REVISION OF RATES OF NPV APPLICABLE FOR DIFFERENT CLASS/CATEGORY OF FORESTS

(Draft Report after internalisation of stakeholders comments on the First Report of June 2013)

Centre for Ecological Services Management (CESM), Indian Institute of Forest Management (IIFM), Bhopal

in collaboration with

Forest Survey of India (FSI), Dehradun

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Revision of rates of NPV applicable for different class/category of forests

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Photo credits

Madhu Verma

Photo description *(clock-wise from top left):*

1. *Urban forests of Shimla;*
2. *Nathpa Jhakri Hydropower project;*
3. *Loktak lake and forest catchment of Keibul Lamjao National Park;*
4. *Submerged forests in Tawa reservoir;*
5. *Nohkalikai Fallsnear Cherrapunji;*
6. *Diamond mining near Panna National Park*

Disclaimer

The views expressed and any errors herein are entirely those of the lead and collaborating authors. The views as expressed do not necessarily reflect those of and cannot be attributed to the project advisors, contacted individuals, institutions and organizations involved. The information contained herein has been obtained from Forest Survey of India, discussions with stakeholders, a review of publications, deliberations of the workshops conducted and are to the best our knowledge accurate. Despite all precautions taken to accurately reflect the information that was collected for this report, any errors pointed out subsequently by any party cannot lead to any liability on the part of the authors. The contents of this report may be used by anyone providing proper acknowledgements.

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We express our sincere thanks to various organizations in reviewing our Draft Report of June 2013 which was uploaded on MoEFCC's website and providing their insights and comments. We are deeply indebted to Dr. V. Rajagopalan, Ex-Secretary, MoEFCC and Mr. Ashok Lavasa, Secretary, MoEFCC and various officials of MoEFCC who spared their precious time discussing these comments and giving their enriched inputs which greatly helped us in the internalisation of diverse comments and suggestions received from several organisations.

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In the end, we once again extend our heartfelt thanks to all individuals and their institutions who contributed their time and expertise in the realization of the objective of the study.

Bhopal, Dated 05th November 2014 **(Madhu Verma)** **(Dhaval Negandhi)**

FOREWORD

Forests provide numerous goods and services that support life. The importance of forests in a country such as ours is even more significant considering the large amount of marginalised communities that depend on forests. When a patch of forests is diverted for non-forestry purposes, its implications on human well-being are felt at various spatial and temporal scales on account of loss of goods and services that the patch of forests has provided. In addition, livelihoods and subsistence needs of rural and tribal communities dependent on forests are severely compromised. While developmental activities are essential for economic development of the country, it is necessary to ensure that this development does not come at the cost of India's invaluable natural capital – its forests. However, a common denomination to scientifically evaluate both these aspects simultaneously is often unavailable. This report is an attempt to bridge this gap by revising the Net Present Value (NPV) of forest diversion for non-forestry purposes.

Indian Institute of Forest Management has been forthcoming in providing useful policy suggestions for improving forest management in the country since its establishment. In furthering its cause, a study titled "Revision of rates of NPV applicable for different class/category of forests" assigned by the Ministry of Environment, Forests and Climate Change, Govt. of India has been executed by IIFM. Following a rigorous research process in collaboration with the Forest Survey of India, team of experts and a thorough consultation process with all concerned stakeholders of forests, the estimates of economic value of forest diversion have been calculated. Areas in the report which deserve a special mention include:

- Estimation of economic value of forest diversion for 14 forest type groups and 4 canopy cover density classes based on recent data and newly developed methodologies.
- Economic value based on estimation of 12 important goods and services from forests.
- Inclusion of add-on factors such as hill talukas and forested wetlands to reflect the site specificity of NPV rates.
- NPV estimation based on rotation period calculated for each forest type group.
- Special care taken in accounting for simultaneous delivery of ecosystem services from forests.
- Introduction of "possession value" of land to reflect the additional amount over and above the NPV realizable for possession of forest lands, keeping in view the market value of such forest lands.
- Recommendation for modification of exemption levels from paying NPV for few project categories which have a significant and/or permanent impact.
- Other recommendations made in furtherance of realization of NPV to make it more objective.
- Development of Standard Compensatory Afforestation Restoration Factor (SCARF) to appropriately adjusti the NPV rates to account for benefits from compensatory afforestation.

I take this opportunity to thank the Ministry of Environment, Forests & Climate Change for assigning this extremely important study to IIFM and compliment the study team for their best endeavours in bringing out this report. I hope that following the intense research process adopted for estimating the NPV rates objectively and associated recommendations, the economic value of loss of forests is duly reflected in the report and it will find wide acceptance among the stakeholders. I am sure that the findings of the report will assist the policy makers in particular and all stakeholders of forests in general to understand the economics of forest diversion in the country such as ours which in turn will help sustainably managing our forests.

New Delhi, Dated 05th November 2014

(A. K. Srivastava)
ADG, MoEFCC

TERMS OF REFERENCE OF THE STUDY

Vide Orders (i) F. No. 5-3/2011-FC dated 5th March 2012, (ii) F. No. 11-134/2011-FC dated 12th November 2012 and (iii) D.O. dated 16th November 2012 , Government of India, Ministry of Environment, Forests & Climate Change (FC Division), New Delhi.

i. Examination of methodology adopted by 2006 NPV Expert Committee for NPV estimation, suggest appropriate amendments and recommend revised rates of NPV;

ii. Recommend validity period of NPV realized for a project;

iii. Incorporate suggestion made by the Committee on Allocation of National Resources (CANR) which recommended "*suitably re-adjusting payments under NPV and above schemes. Forest land has value over and above the value of land itself. This re-adjustment should achieve comparability with guidelines of land valuation for other purposes, e.g. acquisition.*"

iv. Formulate objective parameter(s) to make a project eligible for exemption from NPV;

v. Suggest any other recommendation(s) in the furtherance of realization of NPV to make it more objective and scientific.

Vide Office-Memorandums (i) F. No. 5-3/2011-FC dated 22nd September 2014, (ii) F. No. 5-3/2011-FC dated 6th August 2014; (iii) F. No. 5-3/2011-FC dated 23rd July 2014, and (iv) F. No. 5-3/2011-FC dated 11th July 2014 Government of India, Ministry of Environment, Forests & Climate Change (FC Division), New Delhi.

vi. Analyze, discuss and internalize comments received from stakeholders on the first draft report.

KEY MESSAGES

The rationale for NPV collection, in addition to compensatory afforestation, is to balance the uncompensated benefits of lost forest ecosystem services till the compensatory afforestation area starts providing comparable benefits.

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The current study classifies the forests into 14 Forest Type Groups on the basis of Champion and Seth Classification and 4 Forest Canopy Cover Density Class (Very Dense, Moderately Dense, Open Forest and Less than 10% Canopy). The economic value of forest ecosystem services is estimated for these (14 x 4 = 56) classification units individually.

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The study recognizes the fact that few classification units may have dominant ecosystem services in terms of their economic value which may be very different from other classification units in which some other ecosystem services may dominate. The methodology is thus designed to objectively estimate the economic value of ecosystem services originating from different classification units by appropriately considering the specific factors rather than using a blanket value across the country.

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The array of forest goods and services valued in the report comprise of timber, bamboo, fodder, fuelwood, NWFP, gene-pool conservation, carbon sequestration, carbon storage, soil conservation, water recharge, pollination and seed dispersal, and water purification.

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Rather than taking a blanket value of 20 years as the rotation period of forest, the study also estimates the rotation period for each unit of classification based on the rotation period of dominant tree species.

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The range of the proposed and existing NPV rates according to different forest canopy density classes is as shown in Box 1 below.

Box 1 – Range of existing, WPI-adjusted and proposed NPV rates (Rs. Lakh / Hectare)

Canopy cover class		Very Dense Forests (VDF)	Moderately Dense Forests (MDF)	Open Forests (OF)	Less than 10% Canopy (LTF)
Range of NPV Rates (₹Lakh / hectare)	*Existing*	*6.26 – 10.43*	*5.63 – 9.39*	*4.38 – 7.30*	*4.38 – 7.30*
	WPI-Adjusted Existing Rates	*9.17 – 15.29*	*8.25 – 13.76*	*6.42 – 10.70*	*6.42 – 10.70*
	Proposed	*14.37 – 55.55*	*13.41 – 45.68*	*9.87 – 26.97*	*5.65 – 24.86*

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In terms of the economic value of forest goods and services estimated in this study accruing at various spatial scales, it is found that about 50% of the total economic value of forests is accrued at the local level with 34% and 16% at the state and national level respectively.

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To make NPV more site-specific, it is suggested that a premium on applicable NPV rates may be applied based on add-on factors of hill talukas and forested wetlands. It is also suggested that for core areas of National Parks and Sanctuaries, the NPV payable should be 10 times and 5 times the applicable NPV in the region respectively. In addition, for Eco-senstivie zones around National Parks and Sanctuaries, this value should be 5 times and 3 times of the applicable NPV respectively.

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To incorporate the value of the using the space of forest land besides its NPV, the report also recommends adoption of "Possession Value" of forest land in urban and peri-urban areas. This one-time charge should be valued either at 50% of the collector rate of market value of land or value as assessed by the local authority in absence of the collector rate plus the NPV or prevalent market rate for acquiring forest land (specially where NPV may be negligible),whichever is higher.

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Based on the consultation carried out with wide range of stakeholders, the current levels of exemptions have been largely accepted. However, modifications are suggested in some project categories that have significant and/or permanent impact on the ecological fabric of the land.

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The study suggests that proper targeting of fund apart from compensating affected local communities is essential to realize the mandate of NPV mechanism through effective compensation & institutional mechanisms. The study also recognizes the need for establishing Incentive Based Mechanisms (IBMs) for promoting good practices among user agencies and encouraging return of land to the forest department after appropriate treatment.

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The first draft of the report uploaded on MoEFCC's website received comments from a range of stakeholders on issues related to frequency of revision of NPV rates, exemptions from NPV, premium on NPV, classification of forests, methodology of calculating NPV rate, and ecosystem services included as well as excluded by the study. After rigorous analysis and discussions with various officials from MoEFCC, this updated draft had made an attempt to internalize stakeholder concerns.

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In addition to paying Net Present Value rates of forest to be diverted, the user agencies are also required to pay for compensatory afforestation (CA). While natural forests can never be replaced by plantations, these measures also compensate for a portion of ecosystem services lost as a result of forest diversion. A Standard Compensatory Afforestation Restoration Factor (SCARF) has been estimated to further adjust the applicable NPV based on the proportion of value of ecosystem services restored due to compensatory afforestation.

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In order to aid decision-making of MoEFCC in dealing with the plethora of issues related to NPV, it is proposed that a year-round data gathering and analysis hub of MoEFCC be located at the Centre for Ecological Services Management, IIFM. The Hub is proposed to render transparency, objectivity and consistency to the decision-making process and provide information on various forest land transfer and ecosystem services related issues and queries received by MoEFCC.

EXECUTIVE SUMMARY

When forest lands are diverted, a whole set of ecosystem goods and services from such forest lands are lost which are not immediately accounted for, by Compensatory Afforestation (CA). Benefits from CA increase slowly over the years and the rationale for NPV collection is to balance the uncompensated benefits till the compensatory afforestation area starts providing benefits comparable to those from the originally diverted forest area. Further, plantations take much longer to mature and even then, can never adequately compensate for natural forests.

The Hon'ble Supreme Court ordered that the rates of NPV for forest diversion should be revised after 3 years. While the Hon'ble Supreme Court did not explicitly state the reason for suggesting this time period, it may be recognized that 3 year period is an appropriate timeframe to revise economic value of forest ecosystem services by accounting for 1) new and more latest tools with advancement of technology to estimate the economic value of forests and 2) reflect the scarcity value of forests. As per this suggestion, Indian Institute of Forest Management was assigned a study on "Revision of rates of NPV applicable for different class/category of forests" by the Ministry of Environment, Forests and Climate Change (MoEFCC), Govt. of India. TOR-wise summary of findings is given below.

TOR 1: Examination of methodology adopted by NPV Expert Committee (2006) for NPV estimation, suggest appropriate amendments and recommend revised rates of NPV

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TOR 2: Recommend a validity period of NPV realized for a project.

Acknowledging the limitations of current NPV rates for forest diversion and to better reflect the diversity among socioeconomic and ecological aspects of forest resources in the country, this study classifies the forests of India into 14 Forest Type Groups on the basis of a modified Champion and Seth Classification. Recognizing the importance of forests with less than 10% canopy cover, it has been included in the classification of forest canopy cover classes along with (i) very dense forest; (ii) moderately dense forest and (iii) open forest. Using 14 Forest Type Groups and 4 Forest Canopy Cover Classes, fifty six classification units have been formed for the estimation of economic value of forests.

The study recognizes the fact that few classification units may have some dominant ecosystem services in terms of their economic value which may be very different from other classification units in which some other ecosystem services may dominate. The methodology is therefore designed to objectively estimate the economic value of ecosystem services originating from each of the classification unit by appropriately considering the specific characteristics and hence values rather than using a blanket value spread over the fifty six classification units across the country.

Economic value of a wide range of forest goods and services has been estimated based on recent data and newly developed methodologies (Box 2). Add-on factors such as hill talukas and forest wetlands are also included to reflect the site specificity of NPV rates for forest diversion. While the estimates for Net Present Value of forest diversion are based on complex calculations to make it objective and scientific, it has been ensured that at the local level use of applicable NPV rates is easy to understand and unambiguous in implementation.

Box 2 – Forest goods and services valued in the current study

Timber	Bamboo
Fuelwood	Fodder
NWFP	Gene-pool conservation
Carbon sequestration	Carbon storage
Soil conservation	Water recharge
Pollination & Seed Dispersal	Water purification

Recognizing the fact that forests across the country differ significantly in terms of their ecological aspects, a weighted average rotation period of proposed forest type groups has been estimated based on the rotation period of dominant species in each forest type group. In addition to the conscious effort of keeping the economic value estimates conservative, special care has been taken to avoid double counting in valuation of forest goods and services. A summary of NPV rates estimated in the study is as shown in Box 3.

Box 3 – Average NPV rates across different scenarios and canopy cover density classes

Scenario	TEV	Rotation Period	Average NPV Rates (₹ Lakhs/ha)			
			VDF	MDF	OF	LTF
I	Complete[1]	FTG specific	₹ 50.9	₹ 36.7	₹ 20.7	₹ 11.8
II	Relevant[2]	FTG specific	₹ 32.0	₹ 23.7	₹ 14.6	₹ 9.4
III	Complete	60 years	₹ 51.4	₹ 37.1	₹ 20.9	₹ 11.9
IV	Relevant	60 years	₹ 32.3	₹ 23.9	₹ 14.7	₹ 9.5

From all 4 scenarios above, the study team recommends using scenario 2 as the NPV applicable for diversion of forests to non-forestry uses in India. The scenario internalizes the issue of simultaneous

[1] As explained in the report, this scenario refers to complete summation of annual estimated economic value of all forest goods and services to arrive at the total economic value.

[2] To avoid double counting and internalize the fact that many forest goods and services are generated simultenously, this scenario discounts the annual benefits appropriately to arrive at the total economic value.

delivery of ecosystem services from forests and thus attempts to avoid double counting. In addition, it is based on rotation period estimated for each forest type group, thus internalizing the ecological diversity among forests of the country. Thus, while making the NPV estimates scientific, objective and region specific, the scenario has kept them conservative without overestimating value of individual services or total economic value.

The change of proposed NPV rates with respect to currently prevalent NPV rates for different forest type groups and forest canopy cover density classes is as shown below in Box 3. It may kindly be noted that the Box 4 containts proposed NPV rates without adjustment for SCARF as discussed later.

Box 4 –Currently Prevalent and Proposed (Scenario 2) NPV Rates

						Area with most lilkelihood of proposed forest diversion		
Proposed and Currently Prevalent NPV Rates (in Rs. Lakhs/ha); figures in parenthesis indicate %change w.r.t. current rates	VDF		MDF		OF		LTF	
NPV Rates	Proposed	Current	Proposed	Current	Proposed	Current	Proposed	Current[3]
Tropical Wet Evergreen Forests – North East	38.85	10.43	21.27	9.39	19.03	7.30	7.52	7.30
	[272%]		*[127%]*		*[161%]*		*[3%]*	
Tropical Wet Evergreen Forests – Western Ghats	43.34	10.43	31.31	9.39	14.22	7.3	9.01	7.30
	[316%]		*[233%]*		*[95%]*		*[23%]*	
Tropical Semi Evergreen Forests - North East	23.62	10.43	17.78	9.39	9.87	7.3	6.46	7.300
	[126%]		*[89%]*		*[35%]*		*[-12%]*	
Tropical Semi Evergreen Forests - Eastern Deccan	55.55	10.43	45.68	9.39	26.97	7.3	24.86	7.30
	[433%]		*[386%]*		*[269%]*		*[241%]*	
Tropical Semi Evergreen Forests - Western Ghats	33.89	10.43	23.66	9.39	15.44	7.3	10.12	7.30
	[225%]		*[152%]*		*[112%]*		*[39%]*	
Tropical Moist Deciduous Forests	30.32	10.43	22.25	9.39	13.55	7.3	7.61	7.30
	[191%]		*[137%]*		*[86%]*		*[4%]*	
Littoral & Swamp Forests	49.02	10.43	35.12	9.39	22.58	7.3	17.48	7.30
	[370%]		*[274%]*		*[209%]*		*[139%]*	

[3] As such there are no separate NPV rates for LTF category at the moment. The NPV rate of Open Forests in the same forest type group are current being charged for LTF.

					Area with most lilkelihood of proposed forest diversion			
Proposed and Currently Prevalent NPV Rates (in Rs. Lakhs/ha); figures in parenthesis indicate %change w.r.t. current rates	VDF		MDF		OF		LTF	
NPV Rates	Proposed	Current	Proposed	Current	Proposed	Current	Proposed	Current[3]
Tropical Dry Deciduous Forests	25.08	8.87	18.62	8.03	11.17	6.26	7.73	6.26
	[183%]		*[132%]*		*[78%]*		*[23%]*	
Tropical Thorn Forests	14.37	6.26	13.41	5.63	10.57	4.38	7.78	4.38
	[130%]		*[138%]*		*[141%]*		*[78%]*	
Tropical & Subtropical Dry Evergreen Forests[4]	28.38	7.83	21.43	7.04	13.24	5.47	7.47	5.47
	[262%]		*[204%]*		*[142%]*		*[37%]*	
Subtropical Pine/Broadleaved Hill Forests	22.74	9.39	17.97	8.45	11.63	6.57	6.64	6.57
	[142%]		*[113%]*		*[77%]*		*[1%]*	
Montane & Moist Temperate Forest	30.14	9.91	23.78	8.97	13.54	6.99	6.93	6.99
	[204%]		*[165%]*		*[94%]*		*[-1%]*	
Sub Alpine & Dry Temperate Forest	25.29	9.91	20.07	8.97	11.29	6.99	5.65	6.99
	[155%]		*[124%]*		*[62%]*		*[-19%]*	
Alpine Scrub	27.23	9.91	19.14	8.97	10.7	6.99	6.83	6.99
	[175%]		*[113%]*		*[53%]*		*[-2%]*	
Colour Keys for percentage change	Decrease		Increase					
	0-100%		0-100%	100-200%	200-300%	> 300%		

In terms of the total economic value of forest goods and services estimated in this study accruing at various spatial scales, it can be reasonably appropriated that, about 50% of this is accrued at the local level with 34% and 16% accruing at the state and national level, respectively. The economic value accruing at the local level can also be seen as the dependence value of forest ecosystems for the local communities dependent on forests for livelihoods and subsistence.

To make NPV more site-specific, it is suggested that a premium on applicable NPV rates may be applied specifically for hill talukas and forested wetlands. It is also suggested that for core areas of

[4] As the current forest type group classification falls in two Eco-classes, average NPV rates have been mentioned here.

National Parks and Sanctuaries, the NPV payable should be 10 times and 5 times the applicable NPV respectively. In addition, recognizing the importance of Eco-sensitive zones around National Parks and Sanctuaries, the NPV for diverting forests in these areas should be 5 times and 3 times of the applicable NPV respectively. In case Eco-sensitive zones have not been identified, a 10-km buffer around the National Park and Sanctuaries should be considered for this purpose.

TOR 3: Incorporate suggestion made by the Committee on Allocation of National Resources (CANR) which recommended "suitably re-adjusting payments under NPV and above schemes. Forest land has value over and above the value of land itself. This re-adjustment should achieve comparability with guidelines of land valuation for other purposes, e.g. acquisition."

To better reflect the space value of forest land specially where the forest to be diverted is located in the vicinity of high value real estate, the report recommends adoption of a "Possession Value" of land as an additional charge. It is suggested that the "possession value" of land may be charged in urban and peri-urban areas, as a one-time payment, either as (i) 50% of the collector rate or value as assessed by the local authority in absence of the collector rate plus the NPV or (ii) prevalent market rate for acquiring forest land (specially where NPV may be negligible), whichever is higher.

TOR 4: Formulate objective parameter(s) to make a project eligible for exemption from NPV

Acknowledging that the area of exemptions from NPV has widely debated and discussed in the Hon'ble Supreme Court, the current exemptions have been largely retained. Only for a few project categories which have a significant and/or permanent impact, suggestions have been given for modifications. The departure for such project categories mainly stems from the consultation process where recommended changes were argued by a large proportion of stakeholders.

TOR 5: Other recommendation(s) in furtherance of realization of NPV to make it more objective and scientific

In addition to estimating the NPV rates for forest diversion, the study recognizes that collection of NPV is only a part of the overall mandate of NPV charge. The fund needs to be flowed back to compensate communities for the loss of forest goods and services. The study thus recommends modifications in institutional mechanism to realize the mandate of NPV charge by specifically targeting NPV funds to increase the institutional capacity in terms of a) financially compensating affected communities for loss of livelihoods and subsistence b) improve NPV estimation in future; c) improve the quality of forest resources in the country. Other issues which came up during the consultation process and need greater analysis have also been flagged which include change in nomenclature of NPV, improving the verification and monitoring systems within existing forest management institutions. Incentive based mechanisms are recommended for encouraging good

practices and interventions leading to generation of positive externalities by user agencies and promoting return of forest land after appropriate treatment.

TOR 6: Analyze, discuss and internalize comments received from stakeholders on the first draft report

The comments received from various stakeholders on the first draft report uploaded on MoEFCC's website were analyzed rigorously and discussed extensively with various officials of MoEFCC. This draft report has made an attempt to internalize these concerns. In addition to paying Net Present Value rates of forest to be diverted, the user agencies are also required to pay for compensatory afforestation (CA). It needs to be acknowledged that while natural forests can never be replaced by plantations, these measures also compensate for a portion of ecosystem services lost as a result of forest diversion. As user agencies are mandated to pay for compensatory afforestation, it is being suggested that the final NPV rates may be adjusted based on the portion of value of ecosystem services restored due to compensatory afforestation. The amounting of discounting needed has been estimated as Standard Compensatory Afforestation Restoration Factor (SCARF). As the NPV rates in the current study have been estimated for each cell individually in the 14 X 4 matrix, it is suggested that the restoration factor should also be applied to each cell. Doing so would avoid any unwanted effects due to generalization over canopy density classes or forest type groups considered.

In order to aid decision-making of MoEFCC in dealing with the plethora of issues related to NPV, it is proposed that a year-round data gathering and analysis hub of MoEFCC be located at the Centre for Ecological Services Management, IIFM. The Hub is proposed to render transparency, objectivity and consistency to the decision-making process and provide information on various forest land transfer and ecosystem services related issues and queries received by MoEFCC.

TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

ACRONYMS

ACU	Adult Cattle Unit
CA	Compensatory Afforestation
CAMPA	Compensatory Afforestation Fund Management and Planning Authority
CAT	Catchment Area Treatment
CEC	Central Empowered Committee
CLEV	Compensation for Loss of Ecosystem's Value
CSO	Central Statistical Organization
CSR	Corporate Social Responsibility
FAO	United Nations Food and Agricultural Organization
FCA	Forest Conservation Act, 1980
FSI	Forest Survey of India
FTG	Forest Type Group
GDP	Gross Domestic Product
GIST	Green India States Trust
GNP	Gross National Product
ICFRE	Indian Council of Forestry Research and Education
IEG	Institute of Economic Growth
IGNFA	Indira Gandhi National Forest Academy
IIFM	Indian Institute of Forest Management
IIRS	Indian Institute of Remote Sensing
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
LPG	Liquefied Petroleum Gas
MDF	Moderately Dense Forest
MoEFCC	Ministry of Environment, Forests & Climate Change
NHAI	National Highway Authority of India
NPV	Net Present Value
NSSO	National Sample Survey Organization
NWFP	Non-wood Forest Produce
OF	Open Forest
PPP	Purchasing Power Parity
SCARF	Standard Compensatory Afforestation Restoration Factor
TEEB	The Economics of Ecosystem and Biodiversity
TERI	The Energy and Resources Institute
TEV	Total Economic Value
TOF	Trees Outside Forests
UNEP	United Nations Environment Programme
VDF	Very Dense Forest
WII	Wildlife Institute of India
WTI	Wildlife Trust of India

GLOSSARY

Benefits transfer approach: economic valuation approach in which estimates obtained in one context are used to estimate values in a different context after due adjustment.

Biodiversity: the variability among living organisms, including terrestrial, marine, and other aquatic ecosystems. Biodiversity includes diversity within species, between species, and between ecosystems.

Canopy: the cover of branches and foliage formed by the crowns of trees.

Canopy density: the relative completeness of canopy usually expressed as a decimal coefficient, taking closed canopy as unit.

Compensatory afforestation: mandated afforestation to be done by the user agency as a compensation for forest land diverted for non-forestry purpose.

Cultural services: the non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection and aesthetic experience.

Discount rate: a rate used to determine the present value of future benefits.

Direct-use value (of ecosystems): the benefits derived from the services provided by an ecosystem that are used directly by an economic agent. These include consumptive uses (e.g. harvesting goods) and non-consumptive uses (e.g. enjoyment of scenic beauty).

Double counting of services: erroneously including the same service more than once in an analysis.

Ecosystem services: the direct and indirect contributions of ecosystems to human well-being. The concept 'ecosystem goods and services' is synonymous with ecosystem services.

Existence value: the value that individuals place on knowing that a resource exists, even if they never use that resource (also sometimes known as conservation value or passive use value).

Forest cover: all lands, more than one hectare in area, with a tree canopy density of more than 10 percent irrespective of ownership and legal status. Such lands may not necessarily be a recorded forest area. It also includes orchards, bamboo and palm.

Forest Inventory: the measurement of certain parameters of forests to assess the growing stand and stock and other characteristics of forests.

Growing stock: the sum (by number or volume) of all the trees growing/living in the forest or a specific part of it.

Hill talukas: decided based on criteria adopted by the Planning Commission for Hill Area and Western Ghats Development Programmes.

Human well-being: concept prominently used in the Millennium Ecosystem Assessment –it describes elements largely agreed to constitute 'a good life', including basic material goods, freedom and choice, health and bodily well-being, good social relations, security, peace of mind, and spiritual experience.

Incentives (disincentives), economic: a material reward (or punishment) in return for acting in a particular way which is beneficial (or harmful) to a set goal.

Indirect-use value (of ecosystems): the benefits derived from the goods and services provided by an ecosystem that are used indirectly by an economic agent. For example, the purification of drinking water filtered by soils.

Less than 10% Canopy Cover Forests (LTF): degraded forest lands having canopy density less than 10 percent. These are classified as scrub forests in State of Forest Report by Forest Survey of India.

Moderately Dense Forest (MDF): all lands with forest cover having a canopy density between 40 and 70%.

Natural capital: an economic metaphor for the limited stocks of physical and biological resources found on earth, and of the limited

capacity of ecosystems to pro-vide ecosystem services.

Net Present Value (NPV): The NPV of a time series of cash flows, both incoming and outgoing, is defined as the sum of the present values (PVs) of the individual cash flows.

Non-use value: benefits which do not arise from direct or indirect use.

Open Forest (OF): all lands with forest cover having a canopy density between 10 and 40%.

Opportunity costs: foregone benefits of not using land/ecosystems in a different way, e.g. the potential income from agriculture when conserving a forest.

Option value: the value of preserving the option to use services in the future either by oneself (option value) or by others or heirs (bequest value). Quasi-option value represents the value of avoiding irreversible decisions until new information reveals whether certain ecosystem functions have values which society is not currently aware of.

Precautionary Principle: If an action has a suspected risk of causing harm to the environment, in the absence of scientific consensus that the action is harmful, the burden of proof that it is not harmful falls on those taking an act.

Provisioning services: the products obtained from ecosystems, including, for example, genetic resources, food and fiber and fresh water.

Public goods: a good or service in which the benefit received by any one party does not diminish the availability of the benefits to others, and where access to the good cannot be restricted.

Regulating services: the benefits obtained from the regulation of ecosystem processes, including, for example, the regulation of climate, water and some human diseases.

Resilience (of ecosystems): their ability to function and provide critical ecosystem services under changing conditions.

Social cost of carbon: estimate of the economic damages associates with increase in carbon dioxide emissions.

Supporting services: ecosystem services that are necessary for the production of all other ecosystem services such as biomass production, soil formation and retention, nutrient cycling, etc.

Threshold/tipping point: a point or level at which ecosystems change, sometimes irreversibly, to a significantly different state, seriously affecting their capacity to deliver certain ecosystem services.

Total economic value (TEV): a framework for considering various constituents of value, including direct use value, indirect use value, option value, quasi-option value, and existence value.

Trees Outside Forests (TOF): trees growing outside recorded forest areas.

Trade-offs: a choice that involves losing one quality or service (of an ecosystem) in return for gaining another quality or service. Many decisions affecting ecosystems involve trade-offs, sometimes mainly in the long term.

Valuation, economic: the process of estimating a value for a particular good or service in a certain context in monetary terms.

Very Dense Forest (VDF): all lands with forest cover having a canopy density of 70 percent and above.

Willingness-to-pay (WTP): estimate of the amount people are prepared to pay in exchange for a certain state or good for which there is normally no market price (e.g. WTP for protection of an endangered species).

Source: (MA 2005; TEEB 2010; FSI 2011b; P. Kumar et al. 2010)

1 INTRODUCTION

KEY MESSAGES

Chapters 1 to 4 of the report respond to TOR 1: Examination of the methodology adopted by 2006 NPV Expert Committee for NPV estimation, suggest appropriate amendments and recommend revised rates of NPV; TOR 2: Recommend validity period of NPV realized for a project of the assigned study and TOR 3: Incorporate suggestion made by the Committee on Allocation of National Resources (CANR) which recommended "suitably re-adjusting payments under NPV and above schemes. Forest land has value over and above the value of land itself. This re-adjustment should achieve comparability with guidelines of land valuation for other purposes, e.g. acquisition."

When forests are diverted, a whole set of ecosystem goods and services from forest are lost which are not immediately accounted for by Compensatory Afforestation (CA). Benefits from CA increase slowly and the rationale for Net Present Value (NPV) collection is to balance the uncompensated benefits till the compensatory afforestation area starts providing benefits comparable to those from the original forest area diverted.

To estimate the NPV of forest diversion on economic principles, The 2006 NPV Expert Committee demonstrated valuation of 7 key goods and ecosystem services from forests, namely timber, carbon storage, fuelwood & fodder, NTFP, Ecotourism, watershed benefits and biodiversity. The committee also recommended site specific NPV calculation.

The Central Empowered Committee (CEC) estimated few more services than those demonstrated by the 2006 NPV Expert Committee such as carbon sequestration, bio-prospecting and value of flagship species. As opposed to site-specific value, block values were estimated for 6 eco-classes and 3 forest cover density classes which are currently prevelant as the NPV rates for forest diversion and range from ₹ 4.38 lakhs to ₹ 10.43 lakhs per hectare.

1.1 Background

While the Net Present Value (NPV) for forest diversion was formally enforced across the country in 2008 with the range of ₹ 4.38 lakhs to ₹ 10.43 lakhs per hectare, it has been in practiced in few states of India for over a decade now. In 2002, a special purpose vehicle called CLEV (Compensation for Loss of Ecological Value) was introduced in Himachal Pradesh based on a study on economic value of forests in Himachal Pradesh conducted by IIFM for Himachal Pradesh Forest Sector Reforms (HPFSR) project in 2000. Following this study, states of Madhya Pradesh, Chhattisgarh and Bihar started practising collection of NPV in addition to charging for compensatory afforestation in early 2000s. These states were recovering NPV at the rate of ₹ 5.80 lakhs to ₹ 9.20 lakhs per hectare depending on density and quality of forests. Discussions around NPV were introduced in the Godavarman case (Writ Petition (Civil) No. 202/95)[5] in the Hon'ble Supreme Court through the report of the Central Empowered Committee (CEC), an empowered body and creation of the Hon'ble Supreme Court in 2002,which highlighted that "the States/UTs as well as Ministry of Environment and Forests are of the view that in addition to the funds realized for compensatory afforestation, the Net Present Value of forest land being diverted for non-forestry purposes should also

[5]See order dated 05.05.06 I. A. No. 1337 with I. A. Nos. 827, 1122, 1216, 1473

be recovered from the user agencies. The money so recovered could be utilized for undertaking forest protection, other conservation measures and related activities". After a prolonged debate in court hearings, The Hon'ble Supreme Court (SC) of India accepted that every user agency shall have to pay NPV for forest land diverted for non-forestry use. The NPV rates of earlier mentioned States were accepted at the all-India level. NPV as a concept thus evolved from the need to take precautionary measures in the event of diversion of forest land for non-forestry use to balance the interests of economic development and environmental protection (ELDF & WWF India 2009).

The rationale for charging the compensatory payment of NPV when forests are diverted for non-forestry purpose, in addition to paying for Compensatory Afforestation (CA) is subtle. When forests are diverted, a whole set of benefits (tangible and intangible) flowing from forests in terms of ecosystem goods and services are lost which are not accounted for by CA (yellow area in Figure 1). Benefits from CA increase slowly (orange area) and the rationale for NPV collection is to balance the uncompensated benefits (green area) till the compensatory afforestation area attains maturity and starts providing a portion of benefits provided earlier by the forest area diverted. Even after maturity, it is likely that a portion of benefits lost due to forest diversion will never be compensated by benefits from compensatory afforestation (blue area). The CEC in its report in 2002 further recognized that plantations take much longer to mature and even then can never adequately compensate for natural forests. Hence the NPV amount payable for forest diversion is a conservative charge.

When forests are diverted, a whole set of ecosystem goods and services from forest are lost which are not immediately accounted for by CA. Benefits from CA increase slowly and the rationale for NPV collection is to balance the uncompensated benefits till the compensatory afforestation area starts providing benefits comparable to those from the original forest area diverted. Further, plantations take much longer to mature and even then can never adequately compensate for natural forests.

