

Incentive mechanism for preventing deforestation and promoting conservation of forest ecosystem

Indrani Chandrasekharan*, R. Sendhil Kumar, M. Ravindranath and D. J. Kushwah

Normal Central Assistance and Additional Central Assistance (ACA) are devolved by the Planning Commission to assist the State Governments in specific areas. The present paper details an incentive mechanism for preventing deforestation and promoting conservation of forest ecosystems. A number of options to provide support to the states with vast tracts of forest cover above national average (NA) are discussed. A recommendation to consider excess dense forest cover above NA and devolving funds (Rs 10,000/ha) for management is recommended after discussions with experts. The suggestion could form the basis for an ACA package to the states to enable protection of forests.

Keywords: Deforestation, forest cover, incentive, tree cover, wastelands.

FORESTS provide timber, fuel wood, fodder, and a wide range of non-timber products. They are a source of natural habitat for biodiversity and repository of genetic wealth and provide means for recreation and opportunity for ecotourism. In addition, forests help in watershed development, regulate water regime, conserve soil and control floods. They contribute to the process of carbon sequestration and act as carbon sink, by reducing greenhouse gases (GHGs) and in turn global warming. In ecologically sensitive areas like mountains as well as river catchments forests play an important role in prevention of floods, landslides, etc. Degradation of forest resources has a detrimental effect on soil, water and climate, which in turn affects human and animal life.

Indian forests account for 677,088 sq. km, i.e. nearly 20.6% of the total geographical area (GA) of the country. Of this 54,569 sq. km (1.66%) is very dense forest (canopy cover more than 70%), 332,647 sq. km (10.12%) is moderately dense forest (canopy cover between 40% and 70%), while 289,872 sq. km (8.82%) is open forest cover (FC) (canopy cover between 10% and 40%) and scrub (less than 10%) accounts for 38,475 sq. km (1.17%) (ref. 1).

Madhya Pradesh with 76,013 sq. km of forests accounts for the largest area under FC, constituting nearly 11.23% of the total forest in the country and 24.66% of the state's GA. Arunachal Pradesh, Chattisgarh and Kerala have 2.55%, 4.11% and 1.18% of the country's GA while accounting for 10.01%, 8.25% and 2.3% respectively of

the FC. On the other hand, states like Rajasthan, Punjab, Haryana, Bihar, Uttar Pradesh and Gujarat put together account for 7.8% of the country's forests while covering 29.4% of GA. Arunachal Pradesh, Madhya Pradesh, Maharashtra and Uttarakhand account for nearly 56.52% of the dense FC in the country (Table 1).

The Tenth Five Year Plan² proposed raising the forest and tree cover of the country to 25% in 2007 and 30% by 2012. The 33% forest and tree cover would require an additional area of over 23 MHa to be brought under FC.

Some of the states have raised the issue of compensation for maintaining FC at levels higher than national average (NA) (20.6%). It is alleged that this is adversely affecting the development activity of the states that have minimal FC.

It is recognized that there is a need for appropriate valuation of forests to account for the benefits and costs while considering the requests. However, the issue has wider implications than just the valuation of forests.

Globally, governments support conservation and maintenance of forests. Subsidy for forest maintenance in Switzerland and US, subsidy for forestry in Sweden and UK, subsidy/compensation for forest conservation in Finland and subsidies for forest development, forest based resource, reforestation, etc. in Canada, are some forms of government support rendered for maintaining and conserving FC. These to some extent are based on income foregone, cost incurred on maintenance and implementation of sustainable management practices for production of forest produce.

A paper entitled 'Compensation for forest ecological services in China' advocates incentives considering that the said state/area renders an ecological service to the nation³.

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Table 1. Status of forest, tree and mangrove cover

