FARM FORESTRY IN INDIA – AN OVERVIEW

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Recognising the increasing demand for fuelwood, fodder, and timber the National Commission on Agriculture advocated the Farm Forestry Programme. The programme aimed at bringing fragile and uncultivated lands owned by farmers under tree cover to meet the wood requirements. Implementation of the Farm Forestry programme attracted large number of farmers and also several criticisms against planting of certain tree species. Considering the requirement of promoting tree cultivation activities in the present circumstances of environmental degradation, this paper makes an overview of the Farm Forestry programme in terms of development, farmers' participation, and economics of tree cultivation.

Section I

Social Forestry programme with its components like Farm Forestry, Extension Forestry and others was initiated in India since the eighties to meet certain basic needs like fuelwood, fodder, fruits and small timber, as well as regenerate and improve tree cover on degraded forest and common lands. Thereby, seeking to reduce pressure on surviving natural forests, as well as improve the natural resource base of ecologically fragile regions, which are depleting fast due to economic and demographic factors. Farm Forestry programme was intended to induce farmers, especially in ecologically fragile and economically disadvantaged regions such as arid, semi-arid and hill regions of the country to take up tree growing activities. This would help farmers to make better and optimum use of their lands, as well as earn income by meeting the needs of rural and urban markets for fuelwood, bamboo, pulpwood, small timber, etc. Although the terms Social Forestry and Farm Forestry have been ambiguously used, the two are strictly speaking not the same. While the Farm Forestry has been promoted largely on commercial considerations and with profit motive in view, the same is not the case with Social Forestry which has broader social objectives in view such as improving tree cover on degraded forestlands and village commons, making productive use of the country's wastelands, promoting soil and water conservation and improving the landscape. Promotion of the Farm Forestry programme attracted large number of farmers for tree growing activity and they participated by selecting commercially viable tree species which could meet the cash and other requirements. Considering these points the present paper attempts at an overview of the Farm Forestry programme by examining the development of the Farm Forestry programme in India in later part of Section I; farmers' participation; relative economics of trees grown under the Farm Forestry programme; marketing aspects in Section II and controversies raised against adoption of some tree species in Section III and Section IV makes a concluding remark.

Development of Farm Forestry Programme

The National Commission on Agriculture (NCA 1976) advocated taking up Social Forestry Programme in India by involving people. Farm Forestry programme was implemented as a component of the broad Social Forestry Programme, to grow trees on privately owned agricultural lands, on bunds and wastelands by farmers. The NCA defined the programme as "the practice of forestry in all its aspects on farm or village lands, generally integrated with other farm operations. It is a programme of planting trees on bunds and boundaries of the fields of the farmers and to be taken up by the farmers themselves (GOI 1976)". Thus, the principal concern was to integrate tree cultivation into the land use pattern and produce fuel wood, fodder, etc., to meet rural requirements. With this programme the government aimed at motivating farmers to afforestation activities and make the locals understand the necessity of and threat faced by forests due to extensive exploitation of forest resources. The Farm Forestry programme got added impetus after the announcement of the National Forest Policy (NFP) in 1988. The NFP providing thrust to the programme, advocated that as far as possible forest based industries should meet their raw materials by establishing a direct relationship with farmers. Although this is quite contradictory to the recommendations of the NCA, the NFP recognised the motivation behind planting trees on farmlands.

Since late 1970s, the Farm Forestry programme has been widely practiced by farmers in states like Gujarath, Karnataka, Tamil Nadu, Haryana, Uttar Pradesh and West Bengal (Saxena 1994). The government encouraged farmers by distributing seedlings, saplings and giving guidelines for planting. This attracted large participation as the number of seedlings distributed during the initial period of the Farm Forestry programme crossed the target in some states as shown in Table 1. In Orissa 67 million seedlings were distributed against the target of 5 million. Farmers in Gujarat planted over 713 million trees by surpassing the target fixed at over 311 million trees (Sharma et al 1995). Similarly, West Bengal brought an area of over 62 thousand hectares under plants crossing the target of 52 thousand hectares (NCAER), which indicates the extent of tree growing activity adopted by farmers. The intention of farmers was to meet multiple requirements like fuel wood, fodder and income from their farmlands, by selecting commercially viable tree species like eucalyptus, poplar, casurina, etc. (GOI 1987). The area under trees on farm grew at a rate of 53 per cent per annum between 1975 and 1984 in Haryana.