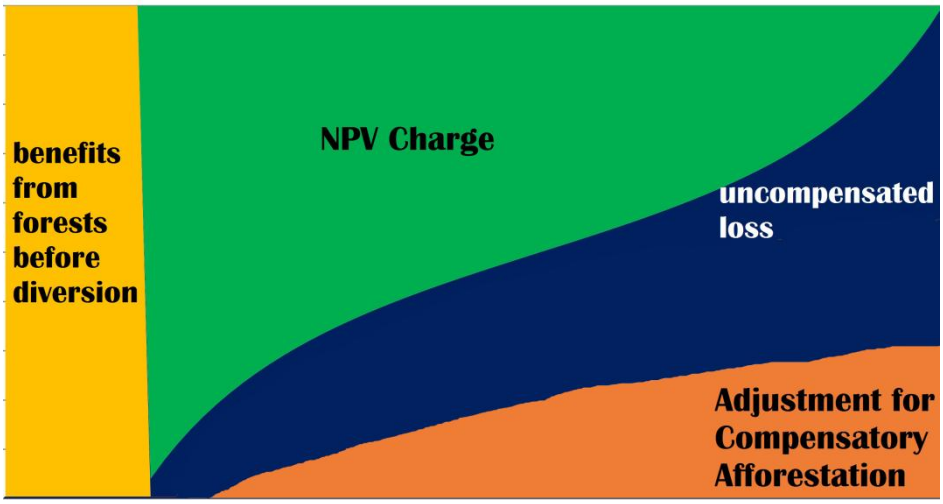

Figure 1 –Stylized description for rationale of NPV collection for forest diversion

In pursuance of the Hon'ble Supreme Court order dated 26.09.2005 in IA No. 826 in IA No. 566 of 2000 in Writ Petition (Civil) 202 of 1995, a 3-member Expert Committee was formed in 2005, to formulate a practical methodology to work out the Net Present Value (NPV) for forest land diverted for non-forest use on economic principles. Under the chairpersonship of Dr. Kanchan Chopra (IEG), the 2006 NPV Expert Committee recommended a 12-step procedure at the forest range level to estimate NPV. It should be noted that the Committee did not estimate NPV of forest diversion for the country as the task of the Committee was to illustrate the NPV estimation methodology with a case study. The Committee also suggested that calculations for determining NPV payment should be site-specific and demonstrated the methodology by calculating circle-wise rates for the state of Himachal Pradesh. The Committee internalized in its recommendation, the methodology & case-study suggested by the Study commissioned by Dr. Kanchan Chopra from IEG to the Principal Investigator of the current study in 2005 on "Estimating Economic Value of Forest Land: A Methodology", which prescribed estimation of benefits and costs of various ecosystem services.

The 2006 NPV Expert Committee demonstrated valuation of 7 key goods and ecosystem services from forests namely timber, carbon storage, fuelwood& fodder, NTFP, Ecotourism, watershed benefits and biodiversity. The NPV calculation was recommended to be site specific. Ground rent for land was also recommended to be approximated by prevailing rents in the region, subject to a minimum of ₹ 10,000 per hectare.

The NPV estimation methodology consisted of seven key goods and services from forests apart from biodiversity. These goods and services were estimated based on parameters tabulated below (See Table 1). NPV was calculated as present value of the net flows accruing over 20 years at 5% social rate of discount. It was further argued that simply adding up services would be incorrect as different forests yield different services. Thus percentage values were developed for each goods and services valued, based on the type of dominant forest practices. Ground rent for land was also recommended to be approximated by prevailing rents in the region, subject to a minimum of ₹ 10,000 per hectare.

Table 1 – Goods and services estimated by the 2006 NPV Expert Committee

Good or service	Basis of estimation
Timber	Long run stumpage value and stumpage price of mature timber
Carbon storage	Carbon content and market rate of carbon
Fuelwood & fodder	Total quantity collected, market price of collection, and cost of collection
NTFP	Total quantity collected, market price of collection, and cost of collection
Ecotourism	Number of people visiting forests, average expenditure per person
Watershed services	Value per hectare of soil conservation and hydrological services
Biodiversity	Based on relative weighing pattern between biodiversity and other services

The NPV amount collected was recommended to be paid by the user agency into a centralized fund called "CAMPA". Payments received from NPV collection, Compensatory Afforestation (CA) charge, Catchment Area Treatment (CAT) charge, Safety Zone (SZ) charges among others are collected in this centralized fund. It was also recommended that the amounts collected in lieu of NPV and other charges should be utilized as per the methodology described between those accruing to local, state and national level stakeholders.

Following the report submitted by the 3 member- Expert Committee (hereafter referred to as 2006 NPV Expert Committee), the Central Empowered Committee (CEC) filed a supplementary report in pursuance of the SC order dated 28.11.2006 in IA No. 826 in IA No. 566 after considering technical inputs from Forest Survey of India, MoEFCC officials, Chairperson and Members of the 2006 NPV Expert Committee. In the report, the forests of India as classified in the Champion and Seth classification were grouped into 6 eco-classes based on climate. Equalization value of forests belonging to different eco-classes and forest canopy cover density was worked out on the basis of value judgment and experience.

The CEC estimated few more services than those estimated by the Expert Committee viz carbon sequestration, bio-prospecting and value of flagship species. As opposed to site-specific value, blanket values were estimated for 6 eco-classes and 3 forest cover density classes which ranged from ₹ 4.38 lakhs to ₹ 10.43 lakhs per hectare.

The CEC, besides considering the findings of the 2006 NPV Expert Committee, also estimated the carbon sequestration value (instead of carbon storage value as estimated by the 2006 NPV Expert Committee), value of flagship species and bio-prospecting as assessed in the Green India States Trust (GIST) report. The total value of per hectare of forest based on these goods and services was estimated to be ₹ 7,77,597 and was approximated to be ₹ 8 lakhs per hectare. Based on equalization value of forests, the CEC recommended the NPV rates for forest diversion for 6 forest eco-classes and 3 forest canopy cover density classes (See Table 2). While keeping the time period of 20 years for NPV calculations, the CEC reduced the social rate of discount to 4% in calculating these values. In 2008, the SC accepted CEC's recommendations of collecting NPV rates which varied from ₹ 4.38 lakhs to ₹ 10.43 lakhs per hectare depending on Forest Eco-value Class and Canopy Cover Density Class.

Table 2 – Current NPV Rates Recommended by CEC (₹ /ha)

Eco-value class	VDF	MDF	OF
Class I	10,43,000	9,39,000	7,30,000
Class II	10,43,000	9,39,000	7,30,000
Class III	8,87,000	8,03,000	6,26,000
Class IV	6,26,000	5,63,000	4,38,000
Class V	9,39,000	8,45,000	6,57,000
Class VI	9,91,000	8,97,000	6,99,000

The 2006 NPV Expert Committee also gave its recommendations on certain types of projects which may be given partial or full exemption

from NPV payment. CEC accepted some of those recommendations. Public purpose projects such as schools, hospitals, rural infrastructure, among others were granted full exemption based on certain conditions. Other project categories which were also believed to result in public good benefits were given partial exemptions. CEC also recommended that use of forest land falling in protected areas will be permissible only in totally unavoidable circumstances for public interest projects by obtaining permission from the Hon'ble Supreme Court and paying up to 10 times the applicable NPV rate.

1.2 Objectives of the current study

Following CEC recommendations, the Hon'ble Supreme Court in its order dated 28th March 2008 suggested that the rates of NPV for forest diversion should be revised after 3 years. While the Hon'ble Supreme Court did not explicitly state the reason for suggesting this time period, it may be recognized that 3 year period is an appropriate timeframe to revise economic value of forest ecosystem services by accounting for 1) latest tools with advancement of technology to estimate the economic value of forests and 2) reflect the scarcity value of forests. As per the direction, Indian Institute of Forest Management was assigned a study (Order No. 1: F. No. 5-3/2011-FC dated 5th March 2012 & D.O. dated 16th November 2012, Order No. 2: F. No. 11-134/2011-FC and Office-Memorandums (a) F. No. 5-3/2011-FC dated 22nd September 2014, (b) F. No. 5-3/2011-FC dated 6th August 2014; (c) F. No. 5-3/2011-FC dated 23rd July 2014, and (d) F. No. 5-3/2011-FC dated 11th July 2014) on "Revision of rates of NPV applicable for different class/category of forests" by the Ministry of Environment, Forests & Climate Change (MoEFCC), Govt. of India with the following Terms of References:

Order No 1:

i. Examination of methodology adopted by 2006 NPV Expert Committee for NPV estimation, suggest appropriate amendments and recommend revised rates of NPV;
ii. Recommend validity period of NPV realized for a project;
iii. Formulate objective parameter(s) to make a project eligible for exemption from NPV;
iv. Suggest any other recommendation(s) in the furtherance of realization of NPV to make it more objective and scientific.

Order No. 2:

v. Incorporate suggestion made by the Committee on Allocation of National Resources (CANR) which recommended "suitably re-adjusting payments under NPV and above schemes. Forest land has value over and above the value of land itself. This re-adjustment should achieve comparability with guidelines of land

valuation for other purposes, e.g. acquisition."

Office-Memorandums:

vi. Analyze, discuss and internalize comments received from stakeholders on the first draft report.

1.3 Structure of the report

The report is structured as follows. Chapter 1 provides background information on the existing methodology used to estimate the NPV rates for forest diversion and the rationale for revision. Chapter 2 provides a very brief discussion on essential ecosystem services from forests and the economic value estimates for the same in India and across the globe. Chapter 3 discusses the methodology used in the report to revise the NPV rates for forest diversion. Brief discussion on how the proposed methodology defers from the current methodology further attempts to justify the need for revision of NPV rates. Chapter 4 is the crux of this report with economic value estimates for all forest ecosystem services valued in this study. In addition to the specific methodology used to estimate each service and final estimates discussed in this Chapter, detailed calculations for all ecosystem services accompanied by associated assumptions are provided in Appendix (Chapter 8). Chapter 5 includes discussion on the proposed exemptions from paying the NPV in case of forest diversion for different project categories. Chapter 6 provides other recommendations in addition to NPV estimation which would help in achieving the very objective for which NPV collection has been mandated. It also flags many other issues which were debated during the consultation meetings and workshops and suggests that they should be intensively researched & discussed before any recommendation for their implementation is made. Chapter 7 finally concludes by discussing the comments received on the first draft report from various stakeholders and develops the concept of Standard Compensatory Afforestation Restoration Factor (SCARF) to adjust the applicable NPV rate for benefits generated from compensatory afforestation.

2 VALUING FOREST ECOSYSTEM SERVICES

KEY MESSAGES

The chapter lays the foundation for linkage between goods and services emanating from forests and human well-being. Briefly summarizing major ecosystem services derived from forests and their importance for humankind, the chapter introduces the concept of Total Economic Value (TEV) used for valuation of forest ecosystem services as the basis for NPV.

Forests are multifunctional ecosystems which provide various services on all spatial and temporal levels. These ecosystem services are benefits which people derive from forests and include provisioning services, regulating services, cultural services and supporting services.

Because of market and institutional failure, the economic value of such goods and services from forests is often not captured in the market prices. To better understand the importance of forests and managing trade-offs between using land for forests or other developmental activities, it is required that a thorough economic valuation of goods and services from forests is carried out.

Estimates of the total economic value of forest ecosystems range from 1/4th of the global GNP at the global level to 7% of India's GDP at the national level.

2.1 Forest ecosystem services

The importance of forest ecosystems to human well-being cannot be understated. These multifunctional ecosystems provide various services on all spatial and temporal levels. The ecosystem services are benefits which people derive from forests and include *provisioning services* such as food, water, timber; *regulating services* such as climate and water quality regulation; *cultural services* such as recreation and spiritual benefits; and *supporting services* such as nutrient cycling (MA 2005). Ensuring flow of these services from forests has significant implications on human well-being (See Figure 2). Many countries identify more than 100 different kinds of services from forests (Sheingauz & Sapozhnikov 1988; Mather 1999). This multifunctionality of forests has also been recognized in the Forest Principles agreed at the United Nations Conference on Environment and Development held at Rio-de-Janeiro. Without the ecosystem services emanating from forests, life on earth would not be possible.

"forest resources and forest lands shall be managed and used sustainably to fulfil social, economic, ecological, cultural and spiritual needs of present and future generations" (Forest Principles 1992)

Among all the ecosystem goods and services that forests provide, timber is currently one of the most readily marketable benefits. While green felling is regulated in the country[6] as per the direction of Hon'ble Supreme Court, the large stock of unharvested wood contributes to the total economic value of forests. Wood is also used in the house, construction, furniture

[6] "The felling of trees in all forests is to remain suspended except in accordance with the Working Plans of the State Governments, as approved by the Central Government." – Hon'ble Supreme Court order dated 12.12.1996

and agricultural implements. In addition, a large proportion of people in rural regions depend on forests as a source of fuelwood for energy requirement. According to Forest Survey of India, the annual consumption of fuelwood from forests is estimated to be about 58 million tonnes while annual wood consumption for house construction, furniture and agricultural implements is estimated to be about 33 million cum (FSI 2011b).

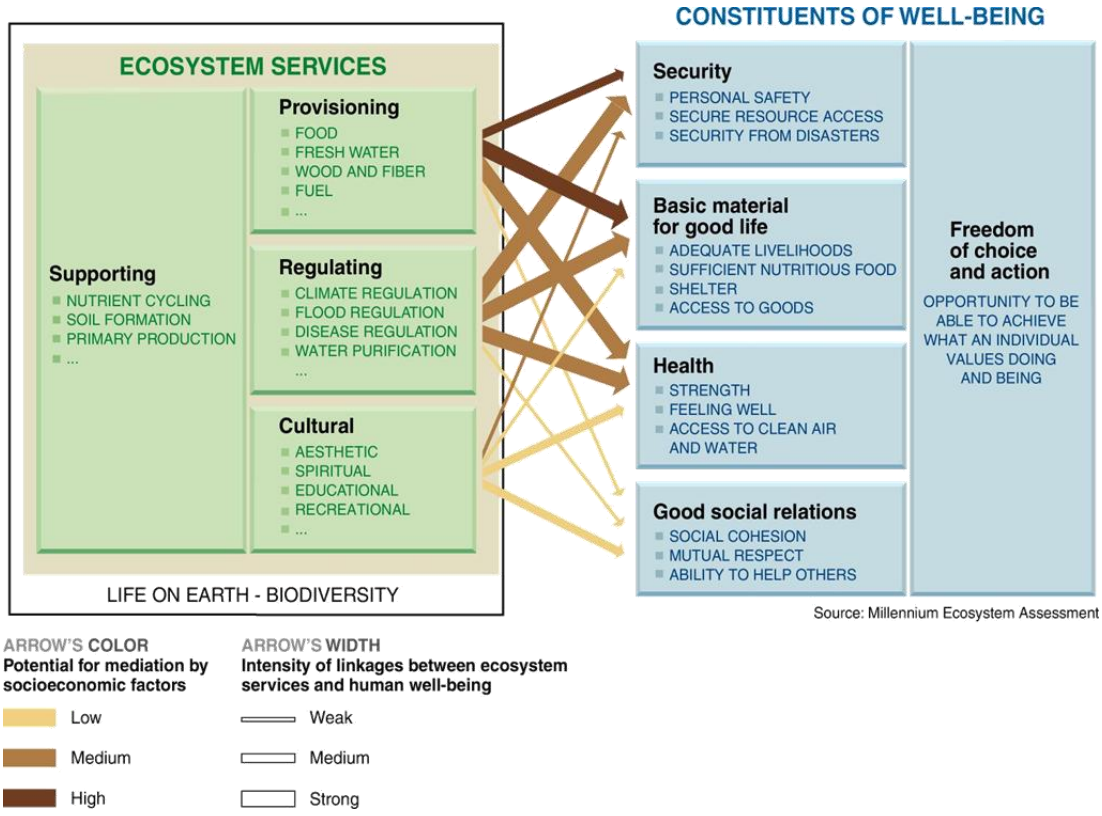

Figure 2 – Ecosystem services from forests and human well-being (MA 2005)

Apart from wood and fuelwood, forests provide goods in the form of a range of non-wood forest products (NWFPs) which are termed as goods of biological origin other than wood, derived from forests and, other wooded land and trees outside the forests (FAO 1999). These NWFPs include a tremendous diversity of items – many of which do not enter the formal market (UNECE 1998). However, they play an important role in the daily life and well-being of hundreds of millions of people dependent on forests (Lampietti & Dixon 1995). Their importance becomes more pronounced while considering the role of NWFPs in providing livelihood opportunities (Vinod Kumar Bahuguna 2000). In addition, forests are a great source of fodder, particularly where animal-based production systems dominate the socioeconomic system. In India roughly 1 in 4 adult cattle units depend on forests for grazing and fodder (FSI 2011b).

Forests are multifunctional ecosystems which provide various services on all spatial and temporal levels. These ecosystem services are benefits which people derive from

forests and include provisioning services, regulating services, cultural services and supporting services.

Forests are an important repository of terrestrial biodiversity. The forest biodiversity has both – its existence value as well as its utilitarian value as the source of innumerable biological resources used by people (WRI 1992). It is now a recognized fact that biodiversity, in addition, is an essential factor in sustaining ecosystem functioning and hence the underpinning for many other forest ecosystem services (Naeem et al. 1999). Forest biodiversity is also associated with an option value, being a vast storehouse of information from which future services such as new pharmaceutical discoveries can be derived (Rausser & Small 2000; Simpson et al. 1996).

Forests are a major stabilizing component of natural landscapes, providing protection of soil and water, households and fields, and reducing floods and landslides (Lele et al. 2008). It has been estimated that in a tropical country such as India, the levels of soil erosion may be 10-20 times higher on areas cleared of forests than in undisturbed natural forests, and this is particularly the case in mountainous regions characterized by fragile soils (Wiersum 1984; Chomitz & Kumari 1998).

Regulation of hydrological cycles and processes is one of the other important services provided by forests. These functions include increasing precipitation, decreasing potential evaporation, regulating the total and redistribution of surface and belowground runoff, smoothing out the seasonal course of river discharges, increasing total annual river runoff, preventing and mitigating consequences of floods, maintaining water quality, preventing siltation of reservoirs among many others (Bruijnzeel 2004; Dhawan 1993; P. Kumar et al. 2006).

Forests also play an important role in the global carbon cycle and consequently in regulating the global climate system. Two main features – forests as major terrestrial accumulators of carbon (Lal et al. 2011; Bansal et al. 2012) and their ability to provide long–term sequestration are particularly important in this regard (MA 2005). According to a new report based on empirical evidence from across the country, the net increment in carbon stock of forests in India was approximately 592 million tonnes between 1994 and 2004 (FSI 2013a). In terms of absolute estimates, the carbon stock of forests in India was approximately 6663 million tonnes in 2004 (FSI 2013a).

Further, forests provide a number of regulating ecosystem services such as pollination and seed dispersal, water purification, pest and disease control, soil formation, nutrient cycling, waste treatment among many others which are essential for human existence (Verma et al. 2009; P. Kumar et al. 2010). Table 3 lists major ecosystem services from forests with their brief description.

Lastly, forests are highly valued for a host of social, cultural and spiritual reasons in the country (Sheil & Wunder 2002; CBD 2001).

For many indigenous communities and traditional societies, forests are sacred and linked to both religious beliefs and the very identity of some communities and tribes (Malhotra et al. 2001). Forests also provide spiritual and recreational services to many people through forest-related tourism. Forests and the species therein support a significant element of many nature-based tourism destinations in the country.

Table 3 – Major Ecosystem Services provided by Forests (Earth Economics 2013)

Services	Infrastructure and Processes	Goods and Services
Provisioning services – provision of natural resources		
Food	Conversion of solar energy into edible plants and animals	Hunting, gathering of fish, game, fruits, etc.; small scale subsistence farming & aquaculture
Raw materials	Conversion of solar energy into biomass for human construction and other uses	Building and manufacturing; fuel and energy; fodder and fertilizer
Genetic resources	Genetic material and evolution in wild plants and animals	Improve crop resistance to pathogens & pests
Medicinal resources	Variety in (bio)chemical substances in, and other medicinal uses of, natural biota	Drugs, pharmaceuticals, chemical models, tools, test and essay organisms
Ornamental resources	Variety of biota in natural ecosystems with (potential) ornamental use	Resources for fashion, handicraft, jewelry, pets, worship, decoration & souvenirs
Regulating services - Maintenance of essential ecological processes and life support systems		
Gas regulation	Role of ecosystems in bio-geochemical cycles	Provides clean, breathable air, disease prevention, and a habitable planet
Climate regulation	Influence of land cover and biological mediated processes on climate	Maintenance of a favorable climate promotes human health, crop productivity, recreation, and other services
Disturbance prevention	Influence of ecosystem structure on dampening environmental disturbances	Prevents and mitigates natural hazards and natural events, generally associated with storms and other severe weather
Water regulation	Role of land cover in regulating runoff and river discharge	Provides natural irrigation, drainage, channel flow regulation, and navigable transportation
Water supply	Filtering, retention and storage of fresh water (e.g. in aquifers and snow pack)	Provision of water for consumptive use, includes both quality & quantity
Soil retention	Role of vegetation root matrix and soil biota in soil retention	Maintains arable land and prevents damage from erosion, and promotes agricultural productivity
Soil formation	Weathering of rock, accumulation of organic matter	Promotes agricultural productivity, and the integrity of natural ecosystems
Nutrient cycling	Role of biota in storage and recycling of nutrients	Promotes health and productive soils, and gas, climate, and water regulations

Services	Infrastructure and Processes	Goods and Services
Waste treatment	Role of vegetation & biota in removal or breakdown of xenic nutrients and compounds	Pollution control / detoxification; Filtering of dust particles through canopy services
Pollination	Role of biota in movement of floral gametes	Pollination of wild plant species and harvested crops
Biological control	Population control through trophic-dynamic relations	Provides pest and disease control, reduces crop damage
Cultural services - Providing opportunities for cognitive development		
Aesthetic information	Attractive landscape features	Enjoyment of scenery
Recreation	Variety in landscapes with (potential) recreational uses	Travel to natural ecosystems for eco-tourism, outdoor sports, etc.
Cultural and artistic information	Variety in natural features with cultural and artistic value	Use of nature as motive in books, film, painting, folklore, national symbols, architecture, advertising, etc.
Spiritual and historic information	Variety in natural features with spiritual and historic value	Use of nature for religious or historic purposes (i.e., heritage value of natural ecosystems and features)
Science and education	Variety in nature with scientific and educational value	Use of natural systems for school excursions, etc. Use of nature for scientific research
Supporting services - Providing habitat (suitable living space) for wild plant and animal species		
Habitat and biodiversity	Suitable living space for wild plants and animals	Maintenance of biological and genetic diversity (and thus the basis for most other functions)
Nursery	Suitable reproduction habitat	Maintenance of commercially harvested species

2.2 Valuation of ecosystem services

The concept of Total Economic Value (TEV) is one of the most widely used framework for identifying and categorizing forest benefits (Pearce 1990; Emerton 2003). It attempts to account comprehensively for all forest ecosystem services, categorizing these into direct values, indirect values, option values and existence values (See Figure 3).

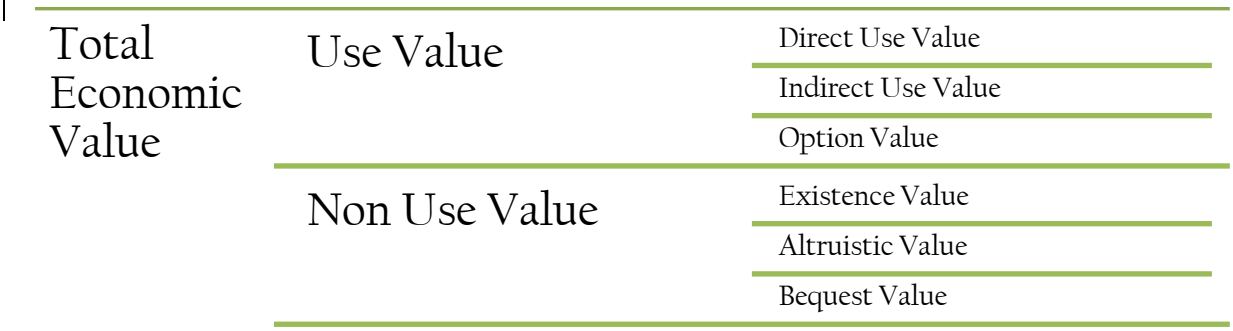

Figure 3 – Total Economic Value (TEV) Framework

Ideally, values of goods and services should reflect the best alternative use for resources (true opportunity cost), or the true willingness to pay for the goods and services, excluding external government interventions and including all the externalities (Kadekodi 1999). However, conventional analysis, based mostly on limited information of marketable value, often fails to capture the benefits completely (Verma 2008; Verma & C. V. Kumar 2008). This is because many of these goods and services do not enter the market, and for those that enter only a part of the total benefits are actually recorded by market transactions. Many of these benefits are also misattributed (Panayotou 1998). For example, the water regulation services provided by forests may appear as higher profits in water using sectors and not as benefits provided by the forest ecosystem.

Because of market and institutional failure, the economic value of such goods and services from forests is often not captured in the market prices. To better understand the importance of forests and managing trade-offs between using land for forests or other developmental activities, it is required that a thorough economic valuation of goods and services from forests is carried out.

A first-of-its kind initiative on valuation of ecosystem services and biodiversity, known as TEEB (The Economics of Ecosystems and Biodiversity), estimates that the benefits of halving global deforestation by 2030 due to climate change alone are about US$ 3.7 trillion in NPV terms (TEEB 2010). The Green Economy Initiative of UNEP also recognizes that forest ecosystems provide shelter, food, jobs, water, and medicine to more than 1 billion people and regulate the global climate. The Initiative illustrates that investing in forest resources is one of the significant requirements for transition to the green economy (UNEP 2011).

While the methodology for valuation of ecosystem services from forests is still evolving, many landmark studies have attempted to shed light on the economic importance of forest ecosystem services. One of the first and highly influential estimate of the annual value of global forest ecosystem services totalled US$ 4.7 trillion, roughly one fourth of the global GNP (Costanza et al. 1997). The lower bound annual value of Mexico's forest was estimated to be about US$ 4 billion (Adger et al. 1994). This aggregate value is derived mainly from non-marketed services provided by non-consumptive uses, from future potential uses of genetic resources and the largest proportion from hydrological regulation and carbon cycling. Another study estimated the net economic value of forests in Canada to be approximately US$ 27 billion per year (Anielski & Wilson 2005). The major components contributing to this estimate were pest control services by birds, nature-related activities, carbon sequestration, NWFPs, watershed services and subsistence value for Aboriginal peoples among other services from forests. In the Indian context, the total annual loss as a result of forest degradation in India is estimated to be about US$ 12 billion (Joshi & P. P. Singh 2003). The annual Total Economic Value of forests of the state of Himachal Pradesh was estimated to be more than ₹ 1 lakhs crore (Verma 2000). In

another study, Verma (2007) estimated the ecosystem service values from forests of Uttarakhand to be in the order of ₹ 1,61,921 crores annually. Further, 2004 Annexure VI (b) of the Forest Conservation Act 1980 (amended in 2004) specifies that "as a thumb rule, the environmental value of fully stocked (density 1.0) forest would be taken as 126.74 lakhs to accrue over a period of 50 years. This value will reduce with the decrease in the density of forest".

The total economic value of global forest ecosystems was estimated to be 1/4th of the global GNP (Costanza et al. 1997). Another recent study estimates the total economic value of India's forests as 7% of its GDP (V. K. Bahuguna & Bisht 2013).

While few attempts have been made to estimate the total economic value of forest ecosystems, a large number of studies have estimated only one or more ecosystem services from forests (Verma 2007; Verma 2000; Chopra & Kadekodi 1997). For example, pollination services from two forests with a total area of about 150 hectares was estimated to be about US$ 60,000 a year for a Costa Rican coffee firm due to impact of pollination on coffee yield and quality (Ricketts et al. 2004). Based on the replacement cost method, the on-site costs of soil erosion in the Magat watershed of the Philippines as a result of conversion of primary and secondary forest to grasslands and other land uses was estimated to be US$ 51/ha/year in terms of nominal price of replacing soil nutrients and US$ 127/ha/year in terms of shadow price of soil nutrients (Cruz et al. 1988).

In the Indian context, some estimates of the storm protection services from mangrove forests to reduce damage caused by tsunamis and tropical storms are available. It was found that the average opportunity cost of saving a life by retaining mangrove forests was 11.7 million rupees per life saved during the super cyclone (Das & Vincent 2009). Each 1 hectare of remaining mangrove forests were estimated to save 0.0148 lives. The hydrological services from forests were estimated by a production function approach in South India and the reduction in expected annual income resulting from changes in forest cover was found to be US$ 107/household (Lele et al. 2008). In terms of air quality regulation services from forests, avoided morbidity method was used to estimate the economic costs of respiratory infections caused by air pollution from mining-induced deforestation and degradation. The study found that living 1 km closer to mines is associated with a 2.7% increase in log-odds of respiratory infections (Saha et al. 2011).

3 METHODOLOGY

KEY MESSAGES

Apart from getting suggestions from Expert Group formed on the subject, extensive consultations were conducted with major stakeholders to internalize their views in the revised methodology for NPV recalculation. The views were further discussed during the National Consultation Workshop in togetherness. Subjective methodological components were finalized through a Group Consultation Workshop.

The study calculates NPV rates of forest diversion for 14 Forest Type Groups of India further categorized into 4 canopy cover density classes.

The methodology recognizes the fact that few classification units may have some dominant ecosystem services in terms of their economic value which may be very different from other classification units in which some other ecosystem services may dominate. The methodology is thus designed to objectively estimate the economic value of ecosystem services originating from different classification units by appropriately considering the specific characteristics and hence values, rather than using a blanket value across the country.

For the purposes of NPV calculation, rather than taking a blanket period of 20 years as the rotation period of forest, the study estimates the rotation period for each unit of classification based on the dominant tree species and their rotation periods. These have been further averaged across forest type groups to obtain the weighted average rotation period for each of the forest type groups proposed in the study.

3.1 Expert Group Formation and Collaboration with FSI

An expert group was formed as a part of this study comprising of experts in the area of natural resource economics, forest conservation, management information systems for forests and related legal issues. The expert group met on several occasions including the consultation workshop and GCM workshop and discussed possible implications of key methodological components in NPV estimation. In addition, to make the methodology objective and scientific and to carry out estimation of NPV on latest data of forest resources in the country, the current study was conducted in collaboration with the Forest Survey of India.

3.2 Stakeholder responses through questionnaires

While attempts were made to reach out to major stakeholders, given the time constraints it was not possible to consult all possible stakeholders from various regions around the country. However to seek views of such stakeholders, questionnaires were designed (each for forest department, user agency and local communities) and circulated for their response. The questionnaires are attached in Appendix 32, Appendix 33 and Appendix 34.

3.3 Consultation process

3.3.1 Consultation meetings

Forests in the context of this study have many stakeholders including Ministry of Environment, Forests & Climate Change (MoEFCC), Govt. of India, State Forest Departments, MoEFCC Regional Offices,

Central Empowered Committee (CEC). The National Green Tribunal, National Tiger Conservation Authority (NTCA), user-agencies seeking forest land for diversion, The Planning Commission of India, The Finance Commission of India constituted by the Govt. of India, research organizations (such as ICFRE, IGNFA, TERI, WII, WTI, and others), data generation agencies (FSI, IIRS, CSO, NSSO, and others), environmental consultants, legal experts/law firms, utility service providers (water, electricity, roads, transmission, and others), consumers, forest dependent industries, local communities and citizens of India. To internalize the view of these stakeholders, consultation meetings were conducted with all major stakeholders (For details, See Appendix 27). Providing detailed information on how NPV is currently calculated and the basis for estimation of NPV rates; issues and concerns of stakeholders were duly noted. These issues have been internalized in the development of revised methodology for recalculation of NPV rates.

3.3.2 National Consultation workshop

While individual concerns, especially those of provider and user agencies, were recognized through individual consultation meetings (note circulated for reference can be found in Appendix 30), a National Consultation Workshop was subsequently conducted to discuss these concerns in togetherness, each for MoEFCC, forest departments and user agencies. Discussions were held during the workshop on each of the objectives. The minutes of the workshop are attached in Appendix 31 and have been the basis of revised methodology for NPV rates estimation.

3.3.3 Group Consultation Workshop

While major issues in estimation of NPV rates were identified and methodology to estimate the economic value of forest ecosystem services was drafted, it was realized that there is unsatisfactory information on some of the methodological components for which data is either incomplete or not verified. This had stemmed from the fact that forests in India have multiple stakeholders and thus economic values differ substantially among different stakeholders. In order to recalculate the NPV rates more objectively, a Group Consultation Workshop was also conducted involving various stakeholders from different regions of India to produce a consensus in opinion on such subjective components. The concept note for GCM and the process followed are attached in Appendix 4.

Extensive consultations were conducted with major stakeholders to internalize their concerns in revised methodology for NPV recalculation. The views were further discussed during the National Consultation Workshop in togetherness. Subjective methodological components were further finalized through a Group Consultation Workshop.

3.4 NPV estimation methodology

3.4.1 Forest Classification

The classification of forest used currently for NPV rates is based on two parameters:

6 Eco-classes (as aggregated by Forest Type Groups according to Champion & Seth Classification)

3 Canopy Cover Density Classes which include Very Dense Forest (VDF), Moderately Dense Forest (MDF) and Open Forest (OF).

Recognizing the fact that forests across the country vary greatly in terms of their composition, species, and biodiversity among various other factors, it was felt that a more detailed matrix be computed for NPV rates. After due consideration to classify India's forests according to various parameters including physiographic zone classification developed by The Planning Commission of India, the classification of India's forests as developed by Champion and Seth was deemed appropriate for the scope of this study. Champion and Seth have classified India's forests into 16 major Type Groups.

The study calculates NPV rates of forest diversion for 14 Forest Type Groups of India further categorized into 4 forest cover density classes.

In an attempt to recalculate rates of NPV for forest diversion more scientifically and objectively, latest forest inventory data collected by the Forest Survey of India has been used. However, to confirm to statistical requirements based on number of samples from each unit of classification, few of the forest type groups mentioned above needed to be aggregated into one. In addition, few of the forest type groups such as Tropical Wet Evergreen Forests are located in more than one patch across the country, often in unique climatic zones and with different species composition. Recognizing this fact, few type groups have been sub-divided. The final classification of forests consisting of 14 Forest Type Groups thus proposed is as shown in Table 4. It should be noted that no separate classification is proposed for "Plantations" and it is recommended that the NPV rate applicable according to the Forest Type Group and Canopy Cover Density Class of plantation area should be charged in the event of its diversion.