State/Union Territories	Geographic area (sq. km)	Forest cover (sq. km)					Mangrove cover	Tree cover	TCFCM	% TCFCM state's geographic area
		Very dense forest	Moderately dense forest	Open forest	% TFC of country	% DFC (11.78)				
Andhra Pradesh	275,069	130	24,199	20,043	6.55	6.28	329	7,640	52,341	19.03
Arunachal Pradesh	83,743	14,411	37,977	15,389	10.01	13.53	—	446	68,223	81.47
Assam	78,438	1,444	11,387	14,814	4.08	3.31	—	1,484	29,129	37.14
Bihar	94,163	110	3,004	2,465	0.82	0.80	—	2,522	8,101	8.6
Chhattisgarh	135,191	2,256	36,472	17,135	8.25	10.00	—	4,492	60,355	44.64
Delhi	1,483	0	54	122	0.02	0.01	—	107	283	19.08
Goa	3,702	55	1,095	1,014	0.32	0.30	16	268	2,448	66.12
Gujarat	196,022	114	6,024	8,577	2.17	1.59	936	7,621	23,272	11.87
Haryana	44,212	3	523	1,061	0.23	0.14	—	1,565	3,152	7.13
Himachal Pradesh	55,673	1,097	7,831	5,441	2.12	2.31	—	709	15,078	27.08
Jammu and Kashmir	222,236	2,135	8,394	10,744	3.14	2.72	—	5,633	26,906	12.11
Jharkhand	79,714	2,544	9,078	10,969	3.34	3.00	—	3,080	25,671	32.2
Karnataka	191,791	464	21,634	13,153	5.21	5.71	3	5,467	40,721	21.23
Kerala	38,863	1,024	8,636	5,935	2.30	2.49	8	2,632	18,235	46.92
Madhya Pradesh	3,08,245	4,239	36,843	34,931	11.23	10.61	—	6,267	82,280	26.69
Maharashtra	3,07,713	8,191	20,193	19,092	7.01	7.33	158	8,978	56,612	18.4
Manipur	22,327	923	5,541	10,622	2.52	1.67	—	142	17,228	77.16
Meghalaya	22,429	338	6,808	9,842	2.51	1.85	—	405	17,393	77.55
Mizoram	21,081	133	6,173	12,378	2.76	1.63	—	122	18,806	89.2
Nagaland	16,579	236	5,602	7,881	2.03	1.56	—	238	13,957	84.18
Orissa	1,55,707	538	27,656	20,180	7.14	7.28	203	4,589	53,166	34.14
Punjab	50,362	0	723	835	0.23	0.19	—	1,823	3,381	6.71
Rajasthan	3,42,239	14	4,456	11,380	2.34	1.15	—	8,379	24,229	7.08
Sikkim	7,096	498	1,912	852	0.48	0.62	—	27	3,289	46.35
Tamil Nadu	1,30,058	2,650	9,790	10,604	3.40	3.21	35	5,621	28,700	22.07
Tripura	10,486	61	4,969	3,125	1.20	1.30	—	134	8,289	79.04
Uttar Pradesh	2,40,928	1,297	4,682	8,148	2.09	1.54	—	8,203	22,330	9.27
Uttarakhand	53,483	4,002	14,396	6,044	3.61	4.75	—	658	25,100	46.93
West Bengal	88,752	2,302	3,777	6,334	1.83	1.57	2118	2,269	16,800	18.93
Andaman and Nicobar	8,249	3,359	2,646	624	0.98	1.55	637	53	7,319	88.72
Chandigarh	114	1	8	6	0.00	0.00	—	9	24	21.05
Dadra and Nagar Haveli	491	0	130	91	0.03	0.03	—	28	249	50.71
Daman and Diu	112	0	2	6	0.00	0.00	1	9	18	16.07
Lakshadweep	32	0	15	10	0.00	0.00	—	4	29	90.62
Puducherry	480	0	17	25	0.01	0.00	1	42	85	17.71
Total	3,287,263	54,569	332,647	289,872	—	—	4445	91,663	773,196	—

The Supreme Court of India in a judgement dated 26 September 2005 in WP 202/1995 directed estimating net present value (NPV), for compensating states having FC above NA. It needs to be mentioned that several states like Madhya Pradesh, Chattisgarh, Bihar charge NPV from user groups which clear forests for alternate uses at of Rs 0.58–0.92 million/ha depending on the quantity and density of the forest land converted.

The President of India had also mooted the idea of 'forest credit'⁴. According to the report of the working group⁵ on forests, 270 MT of fuel wood, 280 MT of fodder and over 12 million cubic metre of timber and countless non-timber forest produce are removed from forests

annually; the total revenue per annum is estimated at Rs 275,000 million.

A study in 2000 (ref. 6), which examined the contribution of forests of Himachal Pradesh in sustaining livelihood of rural population, suggested that the annual indirect benefits far exceed the direct benefits of forests.

According to the National Forest Commission Report⁷, forests are a national wealth and their protection and maintenance should be viewed in that light and therefore compensation for maintaining higher forests area cannot be justified. Further it is suggested that India could learn from Brazil and consider levying an ecological value added tax to compensate for the loss of revenue to those

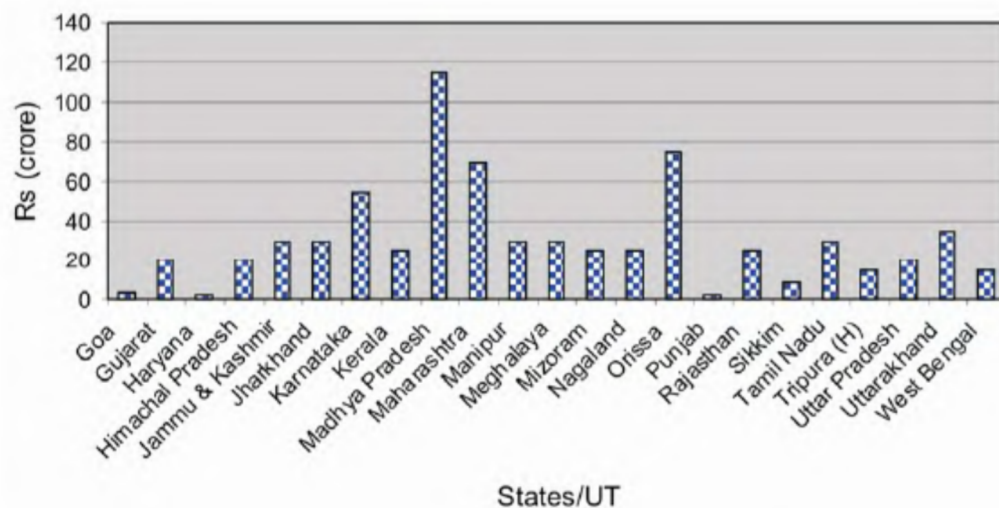


Figure 1. Grants-in-aid for maintenance of forests – 12th Finance Commission.

Indian states which have done a good job of protecting their forests.

In addition to support for afforestation under various centrally sponsored schemes, the 12th Finance Commission has also devolved Rs 10,000 million to states (Figure 1) based on percentage of FC held.

The 13th Finance Commission can also be requested to devolve Rs 30,000 million for this purpose which is of the order of Rs 4000 million every year to the states.