Table 1: Progress of Farm Forestry Programme in the Initial Phase (early 1980s)

States	Seedlings (million)	
	Target	Achievement
Gujarat (Phase I)	150	375
Orissa	5	67
Bihar	200	206.5
Tamilnadu	40.08	101.4

Source: NCAER

Poplar was popularly adopted by Haryana farmers, considering its contributions to the rural economy in terms of employment, availability of fuelwood and its service as a windbreak (Sodhi and Ansari 1996). In Uttar Pradesh

among the afforested broad-leaved species, eucalyptus occupied 8.2 thousand hectares out of total 53.9 thousand hectares constituting 15 percent of the planted area up to 1978-79 (Mathur et al 1984). Farmers in Karnataka also actively participated by bringing large area under tree cultivation. The area under eucalyptus, which was about 48 thousand hectares during 1987-88 increased to 66 thousand hectares in 1996-97 (GoK 1997). Further, for motivating people a new scheme called `tree patta' was launched during 1993-94 in rural and urban areas of Karnataka. Under this the participant i.e., pattadar was entrusted with protection of trees and at the time of harvesting the produce would be shared in the ratio of 75:25 between the pattadar and government. The programme achieved success as over 9000 pattalands were distributed against the target of 5000 during 1994-95 (GoK 1994). The Farm Forestry programme was also encouraged from external agencies, which brought large area under tree cover. As shown in Table 2 the total area covered under the external aid was 1241 thousand hectares. Among the states higher afforestation activity has been reported from Gujarath (20.75 per cent), Uttar Pradesh (11.84 per cent), Karnataka (10.82 per cent) and Andhra Pradesh (9.74 per cent).

Section II

Participation by Farmers: Size Neutral

Tree growing activity under the Farm Forestry programme attracted all farmers irrespective of size of holdings, and is size-neutral in its reach to farmers (Aziz 1995). Farmers participated in the activity considering many factors: (i) natural and technical like uncertainty of rainfall, non-availability of land for field crops, distant location of field from the residence etc.,

Table 2: Area Brought Under the Externally aided Farm Forestry Projects in India State wise
(Area in Thousand Hectares)

States	Area	Percent
Gujarat	230	20.75
Bihar	72	6.49
Uttar Pradesh	147	11.84
Andra Pradesh	108	9.74
Karnataka	120	10.82
Rajasthan	91	8.21
Himachal Pradesh	67	6.04
Tamil Nadu	103	9.29
West Bengal	52	4.69
Kerala	69	6.22
Orissa	89	8.03
Maharashtra	44	3.97
Haryana	30	2.71
Jammu and Kashmir	19	1.71
All India	1241	100

Source: Forestry Statistics India, 1995 (adopted from Compendium of Environmental Statistics, GoI 1997)

(ii) economic reasons such as low human and animal labour requirement, higher returns from tree crops, non availability of family labour for field crops, availability of seedlings at lower price; (iii) domestic needs like fuel,

small timber and fodder (GOI 1987; Bisalaiah 1995; Sharma et al 1995; Saxena 1995). Further, other factors like plantation of trees by neighbour farmers, to avoid leaving land unused, etc., (Puttaswamaiah 2001) also have influenced farmers to opt for tree crops. It is significant to note that economic returns are the determining factors, which motivated large number of farmers. Information on the level of participation by farmers in different states in the Farm Forestry programme, in Table 3, shows that in Karnataka and Gujarath small farmers participation is higher compared to that of medium and large farmers

