates of ITC BPL, the demand for subabul (with bark) wood in the year 2000–2001 was likely to be around 732,400 MT as against the total procurement of 494,600 MT during 1999–2000. The bulk of the additional demand is likely to come from Orient Paper Mills, ITC BPL and AP Rayons. The additional demand is likely to be met in the short run by reduction in the rotation period and in the long run by additional planting by the farmers (personal communication, Mr. Banerjee, Raw Material Officer, ITC BPL).

The demand for eucalyptus wood is unlikely to increase as sharply as the major purchaser of eucalyptus wood, AP Rayons, has decided to use casuarina wood instead. This is likely to increase the demand for casuarina pulpwood but most of it will probably be procured from other districts.

It appears that there is going to be sufficient demand for the pulpwood grown by the farmers of the district at least in the immediate future. Furthermore, as a crop holiday has been declared for tobacco, many more farmers are likely to go in for tree farming. In such a situation, the key to the success of farm forestry will be proper regulation of the pulpwood market. The state government has already taken steps such as introduction of the AMC system and waiver of sale/purchase taxes, which helped in preventing the collapse of the subabul market and, consequently farm forestry,

in 1999. However, more steps are required to prevent recurrence of the 1999 type situation. At present, the AMC system is being followed only in the case of subabul (with bark) wood although the G.O. also lists casuarina and eucalyptus. The current price for subabul (with bark) wood has been fixed at Rs. 860 per MT through negotiations. The companies agreed to this price as the prevailing market price was already about Rs. 800 per MT and the government had promised exemption from sale/purchase taxes. But there seems to be no firm legal basis for this price as it is not the minimum support price assured by the government. A proper system for arriving at prices of the various farm forestry products and their periodic revision needs to be put in place in line with that for agriculture products.

Only if this is done can the unique farm forestry revolution in Prakasam be sustained and strengthened in the future and become a model for the rest of the country.

5. Analysis, recommendations and conclusions

In this chapter, reasons behind the popularity of farm forestry in Uddham Singh Nagar and Prakasam are explored and some recommendations are made to strengthen farm forestry in the country.

5.1 Analysis

5.1.1 Reasons for the popularity of farm forestry

Facilitative government policies

Facilitative government policies have played a crucial role in encouraging and sustaining farm forestry in both districts. These government policies have encouraged farm forestry in two ways: (1) by reduction or stoppage of raw material supplies to the wood-based industries from government forests and (2) through removal of legal and procedural bottlenecks in the way of tree farming. After the 1988 forest policy, several state governments, including Uttar Pradesh and Andhra Pradesh, have reduced the supplies of raw material to industries from state forests. In both states, felling and transport of important farm forestry species has been made easy and paperwork has been reduced to the minimum. The Andhra Pradesh government has further facilitated the growth of farm forestry by declaring subabul, eucalyptus and casuarina as 'agricultural produce' and abolishing sale/purchase tax in case of

purchase of wood by the paper mills from farmers through the AMCs. In the case of Prakasam district, the District Administration has also played an important facilitative role.

Commercialised agriculture and enterprising farmers

In both the districts, agriculture was already commercialised and farmers were growing agriculture cash crops for sale in the market. For instance, farmers of Uddham Singh Nagar were growing sugarcane, wheat and paddy while those of Prakasam were growing tobacco, cotton and chillies before they adopted farm forestry. As farmers of these districts were already operating in the cash economy and understood the functioning of the market, it was easier for them to adopt commercial farm forestry.

The farmers in these districts are willing to try out new crops and combinations, if they feel that this is going to bring them higher returns on their investment. The enterprising nature of the farmers of Uddham Singh Nagar is evident from the case of mentha cited earlier in this report.

Similarly, in Prakasam district when the tobacco market became very volatile and uncertain, many farmers shifted to other crops such as cotton. When these farmers found tree farming to be a better option, they adopted it. The efforts of the farmers in these areas have been directed essentially towards getting higher returns from their land and it is only due to this reason that they have adopted farm forestry. Thus, in the future, if farmers start getting increased returns from some other crop they would not hesitate to shift from farm forestry to that crop.

Climatic and edaphic factors

The climatic and edaphic conditions of both the districts have played an important part in the spread of farm forestry there. In Uddham Singh Nagar, poplar farming would not have been possible if the area did not have fertile soils, good surface drainage, easy availability

of irrigation and suitable climate. Poplar has very exacting requirements and all of these are fulfilled in Uddham Singh Nagar. Due to fertility of soils, farmers of the district have been able to raise poplar crops without sacrificing much of their agriculture crop, especially in the *rabi* (winter) season.

By contrast, in Prakasam district farmers took to tree farming because the climatic and edaphic conditions are such that the choice of crops available to the farmers is limited. Due to a combination of low rainfall, saline-alkaline soils, saline groundwater and lack of irrigation facilities, only a few agriculture crops such as tobacco or some trees can be raised by the farmers. When farmers started facing problems in marketing tobacco, they shifted to tree crops such as subabul that can be raised on such refractory soils under low rainfall conditions without much investment or care. Once subabul farming picked up in the area, several farmers who had wastelands on which they were not raising any crop also started tree cultivation on such lands.

Higher profitability and lump sum money

The cost of production under conventional agriculture has increased considerably over the years because of increasing input costs (prices of fertilisers, diesel, pesticides etc.). The stagnating productivity levels and increasing input costs of certain agricultural products have made agriculture less lucrative to farmers in these districts. Farm forestry is lucrative to the farmers as it requires lower inputs and the profit margins are higher. Another major attraction for farmers is the lump sum income, which they get at the time of harvest. Thus, farmers tend to view trees (especially those on farm boundaries) as 'bank deposits', which can be encashed as and when the need arises.

Risks associated with alternative crops

Agricultural crops carry considerable risks, which, according to the farmers, have increased in recent years due to erratic rainfall

and emergence of new pests. While a farmer cannot be very certain about the return he or she is going to get from an agriculture crop, tree crops are comparatively less risky. Firstly, trees are not so easily damaged and secondly these can be retained on the farm in case the market price falls. Therefore, farmers prefer to grow a combination of trees and agricultural crops. The increasing risks (pest attacks/ climatic variations/market crash) associated with the alternative agricultural crops have been instrumental in pushing the farmers towards more reliable and relatively less susceptible tree crops.[76] For example, the volatility of tobacco and chilli markets and pest problems in cotton were the main reasons that have forced the farmers in Prakasam to shift to relatively safer tree crops such as subabul. Similarly, high costs of inputs and uncertainty of production and marketing associated with agriculture crops such as paddy and sugarcane are the reasons why farmers in Uddham Singh Nagar have adopted farm forestry.

Availability of suitable tree species

Availability of suitable fast growing tree species, that fitted in well with the local climatic/edaphic conditions and the cropping pattern, was an important reason for the adoption of farm forestry in both the districts.

Farmers of Uddham Singh Nagar adopted poplar as it fitted well with the local cropping pattern. Further, it can be easily and rapidly multiplied through vegetative propagation methods. There is no need for special technology, equipment or infrastructure. The tree cuttings root easily under the local climatic conditions and the farmers are able to prepare their nurseries from cuttings. Similarly, subabul is popular in the Prakasam district as it is able to grow well

[76] While it is true that even tree crops, especially clonal ones, become susceptible to diseases over time, farmers consider these to be far less risky than agricultural crops.

under the harsh climatic and edaphic conditions prevailing in the district and needs no irrigation. It is also extremely easy to multiply and its plantations can be raised by farmers by using locally collected seeds or wildlings.