Table 4 – Proposed Forest Type Classification

Eco-class[7]	Champion & Seth Classification	Proposed Classification
Eco-class I	Tropical Wet Evergreen Forests	Tropical Wet Evergreen Forests – North East
		Tropical Wet Evergreen Forests – Western Ghats
Eco-class I	Tropical Semi Evergreen Forests	Tropical Semi Evergreen Forests-North East
		Tropical Semi Evergreen Forests-Western Ghats
		Tropical Semi Evergreen Forests-Eastern Deccan
Eco-class I	Tropical Moist Deciduous Forests	Tropical Moist Deciduous Forests

[7] As used in the current NPV rates estimated (CEC 2007b)

Eco-class[7]	Champion & Seth Classification	Proposed Classification
Eco-class II	Littoral & Swamp Forests	Littoral & Swamp Forests
Eco-class III	Tropical Dry Deciduous Forests	Tropical Dry Deciduous Forests
Eco-class IV	Tropical Thorn Forest	Tropical Thorn Forest
Eco-class IV	Tropical Dry Evergreen Forests	Tropical & Subtropical Dry Evergreen Forests
Eco-class V	Subtropical Dry Evergreen Forests	
Eco-class V	Subtropical Pine Forests	Subtropical Pine/Broadleaved Hill Forests
Eco-class V	Broadleaved Hill Forests	
Eco-class VI	Montane Temperature Forest	Montane & Moist Temperate Forest
Eco-class VI	Moist Temperature Forest	
Eco-class VI	Sub Alpine Temperate Forest	Sub Alpine & Dry Temperate Forest
Eco-class VI	Dry Temperate Forests	
Eco-class VI	Moist Alpine Scrub	Alpine Scrub
Eco-class VI	Dry Alpine Scrub	

As regards the second parameter used in the 2006 NPV Expert Committee Report and the CEC Report submitted thereon, an additional forest canopy cover density class, namely Lowe Density Forests, has been added[8]. This class represents recorded forest areas with less than 10% canopy cover (See Table 5).While such areas do not have dense forest cover, they nevertheless provide many ecosystem services. Recent studies, for example, have found that grasses and bushes in these areas help in sequestration of carbon in significant quantity along with preventing release of soil carbon (FAO 2010). Many such areas are also critical habitats for biodiversity and hence are important. In the light of these facts, the forest canopy density class has been included as the second parameter for classification with four levels – namely Very Dense Forest (VDF), Moderately Dense Forest (MDF), Open Forest (OF) and Less than 10% Canopy (LTF).

[8] Earlier the category of open forests also covered 'Scrub'but now on account of its unique nature, the Forest Survey of India has introduced this category in its recent State of Forest Resource Assessment and hence the same has been incorporated in the report.

Table 5 – Forest Density Classes used for classification

Forest Density Class	Forest Canopy Cover	% of Total Forest Cover
Very Dense Forest (VDF)	More than 70%	8%
Moderately Dense Forest (MDF)	Between 40 and 70%	47%
Open Forest (OF)	Between 10 and 40%	39%
Less than 10% Canopy (LTF)	Less than 10%	6%

Taking these two parameters – i.e. forest type group (reclassified) and forest canopy density classes – a 14 X 4 matrix has been prepared with each cell showing the NPV of forest diversion. In addition, to remove subjectivity in estimation across different forest type groups and density classes, instead of starting with one averaged NPV estimate and then using relative 'weighing factors, value judgment and experience' for different forest type and canopy cover density classifications as suggested in the CEC report for estimating NPV rates which are currently prevalent, the NPV rates in the current study have been estimated independently for each of the cells in the matrix mentioned above. The methodology recognizes the fact that few classification units may have dominant ecosystem services in terms of their economic value which may be very different from other classification units in which some other ecosystem services may dominate. The methodology is thus designed to objectively estimate the economic value of ecosystem services originating from different classification units by appropriately considering the specific factors rather than using a blanket value across the country.

The methodology recognizes the fact that few classification units may have dominant ecosystem services in terms of their economic value which may be very different from other classification units in which some other ecosystem services may dominate. The methodology is thus designed to objectively estimate the economic value of ecosystem services originating from different classification units by appropriately considering the specific factors rather than using a blanket value across the country.

3.4.2 Rotation Period

Currently used methodology for calculation of NPV of forest diversion discounts future benefits and costs for 20 years. It was felt that 20 years is too generic a time period for calculating NPV in different forest types groups across India. Since the earlier study which presented a methodology for NPV calculation, rich datasets are now available for forest resources of the country. Along the lines of classification units proposed here, weighted averaged rotation period for each unit has been estimated based on the rotation period of dominant tree species within each unit (Shiva 1998). It may be noted that for the purpose of this study, the physical rotation period of a tree is used as its rotation period.

For each unit of classification based on forest type group and forest canopy density class, 12-15 dominant tree species were first identified from forest inventory data collected by Forest Survey of India. Appendix 2 gives the list of

species considered for estimation and their respective rotation period.

Rather than taking a blanket value of 20 years as the rotation period of forest, the study estimates the weighted average rotation period for each unit of classification based on the dominant tree species and their rotation periods.

Based on rotation period of different species mentioned and their proportion in the total number of trees per hectare within each unit, weighted average rotation period has been estimated for each classification unit (See Table 6). For few forest type groups, rotation period in Less than 10% canopy cover forest category could not be estimated due to unavailability of data. From these, the mean and standard deviation of rotation period for each forest type group has been estimated. While an attempt was made to include as many tree species as possible in calculation of rotation period, their shares and hence their average rotation periods varied between different forest type groups. Appendix 3 provides this information. While the classification units vary among the percentage of total trees per hectare for which specific rotation period was used, it should be noticed that higher percentage of trees for which specific information was used corresponds to a higher rotation period in a particular unit of classification and hence the estimates of rotation period can be considered conservative.

Table 6 – Weighted average rotation period (years)

Forest Type Groups	VDF	MDF	OF	LTF	Mean	Standard Deviation
Tropical Wet Evergreen-North East	40	60	63		54	12
Tropical Wet Evergreen-Western Ghats	57	59	40	52	52	9
Tropical Semi Evergreen-North East	71	65	57	61	64	6
Tropical Semi Evergreen-Eastern Deccan	79	29	46		51	25
Tropical Semi Evergreen-Western Ghats	61	60	54	70	61	6
Tropical Moist Deciduous Forests	76	64	60	53	63	10
Littoral & Swamp Forests	93	58	55		69	21
Tropical Dry Deciduous Forests	63	57	51	51	55	6
Tropical Thorn Forest	77	48	45	48	54	15
Tropical & Subtropical Dry Evergreen Forests	69	61	52	39	55	13
Subtropical Pine/Broadleaved Hill Forests	72	74	73	58	69	7
Montane & Moist Temperate Forest	76	78	76		76	1
Sub Alpine & Dry Temperate Forest	84	89	92	73	84	8
Alpine Scrub	66	81	67		71	8
Weighted average rotation period					63	14

4 ANALYSIS AND NPV ESTIMATION

KEY MESSAGES

In a questionnaire based survey conducted for the study, more than 3/4th of the stakeholders that responded opined that the current NPV rates for forest diversion are either highly underestimated or slightly underestimated.

The current study represents a significant departure from the earlier methodology used to estimate the NPV rates. The study estimates the economic value of many forest goods and services which were not valued earlier such as bamboo, pollination & seed dispersal, water purification, soil conservation and water recharge. Values of forest goods and services that were considered earlier such as timber, fuelwood, and fodder among others were derived more scientifically and objectively.

The array of forest goods and services valued in the study include timber, bamboo, NTFP, fuelwood, fodder, gene-pool conservation, carbon sequestration, carbon storage, water recharge, soil conservation, water purification and pollination & seed dispersal.

Based on the argument that many of these services are complimentary to each other and hence to avoid the possibility of double counting of the service benefits, assumptions are made on the percentage of value additions relevant for each goods and services. NPV rates for 4 scenarios are estimated here based on the methodology for estimating the total economic value (i. complete summation or ii. relevant summation by accounting for double counting) and rotation period used (i. forest type group specific or ii. a blanket value of 60 years). The summary of estimates is as follows:

Scenario	TEV	Rotation Period	Average NPV Rates (₹ Lakhs/ha)			
			VDF	MDF	OF	Scrub
I	Complete	FTG specific	₹ 50.9	₹ 36.7	₹ 20.7	₹ 11.8
II	Relevant	FTG specific	₹ 32.0	₹ 23.7	₹ 14.6	₹ 9.4
III	Complete	60 years	₹ 51.4	₹ 37.1	₹ 20.9	₹ 11.9
IV	Relevant	60 years	₹ 32.3	₹ 23.9	₹ 14.7	₹ 9.5

While the NPV rates estimated in this study are at a significant departure from the existing rates, caution has been used not to overestimate the value of any of the goods and services estimated. Even though the NPV rates are higher than the current rates, reasons are provided why even the estimated NPV rates can be considered as conservative.

While an attempt has been made to estimate the value of important goods and services from forests, the economic value of provisioning services from forests constitute a major part of estimated NPV. While regulating and supporting services have been valued in this study, there is a need for more sophisticated valuation methodologies and appropriate datasets to truly reflect the economic value of such services from forests in future.

In terms of the economic value of forest goods and services estimated in this study accruing at various spatial scales, it is found that about 50% of the total economic value of forests is accrued at the local level with 34% and 16% at the state and national level, respectively. The economic value accruing at the local level can also be seen as the dependence value of forest ecosystems for the local communities dependent on forests for livelihoods and subsistence.

To make NPV more site-specific, it is suggested that a 20% premium on applicable NPV rates may be applied based on add-on factors of hill talukas and forested wetlands. It is also suggested that for core areas of National Parks and Sanctuaries, the NPV payable should be 10 times and 5 times the applicable NPV in the region respectively. In addition, for Eco-senstivie zones around National Parks and Sanctuaries, this value should be 5 times and 3 times of the applicable NPV respectively.

In addition, it is suggested that to truly reflect the space value of forest land in urban and peri-urban areas, "possession value" of land may be charged in urban and peri-urban areas. It is suggested that the "possession value" of land may be charged in urban and peri-urban areas, as a one-time payment, either as (i) 50% of the collector rate or value as assessed by the local authority in absence of the collector rate plus the NPV or (ii) prevalent market rate for acquiring forest land (specially where NPV may be negligible), whichever is higher.

4.1 Stakeholder responses through survey

Among many questions that were asked to various stakeholders including provider and user agencies via a survey instrument, was the fundamental question of whether NPV rates, as they are, require recalculation and if so, in what direction. Based on the responses received, more than 75% of the respondents felt that the current NPV values are either slightly underestimated or highly underestimated and need upward revision (See Figure 4). Some of the major issues from the side of forest department and user agencies identified through the survey are listed in

Table 7 and Appendix 36. The views of forest department were fairly equally divided on issues such as time period for calculating NPV (a blanket time period of 20 years or site-specific estimate), and the need for separate estimation and regulating agency for NPV, devolution of CAMPA funds to state and local levels. With respect to user agencies, most of the respondents raised their concerns over the process of calculation and collection of NPV in terms of time taken and transparency.

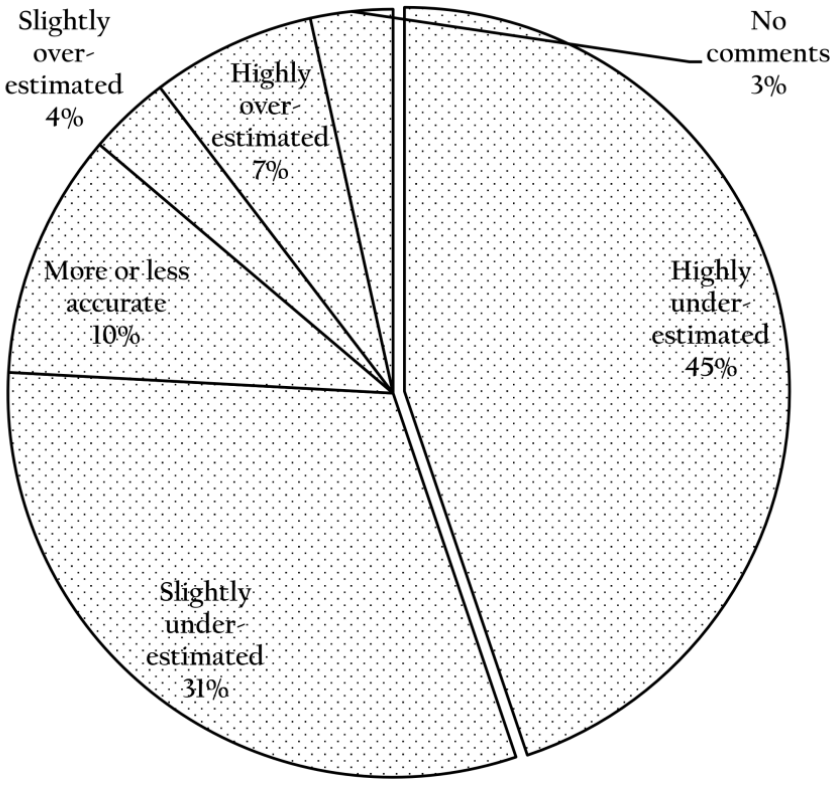

Figure 4 – Stakeholder views on the current value of NPV charged for forest diversion (n=29)

Table 7 – Major concerns among provider and user agencies with respect to NPV rates estimation

Issues from forest department	Issues from user agencies
Change of extent in land use by the proposed non-forest activity should be part of NPV calculation	Deferred payments for NPV charge should be allowed
Dependency of local communities on diverted forest area needs to be accounted for	Positive externalities from a project should be included in NPV calculation
Absence of biodiversity values in NPV and issues of critical wildlife corridors and breeding areas	NPV should be project-specific based on its impact on forests[9]
Absence of Trees Outside Forests (TOF) in NPV estimation	User agencies should be involved in activities undertaken at local level through the CAMPA fund
Differential land rent based on proximity to urban area should be charged	Land for Compensatory Afforestation should be decided by the Forest Department
Fragmentation of forest area at a landscape level should be an integral part of NPV	Projects that change the land use permanently should be charged higher rates
The procedure for NPV calculation should be simple	Need for a single payment window for forest clearance process to avoid delay
	Issues of delay and transparency in NPV calculation and collection

[9] Since the enactment of Forest Conservation Act in 1980, forest area diverted till 2012, including both final approval and in-principal approvals, is about 1.15 million hectare. This does not include forest lands diverted under general approvals given by MoEF for creation of critical public utility infrastructure of specified categories in forest fringe areas and the LWE affected districts. Within this, about 5.2 lakh hectare was diverted for regularization of encroachments, delisting of PLPA lands, conversion of forest villages, etc. The forest land diverted for developmental activities such as mining, hydel, road and other infrastructure is estimated to be about 6.3 lakh hectare (Bansal 2013).

4.2 Valuation of Ecosystem Services from forests

4.2.1 Departure from 2006 study methodology

The study recognizes that forest ecosystems provide many more goods and services than those used for estimation of NPV in the 2006 NPV Expert Committee and the subsequent CEC recommendation report. In an attempt to expand this calculus to make the NPV rates more representative of the economic value of forests, many other goods and services have been included in this study. However, caution has been used not to include those goods and services for which either datasets are unreliable or methodologies are inconsistent. Table 8 below provides a snapshot of forest goods and services used for estimating of economic value of forests in this report. In addition to simplifying calculations, specific cost factors (See Table 25) are used for each goods and services to account for costs incurred in various activities such as collection, transportation and management to obtain the net value estimations.

Table 8 – Comparison of forest goods and services valued in current and past studies for NPV estimation of forest diversion

Forest goods and services	2006 NPV Expert Committee	CEC Recommendations	Current Study
Timber	☑	☑	☑
Fuelwood	☑	☑	☑
Fodder	☑	☑	☑
NWFP	☑	☑	☑
Carbon storage	☑	☑	☑
Eco-tourism	☑	☑	☒
Watershed benefits	☑	☑	☒
Biodiversity	☑	☑	☒
Carbon sequestration	☒	☑	☑
Gene-pool conservation (Bioprospecting)	☒	☑	☑
Flagship species	☒	☑	☒
Bamboo	☒	☒	☑
Pollination& seed dispersal	☒	☒	☑
Water purification	☒	☒	☑
Soil conservation	☒	☒	☑
Water recharge	☒	☒	☑

There are four ecosystem services from forests which have been valued in the 2006 NPV Expert Committee and subsequent supplementary report by CEC for estimation of NPV rates of forest diversion but are excluded in the current study. These include eco-tourism, watershed benefits, biodiversity and flagship species. This has been done

consciously due to following reasons. Firstly, there has been a major change in the area of ecological economics where eco-tourism is now replaced by a much more holistic concept of landscape values which includes aesthetic beauty. In addition, eco-tourism in India is limited primarily to protected areas (PAs) which do not directly qualify under the ambit of NPV calculations since such area in PA's are not to be diverted to non-forest purposes under normal circumstances. Recognizing these facts, the eco-tourism/landscape values of forests have not been estimated in the study. Secondly, watershed benefits accounted by the 2006 NPV Expert Committee were mainly associated with soil conservation and hydrological functions of forests and were estimated using 'benefits transfer' approach. Recognizing the uncertainty of this method and the relative large contribution of watershed benefits to the final NPV estimate, the current study has made an attempt to value these two services – soil conservation and water recharge based on more reliable economic valuation methodologies and primary datasets in place of watershed benefits. Thirdly, the current study made intense effort to determine objective parameters based on which the economic value of biodiversity can be captured but could not find any scientific indicator for the same. While part of the biodiversity benefits are visible in other ecosystem services such as gene-pool conservation, pollination and seed dispersal or soil conservation, the current study recognizes the large uncertainty associated with a direct valuation of biodiversity in the light of limitations with regards to appropriate datasets and valuation methodologies. This has also been acknowledged by the international study on economics of ecosystems and biodiversity which concludes that our ability to assess the benefits from an ecosystem is severely limited by lack of information at several levels and our inadequate understanding of "production functions" operating at ecological level among others (TEEB 2010). Lastly, the economic value of flagship species as used in the CEC report has not been used in the current study based on the argument that most of the flagship species are found in protected areas which do not directly come under the ambit of NPV calculations. For protected areas, separate recommendations are provided in Section 4.2.3.3 for determining the NPV rates applicable in case of forest diversion after due approval from the Hon'ble Supreme Court.

4.2.2 Valuation of Individual Services

4.2.2.1 Timber/Wood production

While green felling is regulated in India following the Hon'ble Supreme Court order, timber continues to be one of the most readily marketable benefits from forests. Although after the National Forest Policy of 1952 & 1988, forests in India are not specifically managed with the goal of timber production, it is important to recognize that the economic value of timber production from forests of India is significant.

One of the areas of confusion regarding calculation of NPV that was identified during the consultation meetings and National Consultation Workshop was the inclusion of timber value in NPV. It is important to clarify here that when forests are diverted, the standing timber is cleared by the concerned state forest department and its economic value is not included in the NPV. The economic value of timber included in NPV calculation relates to the potential timber production that would have occurred if the land would have continued to be used for forestry purposes.

The 2006 NPV Expert Committee Report on NPV suggested valuing timber benefits from forests based on the stumpage value. While the methodology has its advantages in terms of simplified assumptions and calculations, it ignores a vital aspect of timber production in India – its under-reporting. In an attempt to address this concern and use most recent data on timber production in India, the study uses growing stock estimates in different forest type groups of India further classified by canopy cover density classes. These estimates are sourced from the Forest Inventory Data of the Forest Survey of India. Von Mantel's formula (Armitage 1998), a conservative approach of yield determination, has been subsequently used to derive mean annual increment in these classification units on the basis of rotation period estimated for each forest type group earlier in Table 6. Further, a very conservative 50% cost factor has been applied on the market value of timber to account for costs of bringing timber to maturity along with other costs such as transportation, for getting at in-situ value of timber. The estimated market price of timber were sourced from the latest issue of Timber and Bamboo Trade Bulletin published by the ICFRE (ICFRE 2011). The final estimates of economic value of timber so obtained are presented in Table 9. Estimates of growing stock and other calculations can be found in Appendix 5.

Table 9 – Economic value of timber production

Forest Type Group / Value of timber (₹ /ha/yr)	VDF	MDF	OF	LTF
Tropical Wet Evergreen Forests – North East	₹ 1,86,148	₹ 94,393	₹ 64,733	₹ 6,370
Tropical Wet Evergreen Forests – Western Ghats	₹ 2,40,183	₹ 1,56,800	₹ 36,061	₹ 6,688
Tropical Semi Evergreen Forests - North East	₹ 77,299	₹ 66,394	₹ 26,604	₹ 11,022
Tropical Semi Evergreen Forests - Eastern Deccan	₹ 1,66,836	₹ 1,24,885	₹ 13,037	₹ 6,490
Tropical Semi Evergreen Forests - Western Ghats	₹ 1,49,128	₹ 77,376	₹ 30,482	₹ 5,428
Tropical Moist Deciduous Forests	₹ 1,24,682	₹ 64,627	₹ 25,884	₹ 2,615
Littoral & Swamp Forests	₹ 1,84,491	₹ 1,01,498	₹ 29,997	₹ 4,849
Tropical Dry Deciduous Forests	₹ 60,058	₹ 41,198	₹ 15,346	₹ 1,707
Tropical Thorn Forests	₹ 35,367	₹ 12,637	₹ 13,223	₹ 1,727
Tropical & Subtropical Dry Evergreen Forests	₹ 1,17,247	₹ 82,836	₹ 31,992	₹ 717
Subtropical Pine/Broadleaved Hill Forests	₹ 96,794	₹ 70,688	₹ 32,170	₹ 1,237
Montane & Moist Temperate Forest	₹ 1,51,103	₹ 1,14,471	₹ 48,058	₹ 1,114

Forest Type Group / Value of timber (₹ /ha/yr)	VDF	MDF	OF	LTF
Sub Alpine & Dry Temperate Forest	₹ 1,13,507	₹ 95,347	₹ 39,892	₹ 1,008
Alpine Scrub	₹ 79,263	₹ 72,642	₹ 22,976	₹ 1,195

4.2.2.2 Bamboo production

The 2006 NPV Expert Committee Report did not account for the value of bamboo production in the calculation of NPV for forest diversion. However, reliable datasets are now available on bamboo production which has been used in this study. As in the case of timber, biomass of bamboo in different classified units is obtained from the Forest Inventory Data of The Forest Survey of India. Assuming an average rotation period of 4 years, Von Mantel's formula is used to estimate the mean annual production of bamboo from the bamboo biomass estimates. A cost factor of 20% is used to obtain the cost-adjusted price of bamboo from the market price of bamboo on account of factors such as high proportion of use by local communities and opportunity cost of bamboo extraction & transportation cost to local communities. The final estimates of economic value of bamboo production are presented in Table 10 and the detailed datasets and estimation methodology are shown in Appendix 6.

Table 10 – Economic value of bamboo production

Forest Type Group / Value of bamboo (₹ /ha/yr)	VDF	MDF	OF	LTF
Tropical Wet Evergreen Forests – North East	₹ 21,995	₹ 593	₹ 22,569	₹ -
Tropical Wet Evergreen Forests – Western Ghats	₹ -	₹ 1,302	₹ 942	₹ -
Tropical Semi Evergreen Forests - North East	₹ 11,999	₹ 3,784	₹ 3,309	₹ 3,836
Tropical Semi Evergreen Forests - Eastern Deccan	₹ -	₹ -	₹ -	₹ -
Tropical Semi Evergreen Forests - Western Ghats	₹ 191	₹ 3,826	₹ 6,006	₹ 5,103
Tropical Moist Deciduous Forests	₹ 5,356	₹ 9,236	₹ 6,663	₹ 529
Littoral & Swamp Forests	₹ -	₹ -	₹ -	₹ -
Tropical Dry Deciduous Forests	₹ 23,376	₹ 4,274	₹ 909	₹ 275
Tropical Thorn Forests	₹ -	₹ 4,627	₹ 1,076	₹ 250
Tropical & Subtropical Dry Evergreen Forests	₹ 6,622	₹ 2,251	₹ 3,268	₹ 353
Subtropical Pine/Broadleaved Hill Forests	₹ 142	₹ 1,320	₹ 843	₹ -
Montane& Moist Temperate Forest	₹ 420	₹ 228	₹ 56	₹ -
Sub Alpine & Dry Temperate Forest	₹ 4,023	₹ -	₹ -	₹ -
Alpine Scrub	₹ 27,648[10]	₹ -	₹ -	₹ -

[10]This value is estimated from the information which is gathered from the sample plots laid by FSI and it represents also the biomass by some other tree species that would have grown.

4.2.2.3 Fodder production

Forests are one of the most important sources of fodder for people involved in livelihoods associated with livestock. A significant proportion of cattle used in livestock management are grazed in forests. The 2006 NPV Expert Committee estimated the value of fodder production from forests based on data obtained from the NSSO 54th Round Survey on Common Property Resources in India conducted in 1999. Apart from the fact that the data is relatively old now, a major limitation of using that data is that it is based on consumption figures which are known to be severely underestimated in India.

A recent study conducted by the Forest Survey of India found that more than 86 million Adult Cattle Units (ACUs) are completely dependent on forests for fodder requirements (FSI 2011b). The study provides state-level estimates on the number of ACUs completely dependent on forests for fodder. Based on standard fodder requirements for each ACU (22 kg./ACU/day), the total consumption of fodder from forests is estimated (R. Pandey 2011). Again, assuming a 10% cost factor on market price of fodder, cost-adjusted price of fodder is obtained which is finally used in the estimation of economic value of fodder production from forests in each state. These economic value estimates are further converted to economic value of fodder production in different forest type groups of India based on the proportion of area under different forest type groups in each state (See Appendix 1). Based on ease of access to forests under different canopy cover density classes, it is assumed here that the economic value of fodder production is same across all forest canopy cover density classes. The final estimates for economic value of fodder production from forests thus estimated are shown in Table 11 and the detailed datasets and methodology are presented in Appendix 7 and Appendix 8.

Table 11 – Economic value of fodder production

Forest Type Group / Value of fodder (₹ /ha/yr)	VDF	MDF	OF	LTF
Tropical Wet Evergreen Forests – North East	₹ 5,974	₹ 5,974	₹ 5,974	₹ 5,974
Tropical Wet Evergreen Forests – Western Ghats	₹ 3,583	₹ 3,583	₹ 3,583	₹ 3,583
Tropical Semi Evergreen Forests - North East	₹ 2,496	₹ 2,496	₹ 2,496	₹ 2,496
Tropical Semi Evergreen Forests - Eastern Deccan	₹ 42,589	₹ 42,589	₹ 42,589	₹ 42,589
Tropical Semi Evergreen Forests - Western Ghats	₹ 8,866	₹ 8,866	₹ 8,866	₹ 8,866
Tropical Moist Deciduous Forests	₹ 8,753	₹ 8,753	₹ 8,753	₹ 8,753
Littoral & Swamp Forests	₹ 26,770	₹ 26,770	₹ 26,770	₹ 26,770
Tropical Dry Deciduous Forests	₹ 12,535	₹ 12,535	₹ 12,535	₹ 12,535
Tropical Thorn Forests	₹ 11,973	₹ 11,973	₹ 11,973	₹ 11,973
Tropical & Subtropical Dry Evergreen Forests	₹ 7,818	₹ 7,818	₹ 7,818	₹ 7,818
Subtropical Pine/Broadleaved Hill Forests	₹ 4,514	₹ 4,514	₹ 4,514	₹ 4,514
Montane& Moist Temperate Forest	₹ 6,236	₹ 6,236	₹ 6,236	₹ 6,236

Forest Type Group / Value of fodder (₹ /ha/yr)	VDF	MDF	OF	LTF
Sub Alpine & Dry Temperate Forest	₹ 3,136	₹ 3,136	₹ 3,136	₹ 3,136
Alpine Scrub	₹ 4,118	₹ 4,118	₹ 4,118	₹ 4,118

4.2.2.4 NWFPs

The importance of NWFPs for local forest communities cannot be underscored. The non-timber products play a very important role in the livelihoods of these communities. While absolute estimates about the contribution of NWFPs to an average family income vary, studies unequivocally suggest that NWFPs often contribute a very significant part to the total family income of forest dependent communities. The 2006 NPV Expert Committee deduced the value of NWFP production from forests based on data obtained from the NSSO 54th Round Survey on Common Property Resources in India conducted in 1999. Again as argued in the estimation of fodder production from India, a major limitation of using this data is that it is based on consumption figures which are known to be severe underestimates.

To obtain a more realistic estimate of NWFP production from forests, the study estimates the production potential of 12 major NWFPs (bel, neem, chironji, tendu patta, aonla, mahua, karanj, kusum, sal, imli, bahera & harad) from forests. Average annual production figures per tree of each along with their market price were collected from various sources (See Appendix 9). These were used in conjunction with forest inventory data from the Forest Survey of India which provided the number of trees of each of these 12 major NWFPs per hectare. As the market prices used for these NWFPs were derived from a study which estimates them on the basis of market prices in major cities, a cost factor of 50% was used to account for low price fetched at the local market for many of these NWFPs and the opportunity cost to collect them. The values were finally aggregated for each of the classification unit. The economic value for NWFP thus estimated is shown in Table 12 and the detailed datasets and methodology can be found in Appendix 9.

Table 12 – Economic value of NWFP

Forest Type Group / Value of NWFP (₹ /ha/yr)	VDF	MDF	OF	LTF
Tropical Wet Evergreen-North East	₹ 4,263	₹ 222	₹ -	₹ -
Tropical Wet Evergreen-Western Ghats	₹ 13,059	₹ 11,714	₹ 5,600	₹ 1,364
Tropical Semi Evergreen-North East	₹ 893	₹ 1,781	₹ 1,942	₹ -
Tropical Semi Evergreen-Eastern Deccan	₹ 30,480	₹ 27,794	₹ -	₹ -
Tropical Semi Evergreen-Western Ghats	₹ 12,405	₹ 13,408	₹ 8,024	₹ -
Tropical Moist Deciduous Forests	₹ 13,411	₹ 16,753	₹ 7,212	₹ 798
Littoral & Swamp Forests	₹ 12,600	₹ 10,853	₹ 5,240	₹ -
Tropical Dry Deciduous Forests	₹ 17,074	₹ 17,026	₹ 7,754	₹ 930

Forest Type Group / Value of NWFP (₹ /ha/yr)	VDF	MDF	OF	LTF
Tropical Thorn Forest	₹ -	₹ 11,421	₹ 5,344	₹ 895
Tropical & Subtropical Dry Evergreen Forests	₹ 10,364	₹ 7,961	₹ 4,618	₹ 706
Subtropical Pine/Broadleaved Hill Forests	₹ 249	₹ 1,657	₹ 1,825	₹ -
Montane& Moist Temperate Forest	₹ 232	₹ 100	₹ -	₹ -
Sub Alpine & Dry Temperate Forest	₹ -	₹ -	₹ -	₹ -
Alpine Scrub	₹ -	₹ -	₹ -	₹ -

4.2.2.5 Fuelwood

Fuelwood is the main-stay of rural population of India for cooking, along with other household and non-agricultural uses. NSSO 54th Round data revealed that more than half of the fuelwood requirement of the country is met from forests. While many surveys have been conducted to estimate the fuelwood consumption from forests, most suffer in failing to account for substantial quantum of unauthorized removal of fuelwood that goes unreported. The percentage of actual fuelwood consumption in the country to that which is actually reported is only about 10% (Chakravarti 1985).

The 2006 NPV Expert Committee demonstrated the value of fuelwood production from forests based on data obtained from the NSSO 54th Round Survey on Common Property Resources in India conducted in 1999. However, a recently completed study by Forest Survey of India has estimated state-wise consumption of fuelwood from forests (FSI 2011b). To account for unauthorized removal of fuelwood, it is conservatively assumed here that only 50% of the fuelwood consumed from forests was actually recorded in the FSI study. Economic value of fuelwood production from forests is estimated for various states based on the modified consumption estimates, market price of fuelwood (ICFRE 2011) and a cost factor of 10% to obtain the cost-adjusted price of fuelwood. Similar to the methodology followed for economic valuation of fodder production, economic value of state-wise fuelwood production is allocated to different forest type groups based on the proportion of area under different forest type groups in each state (See Appendix 1). As assumed in fodder production, it is again assumed here that based on ease of access to forests under different canopy cover density classes, the economic value of fuelwood production is same across all forest canopy cover density classes. The final estimates for economic value of fuelwood production from forests are shown in Table 13 and the detailed datasets and methodology is presented in Appendix 10 and Appendix 11.

Table 13 – Economic value of fuelwood production

Forest Type Group / Value of fuelwood (₹ /ha/yr)	VDF	MDF	OF	LTF
Tropical Wet Evergreen Forests – North East	₹ 3,564	₹ 3,564	₹ 3,564	₹ 3,564

Forest Type Group / Value of fuelwood (₹ /ha/yr)	VDF	MDF	OF	LTF
Tropical Wet Evergreen Forests – Western Ghats	₹ 7,784	₹ 7,784	₹ 7,784	₹ 7,784
Tropical Semi Evergreen Forests - North East	₹ 1,622	₹ 1,622	₹ 1,622	₹ 1,622
Tropical Semi Evergreen Forests - Eastern Deccan	₹ 38,593	₹ 38,593	₹ 38,593	₹ 38,593
Tropical Semi Evergreen Forests - Western Ghats	₹ 7,350	₹ 7,350	₹ 7,350	₹ 7,350
Tropical Moist Deciduous Forests	₹ 4,230	₹ 4,230	₹ 4,230	₹ 4,230
Littoral & Swamp Forests	₹ 24,121	₹ 24,121	₹ 24,121	₹ 24,121
Tropical Dry Deciduous Forests	₹ 5,320	₹ 5,320	₹ 5,320	₹ 5,320
Tropical Thorn Forests	₹ 7,794	₹ 7,794	₹ 7,794	₹ 7,794
Tropical & Subtropical Dry Evergreen Forests	₹ 4,348	₹ 4,348	₹ 4,348	₹ 4,348
Subtropical Pine/Broadleaved Hill Forests	₹ 3,385	₹ 3,385	₹ 3,385	₹ 3,385
Montane & Moist Temperate Forest	₹ 3,921	₹ 3,921	₹ 3,921	₹ 3,921
Sub Alpine & Dry Temperate Forest	₹ 2,246	₹ 2,246	₹ 2,246	₹ 2,246
Alpine Scrub	₹ 3,022	₹ 3,022	₹ 3,022	₹ 3,022

4.2.2.6 Carbon sequestration

While the 2006 NPV Expert Committee Report estimated the value of existing carbon storage, it did not suggest to estimate the value of carbon sequestration services from forests in India. Drawing an analogy from timber, while carbon stock relates to the standing timber whose value is being accounted for, carbon sequestration relates to the potential timber production that cannot be neglected too. Forests sequester large amounts of CO_2 while mitigating the perilous impacts of climate change. When forests are diverted, this ability to sequester CO_2 is severely paralyzed. The amount of CO_2 which would have been sequestered had the forests not been diverted have a social cost which needs to be accounted for in NPV calculation.