Table 3: Level of Farmers' Participation in Farm Forestry Programme

Author	State Referred	Districts Covered	Year of Reference	Categories of Farmers			Total Sample
				Small	Medium	Large	
Aziz (1995)	Karnataka	Kolar	1989-90	21 (25.92)	39 (48.14)	21 (25.9)	81
Bisalaiah (1995)	Karnataka	Kolar	1990	48 (58)	21 (25)	14 (17)	83
Sharma et al (1995)	Gujarat	Kheda, Pancha-mahal Junaghad	1990	40 (40.40)	28 (28.28)	31 (31.3)	99
Sodhi & Ansari (1996)	Haryana	Ambala Kuruksh-etra Karnal	Na	Na	Na	Na	126
Singh & Bhattacharjee (1995)	West Bangal	Midnapur	1988 –89	Land less 10 (15)	Marginal 51 (75)	Small & Medium 7 (10)	68

Note: Na = Not available
Figures in brackets are percentages to the total sample
Source: Compiled from the Sources quoted in the Table

(Bisalaiah 1995; Sharma et al 1995). The Indian Institute of Public Opinion also reported that in Karnataka participation by marginal and small farmers was high, where out of a sample of 3014 tree growers 44 per cent were marginal and small farmers (quoted in GoK 1997). The marginal farmers who got land under the patta land scheme in West Bengal also largely cultivated trees. The small farmers have allotted relatively a larger share of their total land to tree cultivation. For instance, in Karnataka, the small farmers who accounted for 24 per cent of the total land had put 37 per cent of it under trees, while large farmers who accounted for 53 per cent of the total land reported 41 per cent to be under trees (Bisalaiah 1995). All this indicates that irrespective of size classes of holdings farmers participated in tree growing activity on farmland.

Economics of Tree Cultivation under the Farm Forestry Programme

Farmers' participation in any programme, particularly one that seeks to induce them to grow new or non-traditional crops on farmlands depends upon its returns. In the Farm Forestry programme also this factor played a

major role as revealed by farmers' preference towards commercially viable tree species, like eucalyptus, poplar, etc., for higher economic benefits along with meeting fuelwood and fodder requirements. Trees cultivated on farm land under the Farm Forestry programme are economically profitable as revealed in Table 4. In Karnataka eucalyptus cultivation has generated a return of Rs. 1009 per acre per annum (undiscounted) to a cultivation cost of Rs. 92 per acre per annum (undiscounted). Eucalyptus plantation in a village of Midnapur district of West Bengal showed a return of over Rs. 41 thousand per acre, which gave a discounted (15 per cent discount rate) net benefit of Rs. 12563 per acre. Asuthosh et al (1996) found the NPV of bamboo cultivation to be higher on a low value agricultural land than medium and high value agricultural land. Similarly, Mathur et al (1984) showed eucalyptus cultivation to be more economical and profitable in Uttar Pradesh. An economic analysis of poplar trees in three regions of Haryana showed that the poplar trees (age 4 years) are economically viable to all categories of farmers (Sodhi and Ansary 1996). Further, there is a difference between the cultivation cost of trees and annual crops where the cultivation cost of trees is less than that of annual crops, as the number of operations involved in tree cultivation are less and the amount of labour and other material inputs used are low as compared to annual crops. For instance, in Karnataka eucalyptus growing involves a cost of Rs. 92 per acre per annum for a return of Rs. 1009 per acre per annum (Aziz 1995). The total cultivation cost is over