Research and development effort by private sector companies

The R&D effort put in by the companies in developing suitable clones of tree species has played an important role in the promotion of farm forestry, especially in Uddham Singh Nagar. In Prakasam, eucalyptus farming has become more popular among large farmers after the introduction of 'Bhadrachalam clones' by ITC BPL. While higher productivity of clones as compared to seed route trees is important, other factors such as disease resistance, suitable morphology and phenology have also played a part in popularising tree farming.[77]

Demonstration effect/extension efforts by the private sector

Demonstration effect has played an important role in popularising tree planting in both the districts studied. For instance, many farmers in both Uddham Singh Nagar and Praksam adopted tree farming after seeing other farmers in their neighbourhood earning good profits from the sale of their tree harvest. Extension efforts made by the companies, which included setting up of various demonstration plots, offering free technical advice regarding the clones that would be best suited for their land, and educating farmers in the various aspects of tree planting and maintenance, have also been instrumental in the adoption of farm forestry in these districts.

[77] For instance, while poplar trees were around for several years, they were not very popular with farmers as they did not shed all their leaves in winter. The new clones introduced by Wimco became more popular as these shed all their leaves in winter and time of leaf fall and re-emergence is such that farmers can take the *rabi* (winter) crop.

Ready availability of markets and market infrastructure

Ready availability of market for wood, owing to the presence of a number of wood-based industries in and around both districts, is also a major reason for the popularity of farm forestry. Many farmers in Uddham Singh Nagar initially planted poplars only because of the buy-back guarantee offered by Wimco. Similarly, the buy-back guarantee offered by ITC BPL prompted farmers in the Prakasam district to raise clonal eucalyptus plantations. Availability of market infrastructure such as presence of weigh-bridges, depots and market yards has also encouraged them to plant trees.

5.1.2 Planting pattern

It has been observed that, in general, most farmers plant trees only over a part of their land and use the rest of the land to grow agriculture crops due to (1) their desire to spread the risks and (2) their need for cash income on an annual basis. However, the pattern of planting varies depending on the farmer's land holding size and economic status. Larger landowners generally opt for block plantations as their problems are not of subsistence or cash flow but often of labour shortage. They can afford to make the high initial investment in block plantations, forego agriculture yields and wait for several years to get the returns. On the other hand, small and marginal farmers usually limit themselves to boundary plantations or put only small parcels of their land under block plantations as they are unable to forego the food security and annual cash flow offered by agriculture. Further, they are unable to take risks due to fluctuations in the market prices of wood.

5.1.3 Market regulation

Market related problems were observed in both Uddham Singh Nagar and Prakasam after a large number of farmers started growing trees. In Uddham Singh Nagar, the price of poplar (oversize)

wood came down from Rs. 450–480 per quintal in 1997 to about Rs. 280–310 per quintal in 2000. In Prakasam district, the price of subabul (with bark) wood crashed from about Rs. 910 in 1996 to Rs. 740 in 1999. In both districts, the fall in prices led to a decline in fresh planting by the farmers. Some allegations regarding manipulation of prices and attempts to form cartels have also been levelled against the purchasers of wood in both places. While the intervention by the government has stabilised the situation somewhat in Prakasam, no such initiative has been taken in Uddham Singh Nagar.

The benefits of a regulatory mechanism were seen in the Prakasam district where timely government intervention saved the subabul market from crashing in 1999. Although a mechanism for the trading of subabul (with bark) wood through AMCs has been put in place, it is only a first step. For instance, while the price of subabul (with bark) wood was fixed at Rs 860 per MT, there is no mechanism for periodical review. As this is not the minimum support price offered by the government (as is the case with agricultural crops), some people have questioned its validity. Their argument is that government cannot force the industries to purchase wood at a predetermined fixed rate as the markets for the end produce, such as paper, are not controlled.

5.1.4 Impacts of farm forestry

The spread of farm forestry in an area is likely to have impacts beyond increased production of wood. These may include impacts on local climate, ground water, agriculture, the dairy industry and so on. Some of these may be positive while others may be negative.

In both the districts studied, there has been some controversy over these impacts. For instance, some farmers in Prakasam feel that growth of eucalyptus and subabul plantations have adversely

affected the ground water resources. This is refuted by ITC BPL officials who are promoting eucalyptus plantations. In Uddham Singh Nagar and other *Tarai* areas, some sugar mill owners are opposing poplar on the grounds that the area under sugarcane has come down. A number of people also feel that eucalyptus adversely affects agriculture crops in the neighbouring plots.

5.1.5 Corruption

Corruption is defined as the abuse of public office for private gain (World Bank 1997, in Hill 2000). It is widely acknowledged that there is widespread corruption in the Indian forestry sector, though much of it is 'petty' in nature (Hill 2000).[78] The issue of corruption came up strongly during the field visits, especially in Uttar Pradesh. Although it is an issue in general governance, its negative impact on farm forestry is often ignored by those planning change.

5.2 Recommendations

5.2.1 Policy environment

- There is a need for a countrywide review of all laws and procedures constraining farm forestry. At present, there is wide variation in the initiatives taken by different states. For example, while Andhra Pradesh exempted important farm forestry species such as eucalyptus and subabul from the purview of transit rules in 1984, neighbouring Orissa exempted eucalyptus as late as 1992. While Madhya Pradesh gave powers to issue transit passes with respect to certain species to village *panchayats* in 1995 (which reduced the transaction costs in obtaining permission), in other states farmers still have to get these from

[78] Transparency International refers to corruption as 'petty' when the benefits are relatively small, though they may be large from the perspective of the individual. When the benefits are large at the national level, the corruption is termed as 'grand'.

the Forest and/or Revenue Departments. There is a need for issuance of a national policy or guidelines on these issues.

- The rules and procedures for felling, transport and sale of major farm forestry species should be completely liberalised, and the local *panchayati raj* institutions should be given powers to issue necessary passes with respect to less common farm forestry species.[79] This will ease the marketing problems for the farmers and reduce corruption and consequently their dependence on middlemen. Policies on interstate transport of farm forestry produce also need to be simplified and streamlined. This will facilitate easy movement of farm forestry produce from production to consumption areas. Currently, even transport of ETPs across the state borders is not easy.
- The existing state monopoly on trade of most commercially important NTFPs should be reviewed with a view to promoting greater private sector participation in NTFP production.
- At present, there is provision in the law that private land planted with trees may be declared as 'forest' (FD n.d.b). The laws governing the transfer, management and use of even private forests are so stringent that the landowner virtually loses control over his land: this acts as a disincentive to tree farming. First of all, there is a need to bring about legislative change to ensure that the farmers raising fresh plantations are freed from this fear. Secondly, the laws governing the management of existing private forests need to be liberalised so that private forestry is encouraged. Currently, there are several restrictions on transfer, management and use of these forests.

[79] This will also be in line with national and state policies—as reflected in the 73rd amendment to the Constitution in 1992, the *Panchayat* (Extension to the Scheduled Areas) Act, 1996 and consequent amendments to the state laws on *panchayats*—which aim for decentralisation of powers over local resources.

- Introduction of positive incentives can go a long way in popularising tree farming. The Chandi Prasad Bhatt Committee, set up by the government (in November 1998) to formulate a twenty year action plan for the forestry sector, has recommended introduction of nationally tradable afforestation credits to encourage tree planting by private land owners. These credits will allow tax benefits to the farmers. The small land owners who do not have any tax liability could sell these credits to others. The government should initiate action to implement these recommendations.

