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Forestry (Including Social Forestry) in the Context of Economic Development

FORESTRY AND ECONOMIC DEVELOPMENT*

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Forests constitute an important natural resource base of India. Several major and minor products from forestry make vital contributions to the country's economic development. Railway sleepers, housing furniture, pulp and paper, rayon fibre, packaging material, particle boards, plywood, carved wooden articles, wooden utensils and safety matches account for a major share of industrial demand for forest products in India. Besides, wood is also a main source of energy for households as well as in many industries. Additionally, the minor forest products including fruits, flowers, seeds, grasses, dyeing and tanning agents, natural gums, resins, lac, honey, tusser, silk, etc., also substantially contribute to the economy, environment and livelihood of a sizable portion of the population in the country.

I

SPATIO-TEMPORAL CHANGES IN AREA, PRODUCTION AND PRODUCTIVITY OF FORESTS

Forest Area

Forests in India (excluding area under various social forestry programmes) are said to cover about 22.7 per cent (74.7 million hectares) of the country's land area. About half (38.79 million ha.) of this area constitutes the reserved forests and the rest includes unclassed village forests heavily burdened by the villagers' rights of grazing their animals, firewood collection, small timber, etc. The unclassed forests thus represent most irrationally exploited and heavily encroached areas. This seemingly large area is reduced to ridiculous proportion when its spatial distribution is considered. According to recent statistics (Government of India, 1985 *a*, p. 3), ten per cent of the total forest lands (7.94 million ha.) are occupied by national parks and sanctuaries. This leaves barely 9.42 per cent of productive forest which, while representing hardly one per cent of world's forest area, is meant to cater to 15 per cent of human population and 19 per cent of livestock population of the world.

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* Keynote paper.

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The Spatio-Temporal Shifts

Ever since the turn of this century, the biotic pressure on forests had always been causing a continuous decline in the forests area over time. Reports indicate that during 1951-80, about 4.31 million ha. of forests were lost to agricultural activities (60.7 per cent), industries and townships (3.01 per cent), transmission lines, roads, etc. (1.4 per cent) and miscellaneous usages (20.8 per cent) (Kamath, 1985). The annual decline in the forest area has thus been estimated to the tune of 0.14 million ha. Another estimate (Gill, 1987) places the rate of decline to be more than 1.5 million ha. per year. These figures, however, relate only to authorised and documented encroachments on forest area. In reserved forests considerable forest area has been lost during the past four decades.

Temporally, there has been an annual compound decline in forest areas in the States like Assam (0.8 per cent), Bihar (0.4 per cent), Madhya Pradesh (0.4 per cent), Maharashtra (0.1 per cent) and Rajasthan (0.8 per cent) during 1960-77 period (Dass and Vashisht, 1983). In Bihar, due to the increase in human population the compound growth rate in forest areas worked out to be negative (—0.88 per cent) in a decade beginning 1967-68, and the aggregate decline being 0.83 per cent for the twenty years (Das, 1983). In Maharashtra, the regional disparity in forest area in 1977-78 led to disparity in forestry production (Borude and Talathi, 1983, p. 324). Assam, a State endowed with better forest resources and with its economy highly dependent on forestry, registered a decline of over 42 per cent in a 27-year (1951-78) period (Bora, 1983, pp. 325-326).

Contrary to the overwhelming evidence of a decline in forest area, one study has projected a gradual increase in the forest area. With about 40 million ha. in 1950-51 (Table I), the forest area continued to register an

TABLE I. AREA UNDER FORESTS IN INDIA

Period	Area (million ha.)	Per cent annual variation
(1)	(2)	(3)
1950-51	40·48	2·51
1960-61	54·05	1·54
1970-71	63·92	0·52
1980-81	67·42	—
1970-71	63·92	—
1971-72	64·67	1·17
1972-73	65·43	1·16
1973-74	65·73	0·04
1974-75	65·87	0·02
1975-76	66·70	1·24
1976-77	67·16	—0·68
1977-78	67·14	—0·02
1978-79	67·47	+0·49
1979-80	67·48	+0·01
1980-81	67·42	—0·08

Source: Government of India : Indian Agriculture in Brief, Directorate of Economics and Statistics, Ministry of Agriculture and Rural Development, New Delhi (various editions).

increase to 67 million ha. by 1980-81. The annual variations, however, indicate that the area under the forests (since 1970-71) has increased at a declining rate of growth, the actual decline being after 1976-77. The increase in forest area is at a negligible rate of 0.55 per cent per annum linearly and 0.54 per cent per annum geometrically. But this apparent increase in forest area over time cannot be taken on its face value. The area notified as forests under the Indian Forest Act, 1952 carries no guarantee of a uniform forest cover in the area. *Ipso facto*, a large portion of notified forest area includes wastelands (Government of India, 1981, Table 20.1) which added significantly to paint a complacent 75 million ha. or 23 per cent of the area under forests in 1983. This is a reclame to conceal the degraded lands in the garb of forest area. Simultaneously, the choicest of forest lands are being denuded for various reasons ranging from clearing for agriculture to the industrial, mining or residential uses, justifying unauthorised encroachments even in reserved forests (Kamath, 1985; CSE, 1985). Discrepancies of reporting notwithstanding (Government of India, 1976 *b*, p. 445), the dynamics of forest area in India has been that of deterioration since Independence.

Forest Production

The output from forestry is conditioned by man-made and natural determinants. While the latter includes climate-soil-environment-mix, the former includes the technology of exploiting forests for maximum production. In terms of value contribution, major forest produce accounts for about 70 per cent of the total value-added by the forestry sector in the country.