Table 4: Economics of Tree Cultivation under the Farm Forestry Programme

Author and Tree species	Reference Year	State	Districts Covered	Cost (Rs)	Return (Rs)	NPV	B:C Ratio	Sample Size
Eucalyptus								
Aziz (1995)	1989-90	Karnataka	Kolar	92 per acre	1009 per acre	NA	NA	81
Sing and Bhattacharjee (1995)	1981-82 to 1987-88	West Bengal	Midnapur	7192 per acre	41674 per acre	NA	NA	68
Sharma et al (1995)	NA	Gujarath	Kheda	NA	Net 4331 per acre	NA	NA	8
			Panchamahals	NA	Net 2545 per acre	NA	NA	8
			Junaghad	NA	Net 5247 per acre	NA	NA	2
Saxena (1994)		Uttar Pradesh	Muzafarnagar Nainital Allahabad	Rs. 1.02 per plant	NA	NA	Small Farmers 2..9 Large Farmers 1.6	
Mathur et al (1984)	NA	Uttar Pradesh	Mohanwali	1263	Net 12079	4598 (12% Dic. Rate)	1:5.08	NA
			Barahpur	1148	Net 4459	1290(12% Dic. Rate)	1:2.3	NA
Bamboo Ashuthosh et al (1996)	NA	NA	NA	NA	NA	Size of poles / Land Group*[1]: 3000/Ha, 9000/Ha, 19000/Ha, 31000/Ha.		
						3*4 metres: 17792, 13995, 5175, -7403		NA
						4*5 metres: 13673, 11394, 6099, -1451		NA
						5*6 metres: 11099, 9581, 6055, 1027		NA
Poplar Sodhi and Ansary (1996)	NA	Haryana				At 15 % discount rate: Small / Medium / Large	Small / Medium / Large	Total 126
			Ambala	NA	NA	29 / 29.5 / 33	6 / 7 / 8	NA
			Kurukshetra	NA	NA	25 / 30.9 / 25.7	7 / 8 / 9	NA
			Karnal	NA	NA	33 / 37 / 39	6 / 8 / 8	NA

Note: NA = Not Available, *Land group based on the agricultural value of land, 1 at 8% Discount rate

Source: Compiled from the Sources quoted in the Table

Rs. 7 thousand per acre to a return of Rs. 41 thousand per acre in West Bengal (Singh and Bhattacharjee 1995). The analysis reveals that trees cultivated on farmlands under the Farm Forestry programme are profitable to farmers.

Marketing Aspects

Expected profit is one of the significant determinants of farmers' participation in tree cultivation activity. Profitability in turn depends upon access to market, prevailing demand and supply conditions and the price of the product in the market. Further, adoption of new technologies in agriculture depends upon the development level of a region. A region with commercialised agriculture has more potential for farmers' participation in adopting modern technologies than a non-commercialised region. This is also true in the case of Farm Forestry programme, which intends to motivate farmers to take up tree cultivation activity. For instance, a dry region in Uttar Pradesh experienced low participation and low investment in tree cropping activity by farmers as compared to the agriculturally advanced regions (Saxena 1995). Contrarily in West Bengal and Karnataka tree cropping is practised well on dry lands due to market advantages (Singh and Bhattacharjee 1995; Aziz 1995). This indicates that tree growing is more profitable and successful given stable and remunerative market conditions (Saxena 1995; Aziz 1995).

Farmers have differential access to market viz. (i) they can sell their tree plantations through village petty traders (ii) they can contact middlemen/ brokers in big towns to sell their plantation (Aziz 1995). Usually trees are sold through middlemen or intermediaries. Saxena (1994) observes that between the producers and retailers there were about three to four layers of intermediaries, showing no direct contact between tree growers and consumers. Even though farmers contacted the intermediaries to sell their products, most of the farmers resorted to pre-harvest selling than post-harvest selling. For instance, study by Chatha et al (quoted in Saxena 1994) found that 77 per cent out of 53 farmers who planted eucalyptus on farm bunds and 56 per cent out of 23 farmers who grow eucalyptus in block plantation resorted to pre-harvest selling. Farmers tend to pre-harvest disposing because of the problems involved like high labour input, technical skill for coppicing, transportation of products, finding consumers, etc., in harvesting and selling of tree production. It is known that the wood market is not well developed in India and the tree growers have to face many problems to dispose off their tree products. Factors like concentration of market activities among few traders, existence of brokers etc., dissuade farmers from participating in tree growing and marketing activities (Saxena 1995; Sharma et al 1995; Singh and Bhattacharjee 1995). The price of Farm Forestry products like eucalyptus was remunerative in the beginning of the programme and hence it attracted large number of farmers. But, in the course of time due to oligopsnonistic (dominated by few buyers) nature in the market prices declined (Singh and Bhattacharjee 1995) in some states. Further, it was observed that large farmers are in an advantageous position in the market as compared to small and medium farmers, and this adversely affected the prices of products. The price received by farmers for eucalyptus trees in different states and at different points of time is presented in Table 5. The price received by small and medium farmers (Rs. 784.92 and Rs. 945.59 per acre of eucalyptus respectively) is less than the