In order to address the concerns and possibly provide incentives to states to preserve and raise FC and tree cover, a simple criterion of distribution was proposed in the working paper of the Planning Commission (PC) on 'Towards economic approach to sustainable forest development'⁸. Essentially, the criterion is based on four parameters, viz. FC in 2001, the wastelands available, total GA and the population of the state in 2001. The paper has developed an index as follows:

$$I_i = \{(f/g) \times 0.5 + (w/g) \times 0.25 + (p) \times 0.25\}.$$

The index has been normalized to 100.

F_i is the FC and tree cover in state, i the total forest area in country; W_i the potentially convertible wasteland in state, i the total potentially convertible wasteland in country; G_i the geographical area in state, i the total geographical area in the country; P_i the population in state, i the total population in the country and taking; $f = F_i$, $w = W_i$, $g = G_i$ and $p = P_i$.

In this article, a methodology to provide incentives to states holding and maintaining large tracts of FC above the NA has been worked out. The FC in excess of the NA of 20.6% held by states and the area required to be afforested by states to achieve the NA is indicated in Table 2. States/union territories, viz. Madhya Pradesh,

Arunachal Pradesh, Andaman and Nicobar have 60.33%, 4.06% and 59.76% respectively of FC in excess of NA. As can be seen from Table 2, 19 states have FC in excess of the NA of which 9 are hill states and 10 belong to the plains. Arunachal Pradesh has the highest excess FC of 50,522 sq. km. While Lakshadweep has the lowest of 18 sq. km. The total excess FC works out to 21.27 Mha belonging to 19 states which qualify for incentives. The 16 states with below NA FC will have to afforest 21.80 Mha to achieve the NA; of which Rajasthan requires to afforest the highest of 0.55 Mha to achieve the NA.

The national dense forest coverage is 11.78% of the national GA. 13.59 Mha under dense forest cover (DFC) qualifies for incentive spread over 19 states. The largest tract of FC is in the states of Arunachal Pradesh and Chhattisgarh followed by Uttarakhand (Table 3).

The total tree, forest and mangrove (TCFCM) cover of the country is 77.32 Mha. In terms of percentage of TCFCM, Madhya Pradesh continues to have the largest tract, accounting for 10.64% of the TCFCM of the country followed by Arunachal Pradesh and Chhattisgarh. Tree cover and mangrove (TC&M) comprises 2.92% national GA. The excess TCFCM cover and area required to be afforested by states taking into account tree cover and mangroves, if any, is in Table 3.

NPV of the excess FC held has been worked out based on average monies currently collected by states, i.e. Rs 3 lakh/ha and the said amount is considered to be held under fixed deposit at the prevailing interest rates (8%) and the interest accruing calculated as available to be disbursed as incentive to the State Forest Department. Incentives to states have been calculated on the current excess FC (Table 3), excess DFC and excess TCFCM cover held (Table 4) by states. Based on accepted norms of

Table 2. Forest cover (FC), dense forest cover (DFC) and tree, forest and mangrove cover (TCFCM) qualifying for incentives