A long-term Statewise trend analysis for a 17-year period (1961-77) revealed an increase in the production of timber estimated at 4.36 per cent per annum at the all-India level. The production of fuelwood, however, declined in almost all States of India except in Andhra Pradesh, Assam, Bihar, Haryana, Himachal Pradesh, Kerala, Karnataka, Orissa, Punjab, Rajasthan, leading to an annual increase of only 1.92 per cent (Dass and Vashisht, 1983). The analysis of production performance for the 11-year period (1972-83) reveals that the proportion of total wood used as raw material as investment input for different wood based industries in India is quite low. Thus while Japan used 98 per cent of wood for industrial purposes, India utilised only 9 per cent of the wood for industrial purpose. Most of the removals from forests are utilised as fuel which curb the acceleration in forest-based industrial development (Mahendra and Maithani, 1986).

A long-term analysis of forest produce in India (Table II) indicates that barring the dissolved wood pulp, newsprint and chemical wood pulp, all other products had less than 5 per cent annual compound growth rate for a 12-year (1969-83) period. Similarly, barring production of pulp wood and particles, wrapping and packaging paper and boards, there has been a decline in the annual rate of production of forest products in 1972-83 period as compared to 1968-79 period.

TABLE II. MAJOR WOOD AND WOOD PRODUCTS IN INDIA ('000 m^3)

Year	Wood			Wood products		
	Round	Industrial	Fuel	Plywood	Particle boards	Fibre board
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1972	1,83,364 (100)	14,064 (100)	1,69,300 (100)	172 (100)	14 (100)	37 (100)
1973	1,88,095 (102·60)	14,904 (106)	1,73,191 (102·30)	184 (108·14)	15 (107·14)	34 (91·39)
1974	1,92,968 (105·20)	15,800 (112·30)	1,77,168 (104·60)	196 (113·92)	12 (85·77)	32 (86·49)
1975	1,97,709 (107·80)	16,479 (117·20)	1,812,30 (107·00)	180 (104·64)	10 (71·43)	26 (70·27)
1976	2,02,331 (110·30)	17,224 (122·50)	1,85,107 (109·30)	196 (113·92)	12 (85·17)	24 (64·86)
1977	2,06,718 (112·80)	17,769 (126·30)	1,88,949 (111·60)	200 (116·24)	13 (92·86)	26 (70·27)
1978	2,11,175 (115·20)	18,382 (130·70)	1,92,793 (113·90)	220 (127·84)	14 (100·00)	21 (56·76)
1979	2,15,718 (117·60)	19,060 (135·50)	1,96,658 (116·20)	240 (139·44)	18 (128·57)	26 (70·27)
1980	2,20,360 (120·20)	19,780 (140·60)	2,00,580 (118·50)	200 (116·24)	28 (200·00)	20 (54·05)
1981	2,24,368 (122·40)	19,834 (141·00)	2,04,534 (120·80)	280 (162·64)	31 (221·43)	42 (113·51)
1982	2,28,316 (124·50)	19,862 (141·20)	2,08,454 (123·10)	300 (174·24)	28 (200·00)	45 (121·62)
1983	2,32,537 (126·80)	19,910 (141·60)	2,12,627 (125·60)	355 (206·14)	31 (221·43)	42 (113·51)
Mean annual	2,08,638	17,755.7	1,90,882	226·9	18·83	31·25
C.V.	7·74	11·65	7·40	24·93	43·30	27·77
GR LGR	2·43	3·81	2·31	8·97	22·91	2·48
CGR	2·18	3·29	2·08	5·79	10·07	1·60

Figures in parentheses are annual growth indices.

The growth indices (Rai *et al.*, 1983) for major forest products during the period (1972-83) would reveal a consistent increase without any 'dip' (Table II) for round wood (100-126.80), industrial wood (100-141.60) and fuelwood (100-125.60). Plywood production experienced a decline as related to the previous year in 1975 and 1980. However, the production did not decline to the base year level. In the case of particle wood, the production remained below the base year for the 1974-77 period. Subsequently, its production registered a rise. Similar trends were also discernible for fibre board. Thus the forest sector's most conspicuous production accounting for about 90 per cent of production and similar value addition has been industrial wood which accounts for not more than ten per cent of production. Other components of forest products like honey, silks, fruits, seeds, edible oils, catechu, bidi leaves, grazing resources, etc., have not been included in this analysis for want of sufficient data. The productivity of forest sector in India is conditioned by a subsistence bias because of increased fuelwood production to meet increased demands. Further, the demand for round wood (saw logs, veneer logs, pit props and pulp wood) originates from primary domestic markets in the country. Obviously, forest production in India has been consumption-oriented, not productivity-oriented without any strong forward and backward linkages with other sectors.

II

DEMAND-SUPPLY ANALYSIS OF MAIN FOREST PRODUCTS

Demand Analysis

Several studies have projected the aggregate national demand for forest products estimating the demand by compound growth functions and by the transcendental consumption functions, using the projected income and investment data derived through the estimated compound growth rate equations of income and investment (Rai *et al.*, 1983; Chandrakanth *et al.*, 1979; Government of India, 1976 *b*, pp. 51-67). The studies seem to suffer from two inherent defects. Firstly, demand denotes a sum of production and import of a produce net of export, ignoring the possibility of accumulation of inventories of forest products. Actually there is a possibility of cumulative inventories of previous years to be consumed currently. Secondly, the only determinant considered for such analysis is national income. In such analyses demand elasticities are also generated. The results indicate that all the processed products from forest wood have shown high to moderate responses to the shifts in national income during 1961-76. The projected demands for all major forest products have indicated sizable increases of varying magnitudes for the 1980-90 period.