average price received by all farmers as a whole (Rs. 993.80) and large farmers (Rs.1292 per acre of eucalyptus) in Karnataka. In Uttar Pradesh also farmers with a holding of more than 2.5 hectares received a price of Rs. 45 per eucalyptus tree as against only Rs. 25 per tree for the farmers with a holding of less than 2.5 hectares. Apart from the difference in price across size classes of holdings, the price fluctuation too adversely affected the returns. As some of the studies show the price of eucalyptus products experienced wide

Table 5: Prices of Eucalyptus Products in Different States

Author	Ref. Year	State	Unit	Price (Rs.)				
				1985	1986	1987	1988	1989
Sharma et al (1995)	1989	Gujarath	One pole	39	35	35	33	34
Singh & Bhattacharjee (1995)	1989	West Bengal	Per pole of girth	1985	1986	1987	1988	1989
			3 Inches	14	13	8	5.6	5
			4 Inches	26.47	22.4	14.6	11.3	10.2
			5 Inches	55.35	48	31.7	28.35	24.1
			6 Inches	92.1	96.2	58.2	52.1	41.3
Bisalaiah (1995)	1988-89 to 1989-90	Karnataka		Small farmers	Medium farmers	Large farmers	All	
			One ton	340.68	463.16	409.5	386.29	
Aziz (1995)	1989-90	Karnataka	Eucalyptus Per acre	Categories of Farmers				
				<5 acres	5 to 10	>10	All	
				784.9	945.5	1292.2	993.8	
Saxena (1995)	1990	Uttar Pradesh	Per tree	>2.5Ha.	< 2.5 Ha.	Average		
				45	25	39		

Source: Compiled from the sources quoted in the Table

fluctuations over time. In West Bengal the price for a eucalyptus pole of size 16 feet long 3 inches diameter was Rs. 14 in 1985, and declined to Rs. 5 in 1989 (Singh and Bhattacharjee 1995). Similarly, in Uttar Pradesh the price of eucalyptus reduced from Rs. 40 – 42 per quintal in 1987-88 to Rs. 33 – 35 per quintal in 1989-90 (Saxena 1995). The prices declined owing to several factors like increased aggregate supply of eucalyptus poles causing glut in the wood market; lockout of many paper mills decreasing the demand for eucalyptus products; unethical practices of middlemen and agents to keep lower price for the product; supply of low quality wood; etc. Additionally, lack of adequate information about the wood market also played a major role in adversely affecting the market price. An Evaluation Study of Social Forestry Project in Karnataka reports that only a few farmers were aware of market conditions and the price they could expect for their product (ODA 1989). But, it is significant to note that in Karnataka the price of eucalyptus has not fluctuated much as in other states because of the presence of paper mills, which are the major source of demand for eucalyptus products (Aziz 1995). This indicates that stable and enough demand can sustain the tree growing activity on farmlands. Hence, measures like establishing wood markets with easy access to growers and consumers, providing transport facilities, developing the wood market by finding new diversified uses of trees, market information dissemination to farmers, etc., (Bisalaiah 1995; Sharma et al 1995) need to be taken up to provide development support to tree growers.