5.2.2 Research and development

- Identification of suitable trees species has played an important role in the popularity of farm forestry in Uddham Singh Nagar and Prakasam districts. There is need to identify such suitable species for other areas depending on the local climatic/ edaphic conditions and the cropping practices. So far, very little improvement work has been done on indigenous species. Tree improvement work on promising indigenous species (such as kadamb) should be initiated. Even in the case of popular farm forestry species, there is good scope for improvement through R&D. For instance, there has been virtually no improvement work on subabul as a pulpwood species, which is the major farm forestry species in Prakasam district.
- Identification of suitable species and development of a few suitable clones is not going to be enough. It is of utmost importance that continued research is undertaken to develop new clones as sooner or later all clones become susceptible to pathogens. Another way through which tree farming can be promoted is by developing new uses for farm forestry species. One of the reasons for the popularity of poplar among farmers is its versa-

tility as it can be used in match, plywood, plyboard, chipboard, packing and several other industries. This diversified usage has ensured a ready market for the produce of poplar farmers and thus encouraged them to plant it. If other new uses for poplar wood are developed, it will increase its popularity. For instance, if technology is developed for using poplar as pulpwood, its market will increase. Similarly, if eucalyptus can be made easily peelable, its market will increase manifold and make it more popular with the farmers.[80] This was seen clearly in the case of subabul. Subabul was around for several years and was being actively promoted as a fodder and wasteland reclamation species. It was only after it started being used as a pulpwood that its market developed and farmers started planting it on a large scale in the Prakasam district.

- The impacts of farm forestry go beyond increase in the raw material supply. Often the ground water resources, agriculture and even climate are affected if farm forestry is adopted on a large scale in an area. Although these impacts are going to be critical to the long-term success of farm forestry, they have not been properly studied. These need to be studied in detail by an independent body.
- The important role of the private sector in research and development has already been discussed. However, as the private sector is likely to concentrate on species having commercial uses and on research and development having direct applications, government research institutions should concentrate on other areas where private sector is unlikely to take much interest, such as in developing varieties which can bring poorer farmers into

[80] It has been reported that this technology has actually been developed recently and that this has led to a jump in the demand for eucalyptus wood (Chaurasia 2000).

the ranks of farm foresters. Collaborative research projects between government institutions and companies should also be encouraged. The government budget for forestry research, which was a meagre Rs. 225 million per year during the Eighth Five-Year Plan, needs to be substantially increased.

5.2.3 Review of subsidies

- There is ample evidence to show that the success rate of seedlings supplied either free or at heavily subsidised rates is low. Still, the bulk of government funds meant for farm forestry promotion is spent on production and distribution of a very large number of heavily subsidised seedlings. Between 1990–91 and 1997–98, government agencies distributed a total of 9.309 billion seedlings. In 1997–98 alone, 1.033 billion seedlings were distributed across the country (MoEF 1999). Very little attention is paid to the quality and generally these seedlings do not perform well in the field. There is an urgent need to review this policy. Some of the resources devoted to providing subsidies should be re-allocated for developing and producing better and higher yielding clones, which may be supplied in smaller numbers and at higher rates to farmers willing to invest in farm forestry.[81] This should be backed by suitable extension efforts such as setting up of demonstration plots, farmer to farmer contact, etc. This effort may initially be started in selected high potential districts, where farmers are more likely to be willing to pay higher rates for better clonal plants. The existence of demand for better clonal seedlings is indicated by the current good sales of clonal plants by private sector companies even though they charge high commercial rates.

[81] In future, farm forestry in the commercialised agriculture areas is likely to be mainly based on improved or clonal plants. As a result of the higher productivity of clonal plantations, most companies engaged in forestry extension prefer clonal plantations since they can then meet their requirements from a much smaller area and thus have to deal with fewer farmers, thereby saving on their extension costs.

5.2.4 Farm forestry markets

- As more farmers take to farm forestry, a system of market regulation along the lines of agricultural markets needs to be put in place. In the absence of such a regulatory mechanism, the volatility of markets may result in collapse. While the AMC system introduced in Andhra Pradesh is a laudable first step, much more needs to be done to adequately regulate the farm forestry markets and to protect the interests of both producers and consumers of farm forestry produce.
- In addition to the regulation of wood markets, a suitable market information system along the lines of agricultural markets should be introduced to inform the farmers regarding major buyers, prevailing prices at different places, trends and procedures, etc.
- While the cases in which industry is supplied raw material at concessional rates need to be reviewed, there is also a need to consider whether the government should continue to raise farm forestry species on forest lands that can be grown more easily and efficiently by farmers on their farm lands. Apart from affecting the farmers' market directly (as was seen in Uddham Singh Nagar), this also acts as a hindrance to liberalisation of felling and transit rules pertaining to these species. For instance, in May 2000, the Orissa government re-introduced the regime of timber transit permit in the three districts of Koraput, Nawarangapur and Malkangiri mainly to control pilferage from the eucalyptus plantations raised on forest lands. But this is also likely to discourage tree planting by the farmers.
- The government may consider revoking the ban on export of wood-based products and imposing a higher duty on import of wood-based raw material to safeguard the interests of the domestic producers. Industry may be given some concessions in excise or sale tax. In this way, domestic production will be

encouraged and industries will also have greater incentive for improving wood conversion ratios and overall efficiency and competitiveness. Contrary to the common perception that the scope for increasing duties is severely limited by obligations to the WTO, the bound rates for several items are much higher than those applied.[82]

- The government also needs to reconsider some of the existing trade policies that stifle private initiative. For instance, in several states the government has a monopoly on the purchase of major tree species. In Himachal Pradesh, the government is the sole agency to purchase all forest produce. Such controls limit the marketing opportunities for growers and often lead to the development of parallel markets. State monopolies in the trade of forest produce need to be reviewed in the current context of industrial liberalisation in the country. In several states, concessions on wood produce are given to government departments. Similarly, items such as fuelwood are sold to the general public at subsidised rates. The practice of subsidised supply to government departments must be stopped and instead of subsidising forest produce to the general public, it should be targeted at poor households through the public distribution system.

5.2.5 Region specific focus

- In a vast and varied country like India, one cannot have a single strategy for the entire country. Available experience shows that

[82] Where there is political will, such measures can be easily implemented as has been demonstrated by the government in the case of agricultural products. In order to safeguard the interests of farmers, government has recently increased the tariff barriers for a number of agricultural products—70–80% duty has been imposed on rice; 50% on wheat, duty on sugar has been increased from 25% to 60% within the last six months; duty on edible oil has been increased four times during the past 15 months: import duty on crude edible oil has increased from 15% to 75% and that on refined edible oil from 25% to 85% (Government advertisement in *The Times of India* dated 8 March 2001).

farmers in different regions have different reasons for adopting farm forestry. Commercially oriented tree production on farms is more likely to succeed in areas with commercialised agriculture where farmers are relatively more enterprising, can afford to take risks and are used to raising cash crops. In areas that are characterised by subsistence oriented agriculture, farmers are more likely to accept trees that can be integrated into their farming systems without affecting their food security. In future, private sector and government policies and schemes should be developed keeping this in mind. Rather than spreading resources too thin by having a uniform strategy for the whole country, a commercial farm forestry strategy should be developed focusing on selected high potential districts. For subsistence agriculture areas, a separate strategy primarily focusing on trees for home or local consumption should be developed.

5.2.6 Corruption

- Corruption is an important factor constraining the growth of farm forestry in several regions. The corruption indices appear to be highly correlated with measures of bureaucratic efficiency—the more red tape the more corruption (Hill 2000). Thus, the level of corruption can be reduced if (1) procedures are simplified and red tape is reduced and (2) transparency is promoted. As a first step, a nation wide review of existing rules and regulations pertaining to farm forestry should be undertaken; and these should be rationalised and simplified keeping practical realities in mind. Efforts should also be made to make farmers and others involved in farm forestry aware of the simplification and rationalisation, so that they are not harassed by unscrupulous officials. There is also a need to make Forest Department staff more accountable and speed up decentralisation efforts (such as giving greater powers to the *panchayats*).