At the micro level, sporadic studies have attempted simply to quantify the demand for fuelwood (Maithani, *et al.*, 1986; Mathur *et al.*, 1984; Negi *et al.*, 1986). The size of family, availability of substitute and income seem to determine the demand for fuelwood. The cause-effect relation of fuel consumption with parity price ratio between fuelwood and alternative fuels and income has not been studied. Further, the spatial aspects of distance of families from availability of fuel sources have never been taken into account. In the light of its fast monetisation (von Oppen, 1980), the micro level studies on fuel demand and secondary products need no emphasis.

To sum up, most workers have employed the data base of the FAO Year Book of Forest Products for generating income elasticities of demand for various forest products. The demand projections till 1990 show signs of quantum leaps in demand for all the forest products. Economic classification of products reveals that demands for primary forest products are largely income-inelastic or only mildly elastic; those for processed products like paper, boards, panels, etc., are highly elastic. Thus more attention would require to be paid on supply management of the raw materials required for processed forest products.

Supply Analysis

The supply of forest products mainly constitutes the outturn of forests. The supply of primary forest product would be conditioned by actual forest cover, investment on forest management, the input of labour and the market prices of the products under consideration. The supply of the secondary products would be conditioned by the availability of processing chemicals, machines, skilled labour, capital investment, market prices and their management. Actually, the supply functions could take the form of reduced equations for secondary products.

In most of the studies on supply, while supply would mainly constitute production in the relevant year, the possibility of part accumulation of inventories of forestry product actually used currently cannot be ruled out of the total supply. Similarly, imports net of export would also form part of the supply system. Actually the supply-demand dichotomy in the present case would be, econometrically speaking, an 'identification' problem. At the most, we can treat production in year 't' + inventory accumulated till year 't' + import in year 't'— export in year 't', as equilibrium value which would, perhaps, depict both demand and supply.

The procedure for estimation of supply of forest product treats production as supply and regresses the supply in time with investment in forestry under transcendental specifications. From this, supply estimates are generated with the help of geometric investment growth rates. The results of a single available study (Table III) reveal sticky supply projection of almost all forest products for 1980-90 period, the production of round wood, fuelwood + charcoal, industrial round wood, other industrial round wood, paper + paper board, wrapping paper + packaging paper + boards and fibre boards + wood pulp production is actually estimated to decline by 1990 (Rai *et al.*, 1983).

At the micro level, studies on supply analyses are lacking despite the fact that data on fuel supply have been generated periodically by individual as well as by National Sample Surveys. The price data compiled in consumer price series by the Labour Bureau and Industrial Workers, Ministry of Labour have not been analysed in relation to supply of fuelwood (Negi *et al.*, 1986). Finally, almost all secondary production which involves wood processing can be provided by individual industries or by Central Statistical Organisation (CSO) so that micro analysis of supply of processed forest products can be conducted.

TABLE III. LONG-TERM TRENDS OF PRODUCTION IN FORESTRY SECTOR IN INDIA

Sr. No.	Forest products	1961-76*	Growth rates (per cent per annum) 1968-79† compound	1972-83 Linear	1972-83 Compound	1972-83 C.V.	Mean annual production (1972-83)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	Round wood ('000 m^3)	2·44	2·70	2·43	2·18	7·74	2,086·38
2.	Fuelwood + charcoal ('000 m^3)	2·28	2·50	2·31	2·08	7·40	1,90,882·50
3.	Industrial round wood ('000 m^3)	4·19	4·70	3·72	3·23	11·44	15,791·17
4.	Charcoal ('000 mt)	—	2·30	2·49	2·22	7·91	1,482·67
5.	Saw logs and veneer logs ('000 m^3)	3·74	4·60	4·47	3·75	13·25	12,777·75
6.	Pit props ('000 m^3)	4·45	2·40	0·45	0·45	2·51	1,237·50
7.	Pulp wood and particles ('000 m^3)	25·50	1·68	3·61	3·86	17·94	1,001·17
8.	Wood pulp ('000 m^3)	9·79	1·39	8·40	6·70	22·78	408·33
9.	Other industrial round wood ('000 m^3)	2·19	2·40	2·57	2·29	8·13	2,539·75
10.	Sawn wood + sleepers ('000 m^3)	3·67	5·20	11·84	7·89	26·41	8,532·52
11.	Wood based panels ('000 m^3)	3·46	3·20	4·28	3·59	13·61	209·58
12.	Veneer sheets ('000 m^3)	—	3·76	2·38	0·13	78·12	6·25
13.	Plywood ('000 m^3)	2·83	2·80	4·77	3·94	14·94	157·67
14.	Chemical wood pulp ('000 mt)	—	11·80	9·67	7·90	25·93	243·17
15.	Other fibre pulp ('000 mt)	6·01	2·10	2·47	2·24	8·80	705·06
16.	Paper + paper board ('000 mt)	4·32	2·80	5·50	4·25	15·66	1,029·50
17.	Newsprints ('000 mt)	2·76	23·60	5·31	3·97	20·16	55·08
18.	Printing + writing paper ('000 mt)	4·91	3·50	4·76	3·82	14·68	547·50
19.	Wrapping + packaging paper + board ('000 mt)	7·26	5·50	16·00	9·54	34·38	225·92
20.	Dissolving wood pulp ('000 mt)	—	23·00	6·17	5·09	18·14	124·42
21.	Round wood ('000 m^3)	—	0·027	2·49	2·22	7·908	1,482·67

Source: * Chandrakanth *et al.* (1979, pp. 51-60). Data are not available thereafter.
† Rai *et al.* (1983).