Section III

Criticisms against Eucalyptus Tree Cultivation under the Farm Forestry Programme

Large-scale tree cultivation, particularly eucalyptus under the Farm Forestry programme raised several criticisms. Most of the criticisms were directed on environmental effects of the widely accepted specie, and other effects like change in labour use, displacement of food crops, etc., due to large scale tree plantation. Some of the allegations and their validity against the scientific findings as observed by studies are summarised in Table 6. The critics argued that mass plantation of eucalyptus increases water run off and soil loss; reduces ground water table; depletes soil productivity; prevents under growth and decreases productivity of nearby crops, etc. (Krishnamurthy 1984; Shiva et al 1984). But, this argument is found to be untrue as tree cover reduces water runoff and soil loss. In fact, eucalyptus trees have no measurable effect on soil loss, instead help to reduce the soil loss on degraded lands. Surface run

Table 6: Environmental Aspects in Eucalyptus Cultivation under the Farm Forestry Programme

Nature of Problem/ Criticism	Author, Year of Reference	Study Area	Method of Study	Sample Size	Remark of the Study
Water run off & Soil Loss	1.Krishnamurthy (1984)	Karnataka	Forest Land	NA	Increases the water run off and soil loss
	2.Shiva & Bandhyopadhyay (1984)	Karnataka	NA	NA	
Ground water level	1.Krishnamurthy (1984)				Decreases ground water
	2.Shiva & Bandhyopadhyay (1984)				
	3. Rajan (1982-83)	Uttar Pradesh	Forest Research Laboratory	NA	Efficient water user & produces more biomass.
	4. Centre for Industrial Information (1989)	Uttar Pradesh	Forest Research Laboratory Dehra Dun	NA	Eucalyptus roots do not grow more than 3.5 metres, so it does not draw more water
Effect on Soil Productivity	1.Krishnamurthy (1984)	Karnataka	Forest Land	NA	Decreases soil Productivity
	2.Shiva & Bandhyopadhyay (1984)	Karnataka	Farm land	NA	
	3. Rajan (1987)	Uttar Pradesh		NA	Beneficial effects on soil
	4. Centre for Industrial Information (1989)				Beneficial effects on soil
	4. Kushalappa (1985)	Karnataka	Scientific		Contributes to the soil nutrients
Effect on Neighbour Crop	Saxena (1994)	Uttar Pradesh	Farmers' Experience	28	Observed loss in the production of nearby crops

Note: NA – Not Availalbe
Source: Compiled from the Sources quoted in the Table

off and soil loss would be reduced and water yield can be increased by 10 per cent of the total flow by cultivating eucalyptus (Centre for Industrial Information 1989).

Another criticism levelled against eucalyptus trees was that it draws down the groundwater table by consuming more water (Krishnamurthy 1984; Shiva and Bandhyopadyay 1984). The controversy that eucalyptus lowers the water table by increasing its demand on underground water reserves at times of stress thereby drying up pools (Shiva and Bandopadyay 1989) has to be considered by the relative ability of the root system of different species to tap the groundwater resources and the rate at which those ground water resources could be recharged (Centre for Industrial Information 1989). A study of the root system of eucalyptus hybrid of 21 years old showed that the taproot was of 3.2 meter length in Marasandra Eucalyptus Plantation of Hosakote taluk in Bangalore Rural district. Since the root of eucalyptus does not go deep, the tree does not draw more water and hence drying up of the water pools is ruled out (Rajan 1987). Further, it has been proved that eucalyptus is an efficient user of water. An experiment carried out at Forest Research Laboratory of Uttar Pradesh Forest Department, shows that among several species tested eucalyptus is the most efficient water user (Rajan 1987). To produce one gram of biomass consumes least quantity of water i.e., 0.48 litre, whereas pongamia pinnata utilises 0.88 litre. Further critics pointed out that the land used for eucalyptus subsequently turns out to be unfit for cultivation of other crops due to depletion of soil nutrients by eucalyptus (Krishnamurthy 1984). But, a study in Dehra Dun Forest Division of Uttar Pradesh noted that eucalyptus hybrid produces nutrients through litter fall (Rajan 1989). The study found out the quantity of each of the nutrients that are contributed to the soil separately by leaf, twig and bark litters in Kg. per hectare per annum in 5, 7 and 10 years old eucalyptus plantation. In each of these plantations the highest quantity of nutrients returned to soil is Calcium (Ca) i.e., 40.2, 42.8 and 73.2 Kg/hectare in ascending order of age, then follow the nutrients of Nitrogen (N), Potash (K), Magnesium (Mg) and Phosphorous (P) in which case contribution of 10 years old plantation is roughly double those returned in 5 years old plantation. Considering these facts it can be said that eucalyptus trees add to soil nutrients instead of depleting them.