5.3 Conclusions

Farm forestry first became popular in the 1970s when the government aggressively promoted it following the NCA recommendations. Farmers in several parts of the country (especially commercialised agriculture areas) adopted it enthusiastically. However, the popularity of farm forestry declined sharply after the mid 1980s as the farmers did not get expected returns on their investments.

In recent years, farm forestry has staged a comeback and has become quite popular with farmers. While the popularity of farm forestry is limited to certain regions of the country, its contribution towards meeting the demand for wood in the country is significant. It is estimated that Uddham Singh Nagar and Prakasam districts alone produce between 0.2–0.28 million MT and 0.65–0.7 million MT respectively of farm grown wood annually. In terms of value, it is estimated that wood worth Rs. 650 million and Rs. 560 million respectively is produced annually in Uddham Singh Nagar and Prakasam districts.[83] Thus, just two districts (or rather parts of these districts) are producing nearly a million MT of wood valued at over Rs. 1,200 million annually. Overall, it is estimated that 50 per cent of the wood supply in the country is currently coming from non-forest sources.

A facilitative policy environment is a necessary though not sufficient precondition for adoption of farm forestry by farmers. Cumbersome laws and procedures related to tree felling, transport and sale discourage farmers from taking up tree farming. While these

[83] The figures for Praksam are based on Forest Department data. The figures for Uddham Singh Nagar have been calculated based on an estimated current harvest of 2,500 to 3,500 acres of poplar annually. Productivity is assumed to be 80 MT per acre. It is assumed that half the produce is sold at 'oversize' rate of Rs. 3,000 per MT while the remaining half is sold at 'undersize' rate of Rs. 1,650 per MT.

restrictions have been imposed in many states with the objectives of preserving the environment and preventing pilferage from government forests, it is the relaxation of these restrictions that has helped in achieving these very objectives in many areas. Relaxation of restrictions encourages more farmers to plant trees, which in turn tends to reduce pressure on the government forests. For example, farmers of Uddham Singh Nagar and Prakasam districts are planting trees on a large scale because state governments have removed most restrictions on tree felling, transport and sale, and made the procedures extremely simple.

The other critical factor for the popularity of farm forestry has been the research and development effort of private sector companies. The main benefits of research and development have been the identification of locally suited species and development of high-yielding, disease resistant clones having other desirable qualities as well. The availability of suitable high-yielding clones of trees has made farm forestry popular with farmers who were looking for avenues for higher or more assured returns.

The learning emerging from this study indicates that the availability of market and remunerative prices for farm forestry produce are likely to be major factors determining the future of farm forestry. The farmers' failure to get remunerative prices for their produce was the most significant factor that led to decline of farm forestry in several regions in the late 1980s. It has been observed that, in both the districts studied, farm forestry received setbacks in recent years mainly on account of the volatility of wood markets.

The farm forestry markets are affected by a number of factors including the government's policies e.g. those pertaining to raw material supplies to industries from forest lands and export and import of wood-based materials.

In some states, the government continues to supply raw material

to industry from forest lands (although there has been a general decline in the supply of such raw material), which affects the market of the farmers. For example, major wood-based industries in Uttar Pradesh are still supplied raw material by the government from eucalyptus and poplar plantations raised on government forest lands. Often, the rate charged is also lower than the market rate.

The import of wood and wood products is now virtually unregulated and customs duty on these has been substantially reduced (see Annex 9). While import of wood-based raw material has been liberalised and duties have been kept at the lowest level possible, the export of wood and wood products in the form of logs, timber, bark, pulp, charcoal etc. is banned. The low import duties on wood-based raw material along with the ban on export work together to depress domestic prices and thus adversely affects the domestic producers.

Farm forestry is at a critical juncture in its development. Farmers of certain regions in the country have demonstrated that, given the right policy environment and incentives, they are willing and capable of raising tree crops on a large scale. However, available experience indicates that certain policy interventions are needed to sustain farm forestry in these regions and to promote it in others. Currently there appears to be no comprehensive policy on this issue. Although the National Forest Policy does mention that forest-based industries should be encouraged to procure their raw material from farmers, the thrust of the policy seems to be encouraging tree planting by farmers for environmental reasons or for meeting their subsistence needs.[84] There is a need to acknowledge the commercial nature of much of farm forestry and the potential

[84] This focus of the policy is clear from a clause in the paragraph dealing with farm forestry that stresses the need for regulating tree felling on private holdings.

for this to provide significant improvements to local livelihoods. If a comprehensive policy is developed to address various issues related to farm forestry and to sustain and further promote it, it is likely that within a relatively short period farmers could meet the entire industrial wood needs of the country.

Annex 1: Questionnaire and checklists used during field visits

A. *Questionnaire for Farmers*

1	Name of the farmer Place of Residence: Village Name Hamlet	
2	Has the farmer planted any trees on his field? If No, what are the reasons for not doing so? [Subsequently ask only question numbers 3, 6i, 21, 27, 28, 29, 30]. If Yes, continue.	
3	Farmer Profile Total land owned (ha or any other units) Area leased out/share cropped Area leased in Irrigated (ha) (Source(s) of irrigation) Unirrigated (ha) Quality of the land Annual income	

	Percentage income from land Percentage income from other sources (specify) Family size Old persons Adult men Adult women Children Source of labour for farming/farm forestry operations Education level Ethnic background/caste Livestock Cattle Buffaloes Goats Bullocks Others (specify) Are these stall fed or open grazed?	
4	When was tree plantation first taken up?	
5	Was the farmer already producing for the market before taking up tree plantation? What was the cropping pattern before planting trees?	
6	i. What is the current cropping pattern? ii. Area under trees a) Block plantation b) Agro forestry c) Boundary plantation d) Any other	

7	Which tree species have been planted? Reasons for the choice of species.	
8	Are planted trees of unimproved, improved or clonal seedling origin? Opinion about the new emerging clones being introduced.	
9	Where did the farmer buy/get his seedlings from at the time of initiation? Did he himself buy the seedlings or was he offered these? Rate per seedling Where does he get his seedlings from now (for further planting)? Rate per seedling	
10	Spacing between trees - Boundary plantation - Block plantation - Agro forestry How was this spacing decided?	
11	From where did the farmer obtain information and technical know-how regarding tree planting?	
12	Type of land where trees have been planted.	
13	What was the use this land was put to before trees (year prior to planting trees)? What was the agricultural production from this land?	

	What was the income earned from this plot prior to planting of trees?	
14	Were/Are there any financial incentives for planting trees?	
15	Did the farmer obtain any loan for planting trees? If yes, from which agency? How much loan? At what rate of interest? What is its current status—repaid, repaying, defaulted? If defaulted, what were the reasons for default?	
16	Rotation adopted by the farmer and reasons for the same.	
17	Productivity of crop i.e. yield from the final crop (per tree or ha) Yield from intermediate tree harvests (year wise) Yield from intercrops over the rotation (year wise)	
18	Different available modes of sale of produce (standing crop, through contractor, directly to consumer etc.). Which mode is preferred and why?	
19	Prevailing market rates (at farm gate/market/factory gate) (per tree/cu.m/cu. feet/tonne etc.)	