Demand-Supply Imbalances

If the available data are any indicators, demand for most of the forest products is far greater than supply. Table IV gives the projections of the demand for and supply of forest products based on compound growth rate and transcendental function (Rai *et al.*, 1983). In future, these imbalances are going to be more acute and there are frightening prospects of accentuation in deforestation process of even ten per cent of the actual of forested area that has remained in the country.

The validity of the projections and thus the methodology employed should be tested before making any such inferences. For this purpose, the data for 1980 available in the FAO Year Book of Forest Products (1983) are taken as the point where both predicted and observed values are available. This exercise generated substantial variations between observed and predicted products in general and for processed forest products in particular. There is thus a need to modify the methodology for prediction of demand for and supply of forest production.

III

ECONOMIC ANALYSIS OF AFFORESTATION OF WASTELANDS

The National Commission on Agriculture estimated 40 million ha. of lands which constitute waterlogged areas (6 million ha.), salinity and sodicity affected areas (7 million ha.), ravines (3.7 million ha.), lateritic soils (12 million ha.), riverine lands, coastal sandy areas, stony and gravelly lands, high altitudes and steeply slope lands (11.3 million ha.) (Government of India, 1976 *a*).

Technology: The Technology Mission of National Wastelands Development Board (Government of India, 1985 *b*) has identified several wasteland types which can be broadly grouped into culturable (gullied and/or ravinous lands, undulating lands, surface waterlogged lands and marshes, salt affected lands, shifting cultivation areas, degraded forest lands, sands, mining and industrial wastelands), and unculturable wastes (barren and rocky lands and snow cover and/or glacial lands).

Economic analysis: The differences in package of practices for different wastelands result in sizable differences in cost-return structure. Vegetal productivity on these lands may not be characterised by high degree of economic resilience and viability. For, these lands may have already lost their production potential owing to natural and man-made hazards. The wastelands transcend both private and public ownerships. Thus the strategies of managing wastelands falling in both categories may have to be dealt with separately. Economic analysis of managing wasteland would essentially involve computations of benefits and costs (market and extra market) under existing and proposed alternative uses. For the purpose, all benefits and costs in short and long runs need to be explicitly taken into account.

TABLE IV. DEMAND (Dt)—SUPPLY (St) IMBALANCES* FOR FOREST PRODUCTS IN INDIA

Sr. No.	Forest products		Projection (1980) Dt	Projection (1980) St	Imbalance (per cent)	Projection (1985) Dt	Projection (1985) St	Imbalance (per cent)	Projection (1990) Dt	Projection (1990) St	Imbalance (per cent)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1.	Round wood ('000 m³)	I†	2,17 000	2,21,800+	2·211	2,53,400	2,53,400	0	2,89,400	2,89,400	0
		II†	2,33,000	2,19,500—	— 5·793	3,25,500	2,38,200	—26·82	5,76,600	2,39,100	—58·53
2.	Fuelwood + charcoal ('000 m³)	I	2,06 500	1,96,900—	— 4·648	2,34,100	2,15,100	— 8·12	2,65,500	2,35,100	—11·45
		II	2,30 500	2,02,300—	—12·234	3,16,900	2,06,800	—34·74	5,46,200	1,79,100	—67·21
3.	Charcoal ('000 mt)	I	1,566	1,570+	0·255	1,755	1,761	0·34	1,967	1,976	0·46
		II	1,631	1,549—	— 5·027	2,164	1,800	—16·82	3,503	2,280	—34·91
4.	Industrial round wood ('000 m³)	I	15,320	15,330+	6·527	19,210	19,210	0	24,170	24,070	— 0·41
		II	7,178	15,050	109·639	7,384	17,220	133·21	7,749	10,720	38·34
5.	Saw logs + veneer logs ('000 m³)	I	9,482	9,497	0·158	1,870	11,870	0	14,860	14,850	— 0·07
		II	10,390	10,210	— 1·732	11,580	18,790	62·26	49,870	64,850	30·04
6.	Pit props ('000 m³)	I	1,358	1,358	0	1,532	1,532	0	1,730	1,726	— 0·23
		II	1,407	—	—	1,882	—	0·25	3,096	—	0·37
7.	Pulp wood + particles ('000 m³)	I	2,001	2,004	0·149	4,342	4,353	—	9,423	9,458	—
		II	—	—	—	—	—	—	—	—	—
8.	Other industrial round wood ('000 m³)	I	2,771	2,769	— 7·217	3,130	3,128	— 6·39	3,537	3,534	— 0·08
		II	2,902	2,724	— 6·133	3,962	2,846	—28·17	6,743	2,629	—61·01
9.	Sawn wood + sleepers ('000 m³)	I	4,506	4,618	— 7·501	5,805	6,060	4·39	7,478	7,952	6·34
		II	4,955	5,063	2·179	9,441	13,020	37·91	28,470	1,05,200	269·51
10.	Wood pulp ('000 mt)	I	649	240	—63·020	1,243	—	—	2,379	—	—
		II	—	406	—	—	—	—	—	—	—

(*Contd.*)

TABLE IV (*Concld.*)