State/UT	Geographic Area (GA) (sq. km)	Total FC	FC as % GA state	% Difference with NA FC (20.6)	Area FC qualified for incentive	DFC	% DFC	NDFC (11.78%) DFC %	Area qualified for incentive	TC + FC + mangrove	% TCFCM SGA	TCFCM (23.52%) TCFCM %	TCFCM (excess) eligible for incentive
Andhra Pradesh	275,069	44,372	16.13	-4.47	-	24,329	0.85	-2.93	0	52,341	19.03	-4.42	0
Arunachal Pradesh	83,743	67,777	80.93	60.33	50,522	52,388	62.56	50.78	42,525	68,223	81.47	57.95	48,529
Assam	78,438	27,645	35.24	14.64	11,483	12,831	16.36	4.58	3,593	29,129	37.14	13.62	10,683
Bihar	94,163	5,579	5.92	-14.68	-	3,114	3.3	-8.48	0	8,101	8.6	-14.92	0
Chhattisgarh	135,191	55,863	41.32	20.72	28,012	38,728	28.65	16.87	22,807	60,355	44.64	21.12	28,552
Delhi	1,483	176	11.87	-8.73	-	54	3.64	-8.14	0	283	19.08	-4.44	0
Goa	3,702	2,164	58.45	37.85	1,401	1,150	31.06	19.28	714	2,448	66.12	42.6	1,577
Gujarat	196,022	14,715	7.51	-13.09	-	6,138	3.13	-8.65	0	23,272	11.87	-11.65	0
Haryana	44,212	1,587	3.59	-17.01	-	526	1.19	-10.59	0	3,152	7.13	-16.39	0
Himachal Pradesh	55,673	14,369	25.81	5.21	2,901	8,928	16.04	4.26	2,372	15,078	27.08	3.56	1,982
Jammu and Kashmir	222,236	21,273	9.57	-11.03	-	10,529	4.74	-7.04	0	26,906	12.11	-11.41	0
Jharkhand	79,714	22,591	28.34	7.74	6,170	11,622	14.58	2.8	2,232	25,671	32.2	8.68	6,919
Karnataka	191,791	35,251	18.38	-2.22	-	22,098	11.52	-0.26	0	40,721	21.23	-2.29	0
Kerala	38,863	15,595	40.13	19.53	7,590	9,660	24.86	13.08	5,083	18,235	46.92	26.4	10,260
Madhya Pradesh	308,245	76,013	24.66	4.06	12,515	41,082	13.33	1.55	4,504	82,280	26.69	3.17	9,771
Maharashtra	307,713	47,476	15.43	-5.17	-	28,384	9.22	-2.56	0	56,612	18.4	-5.12	0
Manipur	22,427	17,086	76.53	55.93	12,487	6,464	28.95	17.17	3,834	17,228	77.16	53.64	11,976
Meghalaya	22,429	16,988	75.74	55.14	12,367	7,146	31.86	20.08	4,504	17,393	77.55	54.03	12,118
Mizoram	21,081	18,684	88.63	68.03	14,341	6,306	29.91	18.13	3,822	18,806	89.2	65.68	13,845
Nagaland	16,579	13,719	82.75	62.15	10,304	5,838	55.21	43.43	7,200	13,957	84.18	60.66	10,057
Orissa	155,707	48,374	31.07	10.47	16,303	28,194	18.11	6.33	9,856	53,166	34.14	10.62	16,536
Punjab	50,362	1,558	3.09	-17.51	-	723	1.43	-10.35	0	3,381	6.71	-16.81	0
Rajasthan	342,239	15,850	4.63	-15.97	-	4,470	1.3	-10.48	0	24,229	7.08	-16.44	0
Sikkim	7,096	3,262	45.97	25.37	1,800	2,410	33.96	22.18	1,574	3,289	46.35	22.83	1,620
Tamil Nadu	130,058	23,044	17.72	-2.88	-	12,440	9.57	-2.21	0	28,700	22.07	-1.45	0
Tripura	10,486	8,155	77.77	57.17	5,995	5,030	47.94	36.16	3,792	8,289	79.04	55.52	5,822
Uttar Pradesh	240,928	14,127	5.86	-13.76	-	5,979	2.48	-9.3	0	22,330	9.27	-14.25	0
Uttarakhand	53,483	24,442	45.7	25.1	13,424	18,398	34.4	22.62	12,098	25,100	46.93	23.41	12,520
West Bengal	88,752	12,413	13.99	-6.61	-	6,079	6.85	-4.93	0	16,800	18.93	-4.59	0
Andaman and Nicobar	8,249	6,629	80.36	59.76	4,930	6,005	72.8	61.02	5,034	7,319	88.72	65.2	5,378
Chandigarh	114	15	13.16	-7.44	-	9	7.9	-3.88	0	24	21.05	-2.47	0
Dadra and Nagar Haveli	491	221	45.01	24.41	120	130	26.48	14.7	72	249	50.71	27.19	104
Daman and Diu	112	8	7.14	-13.46	-	2	1.98	-9.8	0	18	16.07	-7.45	0
Lakshadweep	32	25	78.13	57.53	18	15	46.88	35.1	11	29	90.62	67.1	21
Puducherry	480	42	8.75	-11.85	-	17	3.46	-8.32	0	85	17.71	-5.81	0
Total	3,287,263	677,088	-	-	212,683	54,569	-	-	135,901	773,196	-	-	208,270

Table 3. Incentive for excess forest cover – statewide (options – 1 and 2)

State/UT	Geographic area (sq. km)	Total FC	FC % of state GA	% FC-NA FC (20.6)	FC (excess) eligible for incentive		8% NPV (Rs 0.3 million/ha)	Management including maintenance @ Rs 10,000/ha	FC (excess) eligible for incentive under option-2	8% NPV (Rs 0.3 million/ha)	Management including maintenance @ Rs 10,000/ha
					under option-1	under option-2					
Andhra Pradesh	275,069	44,372	16.13	-4.47	-	-	-	-	-	-	-
Arunachal Pradesh	83,743	67,777	80.93	60.33	50,522	26,928	121,250	50,520	26,928	64,630	26,930
Assam	78,438	27,645	35.24	14.64	11,483	11,483	27,560	11,480	11,483	27,560	11,480
Bihar	94,163	5,579	5.92	-14.68	-	-	-	-	-	-	-
Chhattisgarh	135,191	55,863	41.32	20.72	28,012	28,012	67,230	28,010	28,012	67,230	28,010
Delhi	1,483	176	11.87	-8.73	-	-	-	-	-	-	-
Goa	3,702	2,164	58.45	37.85	1,401	1,401	3,360	1,400	1,401	3,360	1,400
Gujarat	196,022	14,715	7.51	-13.09	-	-	-	-	-	-	-
Haryana	44,212	1,587	3.59	-17.01	-	-	-	-	-	-	-
Himachal Pradesh	55,673	14,369	25.81	5.21	2,901	2,901	6,960	2,900	-	-	-
Jammu and Kashmir	222,236	21,273	9.57	-11.03	-	-	-	-	-	-	-
Jharkhand	79,714	22,591	28.34	7.74	6,170	6,170	14,810	6,170	-	-	-
Karnataka	191,791	35,251	18.38	-2.22	-	-	-	-	-	-	-
Kerala	38,863	15,595	40.13	19.53	7,590	7,590	18,220	7,590	7,590	18,220	7,590
Madhya Pradesh	308,245	76,013	24.66	4.06	12,515	12,515	30,040	12,510	12,515	30,040	12,510
Maharashtra	307,713	47,476	15.43	-5.17	-	-	-	-	-	-	-
Manipur	22,327	17,086	76.53	55.93	12,487	12,487	29,970	12,490	6,036	14,490	6,040
Meghalaya	22,429	16,988	75.74	55.14	12,367	12,367	29,680	12,370	5,868	14,080	1,410
Mizoram	21,081	18,684	88.63	68.03	14,341	14,341	34,420	14,340	8,862	21,270	2,130
Nagaland	16,579	13,719	82.75	62.15	10,304	10,304	24,730	10,300	5,700	13,680	1,370
Orissa	155,707	48,374	31.07	10.47	16,303	16,303	39,130	16,300	16,303	39,130	16,300
Punjab	50,362	1,558	3.09	-17.51	-	-	-	-	-	-	-
Rajasthan	342,239	15,850	4.63	-15.97	-	-	-	-	-	-	-
Sikkim	7,096	3,262	45.97	25.37	1,800	1,800	4,320	1,800	156	370	40
Tamil Nadu	130,058	23,044	17.72	-2.88	-	-	-	-	-	-	-
Tripura	10,486	8,155	77.77	57.17	5,995	5,995	14,390	5,990	2,982	7,160	720
Uttar Pradesh	240,928	14,127	5.86	-13.76	-	-	-	-	-	-	-
Uttarakhand	53,483	24,442	45.7	25.1	13,424	13,424	32,220	13,420	1,100	2,640	260
West Bengal	88,752	12,413	13.99	-6.61	-	-	-	-	-	-	-
Andaman and Nicobar	8,249	6,629	80.36	59.76	4,930	4,930	11,830	4,930	2,592	6,220	620
Chandigarh	114	15	13.16	-7.44	-	-	-	-	-	-	-
Dadra and Nagar Haveli	491	221	45.01	24.41	120	120	290	120	120	290	120
Daman and Diu	112	8	7.14	-13.46	-	-	-	-	-	-	-
Lakshadweep	32	25	78.13	57.53	18	18	40	20	18	40	20
Puducherry	480	42	8.75	-11.85	-	-	-	-	-	-	-
Total	3,287,263	677,088	-	-	212,683	112,456	510,450	212,660	112,456	330,410	116,950