Table 14 presents the ranges for social cost of carbon and CO_2 for India estimated by a recent study (Nordhaus 2011). As the diversion of forests has a longer time horizon, a low discount rate is being applied. Average social costs in US$ per ton of CO_2 rates with a low discount rate for the years 2015 (5.47), 2025 (10.12) and 2035 (14.47) are used for India as a whole. This average works out to be approximately equal to US$ 10 / tCO_2.

Table 14 – Social cost of carbon for India (Nordhaus 2011)

All estimates in 2005 US$	Base Run			Low Discount Rate Run		
Model Year	**2015**	**2025**	**2035**	**2015**	**2025**	**2035**
Social cost of 1 ton of carbon	7.98	16.91	26.03	20.11	37.17	53.13
Social cost of 1 ton of CO_2	2.17	4.60	7.09	5.47	10.12	14.47

To estimate the amount of CO_2 that would be sequestered for different classification units used in this study, biomass estimates from the Forest Inventory of The Forest Survey of India have been used (FSI 2013c). The biomass estimates have been used along with the

default IPCC values to estimate the rates of carbon sequestration in different classification units. The average social cost of CO_2 (US$ 10 / tCO_2) is subsequently utilized to estimate the economic value of carbon sequestration. The final value estimates are as shown in Table 15 and the datasets and methodology can be found in Appendix 12.

Table 15 –Economic value of carbon sequestration services

Forest Type Groups / Value of carbon sequestration services (₹ /ha/year)	VDF	MDF	OF	LTF
Tropical Wet Evergreen-North East	₹ 6,970	₹ 3,910	₹ 2,579	₹ 517
Tropical Wet Evergreen-Western Ghats	₹ 9,937	₹ 6,113	₹ 1,943	₹ 424
Tropical Semi Evergreen-North East	₹ 3,074	₹ 2,820	₹ 1,179	₹ 612
Tropical Semi Evergreen-Eastern Deccan	₹ 17,484	₹ 4,845	₹ 2,362	₹ 513
Tropical Semi Evergreen-Western Ghats	₹ 5,975	₹ 3,517	₹ 1,479	₹ 413
Tropical Moist Deciduous Forests	₹ 4,964	₹ 3,006	₹ 1,323	₹ 304
Littoral & Swamp Forests	₹ 8,736	₹ 3,729	₹ 1,207	₹ 623
Tropical Dry Deciduous Forests	₹ 3,361	₹ 2,442	₹ 1,150	₹ 488
Tropical Thorn Forest	₹ 2,055	₹ 1,058	₹ 923	₹ 326
Tropical & Subtropical Dry Evergreen Forests	₹ 4,860	₹ 3,446	₹ 1,516	₹ 134
Subtropical Pine/Broadleaved Hill Forests	₹ 4,003	₹ 2,889	₹ 1,244	₹ 234
Montane & Moist Temperate Forest	₹ 5,357	₹ 3,854	₹ 1,661	₹ 79
Sub Alpine & Dry Temperate Forest	₹ 3,394	₹ 3,421	₹ 1,361	₹ 124
Alpine Scrub	₹ 2,980	₹ 2,669	₹ 1,424	₹ 89

4.2.2.7 Gene-pool conservation

At the backdrop of increasing species extinction rates across the globe, the role of forests in conserving species that may have future economic value is increasingly being recognized. This insurance value of forests relates to the option value in the Total Economic Value framework. While this is still an area of evolving research, state-wise estimates for economic value of gene-pool conservation in terms of bioprospecting are available for India (Gundimeda et al. 2006). While the study provides NPV of economic value of gene-pool conservation for different states in India based on three different parameters namely 1) number of medicinal plants found in each state; 2) number of species of conservation importance in each state; and 3) all species in each state, the current study uses the estimates based on all species in the state. Based on the methodology used for converting state-wise figures to estimates for Forest Type Groups as used for fodder and fuelwood production, state-wise economic value of gene-pool conservation is allocated to different forest type groups based on the proportion of area under different forest type groups in each state (See Appendix 1). Owning to limited data for canopy cover density classes, the economic value of gene-pool conservation is taken as the same across

all forest canopy cover density classes. The final estimates for economic value of gene-pool conservation from forests are shown in Table 16 and the detailed datasets and methodology is presented in Appendix 13 and Appendix 14.

It should be noted that unlike other goods and services discussed till now, the estimates of gene-pool conservation relate to NPV figures rather than annual figures.

Table 16 – Economic value of gene-pool conservation

Forest Type Group / Value of gene-pool conservation (₹ /ha)	VDF	MDF	OF	LTF
Tropical Wet Evergreen Forests – North East	₹ 1,58,096	₹ 1,58,096	₹ 1,58,096	₹ 1,58,096
Tropical Wet Evergreen Forests – Western Ghats	₹ 2,25,856	₹ 2,25,856	₹ 2,25,856	₹ 2,25,856
Tropical Semi Evergreen Forests - North East	₹ 83,998	₹ 83,998	₹ 83,998	₹ 83,998
Tropical Semi Evergreen Forests - Eastern Deccan	₹ 4,87,340	₹ 4,87,340	₹ 4,87,340	₹ 4,87,340
Tropical Semi Evergreen Forests - Western Ghats	₹ 1,79,680	₹ 1,79,680	₹ 1,79,680	₹ 1,79,680
Tropical Moist Deciduous Forests	₹ 1,04,940	₹ 1,04,940	₹ 1,04,940	₹ 1,04,940
Littoral & Swamp Forests	₹ 3,01,806	₹ 3,01,806	₹ 3,01,806	₹ 3,01,806
Tropical Dry Deciduous Forests	₹ 67,852	₹ 67,852	₹ 67,852	₹ 67,852
Tropical Thorn Forests	₹ 1,32,078	₹ 1,32,078	₹ 1,32,078	₹ 1,32,078
Tropical & Subtropical Dry Evergreen Forests	₹ 1,64,378	₹ 1,64,378	₹ 1,64,378	₹ 1,64,378
Subtropical Pine/Broadleaved Hill Forests	₹ 2,11,287	₹ 2,11,287	₹ 2,11,287	₹ 2,11,287
Montane & Moist Temperate Forest	₹ 1,74,512	₹ 1,74,512	₹ 1,74,512	₹ 1,74,512
Sub Alpine & Dry Temperate Forest	₹ 1,61,493	₹ 1,61,493	₹ 1,61,493	₹ 1,61,493
Alpine Scrub	₹ 2,26,953	₹ 2,26,953	₹ 2,26,953	₹ 2,26,953

4.2.2.8 Pollination and seed dispersal

The 2006 NPV Expert Committee did not consider the value of pollination and seed dispersal services from forests in India. The current study however acknowledges their importance in a country such as India where majority of the workforce is dependent on agriculture for their livelihoods. The impact of degradation of such services has also been greatly felt in India (including impact on apple production in Himachal Pradesh) due to shrinking of forests. The economic value of pollination and seed dispersal service has been estimated in the current study based on natural forest regeneration and its replacement cost if done artificially according to the model cost of ₹ 17,100 per hectare as recommended by the National Afforestation Programme Guidelines (NAP 2009). The estimates of natural forest regeneration in all forest type groups classified are further adjusted according to the forest regeneration

in plantations. It may be noted here that the economic value so estimated is limited only to the value of artificially replacing the process of natural forest regeneration and also partly covers the economic value of forest succession. The valuation process, on account of lack of site specific data, ignores a whole range of values associated with the value of pollination and seed dispersal services that forests provide to agricultural fields and orchards in the vicinity. In addition, on account of absence of any reliable estimates for India, it is conservatively assumed here that only 50% of the natural regeneration in forests can be attributed to pollination and seed dispersal services by insects, birds and other animals and the remaining can be attributed to natural processes such as water flow and wind. To account for proximity of agricultural landscapes to less than 10% canopy cover forests and open forests and good habitat for pollinators in moderately dense forest and very dense forest, the same value has been used across different canopy cover density classes. The estimates thus derived for the economic value of pollination and seed dispersal services can be found in Table 17 and the detailed calculations can be seen in found in Appendix 15.

Table 17 – Economic value of pollination and seed dispersal services

Forest Type Group / Value of pollination and seed dispersal services (₹ /ha/yr)	VDF	MDF	OF	LTF
Tropical Wet Evergreen Forests – North East	₹ 8,913	₹ 8,913	₹ 8,913	₹ 8,913
Tropical Wet Evergreen Forests – Western Ghats	₹ 11,907	₹ 11,907	₹ 11,907	₹ 11,907
Tropical Semi Evergreen Forests - North East	₹ 8,529	₹ 8,529	₹ 8,529	₹ 8,529
Tropical Semi Evergreen Forests - Eastern Deccan	₹ 8,195	₹ 8,195	₹ 8,195	₹ 8,195
Tropical Semi Evergreen Forests - Western Ghats	₹ 12,054	₹ 12,054	₹ 12,054	₹ 12,054
Tropical Moist Deciduous Forests	₹ 10,548	₹ 10,548	₹ 10,548	₹ 10,548
Littoral & Swamp Forests	₹ 8,257	₹ 8,257	₹ 8,257	₹ 8,257
Tropical Dry Deciduous Forests	₹ 10,167	₹ 10,167	₹ 10,167	₹ 10,167
Tropical Thorn Forests	₹ 7,448	₹ 7,448	₹ 7,448	₹ 7,448
Tropical & Subtropical Dry Evergreen Forests	₹ 8,441	₹ 8,441	₹ 8,441	₹ 8,441
Subtropical Pine/Broadleaved Hill Forests	₹ 8,298	₹ 8,298	₹ 8,298	₹ 8,298
Montane & Moist Temperate Forest	₹ 7,268	₹ 7,268	₹ 7,268	₹ 7,268
Sub Alpine & Dry Temperate Forest	₹ 6,879	₹ 6,879	₹ 6,879	₹ 6,879
Alpine Scrub	₹ 10,311	₹ 10,311	₹ 10,311	₹ 10,311

4.2.2.9 Soil conservation

The 2006 NPV Expert Committee refers to the value of watershed services which included the value of soil conservation along with hydrological services from secondary site-specific studies. However, on account of inherent uncertainty in using 'benefit transfer'

method, high contribution of watershed services to the total NPV rates as estimated in the 2006 Expert Committee Report and better availability of data to value these services presently, economic value for soil conservation and water recharge have been separately estimated in the current study. The data for average weight of soil per hectare was obtained from the Forest Inventory data of FSI (FSI 2013c). Conservatively assuming that the in absence of forests, the entire soil will take 100 years to erode, annual soil erosion rates have been estimated have been estimated for all VDF category of all forest type groups. Recognizing the fact that the capacity of forests to prevent soil erosion depends on a significant extent to the canopy of forest cover through which precipitation is intercepted[11], relative weights for different canopy density classes have been calculated to estimate their ability to avoid soil erosion. Based on these relative weights (See Appendix 16), estimate of soil erosion prevented has been calculated for the remaining forest canopy density classes. The quantity of annual soil erosion prevented by forests is thus estimated for all forest type groups and canopy cover density classes.

Based on the quantity of soil erosion prevented by forests, avoided nutrient loss of three major nutrients namely nitrogen, phosphorus, and potassium has been estimated (A. N. Pandey et al. 1984). The concentration of nutrients in run-off used for estimation of loss of nutrients through soil erosion is shown in Appendix 17. The avoided loss of nutrients due to soil conservation by forests is then valued according to the price of fertilizers in the Indian market (Appendix 18). Considering that these fertilizers are provided at subsidized rates, the estimates derived can be regarded as conservative. Based on quantity of nutrients loss avoided by forests via soil conservation and price of each of fertilizers for replacing different nutrients, the estimated total economic value of soil conservation by forests is shown in Table 18 and detailed datasets and calculation steps can be found in Appendix 19.

[11]Other factors include soil type and texture, slope and precipitation. However, these factors have not been included in the estimation methodology due to lack of data.

Table 18 – Economic value of soil conservation

Forest Type Group / Value of soil conservation (₹ /ha/yr)	VDF	MDF	OF	LTF
Tropical Wet Evergreen Forests – North East	₹ 25,590	₹ 16,557	₹ 7,523	₹ 1,510
Tropical Wet Evergreen Forests – Western Ghats	₹ 19,436	₹ 12,575	₹ 5,714	₹ 1,147
Tropical Semi Evergreen Forests - North East	₹ 25,638	₹ 16,587	₹ 7,537	₹ 1,513
Tropical Semi Evergreen Forests - Eastern Deccan	₹ 21,384	₹ 13,836	₹ 6,287	₹ 1,262
Tropical Semi Evergreen Forests - Western Ghats	₹ 16,917	₹ 10,946	₹ 4,974	₹ 998
Tropical Moist Deciduous Forests	₹ 21,076	₹ 13,636	₹ 6,196	₹ 1,243
Littoral & Swamp Forests	₹ 25,400	₹ 16,434	₹ 7,468	₹ 1,499
Tropical Dry Deciduous Forests	₹ 13,947	₹ 9,024	₹ 4,101	₹ 823
Tropical Thorn Forests	₹ 12,807	₹ 8,286	₹ 3,765	₹ 756
Tropical & Subtropical Dry Evergreen Forests	₹ 20,173	₹ 13,052	₹ 5,931	₹ 1,190
Subtropical Pine/Broadleaved Hill Forests	₹ 14,589	₹ 9,439	₹ 4,289	₹ 861
Montane & Moist Temperate Forest	₹ 14,256	₹ 9,224	₹ 4,191	₹ 841
Sub Alpine & Dry Temperate Forest	₹ 14,137	₹ 9,147	₹ 4,156	₹ 834
Alpine Scrub	₹ 21,527	₹ 13,928	₹ 6,329	₹ 1,270

4.2.2.10 Water recharge

As mentioned in Section 4.2.2.9, the 2006 NPV Expert Committee considered the value of hydrological services and soil conservation together as "watershed services". However, on account of reasons mentioned above, the current study has estimated these services separately. The economic value of hydrological services, more specifically, the economic value of water recharge has been estimated in this study based on the simple water balance equation as follows.

$$P = E + R + F + GW$$

where, '*P*' is precipitation, '*E*' is the Evapo-transpiration, '*R*' is the run-off, '*F*' is moisture required to saturate the soil to field capacity and '*GW*' is the ground water recharge. Assuming that '*P*', '*E*' and '*F*' remain the same even when forests are diverted, the contribution of forests to ground water recharge is estimated based on the difference between the run-off rates when forests exists to those when forests are diverted. While site-specific estimates for run-off rates as a percentage of precipitation exists for forests and other land-uses, no such estimates exist for the different forest canopy cover density classes. However, recognizing that canopy cover is an influential factor in ground water recharge, a linear relationship is assumed between the run-off as a percentage of precipitation and the vegetation cover. Estimates for the extreme scenarios i.e. run-off rates in VDF (2% of precipitation) and run-off rates in bare soil (19.6% of precipitation) were obtained from the GIST study (P. Kumar et al. 2006). The run-off rates for MDF, OF and LTF were extrapolated from the linear relationship based on the average canopy cover of 0.55, 0.25

and 0.05 respectively. The run-off rates so estimated were further used to calculate the additional ground water recharge that would happen when forests exist as compared to bare land (See Appendix 20). The estimates for additional ground water recharge attributable to forests are then used in conjunction with the economic value of water (M. D. Kumar et al. 2008) to arrive at the economic value of water recharge services from forests. The final estimates are shown in Table 19 and the detailed dataset and calculations can be found in Appendix 21.

Table 19 – Economic value of water recharge services

Forest Type Group / Value of water recharge (₹ /ha/yr)	VDF	MDF	OF	LTF
Tropical Wet Evergreen Forests – North East	₹ 3,993	₹ 2,470	₹ 1,188	₹ 213
Tropical Wet Evergreen Forests – Western Ghats	₹ 4,365	₹ 2,643	₹ 1,142	₹ 208
Tropical Semi Evergreen Forests - North East	₹ 4,682	₹ 2,645	₹ 1,294	₹ 284
Tropical Semi Evergreen Forests - Eastern Deccan	₹ 3,228	₹ 1,777	₹ 1,433	₹ 213
Tropical Semi Evergreen Forests - Western Ghats	₹ 3,793	₹ 2,357	₹ 978	₹ 217
Tropical Moist Deciduous Forests	₹ 2,878	₹ 2,048	₹ 1,115	₹ 193
Littoral & Swamp Forests	₹ 2,660	₹ 1,411	₹ 674	₹ 181
Tropical Dry Deciduous Forests	₹ 1,951	₹ 1,269	₹ 527	₹ 103
Tropical Thorn Forests	₹ 1,578	₹ 1,270	₹ 472	₹ 82
Tropical & Subtropical Dry Evergreen Forests	₹ 3,261	₹ 2,180	₹ 1,042	₹ 140
Subtropical Pine/Broadleaved Hill Forests	₹ 2,171	₹ 1,340	₹ 796	₹ 181
Montane & Moist Temperate Forest	₹ 1,954	₹ 1,247	₹ 588	₹ 119
Sub Alpine & Dry Temperate Forest	₹ 2,047	₹ 1,176	₹ 536	₹ 115
Alpine Scrub	₹ 2,295	₹ 1,716	₹ 753	₹ 164

4.2.2.11 Carbon storage

The 2006 NPV Expert Committee estimated the value of carbon stored in forests based on its impact on mitigating climate change. However, the value of carbon storage was not included in the CEC Calculations and hence is currently not a part of the NPV rates for forest diversion. Apart from potential carbon that would sequester in forests, the existing carbon stored in forests have an economic value too as it is locking up the carbon from getting released into the atmosphere and add to climate change concerns. When forests are diverted, this storehouse of carbon is also removed with increased likelihood of release of carbon into the atmosphere. For the current study, estimates from a recently conducted study by the Forest Survey of India were utilized for getting the carbon stock in different classification units proposed (FSI 2013b). Based on the social cost of CO_2, the economic value of carbon stored in forests is estimated. It may be noted that the value of carbon storage is a one-time value similar to the economic value of gene-pool conservation and genepool protection discussed in Section 4.2.2.7. Hence this value is added to the NPV

estimated from annual value of all other services. The estimates for economic value of carbon storage are shown in Table 20 and the detailed dataset and calculations can be found in Appendix 22. The study used for obtaining the carbon stock estimates did not estimate the same for the Less than 10% Canopy Cover Category. However, it should be noted that the carbon stock of LTF, especially that in below ground biomass, is significant and often comparable to that of Open Forest (OF). As a result, the carbon stock of LTF for each Forest Type Group has been taken as the carbon stock in Open Forest of associated Forest Type Group. It may also be noted that the rates of carbon release from different carbon pools in forest vary. However, for simplifying the calculations, the current study assumes that all the carbon stored will be released in one-go in case of forest diversion.

Table 20 – Economic value of carbon storage

Forest Type Group / Value of carbon storage (₹ /ha)	VDF	MDF	OF	LTF
Tropical Wet Evergreen Forests – North East	₹ 364,473	₹ 221,981	₹ 188,588	₹ 188,588
Tropical Wet Evergreen Forests – Western Ghats	₹ 400,363	₹ 299,470	₹ 198,378	₹ 198,378
Tropical Semi Evergreen Forests - North East	₹ 413,859	₹ 248,082	₹ 111,754	₹ 111,754
Tropical Semi Evergreen Forests - Eastern Deccan	₹ 379,891	₹ 233,436	₹ 157,910	₹ 157,910
Tropical Semi Evergreen Forests - Western Ghats	₹ 359,717	₹ 233,337	₹ 149,289	₹ 149,289
Tropical Moist Deciduous Forests	₹ 247,685	₹ 189,024	₹ 129,312	₹ 129,312
Littoral & Swamp Forests	₹ 368,318	₹ 230,226	₹ 103,351	₹ 103,351
Tropical Dry Deciduous Forests	₹ 300,064	₹ 270,040	₹ 95,721	₹ 95,721
Tropical Thorn Forests	₹ 101,666	₹ 113,716	₹ 56,144	₹ 56,144
Tropical & Subtropical Dry Evergreen Forests	₹ 285,240	₹ 236,290	₹ 186,230	₹ 186,230
Subtropical Pine/Broadleaved Hill Forests	₹ 308,883	₹ 207,177	₹ 153,788	₹ 153,788
Montane & Moist Temperate Forest	₹ 349,768	₹ 276,976	₹ 176,103	₹ 176,103
Sub Alpine & Dry Temperate Forest	₹ 403,475	₹ 248,756	₹ 171,981	₹ 171,981
Alpine Scrub	₹ 381,774	₹ 233,674	₹ 137,715	₹ 137,715

4.2.2.12 Water purification

Another service for which no reliable data exists on a regional or a national level in India is the contribution of forests in water purification services. Forests filter the precipitation naturally and save millions of Rupees in water purification costs. However when forests are diverted, such natural purification process of water is severely paralyzed. In such cases, the services that forests were providing need to be artificially replaced through artificial water purification units. Not only these units have a high set-up cost, a recurring maintenance cost also needs to be incurred in order to ensure availability of pure water on a continuous basis. Studies from across the globe were identified from the TEEB database that estimated the water purification services of forests (Van der Ploeg & R. S. de Groot 2010). These estimates were further adjusted for GDP (PPP) per capita of

the country for which values were estimated and corresponding currency exchange rate (See Appendix 23 and Appendix 24). The average economic value of water purification services from forest so obtained is ₹ 2950/ha/year (See Table 21). On account of lack of any information to provide estimates for different forest type groups or canopy cover density classes, the study proposes to use a blanket estimate of ₹ 2950/ha/year as the economic value of water purification services for all forest type groups and canopy cover density classes.

Table 21 - Studies used to estimate water purification services from forests (Van der Ploeg & R. S. de Groot 2010)

Country	Estimate	Unit	Adjustment for GDP (PPP) per capita	Adjustment for currency	Estimate in ₹ /ha/yr	Reference
Australia	85	AUD/ha/yr	0.089	56	427	(Perrot-Maître & Patsy Davis 2001)
Spain	109	USD/ha/yr	0.125	54	737	(Brenner-Guillermo 2007)
World	432.5	USD/ha/yr	0.319	54	7469	(CBD 2001)
Southern Europe	76.5	EUR/ha/yr	0.119	71	649	(Croitoru 2007)
U.S.A.	1022	USD/ha/yr	0.076	54	4234	(Kaiser & Roumasset 2002)
Europe	609.4	EUR/ha/yr	0.119	71	5175	(Ministerie van Landbouw & Natuur en Voedselkwaliteit 2006)
China	1268.2	CNY/ha/yr	0.418	9	4771	(Tianhong et al. 2010)
Portugal	18.2	USD/ha/yr	0.163	54	161	(Curz & Benedicto 2009)

Blanket economic value of water purification services from forests = ₹ 2950/ha/year

4.2.2.13 Total Economic Value

Based on simple addition of all the values estimated above, the total economic value of forest goods and services is shown in Table 22.

Table 22 – Total Economic Value of Forests (complete summation)[12]

Total Economic Value – ₹ /ha/yr	VDF	MDF	OF	LTF
Tropical Wet Evergreen Forests – North East	₹ 3,11,123	₹ 1,60,295	₹ 1,34,201	₹ 31,464
Tropical Wet Evergreen Forests – Western Ghats	₹ 3,51,594	₹ 2,42,376	₹ 83,459	₹ 37,146
Tropical Semi Evergreen Forests - North East	₹ 1,72,455	₹ 1,38,262	₹ 68,964	₹ 37,679
Tropical Semi Evergreen Forests - Eastern Deccan	₹ 3,57,220	₹ 2,83,397	₹ 1,17,575	₹ 1,01,772
Tropical Semi Evergreen Forests - Western Ghats	₹ 2,75,612	₹ 1,71,847	₹ 94,699	₹ 45,489

[12]Excludes the economic value of genepool conservation and carbon storage which are one-time values.

Total Economic Value – ₹ /ha/yr	VDF	MDF	OF	LTF
Tropical Moist Deciduous Forests	₹ 2,51,712	₹ 1,63,366	₹ 85,967	₹ 33,354
Littoral & Swamp Forests	₹ 3,97,157	₹ 2,51,118	₹ 1,23,022	₹ 72,115
Tropical Dry Deciduous Forests	₹ 1,65,493	₹ 1,16,356	₹ 64,595	₹ 35,809
Tropical Thorn Forests	₹ 89,859	₹ 72,349	₹ 57,949	₹ 34,635
Tropical & Subtropical Dry Evergreen Forests	₹ 2,13,926	₹ 1,54,957	₹ 79,563	₹ 26,992
Subtropical Pine/Broadleaved Hill Forests	₹ 1,91,515	₹ 1,46,204	₹ 78,354	₹ 22,453
Montane & Moist Temperate Forest	₹ 3,02,874	₹ 2,32,066	₹ 1,09,623	₹ 23,360
Sub Alpine & Dry Temperate Forest	₹ 2,54,797	₹ 2,10,885	₹ 97,320	₹ 18,284
Alpine Scrub	₹ 2,02,030	₹ 1,55,233	₹ 66,099	₹ 23,867

It may be noted that in the 2006 NPV Committee Expert Report it was argued that simply adding up services from forest ecosystems is incorrect since different forests types yield different mix of the services (for the locals, regional and global communities), with the benefits being ecologically determined. It can be argued that the present NPV estimation internalizes this aspect to a certain extent as each of the services is individually estimated for each forest type. But in should also be noted that several of the ecosystem services are complimentary to each other and hence there is also the possibility of double counting of the service benefits. Therefore, the total economic value for forests is estimated based on a notional assumption of percentage of full value relevant for each of the forest goods and services to arrive at a more compatible and simultaneous delivery of ecosystem services. The assumptions are listed in Table 23 and the total economic values estimated based on these assumptions are shown in Table 24.

Table 23 – Assumptions for percentage of full value relevant for each forest goods and services

Goods / service	Percentage of full value relevant
Bamboo	70%
Fodder	100%
Timber	50%
NWFP	70%
Carbon Sequestration	80%
Fuelwood	100%
Gene-pool conservation	70%
Pollination& seed dispersal	70%
Water recharge	80%
Soil conservation	80%
Water purification	50%

Goods / service	Percentage of full value relevant
Carbon storage	80%

Table 24 – Towards Total Economic Value of forests (by adjusting for double counting and simultaneous delivery of ecosystem services)[13]

Total Economic Value – ₹ /ha/yr	VDF	MDF	OF	LTF
Tropical Wet Evergreen Forests – North East	₹ 1,78,772	₹ 93,991	₹ 81,716	₹ 22,988
Tropical Wet Evergreen Forests – Western Ghats	₹ 1,97,052	₹ 1,38,537	₹ 53,832	₹ 27,464
Tropical Semi Evergreen Forests - North East	₹ 1,02,971	₹ 80,975	₹ 42,447	₹ 24,170
Tropical Semi Evergreen Forests - Eastern Deccan	₹ 2,40,290	₹ 1,95,825	₹ 1,04,140	₹ 93,733
Tropical Semi Evergreen Forests - Western Ghats	₹ 1,59,497	₹ 1,05,316	₹ 63,064	₹ 34,818
Tropical Moist Deciduous Forests	₹ 1,47,493	₹ 1,01,457	₹ 57,112	₹ 26,102
Littoral & Swamp Forests	₹ 2,40,606	₹ 1,61,884	₹ 92,650	₹ 63,943
Tropical Dry Deciduous Forests	₹ 1,07,810	₹ 77,390	₹ 46,804	₹ 29,565
Tropical Thorn Forests	₹ 61,365	₹ 54,008	₹ 43,238	₹ 29,289
Tropical & Subtropical Dry Evergreen Forests	₹ 1,26,952	₹ 93,131	₹ 51,781	₹ 21,928
Subtropical Pine/Broadleaved Hill Forests	₹ 1,08,322	₹ 83,875	₹ 47,420	₹ 17,256
Montane & Moist Temperate Forest	₹ 1,65,691	₹ 1,27,735	₹ 63,635	₹ 18,541
Sub Alpine & Dry Temperate Forest	₹ 1,39,036	₹ 1,14,532	₹ 54,901	₹ 13,563
Alpine Scrub	₹ 1,20,739	₹ 89,210	₹ 41,483	₹ 18,038

4.2.2.14 Net Present Value

[13]Excludes the economic value of genepool conservation and carbon storage which are one-time values.

The Net Present Value (NPV) is computed using the following formula:

$$NPV = \sum_{t=1}^{N} \frac{B_t - C_t}{(1+r)^t}$$

Where B_t and C_t are the annual benefits and costs from forests in the present state in year 't' respectively, 'N' is the number of years for which this annual benefit from forest will accrue, and 'r' is the social rate of discount.

As already mentioned during the estimation of individual forest goods and services, cost factors have been assumed in the study to simplify calculations. The summary of cost factors used in this report is as shown in Table 25.

Table 25 – Cost factor assumed for various forest goods

Forest goods	Cost factor	Basis
Timber	50%	High transportation and maturity costs
Bamboo	20%	High local usage
Fodder	10%	Opportunity cost of labour
NWFPs	50%	Opportunity cost of labour, low value addition
Fuelwood	10%	Opportunity cost of labour

Based on these cost factors, the benefits have been appropriately discounted and the discounted net annual benefits as calculated in Table 22 and Table 24 include the economic value of goods and services from forests. While the study assumes that the current benefits will remain the same in future for any given forest type and canopy cover density class (to simplify calculations), it is important to note that if and when the overall area under forests decline (attributable to forest conversions), the value from a given plot of forest would go up, reflecting the scarcity value of forests. 'N' is the time horizon in years over which the calculations are made. This needs to be closely linked to length of time needed to regenerate the same type and quality of forests. In its judgment dated 26th Sept, 2005 (page 10, Para 4), the Hon'ble Supreme Court suggested that the basis for calculation of NPV should be the economic value spread over a period of 50 years, which would be the re-generational value for forest regeneration. Based on the recommendations' of CEC, a social discount rate of 4% was also accepted. This study recognized that, forests consist of both renewable (timber, fuelwood, fodder etc.) and non-renewable natural resources (carbon sink, biodiversity, minerals etc). While the discount rates for non-renewable can be as low as 1-2%, that for renewable resources can be much higher. The relevant discount rate for forests as a whole therefore has to be some weighted average of these two. Accordingly, the social rate of discount of 4% as currently accepted by the Hon'ble Supreme Court for estimation of NPV is retained for the calculation (see also an extract from a commentary by Dr. T. C. A. Anant on social rate of discount submitted to the CEC's Supplementary Report is attached in Appendix 25 for further reference).

Based on the type of rotation period used for calculation of NPV rates (forest type group specific or a blanket value across all forest type groups) and the type of total economic value used (complete or relevant summation), the NPV rates for four scenarios are presented

here. The rotation period used in Scenarios 1 and 2 are based on specific rotation periods estimated for each forest type group as referred in Section 3.4.2. For Scenarios 3 and 4, an average rotation period of 60 years, as estimated from the average rotation period of all forest type groups has been used for estimation of NPV of forest diversion.