20	Economics of agro/farm forestry *Initial expenses* Material cost (seedlings, fertiliser, pesticide etc.) Transport Labour (pit digging, planting etc.) a. family b. b. hired Any subsidies availed Opportunity cost of land *Maintenance expenses* Material (irrigation, fertilisers, pesticides, etc.) Labour (protection, weeding, hoeing, pruning etc.) a. family b. hired Harvest costs *Income* From intermediate yields (include items that are not sold in the market but consumed by the farmer). List years of produce e.g. Year 3, 5 etc. From intercrops (List years of produce e.g. Year 3, 5 etc.) From final harvest *Net income*	
21	Economics of alternate agriculture crops	
22	Is the farmer aware of the end uses and markets of his produce?	

23	What is the role of middlemen, especially what services are provided by them? Is he aware of their margins? Does he feel that tree farmers get exploited by the middlemen?	
24	Why did the farmer opt for agro/farm-forestry? List these reasons in order of priority—use paired ranking method to help the farmer in prioritising these. Did the farmer consider other options? If yes, what other options were considered and why did he discard them?	
25	What were the most important constraints faced by the farmer when he initiated farm/agro forestry? What are the most important constrains being faced by the farmer as of today? How important a constraint is grazing?	
26	What, if any, changes have taken place in the recent years in the policies, rules and regulations related to tree farming? What has been the most significant change?	
27	What in the farmer's opinion can be done to promote farm forestry in this region? Role of government in promoting agro/ farm forestry?—current and potential/ desirable. What changes would you like to be made to the existing policy framework?	

	Role of corporate sector in promoting agro/farm forestry—current and desirable/potential.	
28	What's his opinion about good agriculture land being diverted from food crops to tree planting?	
29	What's his opinion about the impact of trees on agricultural output, ground water level and soil productivity?	
30	What are his future plans in terms of farm forestry? Is he planning to start/continue it to the same extent/extend it further/reduce the area under it? What are the reasons for this decision?	

B. *Checklist of Questions for the Industry*

1. What are the various forest-based raw materials required by your industry? Do you feel that your industry's raw material requirements are being adequately met? If no, then what kind of shortages are being faced by your industry?
2. What tree or plant species are preferred for sourcing the raw material?
3. What are the various sources of raw material (percentage-wise breakup)? What is the catchment size for the procurement of the raw materials? What factors are critical in determining the size of the catchment? How do you transport the raw materials? What is the average cost incurred by you in transporting the raw material?
4. Is there a variation in price of the same raw material being purchased from various sources? If yes, what is the price for raw-material being paid by you to different agencies (state dept., imports, middlemen or traders/individual farmers)?
5. What is the procurement mechanism for various raw materials from

different sources? What is the raw material procurement mechanism from individual farmers? Which system is preferred and why?

6. Is your establishment involved in farm forestry activities? If no, then what are the reasons for it? If yes, then why did you opt for it? What in your opinion has been the impact of these activities on local employment scenario (both men and women), environment, food production etc? [Collect relevant statistics]
7. What is the mechanism/system that is being followed by you? What are the characteristics of the farmers who generally come forward to participate in farm forestry activities? [Collect relevant statistics]
8. What other role has your establishment played in promoting farm forestry? Do you prefer to work with certain select class of farmers? If yes, why?

   Mechanisms like company-farmer partnerships, information and extension, research and development, assured market for products, loans/subsidies, free seedlings.
9. Why is farm forestry popular only among farmers of particular regions? Why has farm forestry failed in other regions? Is there any commonality in the facilitating conditions in these regions?
10. What has been your experience with farm forestry activities? What are the constraints being faced by the companies involved in or interested in pursuing farm forestry activities?
11. What is the type of support extended by the state/agencies like NABARD (say in terms of offering subsidised seedlings, extension services, loans etc.) to promote farm forestry?

    Presence of publicly-supported or aid-financed efforts to encourage farmers in the state to grow more trees.
12. Which policies and legal provisions, both intra- and extra-sectoral, impact on tree planting on private land, and in what way?
13. Would you say that the raw material requirements of the various forest based industries are being adequately met? Do you think that in future the forest-based industries might face a raw-material crunch?
14. Do you see farm forestry emerging as a major source of raw material for industries in future? What in your opinion would be required to facilitate farm forestry?
15. What kinds of mechanisms/systems could be followed to promote farm

forestry? Do you think there are lessons that could be learnt from the horticulture sector?

16. What role could industry play in promoting farm forestry?

C. *Checklist of Questions for the Traders*

1. Since when have you been trading wood/timber in this region? What were you doing prior to this? How much quantity of wood have you been trading in for the last five years? What has been the general trend of trade in wood/timber in this region?
2. Do you visit certain selected areas for purchasing the wood? If yes, which areas do you visit? Has this changed over the years? If yes, then why has it changed?
3. What are the main markets for poplar, eucalyptus and other farm forestry species you purchase? What is the catchment area from where the wood comes into this market/this region for sale? In your opinion, why has farm forestry been successful in only some of the regions?
4. What is the percentage of total wood being supplied to you by different category of farmers (large, medium and small)? Do you prefer to deal with a certain category of farmers? If yes, why?
5. What is your mechanism of purchase of wood from the farmers? What are the average rates being paid for a unit of different types of wood to the farmers? Is there any difference in rates being offered to various categories of farmers?
6. What are the criteria for deciding the rates of various types of wood? How have the rates for different types of woods changed in the last five years [enumerate the exact unit rates for different types of woods in the last ten years]? Reasons for the change in prices?

   Would you say that the timber market is very volatile? Why? What could be done to stabilise the market?
7. How do you transport the wood bought from different farmers? Do you require any permits etc, from the FD or any other department for the harvesting and transporting of the wood?

   If yes, how do you get these permits? How long does it take to get these permits? Do you have to pay some fees to get these permits? If yes, how much?

   Are there any other administrative or legal formalities involved?

8. What are the various mechanisms for selling this wood? Which mechanism do you adopt and why?
9. How do timber markets differ from agricultural markets? What is/has been the role of government in timber trade? What role should the government play?
10. What type of wood do you prefer to trade in? Why? Do you prefer to trade in trees of the unimproved, improved or clonal seedling origin? What are the advantages of trading in them?
11. Who are your major buyers [list the type of industry by the percentage of wood purchased]? Are you aware of the end use of this wood? Are the industries also looking towards alternatives to woods as raw material?
12. Do you think that the wood available in the region is adequately meeting the current demands of the industry? What kind of future trend do you see in terms of wood/timber trading? Reasons for it?
13. What is the policy framework governing trade in wood/timber?
14. What has been your experience with trading in wood/timber? What are the constraints being faced by the traders in or interested in pursuing this trade?
15. Traders/middlemen are at times criticised for taking unduly large proportion of the price paid by the end consumer, however they are providing important services—can you list these in the order of priority?
16. Do you see farm forestry emerging as a major source of raw material for industries in future? What in your opinion would be required to facilitate the trade in farm forestry produce?

D. *Checklist of Questions for Nursery Owners*

1. Since when has this nursery been operating in this region? What were you doing prior to operating a nursery? What prompted you to start running a nursery? What were the reasons (priority wise) for locating the nursery at its present location? [Find out the educational level of the nursery owner]

   Are there any financial incentives (say tax concessions, loans etc.) offered by any agency for establishing or running a nursery? If yes, by which agency and what type of incentive?
2. In your estimate how many nurseries are operating in this region? Has

the number of nurseries increased or declined over the last decade? What are the reasons for it?

3. What are the general locational criteria considered by an individual prior to locating his nursery?
4. Where did you procure your initial planting stock from? Did you purchase it? Did you get them under some government scheme? From some other means, please specify? Where are you presently getting your stock from?