Sr. No.	Forest products		Projection (1980) Dt	St	Imbalance (per cent)	Projection (1985) Dt	St	Imbalance (per cent)	Projection (1990) Dt	St	Imbalance (per cent)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
11.	Chemical wood pulp ('000 mt)	I	339	—	—	592	980	65·54	—	—	123·21
		II	—	—	—	—	—	—	1,034	2,308	—
12.	Dissolving wood pulp ('000 mt)	I	315	406	19·764	885	—	—	—	—	—
		II	—	—	—	—	—	—	2,492	—	—
13.	Paper + paper board ('000 mt)	I	1,240	1,040	−16·129	1,418	1,180	−16·78	1,623	1,340	−17·43
		II	1,297	1,016	−21·665	1,815	1,026	−43·47	3,223	850	−73·44
14.	Printing + writing paper ('000 mt)	I	592	576	− 2·702	701	666	− 4·99	830	771	− 7·11
		II	624	553	−11·378	321	346	−46·08	1,919	319	−83·38
15.	Wrapping paper + packaging paper + board ('000 mt)	I	245	254	3·673	—	680	7·79	421	471	111·88
		II	—	289	—	—	—	—	—	393	—
16.	Other fibre pulp ('000 mt)	I	748	751	0·401	829	834	0·60	919	926	0·76
		II	777	803	3·346	1,007	2,291	127·51	1,570	3,806	142·42
17.	Plywood ('000 m^3)	I	—	173	—	—	206	—	—	246	367·6
		II	158	191	—	291	400	73·16	438	2,048	—
18.	Newsprints ('000 m^3)	I	—	61	—	362	—	−78·73	—	98	—
		II	250	—	—	—	—	—	681	—	—
19.	Particle boards ('000 m^3)	I	—	—	—	—	—	—	—	—	—
		II	15	—	—	18	—	—	28	—	—

Source: Rai *et al.* (1983, pp. 305-306).

Note:— * Per cent imbalance $= \frac{St—Dt}{Dt}$ X 100.

† I and II refer to estimates based on compound growth rate equation and transcendental production function respectively.

Essentially, in terms of economic analysis wastelands are also to be treated as a commodity subjected to the processes of buying and selling at a market clearing price. In the process, its intrinsic value as a natural resource which ties the future generation with the present one is usually rendered redundant. Accordingly, the most 'logical' use of wasteland is one which is endowed with greatest net returns over costs. This would evidently take care of immediate or at times medium-term goals for owners of wastelands which include farmers, government or industry. However, the society would invariably have interests in tangible utilisation of these lands.

The state of art available for evaluation of economics of land use involves discounting procedure and the choice of an appropriate social discount rate. These procedures fail to analyse the economic consequences of land allocation for alternative use by society for very long planning horizons, massive uncertainty and irrevocability (Randall, 1981). Further, discounting procedures give overwhelming importance to the present generation over future generations (Ferejohn and Page, 1978). However, safe-minimum-standard approach (Ciriacy-Wantrup, 1968) and resource presumptive approach (Krutilla, 1967) could fruitfully be employed for economic analysis of allocating wasteland resources to the alternative usages.

The socio-economic aspects of afforestation or putting these to alternative vegetal production use should also be considered. Thus all those wastelands which can be used for growing crops after treatment should be allocated for crop production under prescribed technological limitations like dryland crops for arid areas. Simultaneously, all lands which generate negatively benefit-cost ratios should be put to afforestation and grasses. Other uncultivable wastelands should be managed to generate product-mix of fuel, fodder, small timber, fruits, edible seeds, top feed, gums, resins and other raw material for small scale industries. Research conducted in India and elsewhere suggests that afforestation of wastelands is profitable (Yadav, 1980; Gupta and Mohan, 1982; Thakur, 1982) on the premise that removing a part of wastelands from crop production based on economic considerations would minimise overheads of agrarian production and improve their own tangibilities.

Wasteland afforestation has added social opportunity cost especially in the rural areas. Animal dung and agricultural wastes utilised as fuel have more productive alternative uses in the farm sector. Thus contrary to their inherent capabilities, if wastelands are utilised for agricultural purposes, the farmer may end up paying in terms of losses due to reduced production over that possible with afforestation, and the nation pays twice—once in terms of reduced aggregate production and again in terms of irreversible resource depletion. A case can be made for examination of the premise that wastelands in India should be reserved for afforestation programmes only.

Wasteland treatments are generally viable when evaluated by discounting appraisal methods without considering the 'optimum state of conservation' (Ciriacy-Wantrup, 1968). Practically, a 'safe-minimum-standard of conservation' should be an appropriate measure for evaluation of wastelands.

Economic analysis of wasteland management needs to be strengthened by quantifying or at least identifying the extra-market benefits associated with recreation, open space and green belts, soil and watershed management, flood and pollution control, wild life preservation, employment opportunities for the rural poor scrambling for livelihood outside the barbed wire fence of reserve forests, etc. Research efforts to generate data on these lines would put wasteland afforestation in their proper use perspective.

IV

SOCIAL FORESTRY

Traditional 'production' forestry can no longer meet the growing demand of industrial, export and other sectors. Notified forest lands are the main starting points to meet the social needs through the components of farm forestry, extension forestry and by rehabilitation of degraded forests. Social forestry conceptually thus includes: (*i*) creation of woodlots in the village common lands, revenue wastelands and Panchayat lands, (*ii*) planting of trees on road, canal, and rail-sides; this, along with planting of wastelands, has also been called 'extension forestry', (*iii*) afforestation of degraded forests in the vicinity of habitations, (*iv*) planting of trees on and around agricultural fields, dwelling compounds and on private marginal lands, constituting 'farm forestry' or 'agro-forestry' (Government of India, 1976 *b*, pp. 119-125).

Social forestry is essentially a supportive system complementary to agro-pastoral product-mix. It could serve as buffer between people and commercial forest. The area available for social forestry is said to be about 95 million ha. (Government of India, 1982) (12 million ha. along road, canal and rail-sides, 10 million ha. from degraded forests, about 70 million ha. of crop lands and 3 million ha. along the water-courses (BISR, 1984, p. 18). But encroachments and other usages belie this notion (Rai, 1988).