Table 4. Incentive for excess dense forest cover – statewise (options 1 and 2)

State/UT	Geographic area (sq. km)	Total DFC	% DFC SGA	% DFC-NA/DFC (11.78%)	DFC (excess)		8% NPV (Rs 0.3 million/ha)	Management including maintenance @ Rs 10,000/ha	(Area in sq. km) (Rs in million)	
					DFC eligible for incentive under option-1	DFC-NA 23.56% for hills			8% NPV (Rs 0.3 million/ha)	Management including maintenance @ Rs 10,000/ha
Andhra Pradesh	275,069	24,329	8.85	-2.93	0	-2.93	0	0	0	0
Arunachal Pradesh	83,743	52,388	62.56	50.78	42,525	39.00	20,431	42,520	49,030	20,430
Assam	78,438	12,831	16.36	4.58	3,592	4.58	3,592	3,590	8,620	3,590
Bihar	94,163	3,114	3.31	-8.47	0	-8.47	0	0	0	0
Chhattisgarh	135,191	38,728	28.65	16.87	22,807	16.87	22,807	22,800	54,740	22,800
Delhi	1,483	54	3.64	-8.14	0	-8.14	0	0	0	0
Goa	3,702	1,150	31.06	19.28	714	19.28	714	710	1,710	710
Gujarat	196,022	6,138	8.31	-3.47	0	-3.47	0	0	0	0
Haryana	44,212	526	1.19	-10.59	0	-10.59	0	0	0	0
Himachal Pradesh	55,673	8,928	16.03	4.25	2,409	-7.53	0	2,400	0	0
Jammu and Kashmir	222,236	10,529	4.74	-7.04	0	-7.04	0	0	0	0
Jharkhand	79,714	11,622	14.58	2.8	2,232	-8.98	0	2,230	0	0
Karnataka	191,791	22,098	11.52	-0.26	0	-0.26	0	0	0	0
Kerala	38,863	9,660	24.86	13.08	5,083	13.08	5,083	5,080	12,200	5,080
Madhya Pradesh	308,245	41,082	13.33	1.55	4,778	1.55	4,778	4,770	11,470	4,770
Maharashtra	307,713	28,384	9.22	-2.56	0	-2.56	0	0	0	0
Manipur	22,327	6,464	28.95	17.17	3,834	4.39	284	3,830	680	280
Meghalaya	22,429	7,146	31.86	20.08	4,504	8.30	593	4,500	1,420	590
Mizoram	21,081	6,306	29.91	18.13	3,822	6.35	400	3,820	960	400
Nagaland	16,579	5,838	35.21	23.43	3,885	11.65	680	3,880	1,630	680
Orissa	155,707	28,194	18.1	6.32	9,841	6.32	9,841	9,840	23,620	9,840
Punjab	50,362	723	1.44	-10.34	0	-10.34	0	0	0	0
Rajasthan	342,239	4,470	1.31	-10.47	0	-10.47	0	0	0	0
Sikkim	7,096	2,410	33.96	22.18	1,574	22.18	1,574	1,570	3,780	1,570
Tamil Nadu	130,058	12,440	9.56	-2.22	0	-2.22	0	0	0	0
Tripura	10,486	5,030	47.97	36.19	3,795	24.41	1,228	3,790	2,950	1,230
Uttar Pradesh	240,928	5,979	2.48	-9.3	0	-9.3	0	0	0	0
Uttarakhand	53,483	18,398	34.4	22.62	12,098	10.84	1,840	12,090	4,420	1,840
West Bengal	88,752	6,079	6.85	-4.93	0	-4.93	0	0	0	0
Andaman and Nicobar	8,249	6,005	72.8	61.02	5,034	61.02	5,034	5,030	12,080	5,030
Chandigarh	114	9	7.9	-3.88	0	-3.88	0	0	0	0
Dadra and Nagar Haveli	491	130	26.48	14.7	72	14.7	72	70	170	70
Daman and Diu	112	2	1.79	-9.99	0	-9.99	0	0	0	0
Lakshadweep	32	15	53.13	41.35	13	41.35	13	10	30	10
Puducherry	480	17	3.54	-8.24	0	-8.24	0	0	0	0
Total	3,287,263	387,216	—	—	132,612	—	78,964	132,530	189,510	78,960