   Do government agencies also supply ETPs/seedlings to the nursery owners/farmers? If yes, then what kind of planting stock and at what rate?
5. What is the total number of tree seedlings/ETPs (for each species and variety) you have raised and sold in the last five years? What has been the reason for the growth or decline in the sale of seedlings/ETPs?

   Has there been a change in the farmers' preference for different species and varieties? If yes, what have been the changes that have taken place? What have been the reasons for these changes?
6. What is the average cost of each type of planting stock? What has been the change in the cost of the planting stock over the last five years?

   Is there any variation in the price of planting stock sold by different agencies (private/government/others)? If yes, what is the average difference for different types and species? Does this variation have an impact on your sales? Have you taken any steps to mitigate the impacts?
7. What is general profile of the farmers who come to purchase planting stock from your nursery? Where do these farmers generally come from or what is the service area of your nursery? What is the general service area of a nursery in this region?
8. What percentages of planting stock are sold to large, medium, small farmers? What is the average number of seedlings purchased by a large, medium, small farmer in this region?
9. In your opinion, what are the major reasons for the farmers to adopt farm forestry? Why has farm forestry been successful in only some of the regions?
10. Do you think that the wood available in the region is adequately meeting the current demands of the industry? What kind of future trend do you see in terms of farm forestry? Reasons for it.

11. In your opinion, what are the constraints being faced by the farmers involved in farm forestry in this region? Do you see farm forestry emerging as a major source of raw material for industries in future?
12. What, in your opinion, would be required to facilitate farm forestry in future?
13. Detailed economics of running a nursery:
    a) Establishment costs
    b) Maintenance costs
    c) Running costs
    d) Gross returns
    e) Profit

E. *Checklist of Questions for Wimco.*

1. What are the present activities of Wimco in this region? Since when has Wimco been operating in this area? What prompted Wimco to come and locate its operations in this region? What are the various schemes run by Wimco in this region?
2. Details of those schemes [how were the farmers selected, terms of the scheme (loan provided, installment plan, cost charged for ETPs and technical inputs, interest rates, repayment plan, procedure for cost recovery), yearwise data of area covered, number of beneficiaries/participants, success rate, reasons for it]. How did the idea of the scheme originate?
3. What efforts are being put by Wimco in extension (size of the extension team, no. and size of demonstration plots etc.)?
4. What category of farmers came forward to join the scheme?
5. What species were distributed under the scheme? Reasons for the choice of species.

   Where did you procure your initial planting stock from? Did you purchase it? What has been Wimco's input in the research and development of the clones/improved varieties (yearly expenditure for last five/ten years)?

   What role has been played by govt. in R& D? What is the current thrust of the company?
6. Did the farmers prefer to sell their produce to Wimco or elsewhere? (Statistics related procurement through farm/agro-forestry by Wimco)

7. What were the main constraints faced by Wimco in relation to the NABARD Scheme?
8. Details regarding litigation (who started it, why, how many cases were filed, how many have been settled, how many were settled out of court, etc.)
9. What are the main policy bottlenecks being faced with respect to such schemes?
10. What is the total number of seedlings/ETPs (for each type of species/clone) you have produced and sold in the last five years? What has been the reason for the growth or decline in the sale of seedlings? Who are the major buyers of seedlings/ETPs from Wimco [percentage-wise break up]?

    What are the main characteristics of a tree that the farmers consider most important while selecting a particular species/clone? Has there been a change in the farmers' preference for different species and clones? If yes, what have been the changes that have taken place? What have been the reasons for these changes?
11. Is there a variation in the price of different species/clones? What is the average cost of each type of planting stock? What has been the change in the cost of the planting stock over the last five/ten years?

    Is there any variation in the price of planting stock sold by different agencies? If yes, what is the average difference for different types and species? Does this variation have an impact on your sales? Have you taken any steps to mitigate the impacts?
12. What is general profile of the farmers who come to purchase planting stock from your nursery? Where do these farmers generally come from or what is the service area of your nursery?
13. What percentages of planting stock are sold to large, medium, small farmers? What is the average number of seedlings/ETPs purchased by a large, medium, small farmer in this region?
14. What is the typical pattern of planting for different categories of farmers (boundary/block/agro-forestry)?

    What is the general pattern of adoption by different categories of farmers (e.g. do they plant a few trees first & then increase the area under trees)?

    What is the impact of availability of irrigation on the choice of species/pattern of planting/productivity?

15. How many factories does Wimco have? Where are they located? What is the total raw material requirement of these units? What percentage of this met from farm forestry? From where was this demand being met earlier? Of all the units, which units of Wimco are fed by the raw material from *Tarai*?
16. What are the current procurement prices? How are these prices decided? Prices paid in the last five/ten years.
17. What were the reasons behind initiating Wimco Greens scheme? Details if the scheme (when was it started, terms of the scheme, rate of interest to be paid, lock in period etc.). The current status of the scheme.
18. What are the main bottlenecks/constraints being faced by Wimco Greens?
19. What have been the results of agro-forestry trials—which crops are most successful/profitable? Why?
20. What is the future strategy/thinking of Wimco?
21. In your opinion, what are the major reasons for the farmers to adopt farm forestry? Why has farm forestry been successful in only some of the regions?
22. Do you think that the wood available in the region is adequately meeting the current demands of the industry? What kind of future trend do you see in terms of farm forestry? Reasons for it.
23. In your opinion, what are the constraints being faced by the farmers involved in farm forestry in this region? Do you see farm forestry emerging as a major source of raw material for industries in future?
24. What, in your opinion, would be required to facilitate the farm forestry in future?

    What are your views on tree farming on good agricultural land?

Annex 2: Landholding pattern in Uddham Singh Nagar district (1990–91)

Block Name	*Less than 0.5 ha*		*0.5 to 1.0 ha*		*1 to 2 ha*		*2 to 4 ha*		*4 to 10 ha*		*More than 10 ha*		*Total Land Holdings*	
	Number	*Area*	*Number*	*Area*	*Number*	*Area*	*Number*	*Area*	*Number*	*Area*	*Number*	*Area*	*Number*	*Area*
Jaspur	3017	862	1287	1158	1210	3034	1020	4119	826	4004	14	1814	7374	14991
Kashipur	2609	695	1156	1077	1410	2425	1219	4521	1078	4203	107	2296	7579	15217
Bazpur	2429	559	1596	1426	1518	1969	1397	3701	934	6359	104	2425	7978	16439
Gadarpur	2915	901	1617	1224	1281	1264	1346	3600	1518	4342	228	3017	8905	14348
Rudrapur	3097	1096	1511	1201	1539	1988	1420	3794	1725	5669	218	3456	9510	17204
Sitarganj	3372	1114	1504	1300	1783	2339	1522	4060	1129	6875	192	3312	9502	19000
Khatima	3459	1009	1277	1068	2192	3110	1731	4169	744	5223	140	2211	9543	16790
Total	20898	6236	9948	8454	10933	16129	9655	27964	7954	36675	1003	18531	60391	113989
Percentage of total	34.6	5.5	16.5	7.4	18.1	14.1	16.0	24.5	13.2	32.2	1.6	16.3	100	100

Source: District Land Revenue Department, Uddham Singh Nagar

Annex 3: Land use pattern of Uddham Singh Nagar district

1992–93 (in acres)

Black Name	*Total area*	*Forest*	*Cultivable land*	*Current fallow*	*Other fallow*	*Alkaline & uncultivable land*	*Area other than agriculture*	*Grass land*	*Hoticulture and other trees*	*Net sown area*	*Area sown more than once*
Jaspur	21009	716	1447	171	199	202	1302	5	271	16696	12370
Kashipur	19590	745	2184	269	384	171	1712	14	207	13904	12555
Bazpur	28377	1616	612	562	321	233	1611	12	524	22886	11320
Gadarpur	21778	195	1076	170	299	188	984	10	154	18702	15201
Rudrapur	29216	821	1026	398	520	227	1615	15	177	24417	14369
Sitarganj	32852	3275	3204	114	734	213	1365	6	288	23658	20048
Khatima	34563	2730	2185	337	671	334	1772	6	401	26127	21887
Total	187385	10098	11734	2021	3128	1568	10361	68	2022	146390	107750