Economic Analysis

The available literature pertaining to economic analysis of social forestry is limited to some sporadic attempts. Especially, the aspects of afforestation on non-farm lands like uncultivable and barren wastes, foreshores, roads, long fallows and common lands are conspicuous by their absence. The available literature pertains especially to the success stories for Dhanon project in Gujarat, Palamau project in Bihar and again for the whole of Gujarat State. The viability can be safely attributed to people's participation coupled with co-operation from the forestry personnel. Both these elements are naturally crucial for the success of any social forestry programme (Verma, 1988; Sinha, 1959; Dalvi and Shukla, 1988, pp. 262-264).

The Issues

Social forestry is endowed with many benefits which can perhaps be measured only in terms of social value additions, *e.g.*, reduced wandering in depleted forests in search of fuelwood would definitely add ease to the family in deriving the same amount of benefits. The other benefits would be conditioned by the socio-economic structure of villages. The unskewed distribution of benefits accruable from social forestry can be had only when the society itself is also socio-economically unskewed commensurate with hierarchical caste order. Socio-economically powerful lots obviously derive greater benefits than their counterparts constituting lower echelons of rural society endowed with small holdings (Anantha Ram, 1988). Another important issue related with non-neutrality of social forestry lies in the pattern of distribution of costs and returns. Thus if a programme generates size-responsive returns there may be few takers of this programme.

It is obvious that sharply drawn socio-economic strata of the farm families succeed in exerting varying demands on social forestry. A farmer with large size of holding may stay away from the requirement of grazing in a woodlot project, but the same would not hold for a marginal or a landless family with immediate needs of fuel and fodder. There is thus a problem of temporal as well spatial allocation of resources between differently placed socio-economic groups under the social forestry programmes.

Agro-Forestry

Agro-forestry is one of the most extensively operative components of social forestry programme. Like other developing countries, plants have remained the major source of energy for rural communities in India. Almost 45 per cent of harvested wood is used as fuel, small timber and top feed (Mahendra and Maithani, 1986). The economic rationale for agro-forestry lies in cushioning the impact of crop failures especially under unirrigated farming.

The technology (Huxley, 1983) of agro-forestry systems essentially constitutes selection of region-or even site- specific tree species; selection of crops which would do well in association of the selected trees; and determination of crop-tree geometry to ensure tree-crop complementarity in growth, productivity and economic viability.

Variants in Technology

The flexibility in agro-forestry system has generated many variant systems. Some of these include silvi-pastoral, horti-pastoral and agri-horticultural combinations.

(*a*) *Silvi-pastoral system:* This is mostly suitable for arid and semi-arid areas where trees are to be grown along with perennial or even seasonal grasses. The idea is to enhance livestock and forest productivity without enhancement in the intensity of land use. The system is economically viable under the protected conditions of research farms. There are however some unstudied constraints which preclude the farmers to adopt this system (Ahuja *et al.*, 1985).

(*b*) *Horti-pastoral system:* This system is suitable in fruit growing areas in order to maximise returns from diversified enterprise-mix where fruits are countered with fodder crops. The problem of inter-enterprise competition at the time of growth and the resultant greater meticulousness required in management do not allow the farmers to work for fruit-livestock farming-mix.

(*c*) *Agri-horticultural system:* Since livestock management is difficult to manage in orchards, it can be replaced by crops. The results of experimentation of dryland crops, *viz.*, *mung* bean (S-8), cowpea (Charodi-1), clusterbean (2470/12) and sesame (TC-25) planted in interspaces of ber trees in the arid areas of western Rajasthan have proved profitable for both resource conservation and product maximisation (Dauley and Dass, 1983, p. 198).

Barring the age-old practice of allowing trees to complement crops, the farmers in India have not yet adopted agro-forestry technologies. In mechanised grain farming, trees used to be considered as hindrances to the efficiency of farm machinery on farm lands. Consequently, the gains in crop productivity have been at the cost of faster land resource depletion. This has necessitated the revival of the tradition of crop-forest-mix with the label of 'agro-forestry'. 'Live green' fencing advocated in agro-forestry programme has its merits as well as demerits. The 'shade and bird' menace of all trees on farm vis-a-vis the resource conservation (Timm, 1986; Rensama and Tuskan, 1986, p. 217), needs to be economically evaluated on long-term basis under own conditions. Agro-forestry programmes in most of the States (Mathur and Gogate, 1983) including Andhra Pradesh, Arunachal Pradesh, Bihar, Gujarat, Haryana, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Orissa, Punjab, Tamil Nadu, Uttar Pradesh, West Bengal and Rajasthan have been merely treated as typical Government managed programmes of forest department without much concern for the technological, social and economic considerations involved in the adoption of agro-forestry projects at farm family level.

The economic viability of the various agro-forestry systems under the research farm conditions (Reddy and Korwar, 1985) leads one to believe that these 'systems' are worth adopting by all farms, taking for granted that resources, infrastructural and managerial inputs are uniform across the board. This assumption is hardly tenable since all these factors invariably undergo a continuous dynamic process of change. Moreover, there would be a significant difference between cash flows generated by a technology under the conditions of lab-farms and under the farmer's field conditions. Consequently, the adoption of agro-forestry systems under farm conditions is, at best, received with lukewarm response. An appraisal technique to include both these sources of variance should form the precursor of adoption.