Table 5. Incentive for excess tree, forest and mangrove (TCFCM) cover statewide

State/UT	Geographic area (sq. km)	TC + FC + Management	% TCFCM SGA	TCFCM (23.52%) – TCFCM %	TCFCM (excess) eligible for incentive	Deficit TCFCM to be afforested	8% NPV (Rs 0.3 million/ha)	Management including maintenance @ Rs 10,000/ha
Andhra Pradesh	275,069	52,341	19.03	-4.42	0	12,158	0	0
Arunachal Pradesh	83,743	68,223	81.47	57.95	48,529	0	11,647	4,852
Assam	78,438	29,129	37.14	13.62	10,683	0	2,564	1,068
Bihar	94,163	8,101	8.6	-14.92	0	14,049	–	–
Chhattisgarh	135,191	60,355	44.64	21.12	28,552	0	6,852	2,855
Delhi	1,483	283	19.08	-4.44	0	66	0	0
Goa	3,702	2,448	66.12	42.6	1,577	0	378	157
Gujarat	196,022	23,272	11.87	-11.65	0	22,837	0	0
Haryana	44,212	3,152	7.13	-16.39	0	7,246	0	0
Himachal Pradesh	55,673	15,078	27.08	3.56	1,982	0	476	198
Jammu and Kashmir	222,236	26,906	12.11	-11.41	0	25,357	0	0
Jharkhand	79,714	25,671	32.2	8.68	6,919	0	1,661	691
Karnataka	191,791	40,721	21.23	-2.29	0	4,392	0	0
Kerala	38,863	18,235	46.92	26.4	10,260	0	2,462	1,026
Madhya Pradesh	308,245	82,280	26.69	3.17	9,771	0	2,345	977
Maharashtra	307,713	56,612	18.4	-5.12	0	15,755	0	0
Manipur	22,327	17,228	77.16	53.64	11,976	0	2,874	1,197
Meghalaya	22,429	17,393	77.55	54.03	12,118	0	2,908	1,211
Mizoram	21,081	18,806	89.2	65.68	13,845	0	3,323	1,384
Nagaland	16,579	13,957	84.18	60.66	10,057	0	2,414	1,005
Orissa	155,707	53,166	34.14	10.62	16,536	0	3,969	1,653
Punjab	50,362	3,381	6.71	-16.81	0	8,466	0	0
Rajasthan	342,239	24,229	7.08	-16.44	0	56,264	0	0
Sikkim	7,096	3,289	46.35	22.83	1,620	0	389	162
Tamil Nadu	130,058	28,700	22.07	-1.45	0	1,886	0	0
Tripura	10,486	8,289	79.04	55.52	5,822	0	1,397	582
Uttar Pradesh	240,928	22,330	9.27	-14.25	0	34,332	0	0
Uttarakhand	53,483	25,100	46.93	23.41	12,520	0	3,005	1,252
West Bengal	88,752	16,800	18.93	-4.59	0	4,074	0	0
Andaman and Nicobar	8,249	7,319	88.72	65.2	5,378	0	1,291	537
Chandigarh	114	24	21.05	-2.47	0	3	0	0
Dadra and Nagar Haveli	491	249	50.71	27.19	104	0	25	10
Daman and Diu	112	18	16.07	-7.45	0	8	0	0
Lakshadweep	32	29	90.62	67.1	21	0	5	2
Puducherry	480	85	17.71	-5.81	0	28	0	0
Total	3,287,263	773,196			208,270	206,921	49,985	20,819