4.2.2.14.1 Scenario 1 – NPV rates based on Forest Type Group specific rotation period, 4% rate of discount and Total Economic Value based on complete summation

Table 26 – NPV Estimates (Scenario 1)

NPV (in ₹ Lakhs/ha)	VDF	MDF	OF	LTF
Tropical Wet Evergreen Forests – North East	₹ 64.8	₹ 34.6	₹ 29.9	₹ 10.1
Tropical Wet Evergreen Forests – Western Ghats	₹ 74.3	₹ 52.5	₹ 21.1	₹ 12.1
Tropical Semi Evergreen Forests - North East	₹ 36.9	₹ 28.5	₹ 15.1	₹ 9.5
Tropical Semi Evergreen Forests - Eastern Deccan	₹ 80.5	₹ 64.7	₹ 31.4	₹ 28.3
Tropical Semi Evergreen Forests - Western Ghats	₹ 55.3	₹ 36.6	₹ 22.2	₹ 13.2
Tropical Moist Deciduous Forests	₹ 49.1	₹ 34.1	₹ 19.5	₹ 9.7
Littoral & Swamp Forests	₹ 75.7	₹ 51.0	₹ 28.9	₹ 20.2
Tropical Dry Deciduous Forests	₹ 37.1	₹ 26.9	₹ 15.1	₹ 9.5
Tropical Thorn Forests	₹ 20.4	₹ 17.8	₹ 14.0	₹ 9.4
Tropical & Subtropical Dry Evergreen Forests	₹ 45.7	₹ 34.0	₹ 19.4	₹ 9.4
Subtropical Pine/Broadleaved Hill Forests	₹ 37.2	₹ 29.0	₹ 17.7	₹ 8.7
Montane & Moist Temperate Forest	₹ 51.2	₹ 40.0	₹ 21.3	₹ 8.9
Sub Alpine & Dry Temperate Forest	₹ 42.3	₹ 34.0	₹ 18.1	₹ 7.5
Alpine Scrub	₹ 42.3	₹ 30.7	₹ 15.8	₹ 9.1
Average	**₹ 50.9**	**₹ 36.7**	**₹ 20.7**	**₹ 11.8**

4.2.2.14.2 Scenario 2 – NPV rates based on Forest Type Group specific rotation period, 4% rate of discount and Total Economic Value based on adjusting for double counting and simultaneous delivery of ecosystem services

Table 27 – NPV Estimates (Scenario 2)

NPV (in ₹ Lakhs/ha)	VDF	MDF	OF	LTF
Tropical Wet Evergreen Forests – North East	₹ 38.9	₹ 21.3	₹ 19.0	₹ 7.5
Tropical Wet Evergreen Forests – Western Ghats	₹ 43.3	₹ 31.3	₹ 14.2	₹ 9.0
Tropical Semi Evergreen Forests - North East	₹ 23.6	₹ 17.8	₹ 9.9	₹ 6.5
Tropical Semi Evergreen Forests - Eastern Deccan	₹ 55.6	₹ 45.7	₹ 27.0	₹ 24.9
Tropical Semi Evergreen Forests - Western Ghats	₹ 33.9	₹ 23.7	₹ 15.4	₹ 10.1
Tropical Moist Deciduous Forests	₹ 30.3	₹ 22.3	₹ 13.5	₹ 7.6
Littoral & Swamp Forests	₹ 49.0	₹ 35.1	₹ 22.6	₹ 17.5

NPV (in ₹ Lakhs/ha)	VDF	MDF	OF	LTF
Tropical Dry Deciduous Forests	₹ 25.1	₹ 18.6	₹ 11.2	₹ 7.7
Tropical Thorn Forests	₹ 14.4	₹ 13.4	₹ 10.6	₹ 7.8
Tropical & Subtropical Dry Evergreen Forests	₹ 28.4	₹ 21.4	₹ 13.2	₹ 7.5
Subtropical Pine/Broadleaved Hill Forests	₹ 22.7	₹ 18.0	₹ 11.6	₹ 6.6
Montane & Moist Temperate Forest	₹ 30.1	₹ 23.8	₹ 13.5	₹ 6.9
Sub Alpine & Dry Temperate Forest	₹ 25.3	₹ 20.1	₹ 11.3	₹ 5.6
Alpine Scrub	₹ 27.2	₹ 19.1	₹ 10.7	₹ 6.8
Average	**₹ 32.0**	**₹ 23.7**	**₹ 14.6**	**₹ 9.4**

4.2.2.14.3 Scenario3 – NPV rates based on a blanket rotation period of 60 years, 4% rate of discount and Total Economic Value based on complete summation

Table 28 – NPV Estimates (Scenario 3)

NPV (in ₹ Lakhs/ha)	VDF	MDF	OF	LTF
Tropical Wet Evergreen Forests – North East	₹ 66.4	₹ 35.4	₹ 30.6	₹ 10.3
Tropical Wet Evergreen Forests – Western Ghats	₹ 77.1	₹ 54.4	₹ 21.8	₹ 12.4
Tropical Semi Evergreen Forests - North East	₹ 36.5	₹ 28.1	₹ 15.0	₹ 9.4
Tropical Semi Evergreen Forests - Eastern Deccan	₹ 83.7	₹ 67.3	₹ 32.6	₹ 29.3
Tropical Semi Evergreen Forests - Western Ghats	₹ 55.1	₹ 36.4	₹ 22.1	₹ 13.1
Tropical Moist Deciduous Forests	₹ 48.5	₹ 33.7	₹ 19.3	₹ 9.6
Littoral & Swamp Forests	₹ 73.7	₹ 49.7	₹ 28.2	₹ 19.7
Tropical Dry Deciduous Forests	₹ 37.8	₹ 27.4	₹ 15.4	₹ 9.6
Tropical Thorn Forests	₹ 20.9	₹ 18.2	₹ 14.3	₹ 9.6
Tropical & Subtropical Dry Evergreen Forests	₹ 46.6	₹ 34.6	₹ 19.8	₹ 9.6
Subtropical Pine/Broadleaved Hill Forests	₹ 36.2	₹ 28.3	₹ 17.3	₹ 8.6
Montane & Moist Temperate Forest	₹ 49.1	₹ 38.3	₹ 20.5	₹ 8.6
Sub Alpine & Dry Temperate Forest	₹ 40.1	₹ 32.2	₹ 17.2	₹ 7.2
Alpine Scrub	₹ 41.0	₹ 29.8	₹ 15.4	₹ 8.9
Average	**₹ 50.9**	**₹ 36.7**	**₹ 20.7**	**₹ 11.8**

4.2.2.14.4 Scenario 4 – NPV rates based on a blanket rotation period of 60 years, 4% rate of discount and Total Economic Value based on adjusting for double counting and simultaneous delivery of ecosystem services

Table 29 – NPV Estimates (Scenario 4)

NPV (in ₹ Lakhs/ha)	VDF	MDF	OF	LTF
Tropical Wet Evergreen Forests – North East	₹ 39.8	₹ 21.7	₹ 19.5	₹ 7.6
Tropical Wet Evergreen Forests – Western Ghats	₹ 44.9	₹ 32.4	₹ 14.7	₹ 9.3

NPV (in ₹ Lakhs/ha)	VDF	MDF	OF	LTF
Tropical Semi Evergreen Forests - North East	₹ 23.3	₹ 17.6	₹ 9.8	₹ 6.4
Tropical Semi Evergreen Forests - Eastern Deccan	₹ 57.8	₹ 47.5	₹ 28.0	₹ 25.8
Tropical Semi Evergreen Forests - Western Ghats	₹ 33.7	₹ 23.6	₹ 15.4	₹ 10.1
Tropical Moist Deciduous Forests	₹ 30.0	₹ 22.0	₹ 13.4	₹ 7.5
Littoral & Swamp Forests	₹ 47.7	₹ 34.2	₹ 22.0	₹ 17.1
Tropical Dry Deciduous Forests	₹ 25.5	₹ 19.0	₹ 11.4	₹ 7.9
Tropical Thorn Forests	₹ 14.7	₹ 13.7	₹ 10.8	₹ 7.9
Tropical & Subtropical Dry Evergreen Forests	₹ 28.9	₹ 21.8	₹ 13.5	₹ 7.6
Subtropical Pine/Broadleaved Hill Forests	₹ 22.2	₹ 17.5	₹ 11.4	₹ 6.5
Montane & Moist Temperate Forest	₹ 28.9	₹ 22.8	₹ 13.0	₹ 6.7
Sub Alpine & Dry Temperate Forest	₹ 24.0	₹ 19.0	₹ 10.8	₹ 5.5
Alpine Scrub	₹ 26.4	₹ 18.6	₹ 10.4	₹ 6.7
Average	**₹ 32.0**	**₹ 23.7**	**₹ 14.6**	**₹ 9.5**

From all 4 scenarios discussed above, the study team recommends using scenario 2 (NPV estimates in Table 27) as the NPV applicable for diversion of forests to non-forestry uses in India. The scenario internalizes the issue of simultaneous delivery of ecosystem services from forests and thus attempts to avoid double counting. In addition, it is based on rotation period estimated for each forest type group, thus internalizing the ecological diversity among forests of the country. Thus, while making the NPV estimates scientific, objective and regional specific, the scenario has kept them conservative without overestimating value of individual services or total economic value.

From all 4 scenarios discussed, the study team recommends using scenario 2 as the NPV applicable for diversion of forests to non-forestry uses in India. The scenario internalizes the issue of simultaneous delivery of ecosystem services from forests and is based on rotation period estimated for each forest type group.

While the currently proposed rates for NPV of forest diversion are a significant departure from the existing rates (See Table 30), the proposed rates should be viewed in lights of recent developments. Firstly, the discipline of economic valuation of ecosystem services has become more developed as a result of which it is now possible to expand the calculus of ecosystem services that can be valued objectively. The study has thus considered many ecosystem services which were not estimated either in the 2006 NPV Committee Report or the subsequent CEC Report. Secondly, the NPV rates estimated in the present study are based on actual sampling data from forests across India. Estimates of NPV in the two earlier reports mentioned above were largely based on consumption figures which are known to be gross underestimates. And lastly, rather than using a blanket value of 20 years for rotation period across the country, the NPV calculations are

based on objectively estimation rotation period based on rotation period of dominant species in each forest type group. To put the current NPV rates in a better context, Table 31 provides the existing NPV rates adjusted according to the Wholesale Price Index. Table 32 and Table 33 provide detailed comparisons of the existing and WPI adjusted rates of NPV with the proposed rates.

Table 30 – Current NPV rates charged for forest diversion (CEC 2007a)[14]

Eco-class	NPV (in ₹ Lakhs/ha)	VDF	MDF	OF
Class I	Tropical Wet Evergreen Forests – North East	₹ 10.43	₹ 9.39	₹ 7.30
Class I	Tropical Wet Evergreen Forests – Western Ghats	₹ 10.43	₹ 9.39	₹ 7.30
Class I	Tropical Semi Evergreen Forests - North East	₹ 10.43	₹ 9.39	₹ 7.30
Class I	Tropical Semi Evergreen Forests - Eastern Deccan	₹ 10.43	₹ 9.39	₹ 7.30
Class I	Tropical Semi Evergreen Forests - Western Ghats	₹ 10.43	₹ 9.39	₹ 7.30
Class I	Tropical Moist Deciduous Forests	₹ 10.43	₹ 9.39	₹ 7.30
Class II	Littoral & Swamp Forests	₹ 10.43	₹ 9.39	₹ 7.30
Class III	Tropical Dry Deciduous Forests	₹ 8.87	₹ 8.03	₹ 6.26
Class IV	Tropical Thorn Forests	₹ 6.26	₹ 5.63	₹ 4.38
Class IV & V	Tropical & Subtropical Dry Evergreen Forests[15]	₹ 7.83	₹ 7.04	₹ 5.47
Class V	Subtropical Pine/Broadleaved Hill Forests	₹ 9.39	₹ 8.45	₹ 6.57
Class VI	Montane & Moist Temperate Forest	₹ 9.91	₹ 8.97	₹ 6.99
Class VI	Sub Alpine & Dry Temperate Forest	₹ 9.91	₹ 8.97	₹ 6.99
Class VI	Alpine Scrub	₹ 9.91	₹ 8.97	₹ 6.99

Table 31 – WPI Adjusted Current NPV Rates

Eco-class	NPV (in ₹ Lakhs/ha)	VDF	MDF	OF
Class I	Tropical Wet Evergreen Forests – North East	₹ 15.29	₹ 13.76	₹ 10.70
Class I	Tropical Wet Evergreen Forests – Western Ghats	₹ 15.29	₹ 13.76	₹ 10.70
Class I	Tropical Semi Evergreen Forests - North East	₹ 15.29	₹ 13.76	₹ 10.70
Class I	Tropical Semi Evergreen Forests - Eastern Deccan	₹ 15.29	₹ 13.76	₹ 10.70
Class I	Tropical Semi Evergreen Forests - Western Ghats	₹ 15.29	₹ 13.76	₹ 10.70
Class I	Tropical Moist Deciduous Forests	₹ 15.29	₹ 13.76	₹ 10.70
Class II	Littoral & Swamp Forests	₹ 15.29	₹ 13.76	₹ 10.70
Class III	Tropical Dry Deciduous Forests	₹ 13.00	₹ 11.77	₹ 9.17
Class IV	Tropical Thorn Forests	₹ 9.17	₹ 8.25	₹ 6.42
Class IV & V	Tropical & Subtropical Dry Evergreen Forests[15]	₹ 11.48	₹ 10.32	₹ 8.02

[14] The current NPV rates are shown here in the proposed classification format to highlight the departure of estimated NPV rates. No change in current NPV rates has been made in the table.

[15] As the current forest type group classification falls in two Eco-classes, average NPV rates have been mentioned here.

Eco-class	NPV (in ₹ Lakhs/ha)	VDF	MDF	OF
Class V	Subtropical Pine/Broadleaved Hill Forests	₹ 13.76	₹ 12.38	₹ 9.63
Class VI	Montane & Moist Temperate Forest	₹ 14.52	₹ 13.15	₹ 10.24
Class VI	Sub Alpine & Dry Temperate Forest	₹ 14.52	₹ 13.15	₹ 10.24
Class VI	Alpine Scrub	₹ 14.52	₹ 13.15	₹ 10.24

Table 32 – Absolute and percentage change in proposed and current NPV rates

Absolute Change in Proposed and Current NPV Rates in ₹ Lakhs/ha; figures in parenthesis show the percentage change	VDF	MDF	OF	Eco-class
Tropical Wet Evergreen Forests – North East	₹ 28.4 (273%)	₹ 11.9 (126%)	₹ 11.7 (161%)	Class I
Tropical Wet Evergreen Forests – Western Ghats	₹ 32.9 (316%)	₹ 21.9 (233%)	₹ 6.9 (95%)	Class I
Tropical Semi Evergreen Forests - North East	₹ 13.2 (126%)	₹ 8.4 (89%)	₹ -4.1 (35%)	Class I
Tropical Semi Evergreen Forests - Eastern Deccan	₹ 45.1 (433%)	₹ 36.3 (387%)	₹ 19.7 (269%)	Class I
Tropical Semi Evergreen Forests - Western Ghats	₹ 23.5 (225%)	₹ 14.3 (152%)	₹ 8.1 (112%)	Class I
Tropical Moist Deciduous Forests	₹ 19.9 (191%)	₹ 12.9 (137%)	₹ 7.0 (86%)	Class I
Littoral & Swamp Forests	₹ 38.6 (370%)	₹ 25.7 (274%)	₹ 15.3 (209%)	Class II
Tropical Dry Deciduous Forests	₹ 16.2 (183%)	₹ 10.6 (132%)	₹ 4.9 (78%)	Class III
Tropical Thorn Forests	₹ 8.1 (130%)	₹ 7.8 (138%)	₹ 6.2 (141%)	Class IV
Tropical & Subtropical Dry Evergreen Forests	₹ 20.6 (262%)	₹ 14.4 (204%)	₹ 7.8 (142%)	Class IV & V
Subtropical Pine/Broadleaved Hill Forests	₹ 13.3 (142%)	₹ 9.5 (113%)	₹ 5.1 (77%)	Class V
Montane & Moist Temperate Forest	₹ 20.2 (204%)	₹ 14.8 (165%)	₹ 6.6 (94%)	Class VI
Sub Alpine & Dry Temperate Forest	₹ 15.4 (155%)	₹ 11.1 (124%)	₹ 4.3 (62%)	Class VI
Alpine Scrub	₹ 17.3 (175%)	₹ 10.2 (113%)	₹ 3.7 (53%)	Class VI

Table 33 – Absolute and percentage change in proposed and WPI adjusted current NPV rates

Absolute Change in Proposed and WPI Adjusted Current NPV Rates in ₹ Lakhs/ha; figures in parenthesis show the percentage change	VDF	MDF	OF	Eco-class
Tropical Wet Evergreen Forests – North East	₹ 23.6 (154%)	₹ 7.5 (54%)	₹ 8.3 (78%)	Class I
Tropical Wet Evergreen Forests – Western Ghats	₹ 28.1 (183%)	₹ 17.5 (127%)	₹ 3.5 (33%)	Class I
Tropical Semi Evergreen Forests - North East	₹ 8.3 (54%)	₹ 4.0 (29%)	₹ -0.8 (-8%)	Class I

Absolute Change in Proposed and WPI Adjusted Current NPV Rates in ₹ Lakhs/ha; figures in parenthesis show the percentage change	VDF	MDF	OF	Eco-class
Tropical Semi Evergreen Forests - Eastern Deccan	₹ 40.3 (263%)	₹ 31.9 (232%)	₹ 16.3 (152%)	Class I
Tropical Semi Evergreen Forests - Western Ghats	₹ 18.6 (122%)	₹ 9.9 (72%)	₹ 4.7 (44%)	Class I
Tropical Moist Deciduous Forests	₹ 15.0 (98%)	₹ 8.5 (62%)	₹ 2.8 (27%)	Class I
Littoral & Swamp Forests	₹ 33.7 (221%)	₹ 21.4 (155%)	₹ 11.9 (111%)	Class II
Tropical Dry Deciduous Forests	₹ 12.1 (93%)	₹ 6.9 (58%)	₹ 2.0 (22%)	Class III
Tropical Thorn Forests	₹ 5.2 (57%)	₹ 5.2 (62%)	₹ 4.1 (65%)	Class IV
Tropical & Subtropical Dry Evergreen Forests	₹ 16.9 (147%)	₹ 11.1 (108%)	₹ 5.2 (65%)	Class IV & V
Subtropical Pine/Broadleaved Hill Forests	₹ 9.0 (65%)	₹ 5.6 (45%)	₹ 2.0 (21%)	Class V
Montane & Moist Temperate Forest	₹ 15.6 (107%)	₹ 10.6 (81%)	₹ 3.3 (32%)	Class VI
Sub Alpine & Dry Temperate Forest	₹ 10.8 (74%)	₹ 6.9 (53%)	₹ 1.0 (10%)	Class VI
Alpine Scrub	₹ 12.7 (87%)	₹ 6.0 (46%)	₹ 0.5 (4%)	Class VI

In addition to paying Net Present Value rates of forest to be diverted, the user agencies are also required to pay for compensatory afforestation (CA). It needs to be acknowledged that while natural forests can never be replaced by plantations, these measures also compensate for a portion of ecosystem services lost as a result of forest diversion. As user agencies are mandated to pay for compensatory afforestation, it is being suggested that the final NPV rates may be adjusted based on a restoration factor that considers the portion of economic value of ecosystem services restored due to compensatory afforestation. The amounting of discounting needed has been estimated as Standard Compensatory Afforestation Restoration Factor (SCARF). The methodology relating to estimation of SCARF and associated adjustments in NPV rates are discussed in Chapter 7. As the NPV rates in the current study have been estimated for each cell individually in the 14 X 4 matrix, it is suggested that the restoration factor should also be applied to each cell. Doing so would avoid any unwanted effects due to generalization over canopy density classes or forest type groups considered.

4.2.2.15 Conservative estimates

While the estimated NPV rates differ significantly from the current NPV rates used for forest diversion, the difference may mainly be attributed to the increased availability of reliable data for estimation of goods and services from forests and development of new methodologies for economic valuation of the same. While using more updated data and sophisticated economic valuation methodologies, there has been a conscious effort not to overestimate the economic value of any of the goods and services from forests. Below are some of the major arguments to substantiate the fact that the estimates are, at best, conservative.

While using more updated data and sophisticated economic valuation methodologies, there has been a conscious effort not to overestimate the economic value of any of the goods and services. Reasons are provided why the estimates, even though a significant departure from the current rates, may still be regarded as conservative.

Table 34 –Conservativeness of NPV estimates

Goods/service	Reasons why estimates are conservative
Timber	A very conservative estimate for market price of timber (₹ 45,000 / cum) has been used.
Fodder	Mainly based on reported figures which are gross underestimates.
Fuelwood	Mainly based on reported figures which are gross underestimates.
Bamboo	A conservative estimate for market price of bamboo (₹ 7,500 / 100 culms) has been used.
NWFP	Economic value of only 12 major NWFPs is estimated. Does not include a range of other NWFPs due to non-availability of reliable/authentic data.
Carbon sequestration	Estimates based on default IPCC values which are conservative figures. Social Cost of Carbon in itself is an underestimate according to IPCC.
Gene-pool conservation	Relatively old estimates are used without accounting for inflation.
Pollination and seed dispersal	Only considers the economic value with regards to forest regeneration. Excludes the contribution to agricultural production.
Soil conservation	It is assumed that it will take 100 years to erode the soil in absence of forests which is a very long time period.
Water recharge	Does not include the contribution of root system to water recharge. The economic value of water used for estimation is also conservative.
Carbon storage	Estimated based Social Cost of Carbon in itself is an underestimate according to IPCC.
Water purification	Studies used for benefits transfer do not have dense population as in the case of India.

4.2.2.16 Contribution of various types of ecosystem services to estimated NPV rates

To provide a better insight on the contribution of various types of ecosystem services from forests, Table 35 provides the contribution to average NPV determined as in

Scenario 2 by major types of ecosystem services viz. provisioning services, regulating services and supporting services. The provisioning services include timber, fodder, bamboo, NWFPs and fuelwood; the regulating services include carbon sequestration, carbon storage, soil conservation, water recharge and water purification and the supporting services include pollination & seed dispersal and gene-pool conservation. It may be noted that in spite of an attempt to value as many regulating and supporting services as possible objectively, the economic value of provisioning services still forms a major part of NPV rates (63%). It may also be noted that due to lack of any objective methodologies to value cultural services from forests outside the protected areas, this category of ecosystem services have not been included in the estimation of NPV rates.

Table 35 – Contribution of categories of ecosystem services to estimated NPV rates

Absolute contribution (₹ Lakhs/ha)to average NPV - according to assumptions in Scenario 2	Provisioning Services	Regulating Services	Supporting Services
Tropical Semi Evergreen Forests - North East	13.7	5.5	2.5
Tropical Semi Evergreen Forests - Western Ghats	15.7	5.4	3.4
Tropical Wet Evergreen Forests – North East	7.2	5.2	2.0
Tropical Semi Evergreen Forests - Eastern Deccan	28.2	5.4	4.7
Tropical Wet Evergreen Forests – Western Ghats	13.1	4.5	3.2
Tropical Moist Deciduous Forests	11.6	4.4	2.4
Littoral & Swamp Forests	22.4	5.2	3.5
Tropical Dry Deciduous Forests	10.0	3.6	2.1
Tropical Thorn Forests	7.0	2.5	2.1
Tropical & Subtropical Dry Evergreen Forests	10.5	4.6	2.5
Subtropical Pine/Broadleaved Hill Forests	8.0	4.0	2.8
Montane & Moist Temperate Forest	11.8	4.4	2.4
Sub Alpine & Dry Temperate Forest	9.0	4.3	2.3
Alpine Scrub	8.0	4.7	3.3
Average	**12.6**	**4.5**	**2.8**

4.2.2.17 Attributing economic value of forests to different spatial scales

It may be recognized that the whole array of forest goods and services valued in the study provide potential benefits at different spatial scales. This has direct implication on the NPV rates determined for forest diversion because they reflect the potential economic losses in case forests are diverted. Based on the assumptions of percentage of economic value of different forest goods and services accruing at various spatial scales (See Table 36), the economic value of potential losses due to forest diversion at these scales is estimated. These estimates have direct implications on how NPV money should be used to compensate loss of forest diversion at various scales. It may also be noted that

according to assumptions listed in Table 36 and forest goods and services valued in the study, it is estimated that about 50% of the economic losses of forest diversion occur at the local scale (See Table 37). Suggestions were also received during the consultation meetings and workshop that the quantum of funds should not only be proportionate to the level of use, but also to the rights of local communities.

Table 36 – Assumptions of economic value of forest goods and services accruing at different spatial scales

Goods and services	Local	State	National
Bamboo	70%	30%	0%
Fodder	100%	0%	0%
Timber	50%	50%	
NWFP	70%	30%	
Carbon Sequestration		30%	70%
Fuelwood	100%		
Gene-pool conservation	20%	20%	60%
Pollination & seed dispersal	70%	30%	
Water recharge	40%	40%	20%
Soil conservation	40%	40%	20%
Water purification	40%	40%	20%
Carbon storage		30%	70%

Table 37 – NPV of benefits accruing at various spatial scales

Contribution to average NPV (₹ Lakhs/ha) - according to a blanket rotation period of 60 years and 4% discount rate	Local	State	National
Bamboo	0.38	0.16	0.00
Fodder	2.44	0.00	0.00
Timber	3.52	3.52	0.00
NWFP	0.58	0.25	0.00
Carbon Sequestration	0.00	0.52	1.22
Fuelwood	1.92	0.00	0.00
Gene-pool conservation	0.27	0.27	0.80
Pollination & seed dispersal	1.02	0.44	0.00
Water recharge	0.11	0.11	0.05
Soil conservation	0.70	0.70	0.35
Water purification	0.14	0.14	0.07
Carbon storage	0.00	0.51	1.19
Total	**11.06**	**6.60**	**3.69**
Percentage contribution	**52%**	**31%**	**17%**

4.2.2.18 Dependence and disturbance value

If it is broadly assumed that the benefits of forest goods and services accruing at local level contribute to the dependence value of forests and the benefits that accrue at the state and national level contribute towards the disturbance value of forests, then according to discussion in Section 4.2.2.17, it may be noted that half of the NPV estimated for forest diversion relates to the dependence value of forests.

4.2.3 Add-on factors

While a more scientific approach is followed in estimating NPV for forest diversion in terms of expanding the classification as well as estimation of forest goods and services on a more objective basis, the estimates may still generalize many important location aspects. It is also important to recognize that there exists a trade-off between providing site-specific values of NPV for forest diversion and simplicity in calculation of NPV rates at forest type and canopy cover density class levels. The present approach followed in the study has been to estimate the NPV for a more expanded classification of forest type groups and canopy cover density classes and further add premium based on the applicability of few important parameters to make NPV more site-specific. While many parameters were identified, only three were deemed significant and objective after a series of consultation meetings and workshops. These are discussed below.

4.2.3.1 Hill talukas

Forest diversion in hill areas has a much more significant impact on-site as well as off-site compared to forest diversion in plains. This impact can mainly be regarded in terms of 1) hardships costs to people dependent on forest because of relatively lesser alternatives in such areas; and 2) downstream impacts of forest diversion in hill areas with respect to forest services such as soil conservation and water recharge. This has also been recognized at the National level wherein the hilly states are mandated to keep 2/3rd of the geographical area under forests compared to the national target of 1/3rd of national geographical area under forests. In order to account for such impacts, it is suggested that a 20% premium on the applicable NPV rate be charged in hill talukas which may be decided based on criteria adopted by the Planning Commission for Hill Area and Western Ghats Development Programmes.

4.2.3.2 Forested wetlands

Forests contain a lot of wetlands. When a patch of forests are diverted, the applicable NPV rates are also charged for the area of wetland falling within that patch. However, wetlands play many important functions which are not represented in the NPV rates estimated for forest diversion, especially those relating to carbon sequestration and water conservation & recharge. To account for such benefits of forested wetlands and the associated economic loss due to its proposed diversion, it is suggested that a 20% premium

on the applicable NPV rate be charged for the geographical area of forested wetlands.

To make NPV more site-specific, it is suggested that a 20% premium on applicable NPV rates may be applied based on add-on factors of hill talukas and forested wetlands. It is further suggested Eco-sensitive zones outside the protected areas should be charged higher as compared to any other forest land outside protected areas.

4.2.3.3 Protected Areas

Rate of charge: The diversion of forest land falling in National Parks and Wildlife Sanctuaries has currently been allowed only in exceptional and totally unavoidable cases with the permission of the Hon'ble Supreme Court. Such permissions are considered on payment of an amount of 10 times in the case of National Parks and 5 times in the case of Wildlife Sanctuaries respectively of the NPV payable and permitted only in the cases of public interest. Such a charge is levied for forest diversion recognizing the Precautionary Principle. Recognizing the importance of areas in the vicinity of National Parks and Wildlife Sanctuaries for ensuring flow of forest goods and services, reducing disturbance to movement of wildlife and biodiversity and minimizing defragmentation of forest landscapes near protected areas thereby disturbing wildlife corridors, it is suggested that 5 times the applicable NPV should be charged for diversion of forest areas in Eco-sensitive zones around National Parks. In the case of Sanctuaries, the amount to be charged for forest diversion in the eco-sensitive zone is recommended to be 3 times the applicable NPV in the region. For National Parks and Sanctuaries where eco-sensitive zones have not been identified as of yet, a 10 kilometre buffer may be used as the eco-sensitive zone.

Concentric ring model for charge of NPV in and around Protected Areas

In addition, if an agency (FESMA) such as the one flagged later in Section 6.3 is institutionalized in future, it may be possible to charge the NPV in a more logical and scientific gradation, there may also be potential for charging different NPV rates around National Parks and Sanctuaries as a function of the vicinity of forest area to be diverted to the protected area. One possible scheme which came up during the consultation process for charging NPV in the buffer areas of National Parks and Sanctuaries in the scenario of a fully operational agency such as FESMA is demonstrated below with respect to the applicable NPV rates based on forest type group and canopy cover density class.

	National Parks	Sanctuaries
Inside	10 times	5 times
0-2 kms outside	8 times	4 times
2-4 kms outside	6 times	3 times
4-6 kms outside	4 times	2 times
6-8 kms outside	2 times	Same

However, owing to high administrative cost of implementing distance criterion for charing diversion in and around protected areas, the study does not recomemdned such as agency as of now.

- *Charge for non-forest area*: The use of non-forest land falling within the National Parks and Wildlife Sanctuaries would be permitted on payment of an amount equal

to the NPV payable for the adjoining forest area as is currently the case. With respect to non-forest land falling "within marine National Parks/Wildlife Sanctuaries", the current amount payable is fixed at five times the NPV payable for the adjoining forest area and the study recommends retaining the same.

4.2.4 Sensitivity analysis

Table 38 below presents the effect of change in few of the important parameters on the final NPV estimate. The impact has been shown on the average NPV rates estimated for Scenario 2 above in Table 27 and is based on a forest type group specific rotation period, 4% rate of discount and total economic value estimated based on relevant summation after adjusting for doubling counting.

Table 38 – Sensitivity analysis

Type	NPV Estimate (in ₹ Lakhs/ha)	% change w.r.t. base
Average NPV	₹ 19.91	-
10% increase in market price of bamboo	₹ 19.97	0.30%
10% increase in market price of fodder	₹ 20.15	1.21%
10% increase in market price of timber	₹ 20.61	3.52%
10% increase in social cost of carbon	₹ 20.08	0.85%
10% increase in market price of fuelwood	₹ 20.10	0.95%
10% increase in the model costs for artificial regeneration	₹ 20.06	0.75%
10% increase in the economic value of water	₹ 19.94	0.15%
10% increase in the cost of NPK fertilizers	₹ 20.09	0.90%
Using a discount rate of 3%	₹ 23.72	19.14%
Using complete summation to estimate Total Economic Value	₹ 30.04	50.88%
Using Forest Type Group specific rotation period	₹ 20.62	3.57%

4.3 Possession Value of Land

This section is in response to TOR of Order No 2 (F. No. 11-134/2011-FC dated 12 November 2012) of incorporating suggestions made by the Committee on Allocation of National Resources (CANR) which recommended "*suitably re-adjusting payments under NPV and above schemes. Forest land has value over and above the value of land itself. This re-adjustment should achieve comparability with guidelines of land valuation for other purposes, e.g. acquisition.*"

The 2006 NPV Expert Committee recommended collection of ground rent for the land acquired for diversion in addition to the NPV charge for forest diversion. However, the current study recommends a more appropriate name for such a charge in this regard as the "Possession Value" of land to reflect the value

of space provided by the diverted forest land over and above its NPV. The 2006 NPV Expert Committee suggested that this charge should be approximated by prevailing rents in the region, subject to a minimum of ₹ 10,000 per hectare but such a charge was not recommended by CEC, hence is not currently levied. During the consultation meetings and workshops, it was argued by many stakeholders that the "land rent" charge does not adequately represent the value of land over and above NPV. This is especially true for areas in vicinity to urban and peri-urban areas as well as for those projects which have very less likelihood of returning back the forest land. The study team received a range of suggestions starting from charging the full market value of land for such diversion projects to no charge for this value from many stakeholders during the consultation meetings and the National Consultation Workshop (Excerpts of discussion can be found in Appendix 37).

As suggested by the Committee on Allocation of Natural Resources (CANR) and in the light of above discussions, it is suggested that the "possession value" of land may be charged in urban and peri-urban areas, as a one-time payment, either as (i) 50% of the collector rate or value as assessed by the local authority in absence of the collector rate plus the applicable NPV or (ii) prevalent market rate for acquiring forest land (specially where NPV may be negligible), whichever is higher.

It may be recognized that the forests in urban and peri-urban areas often cater to the needs of a much larger population as compared to those in remote areas. Thus, the economic value of such forests is much more significant. As the NPV estimation methodology in the current study does not consider this aspect of population density, the value of forests, in spite of it belonging to open forest or less than 10% canopy cover category, often has a much higher economic value than that estimated in this report. The "possession value" charge may also help in addressing this limitation of proposed methodology. The study team recommends this charge in urban and peri-urban areas on account of high real estate property prices which often are astronomical as compared to the NPV rates. It should also be noted that no exemption should be allowed in payment of this charge as suggested in Chapter 5 except in the case of public works category.

5 EXEMPTIONS

KEY MESSAGES

This chapter is in response to TOR 4: Formulate objective parameter(s) to make a project eligible for exemption from NPV for the assigned study.

Based on the consultation carried out with wide range of stakeholders, the current levels of exemptions have been largely retained. However, modifications are suggested in a few project categories that have significant and/or permanent impact on the ecological fabric of the land. These include relocation of villages from protected areas to alternate forest lands, underground mining, field firing ranges and wind energy projects.

The 2006 NPV Expert Committee made suggestions on granting full or partial exemptions from NPV payment to a range of development projects that need the diversion of land with forest cover. Based on various criteria of non-commercial nature, contribution of activity to forest and environment conservation, temporal nature of impact, additional cost burden on account of NPV, among others, Committee provided a list of categories which may be exempted from NPV charge along with associated exemption levels. The CEC further analyzed the exemptions recommended by the 2006 NPV Expert Committee and suggested the final list of activities which should be exempted from NPV charge along with exemption levels. Based on the consultation carried out with wide range of stakeholders for the current study, the current levels of exemptions have largely been retained. However, modifications are suggested in a few project categories that have significant and/or permanent impact on the ecological fabric of the land. These include relocation of villages from protected areas to alternate forest lands, underground mining, field firing ranges and wind energy projects. The current exemption levels for a list of activities along with proposed exemption levels based on consultation and analysis carried out in this study are listed in Table 39.

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Table 39 – Activity-wise current &proposed levels of exemption from applicable NPV payable

List of activities/projects	Current Exemption levels for NPV (% of full chargeable NPV)[16]	Proposed Exemption levels for NPV (% of full chargeable NPV)	Remarks for proposed exemption levels

[16] See order dated 09.05.2008 in I.A. Nos. 826 in 566 with 955 in 566, 958, 985, 1001-1001A, 1013-14, 1016-1018, 1019, 1046, 1047, 1135-1136, 1164, 1180-1181, 1182-1183 1196, 1208-1209, 1222-1223, 1224-1225, 1229, 1233 in 1135-1136, 1248-1249, 1253, 1301-1302, 1303-1304, 1312, 1313, 1314, 1318, 1319 in 1137, 1325, 1364, 1365-1366, 1370-1370A, 1371, 1384, 1385-1386, 1387, 1434, 1435-1437, 1438, 1441 with 1634, 1475-1476, 1513, 1573, 1639 in 1135-1136 in I.A. Nos. 566, 1664, 1665, 167l, 1676, 1707, 1721, 1779 in 1164 in 566, 1785-1786 in I.A. Nos. 1441, 1980-1981, 1993, 2013 2074-2076, 2077-2078 in 1441 and 2098 in 1233 in 1135-1136, 2145-2146, 2147-2148, 2149-2150 and 2153-2154 in I.A. No. 566 in W.P.(C) No. 202/1995.

List of activities/projects	Current Exemption levels for NPV (% of full chargeable NPV)[16]	Proposed Exemption levels for NPV (% of full chargeable NPV)	Remarks for proposed exemption levels
Public works: • Schools • Hospitals • Children's playground • Community centres in rural areas • Over-head tanks • Village tanks • Police stations • Court rooms • Laying of underground drinking pipeline up to 4" diameter • Electricity distribution line in rural areas up to 22 kV	Full Exemption up to 1 ha of forest land provided: • no felling of trees in involved; • alternative forest land is not available; • the project is of non-commercial nature and is a part of the Plan/Non-Plan Scheme of Government; and • the area is outside National Park / Sanctuary.	Full exemption up to 1 ha of forest land provided: • No felling of trees in involved; • No alternative land is found suitable ; • The project is of non-commercial nature and is a part of the Plan/Non-Plan Scheme of Government; and • The area is outside National Park and Sanctuary.	It is necessary that all of the conditions are met.
Relocation of villages from the National Park / Sanctuaries to alternate forest land	Full Exemption	50% Exemption	While Full Exemption was provided earlier, it has to be recognized that diversion of forests at the relocation site has implications on loss of forest goods and services in addition to the increased pressure on forests in the vicinity.