1995–96 (in acres)

Black Name	*Total area*	*Forest*	*Cultivable land*	*Current fallow*	*Other fallow*	*Alkaline & uncul-tivable land*	*Area other than agri-culture*	*Grass land*	*Hoticulture and other trees*	*Net sown area*	*Area sown more than once*
Jaspur	21525	531	675	170	136	199	2360	3	125	17326	11991
Kashipur	19585	561	730	285	310	170	2607	5	110	14807	12280
Bazpur	29526	1529	410	590	29	230	2730	7	220	23520	11040
Gadarpur	22441	72	230	180	215	185	1809	3	130	19617	15210
Rudrapur	29981	637	365	375	410	223	2750	4	107	25110	13935
Sitarganj	31629	3090	615	105	650	207	2575	2	155	24230	19864
Khatima	35661	2543	610	474	620	330	2889	2	230	27961	20494
Total	190348	8963	3635	2179	2370	1544	17720	26	1077	152571	104814

Source: Land Records Department, District Uddham Singh Nagar.

Annex 4: Work force classification in Uddham Singh Nagar district (in percentage)

Year	*Total Workers*	*Cultivators*	*Agricultural labourers*	*Livestock, Forestry, Fishing and allied activities*	*Mining and Quarrying*	*Manufacturing & processing in household industry*	*Manufacturing & processing other than household industry*	*Construction*	*Trade & Commerce*	*Transport Storage & Communication*	*Other services*
1971	264924	45.6	18.4	4.4	0.5	2.0	5.0	1.8	6.3	3.6	12.4
1981	360029	44.7	19.1	2.5	0.5	2.0	6.4	2.2	6.6	3.1	12.9
1991	292076	36.4	26.0	2.0	0.0	1.0	9.0	2.2	7.7	2.9	12.7

Source: GoUP 1997b.

Annex 5: Number of operational holdings and areas operated according to size in the Prakasam district (1990–91)

Size Class of the Holding (ha)	*Number*	*Number (%)*	*Area (ha)*	*Area (%)*
Below 0.5	134,383	27.67	40,299	4.95
0.5 to 1.0	105,933	21.81	79,711	9.79
1.0 to 2.0	119,874	24.68	174,560	21.43
2.0 to 3.0	57,209	11.78	136,079	16.70
3.0 to 4.0	25,869	5.33	89,220	10.95
4.0 to 5.0	15,017	3.09	66,811	8.20
5.0 to 7.5	16,223	3.34	98,557	12.10
7.5 to 10.0	6055	1.25	52,244	6.41
10.0 to 20.0	4514	0.93	58,691	7.20
20.0 and above	600	0.12	18,454	2.27
Total	485,677	100.00	814,606	100.00
Average size: 1.67 ha				

Source: GoAP 1999

Annex 6: Communal plantations raised in Prakasam district since 1985

Year	*Area covered (ha)*
1985	200
1986	312
1987	320
1988	412
1989	282
1990	300
1991	638
1992	308
1993	235
1994	90
1995	345
1996	314
1997	494
1998	603
1999	75
Total	4,928

Source: Planning and Extension Division, Ongole

Annex 7: Material receipts details of West Coast Paper Mills from 1988–89 To 1999–2000

Sl. No.	*Period (Apr-Mar)*	*Casuarina Wood (MT)*	*Subabul Wood (MT)*	*Total (MT)*	*Rate (Rs./Ton)*	
					Casuarina Wood	*Subabul Wood*
1.	1988–89	10,796.495	1247.800	12,044.295	550	470
2.	1989–90	13,645.555	1230.000	14,875.555	550	470
3.	1990–91	19,015.175	5860.275	24,875.450	570	520
4.	1991–92	9227.035	46,023.540	55,250.575	570	520
5.	1992–93	1626.210	20,512.440	22,138.650	620	570
6.	1993–94	10,580.850	20,016.980	30,597.830	670	620
7.	1994–95	18,809.020	30,336.360	49,145.380	740	690
8.	1995–96	22,081.390	49,829.495	71,910.885	780	730
9.	1996–97	–	18,712.140	18,712.140	–	810
10.	1997–98	25,058.770	35,971.400	61,030.170	890	840

Sl. No.	*Period (Apr-Mar)*	*Casuarina Wood (MT)*	*Subabul Wood (MT)*	*Total (MT)*	*Rate (Rs./Ton)*	
					Casuarina Wood	*Subabul Wood*
11.	1998–99	35,889.210	54,846.340	90,735.550	950	840
12.	1999–2000	31,019.480	35,594.060	66,613.540	1050	990*
13.	Total	1,97,749.190	3,20,180.830	5,18,110.020		

Source: Personal communication, Mr. Venugopal, Assistant Manager (Raw Material), West Coast Paper Mills.

* Price at the railway yard.

Annex 8: Package of practices for farmers prescribed by ITC BPL

I. SITE SELECTION AND PREPARATION

1. It is absolutely mandatory to study soil profiles, pH and electric conductivity of soils before deciding to raise clonal plantations.
2. Areas with shallow soils less than 1m in depth or those with strong calcareous or lateritic pans must be avoided. Likewise, areas with great alkalinity or salinity must not be planted. Generally the pH should be less than 8.5 and electric conductivity less than 2 milli mho/cm. Plants will suffer from chlorosis on saline, alkaline or calcareous soils.
3. Highly eroded sites or lands subjected to heavy water logging must also be avoided.
4. Planting sites must be extremely well prepared by deep ploughing in either direction followed by harrowing.
5. The recommended spacing for clonal plantations is 3 x 2 m. In case of slope or undulating terrain, the 3m rows should be along the contours. This will facilitate ploughing in between the 3m wide rows along the contours to conserve moisture and prevent soil erosion.
6. In case of level plane areas, the 3m wide spacing should be in the east and west direction. This will ensure exposure to sunlight through 3m wide inter spacing. Ploughing in between the lines in such cases will be in the north-south direction.
7. However, in the coastal districts subjected to winds, the 3m wide spacing should be parallel to the prevalent wind direction. This will ensure exposure of minimum number of trees to the onslaught of direct strong winds. Clones susceptible to wind breaks should not be planted in the coastal areas.

8. Planting of 'Bhadrachalam' clones in single row avenues around farm boundaries, field bunds or along farm roads and irrigation channels can be a highly paying proposition for the farmers, provided such plantations can be effectively protected against damage by cattle. We should encourage such single line avenue plantations wherever farmers can ensure proper protection. The spacing in single line avenues can be 1.5 m apart.
9. Each farmer must be encouraged to plant minimum 3 or more 'Bhadrachalam' clones in separate blocks of each year's planting area to safeguard against possible future risks like epidemic diseases.
10. A proper lay out design of the field showing details of specific clones planted should be maintained. This will facilitate comparisons of comparative performance of different clones on different sites.