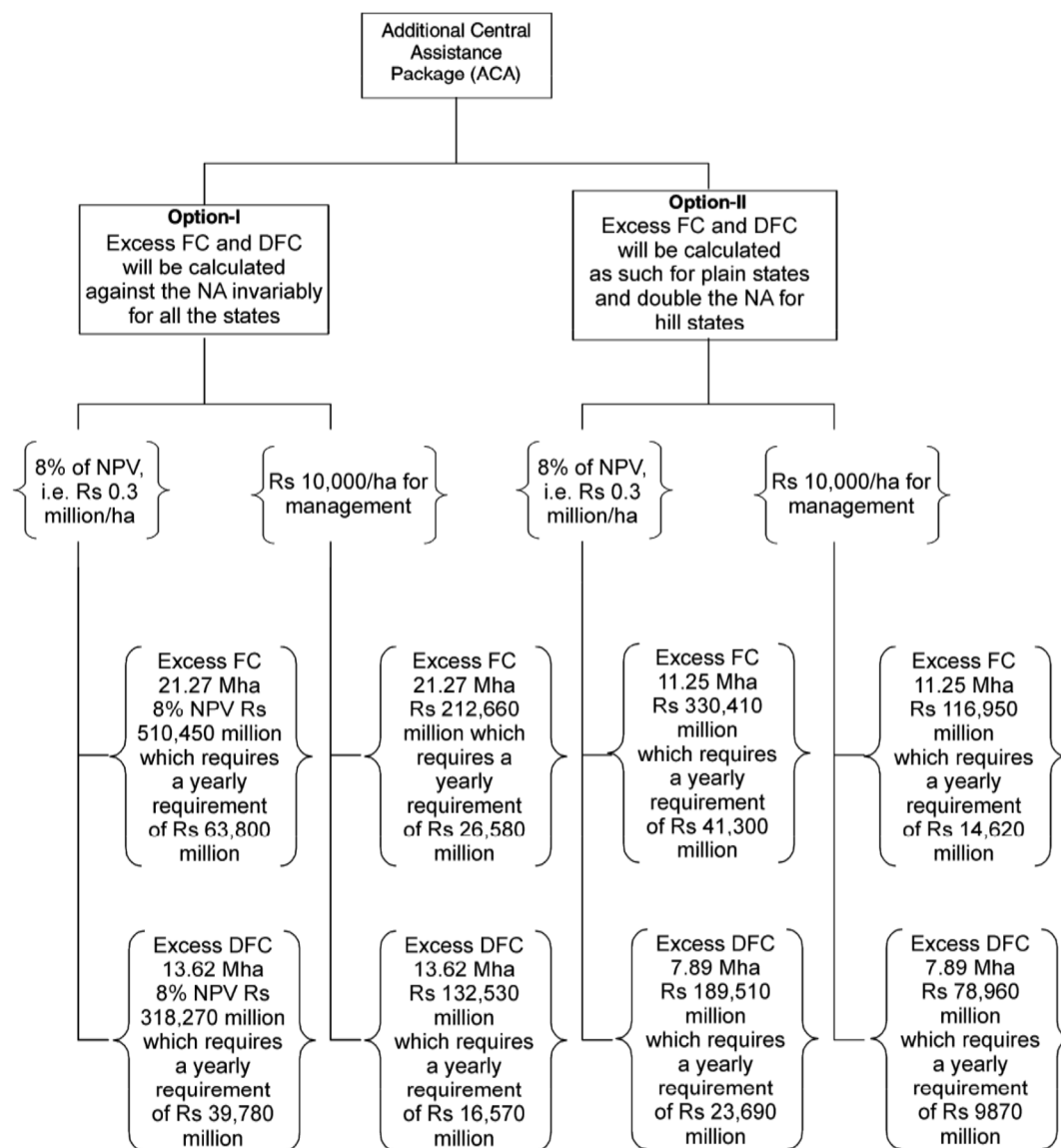


Figure 2. Additional central assistance package and options recommended.

afforestation, monies at Rs 10,000/ha for management including maintenance has also been worked out. Rs 510,440 million as interest on NPV and Rs 212,660 million for management including maintenance shall be required for providing incentive for excess FC. Rs 318,270 million and Rs 132,530 million are required respectively if DFC alone, i.e. 13.6 Mha is considered. Based on the incentive calculated for management of FC and DFC, Rs 26,580 million per year for FC and Rs 16,580 million for DFC will be required (Figure 2).

It is generally accepted that hilly states need to hold 60% FC to control soil erosion, landslide, etc. As a second option therefore, incentive for management alone was calculated by subtracting double the NA of FC and DFC held by hill states. Requirement of Rs 116,950

million for FC and Rs 78,960 million for DFC was thus arrived at. The yearly incentive package therefore works out to Rs 14,620 million for FC and Rs 9760 million for DFC (Table 4).

A sum of Rs 499,850 crore and 208,190 million respectively is required for increasing TCFCM cover by 20.69 Mha and Rs 526,060 million is estimated for afforestation and maintenance for a period of four years to afforest 21.04 Mha to equalize the FC to GA of country, held by the states.

In order to achieve the targeted 30% FC, it is suggested that the same percentage of FC of the GA of the country held by the states should be brought under FC to begin with or all states achieve the NA. A total area of 21.8 Mha shall thus become available to be brought under

Table 6. Statewise forest cover target for afforestation and waste land availability

(area in sq. km)

State/UT	Geographic area (sq. km)	Total FC	FC as % GA of state	Area to be afforested	To be afforested/ per year	Total WL	To be increased by the concerned states	Area lacking
Andhra Pradesh	275,069	44,372	16.13	12,296	1,537	45,267	4,331	
Arunachal Pradesh (H)	83,743	67,777	80.93	—	—	18,176	—	
Assam	78,438	27,645	35.24	—	—	14,034	—	
Bihar	94,163	5,579	5.92	13,823	1,728	5,448	11,264	–5,816
Chhattisgarh	135,191	55,863	41.32	—	—	7,584	—	
Delhi	1,483	176	11.87	129	16	—	56	
Goa	3,702	2,164	58.45	—	—	531	—	
Gujarat	196,022	14,715	7.51	25,659	3,207	20,378	17,082	
Haryana	44,212	1,587	3.59	7,520	940	3,266	5,989	–2,723
Himachal Pradesh (H)	55,673	14,369	25.81	—	—	28,337	—	
Jammu and Kashmir (H)	222,236	21,273	9.57	24,513	3,064	70,202	18,865	
Jharkhand (H)	79,714	22,591	28.34	—	—	11,165	—	
Karnataka	191,791	35,251	18.38	4,258	532	13,537	—	
Kerala	38,863	15,595	40.13	—	—	1,789	—	
Madhya Pradesh	308,245	76,013	24.66	—	—	57,134	—	
Maharashtra	307,713	47,476	15.43	15,909	1,989	49,275	6,763	
Manipur (H)	22,327	17,086	76.53	—	—	13,175	—	
Meghalaya (H)	22,429	16,988	75.74	—	—	3,411	—	
Mizoram (H)	21,081	18,684	88.63	—	—	4,470	—	
Nagaland (H)	16,579	13,719	82.75	—	—	3,709	—	
Orissa	155,707	48,374	31.07	—	—	18,953	—	
Punjab	50,362	1,558	3.09	8,818	1,102	1,173	6,978	–5,805
Rajasthan	342,239	15,850	4.63	54,656	6,832	101,454	46,256	
Sikkim (H)	7,096	3,262	45.97	—	—	3,808	—	
Tamil Nadu	130,058	23,044	17.72	3,746	468	17,303	—	
Tripura (H)	10,486	8,155	77.77	—	—	1,323	—	
Uttar Pradesh	240,928	14,127	5.86	33,152	4,144	16,984	27,301	–10,317
Uttarakhand (H)	53,483	24,442	45.7	—	—	16,097	—	
West Bengal	88,752	12,413	13.99	5,867	734	4,398	1,481	
Andaman and Nicobar	8,249	6,629	80.36	—	—	314	—	
Chandigarh	114	15	13.16	8	1	—	—	
Dadra and Nagar Haveli	491	221	45.01	—	—	—	—	
Daman and Diu	112	8	7.14	15	2	—	—	
Lakshadweep	32	25	78.13	—	—	—	—	
Puducherry	480	42	8.75	57	7	—	—	
Total	3,287,263	677,088	—	210,426	26,303	552,692	145,026	–24,661