List of activities/projects	Current Exemption levels for NPV (% of full chargeable NPV)[16]	Proposed Exemption levels for NPV (% of full chargeable NPV)	Remarks for proposed exemption levels
Collection of boulders / silts from the river belts in the forest area	Full Exemption provided: • area is outside National Park / Sanctuary; • no mining lease is approved / signed in respect of this area; • the works including the sale of boulders / silt are carried out departmentally or through Government undertaking or through the Economic Development Committee; • the activity is necessary for conservation and protection of forests; and • the sale proceeds are used from for protection / conservation of forests;	Full Exemption provided: • The area is outside National Park and Sanctuary; • The site activity is necessary for conservation and protection of forests; • The sale proceeds are used from for protection / conservation of forests; • No mining lease is approved / signed with regards to this area; and • The works including the sale of boulders / silts are carried out departmentally or through Government undertaking or through the Economic Development Committee or Joint Forest Management Committee;	It is necessary that all of the conditions are met.
Laying of underground optical fibre	Full Exemption provided: • No felling of trees in involved; and • area falls outside National Park / Sanctuary;	Full Exemption provided: • No felling of trees in involved; and • The area is outside National Park and Sanctuary;	It is necessary that all of the conditions are met.

List of activities/projects	Current Exemption levels for NPV (% of full chargeable NPV)[16]	Proposed Exemption levels for NPV (% of full chargeable NPV)	Remarks for proposed exemption levels
Pre-1980 regularization of encroachments and conversion of forest villages into revenue villages	Full Exemption provided these are strictly in accordance with MoEFCC's Guidelines dated 18.9.1990	Full Exemption[17] provided these are strictly in accordance with the Forests Rights Act, 2006 and MoEFCC's guidelines dated 18.9.1990	
Underground mining	50% of the NPV of the entire area	20% Exemption on the applicable NPV	It has been observed that while underground mining mitigates some of the impacts of open cast mining, the damage to aquifers and hydrological systems is often irreparable. In light of this finding, the study team recommends that underground mining should not be provided any exemption from NPV payment.
Field firing range	Full exemption provided: • no felling of trees in involved; and • no likelihood of destruction of forest is involved;	80% Exemption provided: • no felling of trees in involved; and • no likelihood of destruction of forest is involved;	Recognizing that although field firing ranges conserve forests, they inhibit the access of people which depend on forests. As a result, a change is recommended to account for the social cost of fencing-off the area.

[17] Section 3(2) of the Forest Rights Act has to be considered accordingly which states : "Notwithstanding anything contained in the Forest (Conservation) Act, 1980, the Central Government shall provide for diversion of forest land for the following facilities managed by the Government which involve felling of trees not exceeding seventy-five trees per hectare, namely:-
(a) schools; (b) dispensary or hospital; (c) anganwadis; (d) fair price shops; (e) electric and telecommunication lines; (f) tanks and other minor water bodies; (g) drinking water supply and water pipelines; (h) water or rain water harvesting structures; (i) minor irrigation canals; (j) non-conventional source of energy; (k) skill upgradation or vocational training centres; (l) roads; and (m) community centres:

Provided that such diversion of forest land shall be allowed only if,-

i. the forest land to be diverted for the purposes mentioned in this sub-section is less than one hectare in each case; and
ii. the clearance of such developmental projects shall be subject to the condition that the same is recommended by the Gram Sabha.

The conditions attached above is the law of the land and supersedes the 2002 guidelines as well as any other government order that may have been issued in this regard.

List of activities/projects	Current Exemption levels for NPV (% of full chargeable NPV)[16]	Proposed Exemption levels for NPV (% of full chargeable NPV)	Remarks for proposed exemption levels
Wind energy projects	50% of the minimum rate of the NPV irrespective of the eco-class in which the project lies provided mining tree felling is involved[18]	50% of the applicable rate of the NPV in the area according to the Forest Type Group and Canopy Cover Density Class provided it involves felling of a maximum of 5 trees.	

[18] Also see order dated 24.04.2008 in I. A. Nos. 1135 and 1136, 1224 and 1225, 1233, 1385-1386 and 1438 with 1639, 1671, 2098 and CEC clarification dated 22.12.2008

6 OTHER RECOMMENDATIONS

KEY MESSAGES

This chapter is in response to TOR 5: Suggest any other recommendation(s) in the furtherance of realization of NPV to make it more objective and scientific.

The money from NPV fund is often used by states on plantation activity and infrastructure development which defeats the very purpose of collecting NPV. There is thus a need to move from afforestation to ecological restoration and forest rehabilitation to satisfy the objective behind NPV collection.

Over and above plantations and infrastructure development, it is recommended that CAMPA money should be utilized in a whole range of activities such as capacity building, forest reclamation, and establishing forest nurseries, promoting green energy, and filling current research gaps among others. It is also recommended that a limit on maximum allowable expenditure under different heads may also be prescribed for utilization of CAMPA money.

To carry out activities effectively in order to compensate for the loss of forest diversion at the local level and in the light of Forest Rights Act, the study recommends a greater decentralization in the collection and management of NPV fund.

The study also recognizes the importance of incentive based mechanisms for encouraging good practices among user agencies and promoting returning of forest land after proper treatment and reclamation.

In addition, the study team is of the view that considering the existing limitations of forest management machinery, the capacity of existing forest management institutions may be built to both – verify the NPV rates applicable and monitor utilization of NPV money. For this purpose, it is recommended that NPV maps for the entire country may be prepared to eliminate discretion in identifying the applicable NPV rates and the permanent establishment of CAMPA, as and when institutionalized, may be given additional monitoring responsibilities.

6.1 From afforestation to forest rehabilitation

While NPV from forest diversion is currently collected in a centralized CAMPA fund, the use of fund in conserving or enhancing forest ecosystem services are yet to achieve the desired results on ground (See Appendix 26 for net accumulation and disbursement from CAMPA fund to various states). The objective behind NPV collection is to compensate those who suffer on account of loss of forest goods and services due to diversion. This finds recognition in the CAMPA guidelines issued by MoEFCC in 2009. However, the two major heads for which CAMPA money is generally used include plantation activity and administrative & infrastructure development. As per CEC Report dated 9.8.2002, plantations will never be able to replace natural forests and hence NPV amount should be used to compensate economic loss of forest diversion. Since the states receive funds from CAMPA under various heads such as NPV, CA, SZ, PCA, and PAF among others, all meant for forest development, there are possibilities of NPV not being directly addressed to the needs of the locals or for restoring ecosystem services (Kohli et al. 2011). But a good monitoring system, if and when instituted, can address to this issue.

The money from NPV fund is often used by states on plantation activity and infrastructure development which defeats the very purpose of collecting NPV.

In the light of issues above, there is need to move from afforestation to holistic ecological restoration and forest rehabilitation based on area specific perspective plans in order to enhance the flow of essential ecosystem services from treated forests. While CAMPA guidelines already exist, there is a need to recognize that CAMPA money has the potential to address many issues which directly or indirectly help in either enhancing ecosystem services or compensating for their loss due to forest diversion. In this regard, it is recommended that the CAMPA guidelines should include what specific activities will be allowed under CAMPA with prescribed limit on maximum budgetary expenditure for each major heads. Few of the important activities that emerged out of consultation process as a part of this study and which have been recommended are as follows:

Capacity building: While this study has made an attempt to minimize the scope for discretionarily choosing the NPV rates applicable for diverting a forest land, there is a need to build capacity at lower levels in the Forest Department to correctly identify the applicable NPV rates. This activity should aim at correct computation of applicable NPV for forest diversion based on forest type and canopy cover density class. There is also a need to create alternate livelihood opportunities for the project affected people through well planned and analytical approach developed in collaboration with the PAP to compensate for economic losses on account of forest diversion. In addition, the study team recognizes a need to build capacity of local communities in communicating their rights to ask for compensation in case they stand to suffer economic losses on account of forest diversion.

Forest reclamation: For many projects under which forest land is diverted for non-forestry purposes, the land is never officially handed back to the Forest Department after completion of project life. Even in cases where the land is handed back officially, it is seldom done after proper reclamation. It is thus recommended that a part of CAMPA money should be utilized for reclamation of forest land after the project activity has been completed. Again in order to serve the purpose for which NPV is collected, the reclamation should not focus only on plantation but should be aimed at generating flow of ecosystem services which have high economic value on a site-specific basis.

Forest nurseries: Bearing in mind that gene pool of a large of forest species, especially palatable grasses is being eroded in the country, the CAMPA fund may also be utilized for development of nurseries including indigenous palatable grasses and other important species. This activity may again be encouraged at local level to conserve site-specific forest species

essential for reclaiming forest land as discussed above.

Green energy: To reduce pressures on existing forests – especially targeted to communities dependent on forests for fuelwood in vicinity to the diverted forest area – CAMPA fund may be used to promote use of green energy such as LPG;

Human-wildlife conflict: Recognizing the fact that diversion of forest land leads to forest fragmentation which is one of the major reasons for increasing human-wildlife conflict in recent time, CAMPA fund may be utilized to compensate for wildlife-inflicted economic losses and human injury in vicinity of forest land diverted;

Over and above plantations and infrastructure development, it is recommended that CAMPA money may be utilized in a whole range of activities such as capacity building, forest reclamation, establishing forest nurseries, promoting green energy, and filling current research gaps among others. It is also recommended that a limit on maximum allowable expenditure under different heads may also be prescribed for utilization of CAMPA money.

Public utility projects: While many of the public utility projects and regularization of encroachments are exempted from NPV payments under a set of conditions, it is important to recognize that loss of forests even in such cases has an immense economic value. While no party may be made to pay NPV for forest diversion, CAMPA fund may be used to compensate communities affected by forest land diversion in such cases;

Fill research gaps: Even while attempting to estimate the NPV of forest diversion more objectively and scientifically, this report has had to depend, at places, on extrapolation and assumptions due to existing data gaps. To fill up these research gaps, a part of CAMPA fund may be used to take up studies for generating information for more objective estimation of NPV in future revisions.

The activities under CAMPA recommended here are based on the consultation process conducted for the study and do not represent an exhaustive list. A more detailed study is recommended to identify more such activities along with the proportion of CAMPA budget that may be used for each. In addition, it has been noticed that in recent years after flow of CAMPA money to states, individual states have reduced the forestry budget allocation. States can only make use of CAMPA money, as understood from the Order of the Hon'ble Supreme Court, for forest and ecosystem development in the impacted areas from forest diversions. Therefore, it is absolutely necessary to target the use of funds in a transparent manner. Again, R & R being part and parcel of the declaration of PA's, village relocation expenditures need not be targeted with CAMPA money. In addition, it is also proposed that rather than compensating for diverted forest land by plantations on an ad-hoc basis, states may identify important ecological areas where CA may be focussed to reduce fragmentation at a landscape level. Such activities also have the potential of

increasing the flow of essential ecosystem services from forests which are influenced by larger spatial scale.

6.2 Institutional mechanism

Moving ahead from the current institutional structure of centralized fund collection and management, the study recommends that devolution of fund is essential for better utilization of NPV funds. Many of the activities recommended here may only be carried out efficiently if managed at the local or state level.

To carry out activities effectively in order to compensate for the loss of forest diversion at the local level and in the light of Forest Rights Act, the study recommends a greater decentralization in the collection and management of NPV fund.

For example, an activity such as providing clean drinking water where loss of forest has impacted water supply services can directly compensate affected local communities due to forest diversion in real terms. Other such activities may include construction and establishment of tribal centres and organizing vocational trainings to compensate for job loss associated with forest diversion. In order to effectively carry out such activities through CAMPA, it is imperative to involve local level institutions such as the Gram Sabhas or JFMCs. It may be further noted that a number of projects where forest land is proposed to be diverted face local resistance due to the inability of the current mechanism for compensating the loss of livelihoods and other benefits by the project affected people and local communities. In order to harmonize development and conservation activities in a country such as India, it is imperative to decentralize the fund allocation and management system so as to effectively carry out activities for compensating the economic loss due to forest diversion. Based on estimates of proportion of benefits of each forest goods and services accruing at different spatial scales, proportion of NPV fund to be allocated at local, state and national level has been worked out as discussed in Section 4.2.2.17.

Based on these estimates, it is recommended that a three-tier structure be put in place for allocation of money collected from NPV charge. It is recommended that 50% of the fund should be allocated at the local level, 33% at the state level and 17% at the national level. A more detailed study is however required to analyze the feasibility of such a mechanism and its operationalization.

It is recommended that a separate study be carried out on how NPV fund should be distributed across different administrative levels and its associated legal implications. While the current study does provide estimates based on the percentage loss of economic value at different levels, it recognizes the need for a detailed study to analyze all associated legal implications.

6.3 Payment Vehicle

Nomenclature: As per the Hon'ble Supreme Court order, NPV is collected for compensating for the loss of ecosystem services that get lost when forests are diverted. However, the name for the

payment vehicle seems to have more financial connotation. NPV is a financial management concept that talks about tangible marketed benefits and hence those marketed ones such as timber are mainly compensated. However, a range of ecosystem services such as loss of hydrological cycling, pollination, flood control, animal habitat, nutrient cycling and above all the dependence value of communities and their rights are not duly reflected. Thus, ecosystem services loss is a more expressive and meaningful term to quantify such losses and in turn channelize compensation. Thus to actually reflect the mandate of payment vehicle, the study proposes that NPV may be rephrased as Compensation for the Loss of Ecosystem's Value (CLEV). As a matter of fact in Himachal Pradesh based on the findings of the study of Principal author, a payment vehicle named as "Compensation for the Loss of Ecological Value (CLEV)" was implemented from 2002 as an additional charge for forest diversion besides compensatory afforestation, and catchment area treatment till the time NPV came into effect.

The Bureau of Environmental Services provides Portland (U.S.A.) residents with Clean River programs including water quality protection, watershed planning, wastewater collection and treatment, sewer installation and storm water management. Environmental Services is organized into six work groups; Office of the Director, Watershed Services, Pollution Prevention Services, Engineering Services, Wastewater, and Business Services.

Deferred payments: During the consultations made for the study, demands were put forward for allowing the NPV payment to be made in instalments on a cost merit basis. A detailed study is required to identify these projects and the implications of such a mechanism in terms of institutional capacity to deal with situations such as default. Such a system of deferred payments may be based on the scale of project category and proportion of NPV payment in the total project cost. For projects such as mining, NPV payment represents a very negligible proportion of total project cost and hence it is not recommended to allow deferred NPV payments for these projects. The study team is thus of the view that a detailed assignment may be carried out to identify the projects for which deferred payments may be relevant, practical considerations of implementation and mechanism's associated implications.

Clarity on variety of charges: During the consultation meetings and workshop, concerns were raised by user agencies that many different kind of charges are levied for diverting the forest land such as the NPV payment, Compensatory Afforestation (CA), Catchment Area Treatment (CAT) charge, Wildlife Conservation Charge (in many states), Safety Zone charges, among others. While user agencies are often willing to pay such charges, they have expressed concerns over the long delay that occurs during this process on account of multiple payment windows and procedures. Suggestions

were also received on whether all kind of charges levied on user agencies (at both central as well as state levels) during forest diversion may be processed under a single umbrella and payment window. However, the study notes that not all charge are applicable in all diversion projects. Based on project activity, forest area to be diverted and its characteristics, only applicable charges are levied. Thus, the study team feels that it would be impractical to have such a system where all charges are collected under a single payment window. It is also recommended that more clarity may be provided by the forest department to user agencies on the applicability and purpose of collecting each specific charges.

6.4 Incentive based mechanisms

Apart from charging NPV for forest diversion, the study found that there are no incentive based mechanisms in place to encourage user agencies to hand back the forest land after project life with appropriate improvement. Based on well-established criteria of forest land improvement, incentive based mechanisms may be established to encourage conservation of forest land during the project period such as effective catchment area treatment or roadside plantations among others. In addition, ambit of such mechanisms may be expanded to include incentives for quickening the process of mutation of non-forest land on which compensatory afforestation is carried out. Further, if a user agency returns the diverted forest land to the Forest Department before the expiry of lease period, it expedites the process of forest rehabilitation and hence may also be part of this incentive based mechanism.

In addition to the impact of such mechanisms on handing over the land after project life, such mechanism may also be important for many project categories which get forest clearances for large forest areas and do not use them immediately. While this does not have a very significant loss from ecological point of view, it does prevent access of local communities in using the forest land. The mechanisms need to be designed in a way to discourage keeping the diverted land unproductive for long periods of time. Further to complement the mechanism, the possession value of land as recommended in the report in addition to NPV should be high enough for unproductive land to discourage such practices.

Designing the framework of such incentive based mechanisms needs a very thoughtful process and the study recommends a detailed analysis on this aspect. It recommends that such a system should collect the full NPV at the time of granting forest clearance and should then refund back a part of it according to well established and frequently monitored criteria at the end of project life. Such a deposit-refund mechanism has been successfully used in other countries such as the European Union for pollution control and has the potential to take care of worst possible scenario along with encouraging good

practices that promote generation of positive externalities during the project activity.

In addition, the study also recognizes a need to incentivize local forest dependent communities in the vicinity of diverted forest area to encourage sustainable use of forest resources. Diversion of a patch of forest has direct consequence of increased pressure on the remaining forests in the region and there is thus a need to reward local communities for its conservation and sustainable use. Many market instruments have been successfully implemented across the globe in this regard (See Appendix 38) and appropriate instruments may be applied after proper modification on a site-specific basis to encourage communities for conservation of remaining forest resources.

6.5 Verification and monitoring

To complement more objective estimation of NPV and incentive based mechanisms, the study team also received suggestion for improving the verification of applicable NPV rate determined for each forest diversion project and monitoring of CAMPA funds to achieve the objective of NPV collection. While many stakeholders were of the view that a separate agency which may be named Forest Ecosystem Service Monitoring Authority (FESMA) may be formed for this purpose, the study team is of the view that considering the existing limitations of forest management machinery, the capacity of existing forest management institutions may be built to both –verify the NPV rates applicable and monitor utilization of NPV money. Specifically the team recommends the following.

6.5.1 Preparation of NPV maps for the country

The study recommends that NPV maps for the entire country may be prepared by the Forest Survey of India on the basis of NPV rates estimated in this report. These maps can be prepared on the information collected and analyzed by FSI on a regular basis and is readily available on forest type groups and canopy cover density classes. It is recommended that the canopy cover density classes may be determined on the basis of highest canopy density in last five assessments conducted by FSI. These maps, providing information on forest type group, canopy cover density, and associated NPV rate, may be made publicly available to remove the discretion in identifying the applicable NPV rate. There is also potential to include the other parameters suggested in this report such as hill talukas, forested wetlands, possession value of land in urban and peri-urban areas, core and buffer areas of National Parks and Sanctuaries in these maps to develop a sort of ready reckoner to identify the applicable NPV rate for diversion of a given patch of forest. These maps may also support information system, which can help user agencies in identify alternative forest lands thereby ensuring harmony between forest conservation and developmental activities. For example, an online portal with the ability to receive spatial data from a user agency and calculating the NPV amount to be payable

based on estimating NPV rates has the potential to provide substantial financial gains to user agencies along with supporting conservation of forests with high economic value.

6.5.2 Speedy establishment of permanent CAMPA

The study team recognizes that the process for transforming ad-hoc CAMPA to a permanent institution is in progress and based on the assumption that a permanent CAMPA institution may be established at the earliest, the study team feels that the CAMPA should regularly monitor its disbursed funds. Apart from monitoring efficient utilization of funds, a permanent establishment would also has the potential to monitor for any non-compliance on the part of user-agencies in terms of diverted forest area; assess the incentives for user agencies if and when the above mentioned incentive based mechanisms are put in place; and evolve strategies for compensation of livelihood loss or hardships due to loss of ecological services from forest diversion.

6.5.3 Monitoring wing in CAMPA

During the consultation process, a variety of concerns and apprehensions were expressed on the use of CAMPA money by various states, often contradicting the very spirit of Forest Conservation Act (FCA). However it should be noted that diversion of forest areas for non-forest purposes is to be driven essentially on a developmental paradigm. Therefore, both the need of precise area, extent of area, purpose of using the diverted area, and integrity of the user agency are to be ascertained under the scheme. Therefore, the NPV maps and a wing of CAMPA involved in monitoring, it is hoped, can push the spirit of NPV collection in the right direction and purpose.

The monitoring wing of CAMPA may also deal with information provision for user agencies as to where their money is being utilized. The user agencies, especially those with interest in Corporate Social Responsibility (CSR), will find this as a welcome move to improve transparency in fund utilization.

6.5.4 Clarity of change

Apart from many issues highlighted in previous sections, the consultations process brought some issues in light which deserve a mention. Participants from the consultation workshop and many user agencies were of the opinion that some fine-tuning needs to be done on specific activities from each project categories on which NPV is charged. Few instances where user-agencies feel that NPV is currently being unfairly charged on account on absence of clear guidelines for the same include plantations along highways, river belt area, and railways. The NPV in such cases is charged at the same rate as adjoining forest area. It is recommended that the monitoring wing of permanent CAMPA, when established, may also be mandated to develop such guidelines and appropriately update the same when such matters are brought to notice. Such a system which removes discretion in identifying the applicable NPV rates and monitors compliance in this regard will help

greatly in improving the overall transparency of the system.

6.6 Future research gaps

While the study has made an attempt to estimate as many forest ecosystem services as possible objectively and scientifically, the field of ecological economics is still relatively new. The fact that methodologies for estimating types of ecosystem services are still evolving is further complicated by limitations of availability of reliable data in India. In future, more data availability in identified areas will help not only in more objective estimation of ecosystem services but also calculation of uncertainty in economic value estimates. Both these information will help decision makers immensely in making informed choices.

One of the major limitations in the area of economic valuation of ecosystem services currently is in estimation of wildlife value[19]. This limitation is an area of concern, especially for India with its rich biodiversity[20]. On account of no objective methodology to estimate its value, the economic value of wildlife could not be estimated in a more scientific manner. However, in future, it is recommended to invest more time and resources to develop methodologies for estimating economic value of wildlife in a country such as India with its associated economic and social implications. The issue of how threatened and endangered species should be addressed is also a subject of future research. Further, the area adjoining national parks are treated very differently from national parks in terms of rates of NPV charged for forest diversion. However, such areas have much larger ecological significance in maintaining the integrity of national park. While the current study has made an attempt to internalize this concern, how such areas should be differentiated from the rest should also be an important part of future research in this area.

Few other areas where a more detailed analysis and research is recommended in future revision of NPV rates are as follows:

- Cost of damage to below ground ecology and underground natural resources such as aquifer in excavation projects;
- Private and community owned forests;
- Potential for inter-state trading of land if suitable land for compensatory afforestation in the state cannot be found;
- Inclusion of social costs;
- Incorporation of some index such as the Human Development Index of an area in the estimation of NPV rates, especially the dependence value of forests;
- NPV rates applicable to Trees Outside Forests (TOF) – along with legal implications of ownership

[19]According to the Wildlife Protection Act, 1972, "wildlife" includes any animal, bees butterflies, crustacean, fish and moths; andaquatic or land vegetation which forms part of any habitat. The discussion here on limitation of current study mainly pertains to the faunal aspect.

[20]Issue raised by Shri V. B. Mathur, Dean, Wildlife Institute of India during the Consultation meeting.

- Economic value of forest succession;
- How to deal with shifting cultivation?
- Factoring in the cumulative impacts of projects in the regions in NPV computations;
- Incorporating site-specific forest fragmentation in estimation of NPV rates at a landscape level;
- Downstream impacts of different project categories to assess the landscape impact value and its internalization in the final NPV rates;
- Accounting for positive externalities from different project categories based on actual performance and its internalization in NPV;
- Ancillary activities of a project such as transportation of extracted materials in case of mining have impacts on forests outside the diverted area which is currently not factored into the NPV rates;
- NPV rates may be based on the extent of change of land use & change in ecological fabric of land brought about by a proposed project activity which may be assessed by developing a scale of projects considering issues of time horizon, total impact, spatial and temporal extent of change among others;

7 Internalization of comments and concerns of stakeholders[21]

KEY MESSAGES

This chapter is in response to TOR 6: Analyze, discuss and internalize comments received from stakeholders on the first draft report

The comments received from various stakeholders on the first draft report uploaded on MoEFCC's website were analyzed rigorously and discussed extensively with various officials of MoEFCC. This draft report, especially the current chapter has made an attempt to internalize those concerns.

Firstly, an easy-to-comprehend and step-wise methodology used for valuation of each of the ecosystem services considered in the study has been presented. Further, in addition to paying Net Present Value rates of forest to be diverted, the user agencies are also required to pay for compensatory afforestation (CA). It needs to be acknowledged that while natural forests can never be replaced by plantations, these measures also compensate for a proportion of ecosystem services lost as a result of forest diversion. As user agencies are mandated to pay for compensatory afforestation, it is being suggested that the final NPV rates may be adjusted based on the proportion of value of ecosystem services restored due to compensatory afforestation. The amount of discounting needed has been estimated as Standard Compensatory Afforestation Restoration Factor (SCARF).

In order to aid decision-making of MoEFCC in dealing with the plethora of issues related to NPV, it is proposed that a year-round data gathering and analysis hub of MoEFCC be located at the Centre for Ecological Services Management, IIFM. The Hub is proposed to render transparency, objectivity and consistency to the decision-making process and provide information on various forest land transfer and ecosystem services related issues and queries received by MoEFCC.

7.1 Comments on the First Draft Report

Rendering to the calculations shown in preceding chapters for estimating the economic value of various ecosystem services from forests, the report was submitted to the Ministry of Environment, Forests & Climate Change (MoEFCC) for consideration in June 2013. As implementation of updated rates for Net Present Value are likely to influence lives and businesses of a large number of stakeholders across sectors in India, MoEFCC later put the report in public domain and invited responses on it by 31st August 2013. A total of 16 organizations submitted their comments on the report to MoEFCC. In addition, 3 other organizations submitted their comments directly to IIFM. Of these 19, 11 organizations are related to mining, 4 organizations to wind energy and the remaining 4 organizations relate to other kind of activities. The latter includes Society for Promotion of Wastelands Development (SPWD), Office of PCCF (Mizoram), ACC Limited and National Hydroelectric Power Corporation (NHPC). The comments received can be broadly categorized into those suggesting underestimation, overestimation of NPV rates, related to exemptions from paying NPV and miscellaneous aspects.

[21] The contents of this chapter were not part of the draft report submitted to MoEFCC in June 2013. Based on the comments received on the report, the chapter has been added for further updating the methodology used.

Indicative comments related to underestimation of NPV rates include several important NWFPs not being considered; underestimation of local services from forests such as fuel wood, fodder and others; non inclusion of important benefits from forests such as flagship species, eco-tourism, religious and cultural values, habitats for humans & wildlife, source of employment; and grasslands in the calculation process. Comments suggesting overestimation of NPV rates include, inter alia, inclusion of less than 10% canopy cover category (scrub); proposal for estimating NPV rates based on forest type group specific rotation period; inadequate representation from industry in the consultation process; usage of low discount rate for estimation of NPV rate; and premium suggested for add-on factors such as hill talukas, forested wetlands and protected areas. Comments related to exemptions from paying NPV include retaining full exemption for underground optical fibres & transmission cables; basing exemption rates for wind energy projects on minimum NPV rate as against the applicable NPV rate; increasing exemptions for underground as well as open cast mining; and exempting charge of possession value of land for projects that relate to 'temporary' diversion of forest land such as mining. Comments related to miscellaneous aspects include, among others, balancing environment & development concerns, specifically in young states and in general in the country; moving beyond Champion & Seth classification; inclusion of plantations as a separate classification category; urgent implementation of mechanism to compensate local communities for their losses; less frequent revision of NPV rates; and inclusion of positive externalities from a project in NPV calculation. The number of comments on major aspects of the study is as shown below.

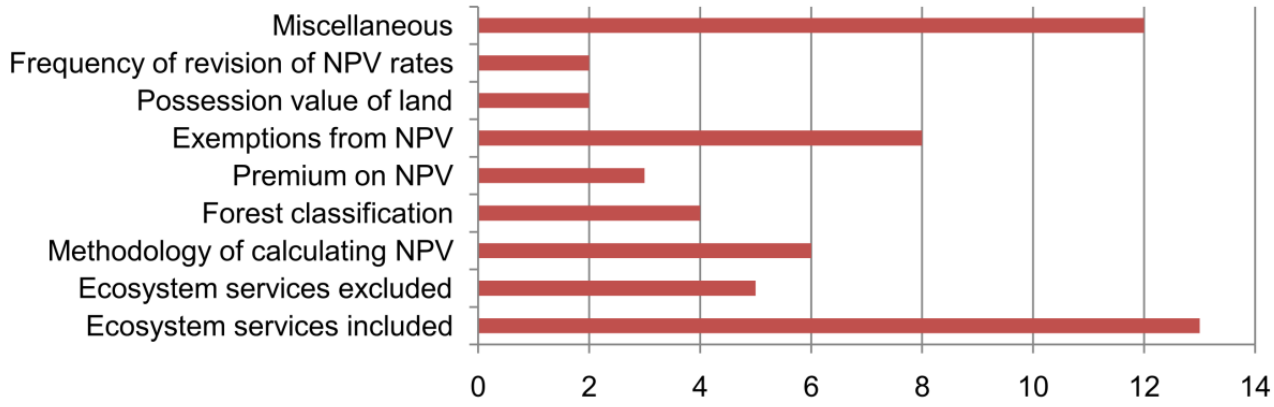


Figure 5 –Issues on which stakeholder comments were received on the first draft report and their frequency

All such major comments have been listed according to the relevant section and their draft responses are as tabulated in Appendix 39. This chapter thus focuses on the issues across which comments were received on the NPV report and how the methodology for estimating NPV rates has been accordingly amended.

A large number of organizations submitted their responses on the report to MoEFCC which were forwarded to IIFM for analysis. Accordingly a detailed analysis was done to understand the spectrum

of responses. In the light of these comments, several discussions were held with officials of MoEFCC including the former (Dr. V. Rajagoplan) and the current Secretary (Shri Ashok Lavasa), MoEFCC on 19th August 2014, 27th August 2014 and 25th September 2014. While largely in agreement with methodology proposed for estimation of NPV rates, the concerns of the stakeholders on the NPV report and subsequent discussions with MoEFCC focused majorly on the following aspects:

1. Include a step-wise methodology used for estimating the economic value of each ecosystem service for clear understanding

2. User agencies pay for compensation afforestation which also leads to generation of an array of ecosystem services. The economic value of these regenerated services should be discounted from the final NPV rates.

3. Develop scenarios using two rates of discount i.e. 4 per cent and 6 per cent for estimating the NPV rates and adjustment for compensatory afforestation.

The following sections discuss these aspects and suggests methodology for estimation of benefits from compensatory afforestation to discount applicable NPV rates. It also provides matrices for amount to be discounted from the applicable NPV at 4 per cent and 6 per cent rates of discount on account of benefits restored from compensatory afforestation.

7.2 Stepwise Methodologies for Estimating Economic Value of Ecosystem Services considered in Estimating NPV

The ecosystem services considered in the estimation of NPV rates include bamboo, fodder, timber, NTFP, carbon sequestration, fuel wood / fodder provisioning, gene-pool conservation, pollination & seed dispersal, water recharge, soil conservation, water purification and carbon storage. The NPV rates so estimated at two different rates of discount are as shown in Tables below.

Table 40 - Proposed NPV rates (Rs. Lakhs per hectare) using 4 per cent rate of discount

Forest Type Group	VDF	MDF	OF	LTF
Tropical Wet Evergreen Forests – NE	38.85	21.27	19.03	7.52
Tropical Wet Evergreen Forests – WG	43.34	31.31	14.22	9.01
Tropical Semi Evergreen Forests – NE	23.62	17.78	9.87	6.46
Tropical Semi Evergreen Forests – ED	55.55	45.68	26.97	24.86
Tropical Semi Evergreen Forests – WG	33.89	23.66	15.44	10.12
Tropical Moist Deciduous Forests	30.32	22.25	13.55	7.61
Littoral & Swamp Forests	49.02	35.12	22.58	17.48
Tropical Dry Deciduous Forests	25.08	18.62	11.17	7.73
Tropical Thorn Forests	14.37	13.41	10.57	7.78

Forest Type Group	VDF	MDF	OF	LTF
Tropical & Subtropical Dry Evergreen Forests	28.38	21.43	13.24	7.47
Subtropical Pine/Broadleaved Hill Forests	22.74	17.97	11.63	6.64
Montane & Moist Temperate Forest	30.14	23.78	13.54	6.93
Sub Alpine & Dry Temperate Forest	25.29	20.07	11.29	5.65
Alpine Scrub	27.23	19.14	10.70	6.83

Table 41 - Proposed NPV rates (Rs. Lakhs per hectare) using 6 per cent rate of discount

Forest Type Group	VDF	MDF	OF	LTF
Tropical Wet Evergreen Forests – NE	29.25	16.20	14.51	6.17
Tropical Wet Evergreen Forests – WG	32.91	23.92	11.23	7.43
Tropical Semi Evergreen Forests – NE	17.87	13.35	7.42	5.01
Tropical Semi Evergreen Forests – ED	42.34	34.82	20.97	19.43
Tropical Semi Evergreen Forests – WG	25.33	17.76	11.71	7.91
Tropical Moist Deciduous Forests	22.29	16.43	10.12	5.91
Littoral & Swamp Forests	35.92	25.84	16.73	13.15
Tropical Dry Deciduous Forests	18.92	14.18	8.41	5.93
Tropical Thorn Forests	10.89	10.22	8.03	6.01
Tropical & Subtropical Dry Evergreen Forests	21.47	16.33	10.30	6.13
Subtropical Pine/Broadleaved Hill Forests	17.12	13.54	8.96	5.46
Montane & Moist Temperate Forest	22.14	17.55	10.20	5.61
Sub Alpine & Dry Temperate Forest	18.74	14.76	8.54	4.66
Alpine Scrub	20.43	14.42	8.29	5.59

Table 42 below presents a short summary of ecosystem services whose economic value has been estimated in the report along with approaches used and sources of data. Readers interested in exploring the methodology in greater detail for a particular ecosystem service are suggested to refer to Chapter 3 and 4 (especially Section 4.2.2).