II. PLANTING OPERATIONS AND MAINTENANCE

11. Planting pits must not be less than 30 x 30 x 30 cms. There should be no weeds in the soil around the planting pit. The dug out soil, which will be used for refilling at the time of planting, must be treated with chloropyriphos @ 3 ml. per litre of water. Part of this chemical solution should be mixed up with the soil to be used for refilling the pit at the time of transplanting. The balance chemical should be poured around the plant after irrigation.
12. Refill the planting pit with treated soil upto 5 cm level. Hold the sapling in an upright position in the centre of the planting pit in such a way that lowest roots or the mass of vermiculite is 2 cm above the level of soil in the planting pit. Holding the sapling in this position, the treated soil should be refilled into the pit and gently compacted. After compaction, about 7.5 cm of the pit should remain unfilled for irrigation and holding rainwater.
13. In case of black cotton soils, aforesaid procedure should be modified. Irrigation water is added to the planting pit after refilling the pit upto 5 cms level. No compaction should be carried out after completing the transplanting operations. Only 5 cm upper part of the pit should be left unfilled to retain irrigation/rainwater.
14. Irrigation or pot watering on alternate days or depending on the need will be required until establishment of the transplanted clonal saplings in case of inadequacy of natural rains.

15. Any chemical fertiliser applied close to the root or stem of the young saplings shall be positively injurious and harmful. Therefore, only limited quantities of chemical fertilisers should be used at the time of transplanting, which must be thoroughly mixed in the entire soil to be used for refilling the pit at the time of transplanting. As most of the soils are deficient in phosphorous and nitrogen, 100 gm of single superphosphate and 25 gm of urea should be mixed with the entire dug out soil, which can then be used for refilling the pit at the time of transplanting the clonal saplings. Alternatively, 50 gm of diammonium phosphate (DAP) can be used in the same manner.

    After the establishment of plants, first dose of nitrogenous fertiliser can be given as top dressing, after weeding, @25 gm. urea per plant. However, the urea granules must be applied in the form of a ring, minimum 20 cm away from the stem. This should be followed by irrigation or the fertiliser should be applied during the course of a mild rain. Any chemical fertiliser placed close to the stem may dehydrate and kill plant.

16. Most of the soils in India are known to be deficient in phosphorus and nitrogen, requisite quantities of these two fertiliser should be applied as basal dressing before sowing of the intercrop in-between the 3m wide planting rows. During subsequent years of growth also the requisite quantities of fertilizers should be applied through broadcast in the 3m wide planting rows. Where irrigation facilities are not available, such fertiliser should be applied when adequate moisture is available or when it is raining lightly. Ploughing in-between the 3m wide lines should be carried out thereafter as soon as the soil is in proper moisture condition.

17. Farmers should be encouraged to apply farmyard manure to the entire field or raise green manure crops for ploughing back into the fields. In any case of manuring, the FYM or chemical fertiliser should never be placed in contact with the roots or stem. There should be no FYM or fertiliser within a radius of 20 cm from the stem of young saplings. Application of FYM and 25 kg/ha zinc sulphate will be helpful to minimise incidence of chlorosis in marginally saline or calcareous soils.

18. Young plants are very sensitive to competition from weeds. At least three weeding, in 50 cm radius around the plants will be required every year during the first three years. Care should be taken not to damage the saplings during weeding operations.

19. Ploughing within the 3m wide rows of plants will help improve soil aeration, moisture conservation and control weeds. During first year, plough the 3m wide strips after harvest of intercrops and arrange second ploughing after the first monsoon showers and sowing of green crops like sunhemp is recommended. Green manure crop should be incorporated into the soil by ploughing just before flowering.
20. Use only tractors for ploughing in-between the 3m wide rows. Do not plough in cross direction. Avoid injuries to the stems and roots of trees during ploughing operations. 20–30 cm space on either side of the plant rows should not be ploughed but maintained free of weeds.

III. PROTECTION OF PLANTATIONS

21. The farmers must be explained that total protection of plants against damage by cattle is absolutely necessary. No grazing should be permitted.
22. Likewise, prevention of damage to the plants during the ploughing operations should also be ensured. Normal ploughing should be only in one direction in the 3m wide strips.
23. No crop residues should be burnt in or near the plantation areas as the young eucalyptus trees are very sensitive to fire. Even scorching hot winds, generated by the fire in adjoining fields, can damage the plants. Therefore, farmers must be suitably cautioned.
24. If the saplings are transplanted in 30cm deep pits, normally there will be no lodging. In case of any incidence of lodging of young saplings, minimum necessary earthing up to support the plants should be carried out. No stakes should be used.
25. All 'Bhadrachalam' clones are self-pruning. No pruning of the branches should be carried out. I f any plant is severely damaged because of physical injuries or broken by the wind, the same should be coppiced back 5 cm above ground level. If the wind damage is at a fairly high level in plants more than 1 year old, there is no need for coppicing such plants, as new leaders will emerge from the pollard shoots.
26. White ants or termites often cause widespread damage to young saplings. Symptoms of damage by termites are sudden wilting of healthy saplings and drying of the leaves leading to death of plant. If such plants are pulled out, one can see girdling of collar or roots by the termites. If any

such symptoms are noticed despite prophylactic treatment carried out as per recommendation at s.n. 19, additional treatment of the soil around all the healthy saplings should be carried out immediately. 6 ml oh Chloropyriphos should be applied per plant dissolved in 2 litres water. Clean cultivation practices should be followed and irrigation should be provided wherever possible.

IV. BEST TIME FOR TRANSPLANTING

27. Beginning of the monsoon rains is the best time for transplanting. Early transplanting ensures full benefit of the entire monsoon rains for optimum establishment and growth of the saplings.

28. However, if assured irrigation facilities are available, transplanting can be carried out any time during the year. No transplanting is advised during the extremely hot summer period between April to June as there is possibility of high mortality rate because of desiccation.

Annex 9: Import duties on forest produce

In the year 2000–2001 there were 4 basic rates of customs duty: 5%, 15%, 25% and 35%.

Item	*Basic duty 2000–01*	*Basic duty 1990–91*
Fuelwood, wood in chips or particles, sawdust, wood waste and scraps, wood charcoal	5%	60%
Wood in the rough	5%	60%
Mechanical and chemical wood pulp	5%	40%
Pulp of fibres from recovered paper and paper board	5%	100%
Recovered paper and paper board	15%	100%
Newsprint	15%	60%*
Tanning extracts of vegetable origin	15%	50–80%
Wood sawn or chipped lengthwise (>6 mm thick)	25%	60%
Wood wool and wood flour	25%	60%
Hoop wood, split poles, piles, pickets, stakes and sticks	25%	60%
Hand tools and toys	25%	60%
Fibre board of wood or other ligneous material	35%	100%
Particle board and similar board of wood or other ligneous material	35%	60%

* plus Rs. 1000/ tonne

Item	*Basic duty 2000–01*	*Basic duty 1990–91*
Veneer sheets, sheets for plywood, other wood sawn lengthwise (<6mm thick)	35%	60%
Plywood, veneered panels and similar laminated wood	35%	60%
Densified wood frames, packing cases, tools, table and kitchen ware, marquetry, inlay work, statuettes	35%	60%
Wooden furniture	35%	100%
Miscellaneous paper products	35%	100%
Bamboo, rattan, and other material used for plaiting	35%	60%
Plaits, mats, basketwork, wickerwork	35%	60%
Vegetation material used primarily in brooms and brushes	35%	60%
Brooms, brushes and pencils	35%	100%
Natural honey	35%	100%
Lac, natural gums, resins, gum resins, oleoresins	35%	60%
Cinnamon and cinnamon tree flowers, cloves, nutmeg, mace and bay leaves	35%	150%
Colouring matter of vegetable origin	35%	150%
Silk worm cocoons	35%	50%
Raw silk	35%	30%
Silk yarn	35%	50–100%
Raw or processed sisal fibre	35%	40%
Tobacco items	35%	100%

Source: Singh 2000

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