It is also argued that nothing grows underneath eucalyptus trees. This criticism has been levelled without any proper examination (Rajan 1989). Eucalyptus generally has narrow crown that cast very little shade even in stands consisting of several thousands of trees per hectare. If there is paucity of undergrowth reasons for its absence are more likely to be excessive grazing, fires, besides the previous vegetation on the site and surface soil conditions (Centre for Industrial Information 1989) than any adverse effects of eucalyptus itself on the site. Contrary to the above criticism in Sulikere Reserve Forest of Karnataka, Kushalappa (1985) found thick undergrowth in the eucalyptus plantation. There were as many as 20 species in the plantation. The eucalyptus plantation had allowed 65 different species to grow underneath than the sal plantation which had 37 species in Uttar Pradesh Forest Research Centre (Rajan 1989). Based on these facts, the allegation that undergrowth is not possible in eucalyptus plantation found to be untrue. It was also argued that eucalyptus reduces the productivity and production of nearby crops. Saxena's (1994) study covering a sample of 28 farmers

in western Uttar Pradesh noted a loss in crop production along the line of plantation (Saxena 1994). The loss was more in rabi than in kharif crop and it was only after the second year of the plantation of the tree these losses became more conspicuous. However these observations are based on a limited sample i.e., 28 observations. As evident from Table 7 except the World Bank (1989) study in Uttar Pradesh that observes negligible crop loss, all other studies have reported crop loss on farmland adjoining eucalyptus plantation. For instance, Khyber (1992) finds decline in wheat yield ranging from 4 per cent in the first year to 61 per cent in the ninth year.

Table 7: Crop Losses due to Bund plantation of Eucalyptus

Author	**State**	**Space in meter**	**Density per Ha.**	**Crop Loss**
Wilson and Trivedi (1987)	Gujarat	1.5	-	Mustard and castor crops were destroyed
Ahmed (1989)	Haryana	1.8	250	8.2 % of total crop in the first year to 48.8 % in the tenth year
World Bank (1989)	Uttar Pradesh	-	200	Negligible
Malik and Sharma (1990)	Haryana	1.5	-	Mustard and wheat crop less by 41 %, losses up to 10 meter of the tree line
Khyber (1992)	Uttar Pradesh	-	100	Decline in wheat yield up to 5 meter ranging from 4 % in the first year to 61 % in ninth year
Saxena (1994)	Uttar Pradesh	0.3 to 3.0 meter	21 to 800	Poor crop in 2-10 meter from the tree line, losses from 5 to 25 % of the total crop

Source: Saxena (1994)

Other Criticisms Against Eucalyptus Cultivation

Eucalyptus cultivation has also been criticised on the grounds that it displaces the area under food crops, benefits only large farmers and displaces labour from agricultural activities, etc. Rao (1988) observed a decline in the total food crop area after 1987-88 due to Social Forestry activities in Khammam district of Andhra Pradesh. But, it is difficult to accept the above report as Deshpande and Chandrashekar (1984) and Aziz (1995) note the contrary in Kolar district of Karnataka. They state that the increase in area under eucalyptus is not at the cost of cereals but by garden crops like mulberry and vegetables. Besides, increase in the area of eucalyptus is not from the cultivable land but from the barren, uncultivable land and cultivable wasteland and when there was a decrease in the area of cereals it was mainly because of bad weather and not due to eucalyptus cultivation.

The argument that large-scale tree cultivation displaces labour has been examined by some studies. After the advent of the Social Forestry programme in 1984-85 eucalyptus cultivation in an acre produced only 104 mandays over 6 years, while the annual crops cultivation in an acre generated 228 mandays of job opportunities thus increasing it by 124 mandays than eucalyptus cultivation (Rao 1988). But, this is not based on the actual farm level data as the author has collected data from official records. Saxena and Srivastava (1995) found that in Muzafarnagar and Nainital of Uttar Pradesh eucalyptus cultivation of 6 years required 398 mandays per hectare for a high density plantation and 296 mandays per hectare for a low density plantation.