Table 42 – Step-wise methodology for economic valuation of each ecosystem service considered

Sr. No.	Step	Sources of data	Adjustments, if any
Timber			
1.	Growing stock	Forest Survey of India	
2.	Calculation of Mean Annual Increament (MAI)	Armitage (1998)	
3.	Price of timber	ICFRE	Discount for cost
	Value = MAI * (Price – Cost)		
Bamboo			
1.	Bamboo biomass	Forest Survey of India	

Sr. No.	Step	Sources of data	Adjustments, if any
2.	Calculation of Mean Annual Production (MAP)	Armitage (1998) and Forest Survey of India	Derived from number of culms
3.	Price of bamboo	ICFRE	Discount for cost
	Value = MAP * (Price – Cost)		
Fodder			
1.	Total Adult Cattle Units compeletely dependent on forests for fodder	Forest Survey of India	Converted from State-wise figures
2.	Standard fodder requirement	R. Pandey (2011)	
3.	Calculate total of fodder supplied from forests	(1) X (2)	
4.	Price of fodder	ICFRE	Discount for cost
	Value = Fodder Supplied * (Price – Cost)		
NWFP			
1.	Potential production of 12 major NWFPs	Forest Survey of India	
2.	Price of NWFPs	Various (Annexure 9)	Discount for cost
	Value = Potential Production * (Price – Cost)		
Fuel wood			
1.	Quantity of fuel wood extracted from forests	Forest Survey of India	Converted from State-wise figures
2.	Price	ICFRE	Discount for cost
	Value = Fuel wood extracted * (Price – Cost)		
Carbon sequestration			
1.	Mean Annual Increment	From (1) in Timber; Forest Survey of India	
2.	Annual carbon sequestration	IPCC (2003)	Assuming 50% of biomass as carbon and 1tC = 3.67 tCO_2
3.	Social cost of carbon (SCC) for India	Nordhaus (2011)	Purchasing Power Parity
	Value = Annual Carbon Sequestration * SCC		
Gene-pool conservation			
1.	Net-bioprospecting value	Gundimeda et al (2006)	For Jharkhand, Chattisgarh and Uttarakhand – values before separation; Converted from State-wise figures
2.	Forest cover	Forest Survey of India	
	Value = Net Value / Forest Cover		

Sr. No.	Step	Sources of data	Adjustments, if any
Pollination and seed dispersal			
1.	% to ideal renegeration in forests	Forest Survey of India	Adjustment regeneration in plantations
2.	Avoided cost of Afforestation	NAP (2009)	
	Value = % of ideal regeneration * Avoided cost of afforestation		
Soil conservation			
1.	Average weight of soil	Forest Survey of India	
2.	Avoided erosion	GIST (2006)	Assuming 100 years time to erode without forest cover
3.	Loss of N, P and K avoided due to erosion	Pandey et al (1984)	
4.	Avoided fertilizer cost	MoCF (2013)	
	Value = NPK Loss avoided * Price of NPK fertilizers		
Water recharge			
1.	Differential run-off avoided (recharge of water)	Kumar et al (2006)	Converted from state-wise figures
2.	Economic value of water	Kumar et al (2008)	
	Value = Differential water recharge * Economic value of water		
Carbon storage			
1.	Carbon stock	Forest Survey of India	
2.	Social cost of carbon (SCC) for India	Nordhaus (2011)	Purchasing Power Parity
	Value = Carbon stock * SCC		
Water purification			
	Economic value of water purification in other countries	Various; Annexure 23	Adjusted for PPP
	Value obtained through benefits transfer approach		

7.3 Accounting for ecosystem services benefits from compensatory afforestation

In addition to paying Net Present Value rates of forest to be diverted, the user agencies are also required to pay for compensatory afforestation (CA). It needs to be acknowledged that while natural forests can never be replaced by plantations, these measures also compensate for a portion of

ecosystem services lost as a result of forest diversion. As user agencies are mandated to pay for compensatory afforestation, it is being suggested that the final NPV rates may be adjusted based on a restoration factor that considers the portion of economic value of ecosystem services restored due to compensatory afforestation. The amounting of discounting needed has been estimated as Standard Compensatory Afforestation Restoration Factor (SCARF).

As the NPV rates in the current study have been estimated for each cell individually in the 14 X 4 matrix, it is suggested that the restoration factor should also be applied to each cell. Doing so would avoid any unwanted effects due to generalization over canopy density classes or forest type groups considered.

The calculations for estimation of SCARF are based on the following assumptions.

1. Potential of any land provided for CA is comparable to the forest land and type in the vicinity.
2. Any plantation is just a surrogate and can compensate a few of the ecosystem services in some proportions.
3. While any such restoration of ecosystem services takes a period beyond the rotation period assumed for estimating the NPV, it is being assumed for practical purposes and convenience, to be the same.
4. Species selected for the CA will be from among the native species of the local area.
5. Irrespective of whether the compensatory afforestation is carried out on revenue land or degraded forest land, the adjustment shall assume compensatory afforestation on an area equal to forest area diverted.
6. To offset their effect, the same discount rate for both NPV and SCARF is being used.

The following steps have been used to estimate the Standard Compensatory Afforestation Restoration Factor (SCARF) for each of the cell in the 14 X 4 matrix.

A) Based on technical consensus among forestry and ecosystem experts at Indian Institute of Forest Management, the following assumptions were made on the portion of ecosystem services restored by compensatory afforestation at the end of 1 felling cycle / rotation period. The forest type group felling cycle / rotation period considered for estimation of NPV rates has been maintained.

Table 43 - Assumptions for portion of ecosystem services restored by compensatory afforestation

Ecosystem service	Percentage of total benefits restored by CA
Bamboo	0%
Fodder	80%
Timber	20%
NTFP	60%
Carbon sequestration	60%
Fuel wood	80%
Gene-pool conservation (bioprospecting)	20%
Pollination & seed dispersal	20%
Water recharge	50%
Soil conservation	50%
Water purification	50%
Carbon storage	50%

B) For each of the cells in the 14 X 4 matrix, the portion of value contributed by each of the 12 ecosystem services in the total NPV rate for the cell was estimated.

C) Based on the proportion of value contributed by each ecosystem service in a particular cell (step b) and the percentage of total benefits restored by compensatory afforestation for that ecosystem service (step a), the percentage of total value of all ecosystem services restored by compensatory afforestation was estimated. As this represents the value restored at the end of 1 felling cycle / rotation period for a particular forest type group, using the same discount rate and forest type group specific duration used for estimating NPV rates, the present value in terms of portion of value restored has been estimated. This is tabulated below for two discount rates (4 and 6 per cent)

Table 44 - SCARF using 4% rate of discount

Forest Type Group	VDF	MDF	OF	LTF
Tropical Wet Evergreen Forests – North East	5.40%	4.12%	3.45%	3.54%
Tropical Wet Evergreen Forests – Western Ghats	5.85%	4.36%	5.24%	4.20%
Tropical Semi Evergreen Forests - North East	2.87%	2.82%	2.93%	2.78%
Tropical Semi Evergreen Forests - Eastern Deccan	8.69%	6.80%	8.44%	6.52%
Tropical Semi Evergreen Forests - Western Ghats	4.14%	3.57%	3.82%	3.29%
Tropical Moist Deciduous Forests	4.22%	3.24%	3.48%	3.00%
Littoral & Swamp Forests	4.32%	3.25%	3.87%	2.90%

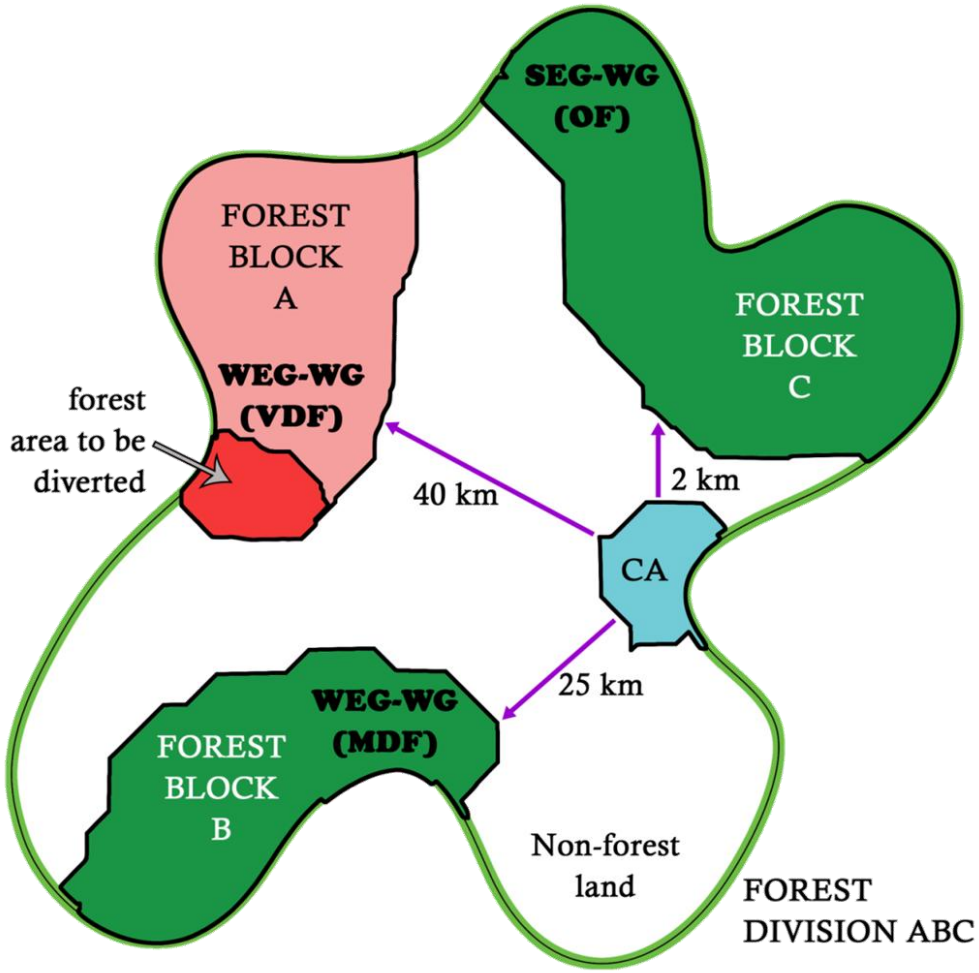
Forest Type Group	VDF	MDF	OF	LTF
Tropical Dry Deciduous Forests	6.44%	5.18%	5.81%	4.36%
Tropical Thorn Forests	6.85%	5.99%	6.20%	5.53%
Tropical & Subtropical Dry Evergreen Forests	5.77%	4.30%	4.73%	4.07%
Subtropical Pine/Broadleaved Hill Forests	2.97%	2.27%	2.48%	2.25%
Montane & Moist Temperate Forest	2.47%	1.65%	1.87%	1.62%
Sub Alpine & Dry Temperate Forest	1.61%	1.15%	1.27%	1.15%
Alpine Scrub	2.59%	2.10%	2.34%	1.83%

Table 45 - SCARF using 6% rate of discount

Forest Type Group	VDF	MDF	OF	LTF
Tropical Wet Evergreen Forests – North East	1.91%	1.46%	1.22%	1.25%
Tropical Wet Evergreen Forests – Western Ghats	2.18%	1.62%	1.95%	1.56%
Tropical Semi Evergreen Forests - North East	0.85%	0.84%	0.87%	0.83%
Tropical Semi Evergreen Forests - Eastern Deccan	3.28%	2.56%	3.18%	2.46%
Tropical Semi Evergreen Forests - Western Ghats	1.29%	1.11%	1.19%	1.02%
Tropical Moist Deciduous Forests	1.26%	0.97%	1.04%	0.90%
Littoral & Swamp Forests	1.17%	0.88%	1.05%	0.79%
Tropical Dry Deciduous Forests	2.24%	1.80%	2.02%	1.52%
Tropical Thorn Forests	2.43%	2.12%	2.19%	1.96%
Tropical & Subtropical Dry Evergreen Forests	2.02%	1.50%	1.65%	1.42%
Subtropical Pine/Broadleaved Hill Forests	0.79%	0.61%	0.66%	0.60%
Montane & Moist Temperate Forest	0.58%	0.39%	0.44%	0.38%
Sub Alpine & Dry Temperate Forest	0.32%	0.23%	0.25%	0.23%
Alpine Scrub	0.67%	0.54%	0.60%	0.47%

It is suggested that the above factors may be used for adjusting the NPV rates to internalize the economic value of ecosystem services flowing from compensatory afforestation financed by user agencies. Refer to Box 5 and Box 6 which demonstrate the concept of SCARF and how it can be used to appropriately adjust the applicable NPV rate.

Box 5 - A hypothetical situation to demonstrate the methodology for SCARF



Let us consider a hypothetical situation to gain more clarity on the proposed mechanism for adjustment. Consider a Forest Division ABC with 3 Forest Blocks i.e. A, B and C. Suppose a patch of 40 hectares is proposed for diversion in Wet Evergreen Forest – Western Ghats (Very Dense Forest) category from Forest Block A (see figure overleaf). The NPV to be charged for diversion of this forest according to the proposed rates is Rs. 43.34 lakhs per hectare. The land for compensatory afforestation has also been identified in the same Forest Division, although it is a revenue land. It is safe to assume that along the ecological continuum (including forest type, soil conditions, terrain, climate, etc.), compensatory afforestation will have highest resemblance/similarity to the nearest forest land. Thus, the forest land in the vicinity (Forest Block B) is the best measure of the potential of compensatory afforestation to restore ecosystem services lost due to diversion of forest in Forest Block A. Thus, the Standard Compensatory Afforestation Restoration Factor (SCARF) should be estimated based on category of forest in Forest Block B (nearest to the compensatory afforestation land). This category, let us suppose, is Semi Evergreen Forests – Western Ghats (Open Forest) for which the estimated SCARF is 3.82% and the associated NPV rates are Rs. 15.44 lakhs per hectare. An adjustment of Rs. 0.59 lakhs per hectare (3.82% of Rs. 15.44 lakhs) should be made in the NPV charged for forest land diverted i.e. Rs. 43.34 lakhs per hectare. The adjusted NPV rate of Rs. 42.75 lakhs per hectare should thus be charged for the diverted forest land after internalizing the potential of compensatory afforestation land to restore a portion of ecosystem services lost.

Box 6 - Another hypothetical situation to demonstrate the methodology for SCARF

Consider another scenario as follows for more clarity (please refer to Table 4 and 5).

Forest Area Diverted belongs to Semi Evergreen Forests – North East in Open Forests Category

Area proposed for diversion = 20 hectare

Suggested NPV rate = Rs. 9.87 lakh per hectare (See Table 40)

Compensatory afforestation land identified is in the vicinity of forest belong to Wet Evergreen Forests – North East in Moderately Dense Forests Category

SCARF Adjustment = 4.12% of Rs. 21.27 lakh = Rs. 0.88 lakh per hectare (See Table 40 and Table 44)

Adjusted NPV rate to be collected from user agency = Rs. (9.87 – 0.88) = Rs. 7.99 lakh per hectare

The proposed amount to be adjusted for SCARF in Rs. Lakhs per hectare thus estimated is as tabulated below for 4 per cent and 6 per cent rate of discount.

Table 46 – SCARF Adjustment (Rs. Lakhs per hectare) using 4% rate of discount

Forest Type Group	VDF	MDF	OF	LTF
Tropical Wet Evergreen Forests – NE	2.10	0.88	0.66	0.27
Tropical Wet Evergreen Forests – WG	2.54	1.36	0.74	0.38
Tropical Semi Evergreen Forests – NE	0.68	0.50	0.29	0.18
Tropical Semi Evergreen Forests – ED	4.83	3.11	2.28	1.62
Tropical Semi Evergreen Forests – WG	1.40	0.84	0.59	0.33
Tropical Moist Deciduous Forests	1.28	0.72	0.47	0.23
Littoral & Swamp Forests	2.12	1.14	0.87	0.51
Tropical Dry Deciduous Forests	1.61	0.96	0.65	0.34
Tropical Thorn Forests	0.99	0.80	0.65	0.43
Tropical & Subtropical Dry Evergreen Forests	1.64	0.92	0.63	0.30
Subtropical Pine/Broadleaved Hill Forests	0.67	0.41	0.29	0.15
Montane & Moist Temperate Forest	0.74	0.39	0.25	0.11
Sub Alpine & Dry Temperate Forest	0.41	0.23	0.14	0.06
Alpine Scrub	0.71	0.40	0.25	0.12

Table 47 – SCARF Adjustment (Rs. Lakhs per hectare) using 6% rate of discount

Proposed SCARF Adjustment (Rs. Lakh per Hectare)	VDF	MDF	OF	LTF
Tropical Wet Evergreen Forests – NE	0.56	0.24	0.18	0.08
Tropical Wet Evergreen Forests – WG	0.72	0.39	0.22	0.12
Tropical Semi Evergreen Forests – NE	0.15	0.11	0.06	0.04
Tropical Semi Evergreen Forests – ED	1.39	0.89	0.67	0.48
Tropical Semi Evergreen Forests – WG	0.33	0.20	0.14	0.08
Tropical Moist Deciduous Forests	0.28	0.16	0.11	0.05
Littoral & Swamp Forests	0.42	0.23	0.18	0.10
Tropical Dry Deciduous Forests	0.42	0.26	0.17	0.09
Tropical Thorn Forests	0.26	0.22	0.18	0.12
Tropical & Subtropical Dry Evergreen Forests	0.43	0.24	0.17	0.09
Subtropical Pine/Broadleaved Hill Forests	0.14	0.08	0.06	0.03
Montane & Moist Temperate Forest	0.13	0.07	0.04	0.02
Sub Alpine & Dry Temperate Forest	0.06	0.03	0.02	0.01
Alpine Scrub	0.14	0.08	0.05	0.03

As the sites for diversion of forests and compensatory afforestation need to be identified before arriving at the final NPV rate to be charged, the matrices (**Error! Reference source not found.** and Table 46 for 4 per cent rate of discount and **Error! Reference source not found.** and Table 47 for 6 per cent rate of discount) need to be used in conjunction.

It is envisaged that internalizing the benefits from compensatory afforestation in appropriately adjusting the NPV rates shall bring more objectivity in the process. However, it is proposed that benefits restored from compensatory afforestation on ground need to be studied in detailed across the forest types and canopy cover densities to scientifically estimate the actual portion of ecosystem services restored from compensatory afforestation. A study in this regard before the next revision in NPV rates is due will greatly assist in fair assessment of benefits from compensatory afforestation.

7.4 Way forward

As also highlighted earlier in Chapter 6, there is scope in improving effectiveness of dealing with issues related to determination of NPV, determination of SCARF and adjusted NPV, effective implementation of CAMPA funds, among various others. In this regard, it is proposed that a year-round data gathering and analysis hub of MoEFCC be established at the Centre for Ecological Services Management, a centre of excellence at IIFM to render transparency, objectivity and

consistency to the decision-making process and provide information on various forest land transfer and ecosystem services related issues and queries received by MoEFCC.

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9 APPENDIX

Appendix 1 - Area (km^2) of proposed Forest Type Groups in different states under various forest cover density classes (FSI 2011a)

States and UTs	Very Dense Forest	Mod. Dense Forest	Open Forest	Less than 10% Canopy	Grand Total
Andaman & Nicobar	**3359**	**2646**	**481**	**3**	**6489**
Littoral & Swamp Forests	268	276	122	0	665
Tropical Moist Deciduous Forests	195	348	52	0	594
Tropical Semi Evergreen Forests - Western Ghats	857	947	185	0	1990
Tropical Wet Evergreen Forests – Western Ghats	2040	1075	123	3	3240
Andhra Pradesh	**129**	**23937**	**19826**	**9755**	**53647**
Littoral & Swamp Forests	1	138	115	56	310
Tropical & Subtropical Dry Evergreen Forests	1	236	195	96	528
Tropical Dry Deciduous Forests	115	21481	17792	8754	48143
Tropical Moist Deciduous Forests	5	988	818	403	2214
Tropical Thorn Forests	6	1094	906	446	2451
Arunachal Pradesh	**14411**	**37977**	**15357**	**128**	**67873**
Alpine Scrub	55	251	316	12	635
Montane& Moist Temperate Forest	1425	2387	1226	7	5045
Sub Alpine & Dry Temperate Forest	808	4379	2837	0	8024
Subtropical Pine/Broadleaved Hill Forests	615	1479	740	11	2844
Tropical Moist Deciduous Forests	217	2383	953	82	3635
Tropical Semi Evergreen Forests - North East	10784	26800	9101	3	46688
Tropical Wet Evergreen Forests – North East	507	298	184	13	1003
Assam	**1380**	**10613**	**12863**	**137**	**24994**
Subtropical Pine/Broadleaved Hill Forests	5	39	79	2	125
Tropical Dry Deciduous Forests	1	5	20	0	25
Tropical Moist Deciduous Forests	435	2656	4011	24	7126
Tropical Semi Evergreen Forests - North East	663	5749	7941	17	14371
Tropical Wet Evergreen Forests – North East	276	2163	813	95	3347
Bihar	**110**	**2779**	**2287**	**129**	**5305**
Littoral & Swamp Forests	0	7	7	0	14
Tropical Dry Deciduous Forests	96	2425	2184	128	4833
Tropical Moist Deciduous Forests	14	306	68	0	389
Tropical Wet Evergreen Forests – North East	0	42	27	0	69
Chandigarh	**1**	**4**	**4**	**1**	**10**
Tropical Dry Deciduous Forests	1	4	4	1	10
Chhattisgarh	**2256**	**36440**	**16912**	**91**	**55698**
Tropical Dry Deciduous Forests	547	18128	10138	91	28904
Tropical Moist Deciduous Forests	1709	18312	6774	0	26794
Dadra & Nagar Haveli	**0**	**129**	**90**	**0**	**219**
Tropical Dry Deciduous Forests	0	11	18	0	29
Tropical Moist Deciduous Forests	0	118	71	0	190
Daman & Diu	**0**	**0**	**1**	**0**	**1**
Littoral & Swamp Forests	0	0	1	0	1
Delhi	**0**	**18**	**39**	**1**	**58**
Tropical Thorn Forests	0	18	39	1	58
Goa	**55**	**929**	**535**	**1**	**1519**
Littoral & Swamp Forests	0	4	6	0	10
Tropical Dry Deciduous Forests	0	0	0	0	0
Tropical Moist Deciduous Forests	0	241	308	0	550
Tropical Semi Evergreen Forests - Western Ghats	0	226	193	0	419
Tropical Wet Evergreen Forests – Western Ghats	55	458	28	0	541

States and UTs	Very Dense Forest	Mod. Dense Forest	Open Forest	Less than 10% Canopy	Grand Total
Gujarat	**114**	**5755**	**7525**	**1475**	**14869**
Littoral & Swamp Forests	0	219	845	29	1093
Tropical Dry Deciduous Forests	8	3523	4476	585	8592
Tropical Moist Deciduous Forests	106	1572	355	1	2034
Tropical Thorn Forests	0	441	1848	861	3150
Haryana	**3**	**322**	**640**	**138**	**1102**
Subtropical Pine/Broadleaved Hill Forests	0	11	13	0	24
Tropical Dry Deciduous Forests	3	311	627	137	1079
Himachal Pradesh	**1097**	**7622**	**5090**	**383**	**14192**
Alpine Scrub	47	257	361	117	782
Montane& Moist Temperate Forest	680	4051	1733	57	6521
Sub Alpine & Dry Temperate Forest	167	890	709	40	1806
Subtropical Pine/Broadleaved Hill Forests	122	1702	1377	96	3297
Tropical Dry Deciduous Forests	43	488	780	72	1383
Tropical Moist Deciduous Forests	38	233	131	0	403
Jammu & Kashmir	**2130**	**8289**	**10577**	**2816**	**23811**
Alpine Scrub	1487	656	456	187	2785
Montane& Moist Temperate Forest	173	2321	4397	1386	8277
Sub Alpine & Dry Temperate Forest	348	2602	3138	1076	7164
Subtropical Pine/Broadleaved Hill Forests	69	1529	1862	151	3611
Tropical & Subtropical Dry Evergreen Forests	0	109	80	8	196
Tropical Dry Deciduous Forests	54	1072	644	9	1778
Jharkhand	**2544**	**8939**	**10154**	**733**	**22370**
Tropical Dry Deciduous Forests	2448	8575	9992	733	21749
Tropical Moist Deciduous Forests	96	364	162	0	621
Karnataka	**464**	**19787**	**11837**	**3150**	**35238**
Littoral & Swamp Forests	0	0	0	0	1
Subtropical Pine/Broadleaved Hill Forests	4	267	123	0	394
Tropical Dry Deciduous Forests	6	3401	4413	1527	9346
Tropical Moist Deciduous Forests	76	6661	2555	0	9293
Tropical Semi Evergreen Forests - Western Ghats	83	3930	1195	1	5208
Tropical Thorn Forests	0	481	2479	1623	4584
Tropical Wet Evergreen Forests – Western Ghats	294	5047	1072	0	6413
Kerala	**1022**	**6133**	**2501**	**69**	**9724**
Littoral & Swamp Forests	0	1	0	0	1
Montane& Moist Temperate Forest	2	56	14	0	73
Tropical Dry Deciduous Forests	2	125	189	5	322
Tropical Moist Deciduous Forests	25	1535	970	1	2530
Tropical Semi Evergreen Forests - Western Ghats	116	2157	891	0	3164
Tropical Thorn Forests	0	1	0	0	1
Tropical Wet Evergreen Forests – Western Ghats	877	2259	436	62	3633
Madhya Pradesh	**4149**	**36063**	**34191**	**2126**	**76530**
Tropical Dry Deciduous Forests	3758	32663	30968	1926	69315
Tropical Moist Deciduous Forests	380	3304	3132	195	7011
Tropical Thorn Forests	11	96	91	6	203
Maharashtra	**8191**	**19866**	**18186**	**4248**	**50492**
Littoral & Swamp Forests	0	21	21	0	43
Subtropical Pine/Broadleaved Hill Forests	76	374	268	78	795
Tropical Dry Deciduous Forests	4708	10351	10804	3830	29694
Tropical Moist Deciduous Forests	3253	6485	5506	192	15437
Tropical Semi Evergreen Forests - Western Ghats	154	2474	1301	68	3997
Tropical Thorn Forests	0	161	286	79	526
Manipur	**923**	**5541**	**10578**	**39**	**17080**
Montane& Moist Temperate Forest	257	609	925	0	1791

States and UTs	Very Dense Forest	Mod. Dense Forest	Open Forest	Less than 10% Canopy	Grand Total
Subtropical Pine/Broadleaved Hill Forests	629	3670	6207	11	10516
Tropical Moist Deciduous Forests	11	245	266	0	523
Tropical Semi Evergreen Forests - North East	25	1017	3180	28	4250
Meghalaya	**338**	**6808**	**9842**	**181**	**17169**
Subtropical Pine/Broadleaved Hill Forests	2	2184	2278	0	4465
Tropical Moist Deciduous Forests	235	3715	6630	0	10580
Tropical Semi Evergreen Forests - North East	1	86	245	0	331
Tropical Wet Evergreen Forests – North East	100	824	689	181	1793
Mizoram	**133**	**6173**	**12378**	**0**	**18684**
Subtropical Pine/Broadleaved Hill Forests	3	69	52	0	123
Tropical Moist Deciduous Forests	63	2472	2586	0	5120
Tropical Semi Evergreen Forests - North East	68	3633	9740	0	13441
Nagaland	**236**	**5602**	**7881**	**13**	**13732**
Montane& Moist Temperate Forest	215	1078	449	0	1742
Subtropical Pine/Broadleaved Hill Forests	20	1566	1577	3	3166
Tropical Moist Deciduous Forests	1	2371	4135	6	6513
Tropical Semi Evergreen Forests - North East	0	569	1672	2	2243
Tropical Wet Evergreen Forests – North East	0	17	49	2	68
Orissa	**538**	**27423**	**19835**	**4742**	**52538**
Littoral & Swamp Forests	0	188	68	0	255
Tropical Dry Deciduous Forests	119	13416	12474	4730	30739
Tropical Moist Deciduous Forests	419	13645	7109	11	21184
Tropical Semi Evergreen Forests - North East	0	174	185	1	360
Puducherry	**0**	**0**	**1**	**0**	**1**
Littoral & Swamp Forests	0	0	1	0	1
Punjab	**0**	**598**	**735**	**15**	**1348**
Subtropical Pine/Broadleaved Hill Forests	0	49	21	0	70
Tropical Dry Deciduous Forests	0	549	714	15	1278
Rajasthan	**14**	**4456**	**10256**	**4527**	**19253**
Tropical Dry Deciduous Forests	14	4363	9617	3999	17993
Tropical Thorn Forests	0	93	639	528	1260
Sikkim	**498**	**1873**	**819**	**363**	**3553**
Alpine Scrub	4	17	10	313	344
Montane& Moist Temperate Forest	184	721	223	4	1132
Sub Alpine & Dry Temperate Forest	300	485	148	45	979
Subtropical Pine/Broadleaved Hill Forests	9	535	368	0	912
Tropical Moist Deciduous Forests	1	115	70	1	187
Tamil Nadu	**2405**	**7780**	**7687**	**1771**	**19642**
Littoral & Swamp Forests	12	50	37	2	101
Montane& Moist Temperate Forest	81	127	51	0	259
Subtropical Pine/Broadleaved Hill Forests	116	120	15	1	252
Tropical & Subtropical Dry Evergreen Forests	119	215	65	0	400
Tropical Dry Deciduous Forests	950	4869	4976	880	11676
Tropical Moist Deciduous Forests	418	954	588	59	2018
Tropical Semi Evergreen Forests - Western Ghats	292	480	137	1	909
Tropical Thorn Forests	85	566	1729	827	3207
Tropical Wet Evergreen Forests – Western Ghats	331	399	89	1	820
Tripura	**61**	**4969**	**3125**	**59**	**8214**
Tropical Moist Deciduous Forests	60	4599	2640	6	7305
Tropical Semi Evergreen Forests - North East	1	370	485	53	909
Uttar Pradesh	**1239**	**4007**	**5538**	**738**	**11522**
Littoral & Swamp Forests	22	160	162	5	349
Tropical Dry Deciduous Forests	80	2518	4208	725	7532
Tropical Moist Deciduous Forests	1133	1188	601	2	2925

States and UTs	Very Dense Forest	Mod. Dense Forest	Open Forest	Less than 10% Canopy	Grand Total
Tropical Semi Evergreen Forests - Eastern Deccan	4	12	17	0	32
Tropical Thorn Forests	0	129	551	5	685
Uttarakhand	**3975**	**14116**	**5699**	**320**	**24111**
Alpine Scrub	23	130	51	6	210
Montane& Moist Temperate Forest	1612	5014	2435	28	9090
Sub Alpine & Dry Temperate Forest	386	882	208	11	1486
Subtropical Pine/Broadleaved Hill Forests	769	4432	1721	189	7111
Tropical Dry Deciduous Forests	81	851	569	78	1579
Tropical Moist Deciduous Forests	1104	2806	716	8	4634
West Bengal	**2248**	**3274**	**2689**	**68**	**8279**
Littoral & Swamp Forests	887	905	323	5	2120
Montane& Moist Temperate Forest	151	238	106	0	496
Sub Alpine & Dry Temperate Forest	2	10	1	0	14
Subtropical Pine/Broadleaved Hill Forests	82	185	73	0	339
Tropical Dry Deciduous Forests	400	1209	1910	57	3576
Tropical Moist Deciduous Forests	526	621	223	6	1376
Tropical Semi Evergreen Forests - Eastern Deccan	200	105	52	0	358
Grand Total	**54024**	**320866**	**266160**	**38219**	**679268**

Appendix 2 - Rotation period of species considered for calculating the weighted average of rotation period for each unit of classification

Botanical Name	Rotation Period (years)	Botanical Name	Rotation Period (years)
Abies densa	100	Abies pindrow	150
Acacia auriculiformis	8	Acacia catechu	10
Acacia ferruginea	25	Acacia lenticularis/ leucophlaea	40
Acer acuminatum	80	Acer campbellii	80
Acer laevigatum	80	Acer oblongum	80
Acer pictum	80	Acer species	80
Albizzia amara	80	Albizzia chinensis	50
Albizzia julibrissin	50	Albizzia lebbek	50
Albizzia lucida/lucidior	80	Albizzia mollis	50
Albizzia odoratissima	50	Albizzia procera/Mimosa elata	50
Albizzia species	50	Alnus nepalensis	50
Amoora species	20	Anogeissus latifolia	15
Anthocephalus cadamba	15	Betula utilis	60
Bombax ceiba	15	Bridelia retusa/squamosa	60
Buchanania latifolia/lanzan	20	Butea monosperma	60
Callicarpa arborea	60	Careya arborea	80
Castanopsis indica	60	Castanopsis species	60
Cedrus deodara	120	Chloroxylon swietenia	60
Cinnamomum cecicodaphne	60	Cinnamomum impressinervium	60
Cinnamomum iners	60	Cinnamomum oblongifolium	60
Cinnamomum obtusifolium	60	Cinnamomum species	60
Cinnamomum tamala	60	Cinnamomum wightianum/ zeylanicum	60
Citrus medica	30	Citrus species	30
Cleistanthus collinus	50	Cupressus kashmiriana	50
Cupressus species	50	Cupressus torulosa	50
Dalbergia paniculata	60	Dillenia indica	50
Diospyros assimilis	60	Diospyros candolleana	60
Diospyros chloroxylon	60	Diospyros crumentata	60
Diospyros marmorataMalabarica	60	Diospyros melanoxylon	30

Botanical Name	Rotation Period (years)	Botanical Name	Rotation Period (years)
Diospyros microphylla	60	Diospyros nilagirica	60
Diospyros obenum	60	Diospyros paniculata	60
Diospyros peregrina	30	Diospyros species	60
Diospyros tupru	60	Diospyros variegata	60
Dipterocarpus macrocarpus	7	Eucalyptus citriodora	7
Eucalyptus globules	7	Eucalyptus grandis	7
Eucalyptus hybrid	7	Eucalyptus species	7
Eucalyptus tereticornis	7	Eugenia alternifolia	100
Eugenia carymbosa	100	Eugenia caryophyllaea	100
Eugenia cymosa	100	Eugenia formosa	100
Eugenia frondosa	100	Eugenia grandis	100
Eugenia hemispherica	100	Eugenia mundagam	100
Eugenia praecox	100	Eugenia species	100
Eugenia zeylanica	100	Ficus asperrima	50
Ficus bengalensis	50	Ficus callosa	50
Ficus carica	50	Ficus cunia	50
Ficus drupace(Ficus mysereovsis)	50	Ficus elastica	50
Ficus hispida	50	Ficus nervosa	50
Ficus racemosa(Ficus glomerata)	50	Ficus religiosa	50
Ficus semicordata	50	Ficus species	50
Ficus tsiela	50	Ficus tsjehele	50
Ficus virene(Ficus infectorial)	50	Gardenia resinifera	30
Hardwickia binata	100	Hopea parviflora	80
Hopea wightiana	80	Lagerstroemia parviflora	40
Lannea coromandelica	40	Lyonia ovalifolia/pieris ovalifolia	40
Mallotus philippinensis	50	Pinus excelsa/wallichiana	80
Pinus roxburghii/longifolia	80	Prosopis ceneraria	50
Quercus dilatata	80	Quercus dilatata floribunda	80
Quercus glauca	80	Quercus griffithii	80
Quercus incana	80	Quercus lamellosa	80
Quercus lanceaefolia	80	Quercus leucotrichophora	80
Quercus lineata	80	Quercus pachyphylla	80
Quercus semecarpifolia	80	Quercus serrata	80
Quercus species	80	Quercus spicata	80
Randia uliginose	80	Rhododendron arboreum	50
Rhododendron barbatum	50	Rhododendron griffithianum	50
Rhododendron hodgsoni	50	Rhododendron species	50
Schima wallichii	50	Shorea assamica	80
Shorea robusta	100	Taxus baccata	60
Tectona grandis	80	Terminalia crenulata/tomentosa	80
Terminalia paniculata	80	Terminalia travancorensis	80
Trewia nudiflora	80	Wrightia tinctoria	50

Appendix 3 – Percentage of total trees per hectare for which specific rotation period was used for calculation of rotation period in each classification unit.