V

'JHUM' CULTIVATION

The sloppy lands in high rainfall areas have traditionally been allocated to forestry. Some of these forest lands used to be allocated to crops for 2-3 years after clear felling and burning a patch of forest. This traditional system, called 'jhum' cultivation, implied that after 2-3 years of cropping, the area under cultivation would be abandoned for 15-20 years in Tripura and 30-40 years in Meghalaya for the regeneration of forest. However, with the increase in population, the period of fallowing to allow regeneration of forests patch by the farmers gets shorter to just 2-3 years; the newly regenerated patch returning to the farmer much earlier and it results in permanent degeneration of forest land. The increase in 'jhuming' has led to extensive soil erosion, drought, silting up of rivers and floods causing havoc on property and life in seven north-eastern States of the country.

There is a difference in opinion on the socio-economic desirability of this shifting cultivation. Some believe jhuming is essentially a part of the unique lifestyle of the tribals and the only source of their livelihood. A check upon it is likely to cause socio-cultural trauma. Others hold the view that the devastating consequences are too obvious for anybody not to act against this system (Bhowmik, 1976).

For regenerating jhum lands, terrace farming (*e.g.*, in Meghalaya), plantation programmes including rubber, cardamom and coffee (in Assam), community orchards, pisciculture, weaving (in Tripura) and bamboo plantation with pulp processing units (in Tripura) are some attractive programmes that have been devised to check the menace of jhum. Integration of production, processing, marketing, and transport and material management is called for to make possible the replication of technologies. Organisational research for the transfer of technology is another important aspect meriting consideration (Gupta and Sambrani, 1978). Diversity in the agro-economic profile of jhumias in all the six States (Sain, 1978; Saikia *et al.*, 1978) precludes the feasibility of any single remedy for the entire region. Depending upon the common tribal factors and agro-climatic conditions, the economic feasibility of an activity-mix constituting terracing, orchard plantations, forestry and forest based industries has to be tried. In areas where jhuming may have to be continued as the best available economic opportunity, optimum 'jhum-cycles' have to develop. Further, the spatial determination of settlement of related industries has to be considered. Next, the programme has to be entrusted to a separate organisation especially endowed with manpower and infrastructural facilities for best results. Jhumia settlement has to be seen as one such strategy which strikes a balanced optimum between resources and the people.

VI

FORESTRY AND THE RURAL POOR

A sizable proportion of the population (50 per cent) living below the poverty line consists mainly of landless labour, poor artisans, small cultivators (with holdings less than 0.5 ha.) and the tribals inhabiting about 5,000 forest villages. Almost the entire population living below the poverty line depends directly or indirectly on the forests by virtue of their 'rights' and 'concession' for their fuel, medicine, fibre and other requirements, *e.g.*, 'tendu' and 'pattal' leaves, seeds for oil crushing, small timber for making toys and furniture, bamboos for basket making, fodder, roots and fruits for consumption. The sizable increase in demand by their growing population has led to the gradual disappearance of small patches of forests from around the countryside in the last 2-3 decades. In fact, during the last 30 years, some 20 million ha. of such patches of forests have been lost. It has, in turn, added to the miseries of the rural poor by the loss of remunerative resources and productive employment. Consequently, these hopeless children of the forests have been subjected to exploitation by the small, medium and large farmers. Actually, much of the complementarity and bargaining position existing between the rural poor and the medium and large landowners has given way to exploitative linkage of the rural poor with forest contractors, on the one hand, and settled farm population, on the other.

Economic research delving into the realistic subsistence relationship of the rural poor with forestry to arrive at optimum balance between commercial-subsistence interests of forestry management on regional and location-specific bases is required. There is an abundant availability of manpower with reference to the availability of people who have had a history of symbiotic relationship with forests. The forward and backward linkages to revive forest patches on the medium and large farms need to be worked out.

In some regions the situation has resulted into forest agitations (Bhushan, 1987). The forest agitations have traditionally been against the commercialisation of forest resources which were hitherto freely available. Major conflicts have emerged between the masses of rural poor dependent on forest produce and the increasing commercial interests in Bastar (Madhya Pradesh), Jharkhand (Bihar), Karnataka, Maharashtra and Orissa. Recent repeated incidences of devastating fires in wildlife sanctuaries of Rajasthan are also manifestation of curbing the grazing rights of the animals of the villages settled on the outskirts of these areas. There is an urgent need for socio-economic investigations on all these aspects.

VII

TREES VS. CROPS

Barring exceptional irrationalities, the extent of scarcity of a resource would, in general, determine its allocation under competitive alternatives. With increasing pressure of population on the land, the land has become increasingly scarce. A simplistic text-book situation would thus call for comparison of marginal value productivities of the competitive usages. However, the land resource base at the national level cannot be aggregately and spatially uniform. Thus almost all degenerated land forms would have to be employed to lighter intensity usage as against arable, fertile crop lands that would be allocated for annual cash crops.

Other than fertility, managerial considerations also determine land use. Farmers who are not able to intensively manage their lands by human labour and material inputs may allocate most or all their lands for farm forestry requiring a much low level of management.

Additionally, price parity ratio and subsidisation of a forestry enterprise may discourage a Punjabi farmer to allocate even his alluvial, irrigated crop land in favour of annual crops.