Eucalyptus absorbs more labour on per hectare basis as compared to the other annual crops. But, annualization of labour use shows poor labour absorption by eucalyptus. NCAER has presented the demand for labour in growing *ragi* (i.e., finder millet) an annual/seasonal crop and eucalyptus as given by the Karnataka Forest Department. The study reveals that over a 5-year cycle, mandays of employment created is 250 per hectare in ragi cultivation, whereas in eucalyptus plantations it is 525. Over a 10-year cycle mandays of employment provided by ragi is 500, while corresponding employment in raising eucalyptus plantations is 800. Therefore, the aggregate employment generated in eucalyptus plantations over its life cycle is greater than that in the cultivation of ragi. The Evaluation Report on Social Forestry Programme (GOI 1987), adopting a before and after the project approach, indicated that the average person days of employment on own work with Farm Forestry increased from 312 mandays in 1982-83 (the year before adoption) to 363 person days in 1983-84. The average employment opportunities created by Farm Forestry is 15 person days taking all states together. Among the states the Farm Forestry programme has generated more employment in West Bengal, while in Karnataka the increased labour absorption is less (only 2 per cent). In total, adoption of Farm Forestry has increased the utilisation of labour over the previous period.

Another criticism levelled is that the programme of Farm Forestry, which was introduced to induce farmers to take up tree growing as a commercial activity has attracted only large farmers, with small and medium farmers left out. It is claimed that this has increased the social tension (Shiva and Bandhyopadhyay 1984). But, studies have shown that all farmers including small, medium and large are participating in tree growing activity. If the size of the land brought under eucalyptus is small in the case of small farmers, it is because of the small size of their holdings and other resource constraints like lack of income, constraints in shifting cropping pattern and farmers dependency on land for food crops, etc. Large farmers have ready access to these resources and they can put more area under eucalyptus. According to Aziz (1995) eucalyptus cultivation is size-neutral; to the small and medium farmers it serves as a cushion against the not too dependable monsoon that largely determines the performance of annual crops. Therefore, the criticism that only large farmers are practising Farm Forestry is not supported with empirical evidence. Many of the criticisms levelled against eucalyptus under the Farm Forestry programme are found to be not true. Studies have shown that eucalyptus is an efficient water user by producing high biomass, it does not deplete the soil nutrients, etc. But, the growth of eucalyptus may affect neighbouring crops as evidenced by some studies.

Section IV

Conclusion

Though the Farm Forestry programme was introduced to produce fuelwood and fodder on farmlands, and to reduce the pressure on forests, farmers grew trees for commercial purpose. The initial success of the programme indicates that farmers expect more income from the changed land use. As the available literature shows tree cultivation under the Farm Forestry programme is economically viable in states like Gujarat, Karnataka, West Bengal, Uttar Pradesh. But, in North-western states and western Uttar Pradesh farmers

incurred loss from tree cultivation in later stage of the farm forestry programme. Many states experienced participation by all size classes of holding i.e., small, medium and large farmers and received more income from tree cultivation. But, this success did not last for too long in some states due to reasons like high profit expectation by farmers, over production, inadequate and unfavourable marketing systems. These factors created a glut in the market that brought down the price of tree products thus driving farmers away from tree cultivation in some western states. In fact, farmers in many states practised it as a substitute for annual crops, which attracted attention. Considering the success of the Farm Forestry programme it indicates that a change in the land use pattern from annual crops to tree crops is profitable and is more suitable particularly in dry and semi-arid regions, which suffer from several environmental constraints. However, mixed plantations consisting of fuelwood, fodder and fruit trees are considered to be some socially desirable than mono – cultivation like eucalyptus, since it can meet the diverse needs of rural communities for fuelwood, fodder and fruits.

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