H, Hill states.

FC in the first instance and 21.04 Mha in the second. If TCFCM is taken into account, then the required area shall be 20.69 Mha (Table 5). In order to achieve the 33% target (30% FC and 3% tree cover) by 2017, the area of land that needs to be brought under FC by every state and the area of land that has to be afforested every year for the eleventh and twelfth plans (next 8 years) are shown in Table 5.

The country has 55.27 Mha of waste land of which the largest tract is in Rajasthan with 10.14 Mha (Table 6). As per NRSA studies, waste land category 4, 5, 13 and 15 account for 10.14% of the total GA of the country which can be afforested, i.e. 33.4 Mha. The wasteland (cat. 4, 5, 13, 14 and 15 as per WALIS) available in the states for TCFCM cover far exceeds the land required of 20.69 Mha (Table 5). However the states of Uttar Pradesh, Punjab, Bihar and Haryana combined have a deficit of 24,661 sq. km or 2.4 Mha.

In order to achieve the 30% target of FC an additional sum of Rs 65,760 million every year over a period of 8 years (2009–17) will be required. According to the outlays for Eleventh Plan for wasteland development over Rs 170,000 million is earmarked for this purpose.

The central assistance being provided for afforestation currently by all departments of GOI is of the order of Rs 19,800 million and the percentage expenditure incurred by states on forests and wildlife, including plantation, wherever relevant during the Tenth Plan is Rs 81,713 million which is 1.38% of the state budget. Expenditure on forestry needs to be increased at least to 4% of the state budget.

An additional central assistance (ACA) package for FC either based on 8% interest on NPV or on the management cost of Rs 10,000/ha can be considered. This works out to over Rs 510,450 million and 212,660 million for management of FC, to be released over a period of

8 years, i.e. Rs 63,800 million/year for NPV and Rs 26,580 million for management. As regards the second option, Rs 330,410 million and Rs 116,950 million respectively shall be required for 8% NPV and management with yearly expenditure of Rs 41,300 million and 14,260 million.

The ACA package for DFC, of 8% of NPV or the management cost at Rs 10,000/ha of the excess DFC works out to Rs 318,270 million and 132,530 million and if released over a period of 8 years, than Rs 39,780 million and Rs 16,570 million every year. As regards the second option, it works out to Rs 189,510 million and Rs 78,960 million for 8% NPV and management and Rs 23,690 million and 98,700 million yearly.

Considering that the Rs 26,580 million for excess FC management required for the first option, every year may not be readily available, the planning commission may consider an ACA package of Rs 9870 million for management of DFC under the second option. Figure 2 indicates the various ACA packages discussed and highlights the options recommended.

Among the options discussed to enable providing support to the states, the suggestion to consider excess DFC above NA and providing Rs 10,000/ha as management charges is recommended. The suggestion could form the basis for the ACA of the states, to enable them to protect the state's FC.

1. State of Forest Report, Forest Survey of India, Ministry of Environment and Forests, Dehradun, India, 2005, p. 171.
2. Planning Commission, Tenth Five Year Plan 2002–07, Government of India, New Delhi, 2002.
3. Liu Can, Wang Sen, Zhang Wei and Liang Dan, Compensation for forest ecological services in China. *Forest. Stud. China*, 2007, **9**, 68–79.
4. A. P. J. Abdul Kalam's speech on the Silver Jubilee Celebrations of the Vivekananda Girijana Kalyana Kendra on 15th October 2006 at B.R. Hills in Karnataka.
5. Planning Commission, Report of the Working Group on Forests for the Eleventh Five Year Plan (2007–2012). Planning Commission, Government of India, New Delhi, 2007.
6. Verma Madhu, Economic valuation of forests of Himachal Pradesh. In *Himachal Pradesh Forest Sector Review*, International Institute for Environment and Development, London, 2000.
7. Report of the National Forest Commission, Government of India, Ministry of Environment and Forests, 2006, p. 421.
8. Archana S. Mathur and Arvinder S. Sachdeva, Towards Economic Approach to Sustainable Forest Development. Working Paper Series Paper No. 2/2003-PC, Perspective Planning Division, Planning Commission, Government of India, 2003.

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