Available researches on the comparative economics of allocation of tree or annual crops on homogeneous land indicate (Gupta and Mohan, 1979) that when cash crops are included, the allocation may overwhelmingly be in favour of crops rather than trees, but with the crops giving low returns, *e.g.*, *ragi* or bajra in drylands, the choice inevitably goes in favour of trees. The recent trends of allocating crop lands in Punjab, Haryana, Karnataka and other States in favour of trees indicate that many factors like land tenure, price parity ratios, industrial pressures may exert undue pressure on the choice of crop lands and in the process may create scarcity conditions in staple food. No study has been conducted which would determine the pay-offs of allocating choice crop lands for alternative tree and crop enterprise-mix. Similarly, employment and distribution effects in villages incidental to such changes need to be studied in detail. The determinants which encourage allocation of marginal lands in favour of crops also need to be studied. Finally, the policy of mixing two crop enterprises under monetarily and fiscally favourable environments need to be studied under different farm conditions in different States. In the States of Gujarat, Karnataka, Tamil Nadu and Uttar Pradesh, about 17.5 per cent of the fallow lands and 17.5 per cent of the cropped lands have been put under afforestation, mainly eucalyptus, casuarina, subabul and *Prosopis juliflora* (Rai, 1988). Systematic studies on the net economic effect of afforestation against the traditional crops under land type, tenure type, natural factors and other socio-economic considerations are warranted before advocating such competitive allocation.

VII

ISSUES IN FORESTRY ECONOMICS RESEARCH

Research in forestry deserves a more sound statistical basis to be able to contribute significantly towards increasing the forest production. Methodologies of surveys should be standardised to generate reliable forest product inventories that may help in generating viability. For, the forest management strategies and realistic working plans prepared on scientifically generated data would be conditioned by the sampling techniques. There is a need for evolving sampling techniques for estimation of minor forest products more efficiently. For the purpose, pilot sample surveys could be undertaken in order to evolve suitable sampling techniques for Statewise (individually or combined) estimation of economically important forest products. Efficiency and suitability of different techniques can be compared on the basis of accuracy achieved.

Improvement upon the existing estimation procedures can also be done. Forest growth modelling and preparation of reliable yield tables need to be undertaken.

Technical

There is a need for continuous experimentation with domestic and foreign plant material suitable for each agro-climatic region, land resource base and for each type of afforestation programme. Thus a technique of identifying plant material with a package of technology needs to be developed separately for production forestry on lands under different managerial systems. Similarly, the production forestry and social forestry need to be enriched by techniques which lead to economically optimum management of both types of forests. Further, plant breeding and genetic advances, especially methods of asexual propagation need to be incorporated into the National Forestry Development Programme. Researches pertaining to tree density per unit of land, felling cycles, harvesting of produce, spatial planning, reboisement and coppicing behaviour and processing methods need to be economically evaluated for scientific management which would hopefully enhance the productivity of all forms of lands allocated to the natural as well as man-made afforestation.

Socio-Technical

Fencing is one of the most important elements of afforestation technology. Afforestation technology relies heavily on fencing the area to protect the biomass from biotic interferences. This brings confrontation between the management and people. Fencing has thus come to be hated and loathed by the rural population who depend on forests for their livelihood. To the rural poor fencing also represents a cruel authority which has usurped 'their' land. An experience of CAZRI, Jodhpur is an interesting pointer to this phenomenon. When the Institute was set up, about 54 areas varying in size from 100 to 700 ha. were taken from the Revenue Department for development of grasslands and afforestation under varying agro-climatic situations. After their complete development, when these areas were handed over to either the Panchayats or Revenue Department, the first casualty were the four strands of barbed wire fence in all these areas. The second casualty was of course the bio-mass. These areas now have regained their old status of barren wastes. Research efforts in the determinants of such hostile attitude towards fencing need to be intensified. Further, the aspect of 'social' and 'live' or 'green' fencing with people's participation in regulation and not the prohibition of bio-mass utilisation needs to be examined with all the attendant socio-economic variants.

Economic

At the macro level, there is an urgent need to quantify the trade-offs over time between domestic production and imports, substitution of forestry products by non-forestry materials, and forward and backward linkages of forestry with both farm and non-farm sectors of the economy. Further, the employment potential of the forestry needs to be systematically examined in greater detail. The micro level issues of the afforestation programmes in relation to their scale-neutrality, distributive capacity of monetary and non-monetary gains, economic viability of forestry component in farming system, extent of economic stability provided by forestry components under stress period, and constraints of marketing of produce by individuals or groups also need to be carefully studied.

Organisational

Every techno-economic analysis of forestry enterprise-mix presupposes an organisational milieu which is uniformly ever responsive to all the technology related to afforestation. Thus despite the highest IRRs and most favourable appraisal attributes when the technologies do not descend to the ground from the protective altars of lab-farms, a plethora of plausible and non-plausible reasons are attributed, without assessing the relationship between productivity and managerial system. Thus for a similar afforestation programme managed by a Forest Corporation, a State Government, Panchayats, NGOs or a Religious Trust, their productivity performances might vary. Much more information on the economic analysis of afforestation needs to be generated under different organisations. There is need to basically identify the existing forest management systems, *viz.*, Government-sponsored, common property, philanthropic, socio-religious and voluntary agencies in the country (Shankarnarayan and Kalla, 1985). Research on identification of existing land management systems with all their ramifications for production as well as social forestry programmes should be carried out intensively. Such research efforts would bring out the socio-economic constraints of adoption of afforestation technologies under varying organisational environments and in the process help strengthen the effective implementation of such programme. At present there is virtually a complete gap in the knowledge of a technology's survival under differing organisational environments.

Available evidence (Shankarnarayan and Kalla, 1985) points out that while the Government-sponsored traditional forest land management system has been the only visible form of system, it is characterised by low outturn-cost ratio, increased incidence of encroachment, unchecked grazing of animal, vandalism with connivance of forest official and lax legal procedures leading to almost no punishment of the offender. Available evidence also suggests that given the right kind of incentives and guidance (Chowdhury, 1988), there is a hope of evolving a Co-operative Land Management system with the people's participation. Certain success stories of this type of model have been reported in the States of India but their replicability in different agro-climatic zones need to be examined.

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