Forest Type Group	VDF	MDF	OF	LTF
Tropical Wet Evergreen-North East	50%	47%	72%	
Tropical Wet Evergreen-Western Ghats	12%	20%	26%	29%
Tropical Semi Evergreen-North East	46%	38%	37%	32%
Tropical Semi Evergreen-Eastern Deccan	68%	42%	45%	
Tropical Semi Evergreen-Western Ghats	31%	42%	38%	42%
Tropical Moist Deciduous Forests	67%	57%	55%	42%
Littoral & Swamp Forests	97%	59%	72%	
Tropical Dry Deciduous Forests	63%	66%	61%	55%

Forest Type Group	VDF	MDF	OF	LTF
Tropical Thorn Forest	71%	48%	51%	67%
Tropical & Subtropical Dry Evergreen Forests	15%	33%	35%	29%
Subtropical Pine/Broadleaved Hill Forests	85%	86%	74%	50%
Montane& Moist Temperate Forest	77%	78%	73%	
Sub Alpine & Dry Temperate Forest	88%	74%	72%	43%
Alpine Scrub	100%	84%	64%	

Appendix 4 – Concept note on Group Consultation Method Workshop

The problem

One of the thorniest problems when designing a new policy or when analyzing an existing policy is posed by the situation where, for a significant segment of the study, there is unsatisfactory information. This deficiency with respect to data – incomplete or unverified – is probably the norm rather than a rare occurrence. The usual ways of handling such a problem is often to use whatever good data exists and leave the discretionary segment as open to interpretation of results. When decision-makers need to base policies on such results, it contrasts with precision, scientific and objective decision-making. In such situations when assessments are partially based on judgements and opinions, it can be assumed that a consensus in opinions from many experts will bring more objectivity in decision-making.

Recalculation of NPV rates for forest diversion

In pursuance of Hon'ble Supreme Court(SC) judgment dated 26.09.2005 in IA No. 826 in IA No. 566 of 2000 in Writ Petition (Civil) 202 of 1995, a 3-member Expert Committee was formed to work out the Net Present Value (NPV) for forest land diverted for non-forest use on economic principles. After the Expert Committee submitted its report, the Central Empowered Committee (CEC) reviewed the report and gave its recommendations for calculation of NPV rates for forest diversion. Based on the principles of ecological economics, the value of ecosystem services from forests were estimated in the range of ₹ 4,38,000 to ₹ 10,43,000 per hectare according on forest eco-class and canopy cover density class.

As per the SC order, this NPV value was to be updated every 3 years and in this regard, Indian Institute of Forest Management has been awarded a study to recalculate these NPV rates. While the area of ecological economics is evolving rapidly, the estimation of NPV rates involves value judgment on few components. In order to be objective and scientific in our approach to calculate these rates, a Group Consultation Method Workshop (GCM) has been proposed to reach a consensus in opinion among all the stakeholders on such components.

What is GCM?

GCM is one of the techniques to produce converged social or group values. It is a group process involving an iterative process between

the facilitator and a group of identified experts on a specified topic. The technique has been identified as one of the most applicable ones when gaining judgments on complex matters where precise information is unavailable.

The GCM Process

The GCM addresses equity issues in an efficient manner. The equity, here, simply means being impartial, fair and just to all the stakeholders (or members of the group participating in the exercise). Individuals with better or best information to implement the consensus process are selected so that they can explain, reveal and share their basis for valuation. The proposed method works on cyclic (iterative) manner and enhances the quality of discussions at each additional round till consensus in opinion is reached among members of the group. For this study, the identified stakeholders include Ministry of Environment, Forests & Climate Change and State Forest Departments, user agencies (agencies seeking land for diversion), research institutions, local community affected by forest diversion and their representatives, and funding institutions. Care has been taken to include equal proportion of participants according to different geographical regions and kind of stakeholder.

The process will be initiated by a facilitator, who shall introduce the problem, the process, and the task (to derive converged value) to each member of the group. An established or accepted listing of items on which consensus needs to be reached have been identified based on consultation meetings with various stakeholders and the discussions held during the National Consultation Workshop organized for the study. The facilitator shall also provide brief information on these issues.

The group members, whose estimate differs from other members, may be individually asked to justify or convince other members by providing the reasons on which his/her/their estimates are based. This shall educate other members who may then either maintain or decide to change their original opinion. The members shall then provide their modified response to the facilitator. This cyclic process shall go on till the facilitator feels that the differences have come down to certain acceptable levels i.e. consensus has been reached.

Expectation from participants

Each participant will be sent a Questionnaire via email. The participants are requested to send their responses prior to the workshop for collation and summary development. These responses shall assist in developing a starting base for the GCM process as outlined above.
During the workshop, the participants will be given the chance to review their responses. Where they differ substantially from the group opinion, participants will be given the chance to provide reasons for their opinion to inform other participants.

Workshop Details

Date: 26th April 2013

Venue: Indian Institute of Forest Management, Bhopal

Time: 1000 hours to 1700 hours

Appendix 5 – Data and calculation steps for economic valuation of timber from forests

Forest Type Group	Canopy cover density class	Growing stock (cum / ha)[22]	Mean Annual Increment (cum/Ha)[23]	Value of Timber (₹ /ha/yr)[24]
Tropical Wet Evergreen-North East	VDF	225.44	8.27	₹ 1,86,148
Tropical Wet Evergreen-North East	MDF	114.32	4.20	₹ 94,393
Tropical Wet Evergreen-North East	OF	78.40	2.88	₹ 64,733
Tropical Wet Evergreen-North East	LTF	7.71	0.28	₹ 6,370
Tropical Wet Evergreen-Western Ghats	VDF	277.05	10.67	₹ 2,40,183
Tropical Wet Evergreen-Western Ghats	MDF	180.87	6.97	₹ 1,56,800
Tropical Wet Evergreen-Western Ghats	OF	41.60	1.60	₹ 36,061
Tropical Wet Evergreen-Western Ghats	LTF	7.71	0.30	₹ 6,688
Tropical Semi Evergreen-North East	VDF	93.88	3.44	₹ 77,299
Tropical Semi Evergreen-North East	MDF	109.32	2.95	₹ 66,394
Tropical Semi Evergreen-North East	OF	37.62	1.18	₹ 26,604
Tropical Semi Evergreen-North East	LTF	15.58	0.49	₹ 11,022
Tropical Semi Evergreen-Eastern Deccan	VDF	142.15	7.41	₹ 1,66,836
Tropical Semi Evergreen-Eastern Deccan	MDF	189.90	5.55	₹ 1,24,885
Tropical Semi Evergreen-Eastern Deccan	OF	14.84	0.58	₹ 13,037
Tropical Semi Evergreen-Eastern Deccan	LTF	7.39	0.29	₹ 6,490
Tropical Semi Evergreen-Western Ghats	VDF	202.95	6.63	₹ 1,49,128
Tropical Semi Evergreen-Western Ghats	MDF	105.30	3.44	₹ 77,376
Tropical Semi Evergreen-Western Ghats	OF	41.48	1.35	₹ 30,482
Tropical Semi Evergreen-Western Ghats	LTF	7.39	0.24	₹ 5,428
Tropical Moist Deciduous Forests	VDF	175.52	5.54	₹ 1,24,682
Tropical Moist Deciduous Forests	MDF	90.98	2.87	₹ 64,627
Tropical Moist Deciduous Forests	OF	36.44	1.15	₹ 25,884
Tropical Moist Deciduous Forests	LTF	3.68	0.12	₹ 2,615
Littoral & Swamp Forests	VDF	281.09	8.20	₹ 1,84,491
Littoral & Swamp Forests	MDF	154.64	4.51	₹ 1,01,498
Littoral & Swamp Forests	OF	45.70	1.33	₹ 29,997
Littoral & Swamp Forests	LTF	7.39	0.22	₹ 4,849
Tropical Dry Deciduous Forests	VDF	74.03	2.67	₹ 60,058
Tropical Dry Deciduous Forests	MDF	50.78	1.83	₹ 41,198
Tropical Dry Deciduous Forests	OF	18.92	0.68	₹ 15,346
Tropical Dry Deciduous Forests	LTF	2.10	0.08	₹ 1,707
Tropical Thorn Forest	VDF	15.30	1.57	₹ 35,367
Tropical Thorn Forest	MDF	42.82	0.56	₹ 12,637
Tropical Thorn Forest	OF	16.01	0.59	₹ 13,223
Tropical Thorn Forest	LTF	2.09	0.08	₹ 1,727
Tropical & Subtropical Dry Evergreen Forests	VDF	143.98	5.21	₹ 1,17,247
Tropical & Subtropical Dry Evergreen Forests	MDF	101.72	3.68	₹ 82,836
Tropical & Subtropical Dry Evergreen Forests	OF	39.29	1.42	₹ 31,992
Tropical & Subtropical Dry Evergreen Forests	LTF	0.88	0.03	₹ 717

[22] Data source: Forest Inventory, Forest Survey of India (FSI 2013c)

[23] Based on Von Mantel's Formula (Armitage 1998); Rotation period assumed on the basis of estimation rotation period for each specific forest type group as in Table 6.

[24] Based on average timber market price of ₹ 45,000/cum (ICFRE 2011) and 50% cost factor to obtain the cost-adjusted price of timber.

Forest Type Group	Canopy cover density class	Growing stock (cum / ha)[22]	Mean Annual Increment (cum/Ha)[23]	Value of Timber (₹ /ha/yr)[24]
Subtropical Pine/Broadleaved Hill Forests	VDF	149.05	4.30	₹ 96,794
Subtropical Pine/Broadleaved Hill Forests	MDF	108.85	3.14	₹ 70,688
Subtropical Pine/Broadleaved Hill Forests	OF	49.54	1.43	₹ 32,170
Subtropical Pine/Broadleaved Hill Forests	LTF	1.90	0.05	₹ 1,237
Montane& Moist Temperate Forest	VDF	256.54	6.72	₹ 1,51,103
Montane& Moist Temperate Forest	MDF	194.35	5.09	₹ 1,14,471
Montane& Moist Temperate Forest	OF	81.59	2.14	₹ 48,058
Montane& Moist Temperate Forest	LTF	1.89	0.05	₹ 1,114
Sub Alpine & Dry Temperate Forest	VDF	178.93	5.04	₹ 1,13,507
Sub Alpine & Dry Temperate Forest	MDF	213.01	4.24	₹ 95,347
Sub Alpine & Dry Temperate Forest	OF	74.86	1.77	₹ 39,892
Sub Alpine & Dry Temperate Forest	LTF	1.89	0.04	₹ 1,008
Alpine Scrub	VDF	125.44	3.52	₹ 79,263
Alpine Scrub	MDF	114.96	3.23	₹ 72,642
Alpine Scrub	OF	36.36	1.02	₹ 22,976
Alpine Scrub	LTF	1.89	0.05	₹ 1,195

Appendix 6 - Data and calculation steps for economic valuation of bamboo from forests

Forest Type Group	Canopy Cover Density Class	Bamboo Biomass / Ha (Tonnes)[25]	Mean Annual Production (Tonnes/Ha)[26]	# of culms (/ha)[27]	Value of bamboo culms (₹ /ha/yr)[28]
Tropical Wet Evergreen-North East	VDF	3.7	1.8	366.6	₹ 21,995
Tropical Wet Evergreen-North East	MDF	0.1	0.0	9.9	₹ 593
Tropical Wet Evergreen-North East	OF	3.8	1.9	376.2	₹ 22,569
Tropical Wet Evergreen-North East	LTF	0.0	0.0	0.0	₹ -
Tropical Wet Evergreen-Western Ghats	VDF	0.0	0.0	0.0	₹ -
Tropical Wet Evergreen-Western Ghats	MDF	0.2	0.1	21.7	₹ 1,302
Tropical Wet Evergreen-Western Ghats	OF	0.2	0.1	15.7	₹ 942
Tropical Wet Evergreen-Western Ghats	LTF	0.0	0.0	0.0	₹ -
Tropical Semi Evergreen-North East	VDF	2.0	1.0	200.0	₹ 11,999
Tropical Semi Evergreen-North East	MDF	0.6	0.3	63.1	₹ 3,784
Tropical Semi Evergreen-North East	OF	0.6	0.3	55.2	₹ 3,309
Tropical Semi Evergreen-North East	LTF	0.6	0.3	63.9	₹ 3,836
Tropical Semi Evergreen-Eastern Deccan	VDF	0.0	0.0	0.0	₹ -
Tropical Semi Evergreen-Eastern Deccan	MDF	0.0	0.0	0.0	₹ -
Tropical Semi Evergreen-Eastern Deccan	OF	0.0	0.0	0.0	₹ -
Tropical Semi Evergreen-Eastern Deccan	LTF	0.0	0.0	0.0	₹ -
Tropical Semi Evergreen-Western Ghats	VDF	0.0	0.0	3.2	₹ 191
Tropical Semi Evergreen-Western Ghats	MDF	0.6	0.3	63.8	₹ 3,826
Tropical Semi Evergreen-Western Ghats	OF	1.0	0.5	100.1	₹ 6,006
Tropical Semi Evergreen-Western Ghats	LTF	0.9	0.4	85.1	₹ 5,103
Tropical Moist Deciduous Forests	VDF	0.9	0.4	89.3	₹ 5,356
Tropical Moist Deciduous Forests	MDF	1.5	0.8	153.9	₹ 9,236

[25] Data source: Forest Inventory, Forest Survey of India (FSI 2013c)
[26] Based on Von Mantel's Formula (Armitage 1998); Rotation period of bamboo is assumed to be 4 years.
[27] Conversion factor: 1 culm = 5 kg.
[28] Based on average bamboo market price of ₹ 75/culm (ICFRE 2011) and 20% discount factor to obtain the cost-adjusted price of bamboo.

Forest Type Group	Canopy Cover Density Class	Bamboo Biomass / Ha (Tonnes)[25]	Mean Annual Production (Tonnes/Ha)[26]	# of culms (/ha)[27]	Value of bamboo culms (₹ /ha/yr)[28]
Tropical Moist Deciduous Forests	OF	1.1	0.6	111.1	₹ 6,663
Tropical Moist Deciduous Forests	LTF	0.1	0.0	8.8	₹ 529
Littoral & Swamp Forests	VDF	0.0	0.0	0.0	₹ -
Littoral & Swamp Forests	MDF	0.0	0.0	0.0	₹ -
Littoral & Swamp Forests	OF	0.0	0.0	0.0	₹ -
Littoral & Swamp Forests	LTF	0.0	0.0	0.0	₹ -
Tropical Dry Deciduous Forests	VDF	3.9	1.9	389.6	₹ 23,376
Tropical Dry Deciduous Forests	MDF	0.7	0.4	71.2	₹ 4,274
Tropical Dry Deciduous Forests	OF	0.2	0.1	15.1	₹ 909
Tropical Dry Deciduous Forests	LTF	0.0	0.0	4.6	₹ 275
Tropical Thorn Forest	VDF	0.0	0.0	0.0	₹ -
Tropical Thorn Forest	MDF	0.8	0.4	77.1	₹ 4,627
Tropical Thorn Forest	OF	0.2	0.1	17.9	₹ 1,076
Tropical Thorn Forest	LTF	0.0	0.0	4.2	₹ 250
Tropical & Subtropical Dry Evergreen Forests	VDF	1.1	0.6	110.4	₹ 6,622
Tropical & Subtropical Dry Evergreen Forests	MDF	0.4	0.2	37.5	₹ 2,251
Tropical & Subtropical Dry Evergreen Forests	OF	0.5	0.3	54.5	₹ 3,268
Tropical & Subtropical Dry Evergreen Forests	LTF	0.1	0.0	5.9	₹ 353
Subtropical Pine/Broadleaved Hill Forests	VDF	0.0	0.0	2.4	₹ 142
Subtropical Pine/Broadleaved Hill Forests	MDF	0.2	0.1	22.0	₹ 1,320
Subtropical Pine/Broadleaved Hill Forests	OF	0.1	0.1	14.0	₹ 843
Subtropical Pine/Broadleaved Hill Forests	LTF	0.0	0.0	0.0	₹ -
Montane& Moist Temperate Forest	VDF	0.1	0.0	7.0	₹ 420
Montane& Moist Temperate Forest	MDF	0.0	0.0	3.8	₹ 228
Montane& Moist Temperate Forest	OF	0.0	0.0	0.9	₹ 56
Montane& Moist Temperate Forest	LTF	0.0	0.0	0.0	₹ -
Sub Alpine & Dry Temperate Forest	VDF	0.7	0.3	67.0	₹ 4,023
Sub Alpine & Dry Temperate Forest	MDF	0.0	0.0	0.0	₹ -
Sub Alpine & Dry Temperate Forest	OF	0.0	0.0	0.0	₹ -
Sub Alpine & Dry Temperate Forest	LTF	0.0	0.0	0.0	₹ -
Alpine Scrub	VDF	4.6	2.3	460.8	₹ 27,648
Alpine Scrub	MDF	0.0	0.0	0.0	₹ -
Alpine Scrub	OF	0.0	0.0	0.0	₹ -
Alpine Scrub	LTF	0.0	0.0	0.0	₹ -

Appendix 7 – State-wise data and calculation steps for economic valuation of fodder production from forests

States	Total Adult Cattle Unit completely dependent on forests (millions)[29]	Total annual fodder consumption (m ton)[30]	Cost-adjusted value of fodder (million ₹)[31]
Andaman & Nicobar	0.04625	0.37	334
Andhra Pradesh	7.57	60.79	54708
Arunachal Pradesh	0.73	5.86	5276
Assam	3.56	28.59	25728

[29] Data source: India State of Forest Report, 2011 (FSI 2011c)

[30] Based on standard fodder requirement of 22 kg./ACU/day

[31] Based on average fodder market price of ₹ 1000/tonne (ICFRE 2011) and 10% cost factor to obtain the cost-adjusted value of fodder.

States	Total Adult Cattle Unit completely dependent on forests (millions)[29]	Total annual fodder consumption (m ton)[30]	Cost-adjusted value of fodder (million ₹)[31]
Bihar	0.66	5.30	4770
Chandigarh	0.04625	0.37	334
Chhattisgarh	5.98	48.02	43217
Dadra & Nagar Haveli	0.04625	0.37	334
Daman & Diu	0.04625	0.37	334
Delhi	0.04625	0.37	334
Goa	0.04625	0.37	334
Gujarat	3.28	26.34	23705
Haryana	0.002	0.02	14
Himachal Pradesh	2.73	21.92	19730
Jammu & Kashmir	0.6	4.82	4336
Jharkhand	1.17	9.40	8456
Karnataka	2.99	24.01	21609
Kerala	0.15	1.20	1084
Lakshadweep	0.04625	0.37	334
Madhya Pradesh	13.18	105.84	95252
Maharashtra	16.56	132.98	119679
Manipur	0.21	1.69	1518
Meghalaya	0.21	1.69	1518
Mizoram	0.21	1.69	1518
Nagaland	0.21	1.69	1518
Orissa	5.6	44.97	40471
Puducherry	0.04625	0.37	334
Punjab	0	0.00	0
Rajasthan	7.19	57.74	51962
Sikkim	0.21	1.69	1518
Tamil Nadu	2.07	16.62	14960
Tripura	0.21	1.69	1518
Uttar Pradesh	3.02	24.25	21826
Uttarakhand	2.66	21.36	19224
West Bengal	5.12	41.11	37002
Grand Total	86.452	694.21	624789

Appendix 8 – Forest type group wise estimates of fodder production from forests

Forest Type Group	Total forest area (Ha)[32]	Total value of fodder production (₹ Millions)[33]	Total value of fodder (₹ /ha/yr)
Tropical Wet Evergreen Forests – North East	628029	3751.6	₹ 5,974
Tropical Wet Evergreen Forests – Western Ghats	1464702	5247.5	₹ 3,583
Tropical Semi Evergreen Forests - North East	8259244	20614	₹ 2,496
Tropical Semi Evergreen Forests - Eastern Deccan	38935	1658.2	₹ 42,589
Tropical Semi Evergreen Forests - Western Ghats	1568714	13909	₹ 8,866
Tropical Moist Deciduous Forests	14118585	123578	₹ 8,753
Littoral & Swamp Forests	496419	13289	₹ 26,770
Tropical Dry Deciduous Forests	29957425	375515	₹ 12,535
Tropical Thorn Forests	1612384	19306	₹ 11,973
Tropical & Subtropical Dry Evergreen Forests	112407	878.83	₹ 7,818

[32] Data source: Atlas of Forest Types of India (FSI 2011a)

[33] Based on % of different forest types in each state (FSI 2011a) and Appendix 1.

Forest Type Group	Total forest area (Ha)[32]	Total value of fodder production (₹ Millions)[33]	Total value of fodder (₹ /ha/yr)
Subtropical Pine/Broadleaved Hill Forests	3804396	17174	₹ 4,514
Montane& Moist Temperate Forest	3442608	21469	₹ 6,236
Sub Alpine & Dry Temperate Forest	1947352	6106	₹ 3,136
Alpine Scrub	475620	1958.7	₹ 4,118

Appendix 9 – Data used for value of NWFP from 12 major species

Botanical Name	Common Name	Part	Production (kg/tree/yr)	Source	Price (₹ /kg)	Source	Value of a tree (₹ /year)
Aegle marmelos	Bel	Fruit	25	Singh and Agrawal	100	ICFRE	₹ 1,250
Azadirachta indica	Neem	Fruit	50	Oil Seed Crops	1	ICFRE	₹ 25
Azadirachta indica	Neem	Seed	10	Oil Seed Crops	2.25	ICFRE	₹ 11
Bunchania lanzan	Chironji	Fruit kernel	4	Chauhan et al (2012)	500	ICFRE	₹ 1,000
Diospyros melanoxylon	Tendu	Leaves	3	ICFRE, FSI, Own Calc	30	OFC	₹ 45
Emblica officinalis	Aonla	Fruit	100	NABARD	30	ICFRE	₹ 1,500
Madhuka indica	Mahua	Flower	50	IIED	18	ICFRE	₹ 450
Madhuka indica	Mahua	Seed	50	Puhan et al (2005)	18	ICFRE	₹ 450
Pongamia pinnata	Karanj	Seed	30	Winrock	66	IIFM	₹ 990
Schleichera oleosa	Kusum	Seed	30	VEGOIL	60	Indian Express	₹ 900
Shorea robusta	Sal	Seed	4	Book, FSI, Own calc	6	MP-MPF	₹ 12
Tamarindus indica	Imli	Fruit	150	Siddig et al (2006)	20	ICFRE	₹ 1,500
Terminalia beleria	Bahera	Fruit	150	Assam Agribusiness	20	ICFRE	₹ 1,500
Terminalia chebula	Harad	Fruit	10	PROTA	120	ICFRE	₹ 600

Appendix 10 - State-wise data and calculation steps for economic valuation of fuelwood production from forests

States	Quantity of fuelwood used from forests (million tonnes)[34]	Cost-adjusted value of fuelwood (million ₹)[35]
Andaman & Nicobar	0.159	859
Andhra Pradesh	2.966	16016

[34] Data source: India State of Forest Report (FSI 2011b)

[35] Based on the following assumptions: 1) only 50% of actual consumption of fuelwood from forests was reported in the FSI study; 2) market price of fuelwood as ₹ 3000/tonnes (ICFRE 2011) and 3) a cost factor of 10% to obtain the cost-adjusted price of fuelwood

States	Quantity of fuelwood used from forests (million tonnes)[34]	Cost-adjusted value of fuelwood (million ₹)[35]
Arunachal Pradesh	0.325	1755
Assam	2.494	13468
Bihar	0.465	2511
Chandigarh	0.159	859
Chhattisgarh	1.378	7441
Dadra & Nagar Haveli	0.159	859
Daman & Diu	0.159	859
Delhi	0.159	859
Goa	0.159	859
Gujarat	2.225	12015
Haryana	0.003	16
Himachal Pradesh	1.163	6280
Jammu & Kashmir	1.015	5481
Jharkhand	2.849	15385
Karnataka	5.776	31190
Kerala	2.183	11788
Lakshadweep	0.159	859
Madhya Pradesh	7.191	38831
Maharashtra	4.527	24446
Manipur	0.637	3440
Meghalaya	0.637	3440
Mizoram	0.637	3440
Nagaland	0.637	3440
Orissa	2.971	16043
Puducherry	0.159	859
Punjab	0.029	157
Rajasthan	3.698	19969
Sikkim	0.637	3440
Tamil Nadu	2.601	14045
Tripura	0.637	3440
Uttar Pradesh	1.294	6988
Uttarakhand	2.139	11551
West Bengal	6.361	34349
Grand Total	58.747	317234

Appendix 11 - Forest type group wise estimates of fuelwood production from forests

Forest Type Group	Total forest area (Ha)[36]	Total value of fuelwood production (₹ Millions)[37]	Total value of fuelwood (₹ /ha/yr)
Tropical Wet Evergreen Forests – North East	628029	₹ 2,239	₹ 3,564
Tropical Wet Evergreen Forests – Western Ghats	1464702	₹ 11,401	₹ 7,784
Tropical Semi Evergreen Forests - North East	8259244	₹ 13,400	₹ 1,622
Tropical Semi Evergreen Forests - Eastern Deccan	38935	₹ 1,503	₹ 38,593
Tropical Semi Evergreen Forests - Western Ghats	1568714	₹ 11,531	₹ 7,350
Tropical Moist Deciduous Forests	14118585	₹ 59,719	₹ 4,230
Littoral & Swamp Forests	496419	₹ 11,974	₹ 24,121
Tropical Dry Deciduous Forests	29957425	₹ 1,59,363	₹ 5,320
Tropical Thorn Forests	1612384	₹ 12,567	₹ 7,794
Tropical & Subtropical Dry Evergreen Forests	112407	₹ 489	₹ 4,348
Subtropical Pine/Broadleaved Hill Forests	3804396	₹ 12,879	₹ 3,385

[36] Data source: Atlas of Forest Types of India (FSI 2011a).

[37] Based on % of different forest types in each state (FSI 2011a) and Appendix 1.

Forest Type Group	Total forest area (Ha)[36]	Total value of fuelwood production (₹ Millions)[37]	Total value of fuelwood (₹ /ha/yr)
Montane & Moist Temperate Forest	3442608	₹ 13,499	₹ 3,921
Sub Alpine & Dry Temperate Forest	1947352	₹ 4,374	₹ 2,246
Alpine Scrub	475620	₹ 1,437	₹ 3,022

Appendix 12 – Data and calculation steps for valuation of carbon sequestration from forests

Forest Type Group	Canopy cover density class	Total Biomass (tonnes/ha)[38]	Mean Annual Increment (tonnes/Ha)[39]	Annual carbon sequestration (tCO2/ha)[40]	Value of carbon sequestered (₹ /ha)[41]
Tropical Wet Evergreen-North East	VDF	191.67	7.03	12.907	₹ 6,970
Tropical Wet Evergreen-North East	MDF	107.52	3.95	7.2407	₹ 3,910
Tropical Wet Evergreen-North East	OF	70.91	2.60	4.775	₹ 2,579
Tropical Wet Evergreen-North East	LTF	14.21	0.52	0.957	₹ 517
Tropical Wet Evergreen-Western Ghats	VDF	260.27	10.03	18.402	₹ 9,937
Tropical Wet Evergreen-Western Ghats	MDF	160.11	6.17	11.32	₹ 6,113
Tropical Wet Evergreen-Western Ghats	OF	50.89	1.96	3.5979	₹ 1,943
Tropical Wet Evergreen-Western Ghats	LTF	11.12	0.43	0.786	₹ 424
Tropical Semi Evergreen-North East	VDF	90.54	3.10	5.6928	₹ 3,074
Tropical Semi Evergreen-North East	MDF	98.70	2.85	5.2221	₹ 2,820
Tropical Semi Evergreen-North East	OF	37.85	1.19	2.183	₹ 1,179
Tropical Semi Evergreen-North East	LTF	19.63	0.62	1.1325	₹ 612
Tropical Semi Evergreen-Eastern Deccan	VDF	125.21	17.64	32.377	₹ 17,484
Tropical Semi Evergreen-Eastern Deccan	MDF	451.88	4.89	8.9713	₹ 4,845
Tropical Semi Evergreen-Eastern Deccan	OF	61.05	2.38	4.3745	₹ 2,362
Tropical Semi Evergreen-Eastern Deccan	LTF	13.26	0.52	0.9498	₹ 513
Tropical Semi Evergreen-Western Ghats	VDF	184.65	6.03	11.066	₹ 5,975
Tropical Semi Evergreen-Western Ghats	MDF	108.69	3.55	6.5135	₹ 3,517
Tropical Semi Evergreen-Western Ghats	OF	45.70	1.49	2.7389	₹ 1,479
Tropical Semi Evergreen-Western Ghats	LTF	12.77	0.42	0.7653	₹ 413
Tropical Moist Deciduous Forests	VDF	158.68	5.01	9.1928	₹ 4,964
Tropical Moist Deciduous Forests	MDF	96.10	3.03	5.5675	₹ 3,006
Tropical Moist Deciduous Forests	OF	42.29	1.34	2.4501	₹ 1,323
Tropical Moist Deciduous Forests	LTF	9.71	0.31	0.5624	₹ 304
Littoral & Swamp Forests	VDF	302.22	8.82	16.177	₹ 8,736
Littoral & Swamp Forests	MDF	128.99	3.76	6.9046	₹ 3,729
Littoral & Swamp Forests	OF	41.75	1.22	2.2348	₹ 1,207
Littoral & Swamp Forests	LTF	21.56	0.63	1.1542	₹ 623
Tropical Dry Deciduous Forests	VDF	94.08	3.39	6.2246	₹ 3,361
Tropical Dry Deciduous Forests	MDF	68.34	2.46	4.5215	₹ 2,442
Tropical Dry Deciduous Forests	OF	32.20	1.16	2.1304	₹ 1,150
Tropical Dry Deciduous Forests	LTF	13.66	0.49	0.9038	₹ 488
Tropical Thorn Forest	VDF	29.08	2.07	3.8059	₹ 2,055
Tropical Thorn Forest	MDF	56.50	1.07	1.9588	₹ 1,058
Tropical Thorn Forest	OF	25.37	0.93	1.7087	₹ 923
Tropical Thorn Forest	LTF	8.97	0.33	0.6041	₹ 326

[38] Data source: Forest Inventory, Forest Survey of India (FSI 2013c).

[39] Based on Von Mantel's Formula (Armitage 1998); As in the case of timber production, rotation period is assumed on the basis of rotation period estimated for each forest type group as in Table 6.

[40] Based on default IPCC values of carbon = 50% of biomass; and 1 tC = 3.67 tCO2 (IPCC 2003).

[41] Based on average social cost of a tCO_2 = US$ 10 (Nordhaus 2011); exchange rate: 1 US$ = 54 INR

Forest Type Group	Canopy cover density class	Total Biomass (tonnes/ha)[38]	Mean Annual Increment (tonnes/Ha)[39]	Annual carbon sequestration (tCO2/ha)[40]	Value of carbon sequestered (₹ /ha)[41]
Tropical & Subtropical Dry Evergreen Forests	VDF	135.53	4.91	9.0007	₹ 4,860
Tropical & Subtropical Dry Evergreen Forests	MDF	96.08	3.48	6.3806	₹ 3,446
Tropical & Subtropical Dry Evergreen Forests	OF	42.27	1.53	2.8075	₹ 1,516
Tropical & Subtropical Dry Evergreen Forests	LTF	3.74	0.14	0.2486	₹ 134
Subtropical Pine/Broadleaved Hill Forests	VDF	139.96	4.04	7.4124	₹ 4,003
Subtropical Pine/Broadleaved Hill Forests	MDF	101.01	2.92	5.3499	₹ 2,889
Subtropical Pine/Broadleaved Hill Forests	OF	43.49	1.26	2.3034	₹ 1,244
Subtropical Pine/Broadleaved Hill Forests	LTF	8.17	0.24	0.4325	₹ 234
Montane & Moist Temperate Forest	VDF	206.53	5.41	9.9208	₹ 5,357
Montane & Moist Temperate Forest	MDF	148.59	3.89	7.1378	₹ 3,854
Montane & Moist Temperate Forest	OF	64.05	1.68	3.0767	₹ 1,661
Montane & Moist Temperate Forest	LTF	3.04	0.08	0.1462	₹ 79
Sub Alpine & Dry Temperate Forest	VDF	144.62	3.42	6.2848	₹ 3,394
Sub Alpine & Dry Temperate Forest	MDF	145.79	3.45	6.336	₹ 3,421
Sub Alpine & Dry Temperate Forest	OF	58.00	1.37	2.5206	₹ 1,361
Sub Alpine & Dry Temperate Forest	LTF	5.28	0.13	0.2294	₹ 124
Alpine Scrub	VDF	95.93	3.01	5.5186	₹ 2,980
Alpine Scrub	MDF	107.09	2.69	4.9435	₹ 2,669
Alpine Scrub	OF	51.17	1.44	2.6371	₹ 1,424
Alpine Scrub	LTF	3.19	0.09	0.1645	₹ 89

Appendix 13 - State-wise data and calculation steps for economic valuation of gene-pool conservation from forests

States	Net-bioprospecting (based on all species)₹ /ha[42]	Forest cover (ha)[43]	Value of gene-pool conservation (million ₹)
Andaman & Nicobar	217813	672400	146457
Andhra Pradesh	44643	4638900	207094
Arunachal Pradesh	34291	6741000	231156
Assam	100760	2767300	278833
Bihar	90974	684500	62272
Chandigarh	0	1678	0
Chhattisgarh	7	5567400	39
Dadra & Nagar Haveli	0	21100	0
Daman & Diu	0	615	0
Delhi	0	17620	0
Goa	520932	221900	115595
Gujarat	133171	1461900	194683
Haryana	652147	160800	104865
Himachal Pradesh	154152	1467900	226280
Jammu & Kashmir	205203	2253900	462507
Jharkhand	90974	2297700	209031
Karnataka	73815	3619400	267166
Kerala	219721	1730000	380117
Lakshadweep	0	2706	0
Madhya Pradesh	7	7770000	54

[42] Data source: Green India States Trust, Monograph 4 (Gundimeda et al. 2006); The values for Jharkhand, Chhattisgarh and Uttarakhand were not available in the study and are assumed to be the same as that of Bihar, Madhya Pradesh and Uttar Pradesh respectively.

[43] Data source: India State of Forest Report (FSI 2011b)

States	Net-bioprospecting (based on all species)₹ /ha[42]	Forest cover (ha)[43]	Value of gene-pool conservation (million ₹)
Maharashtra	32991	5064600	167086
Manipur	240740	1709000	411425
Meghalaya	310300	1727500	536043
Mizoram	131166	1911700	250750
Nagaland	262266	1331800	349286
Orissa	40856	4890300	199798
Puducherry	0	5006	0
Punjab	722339	176400	127421
Rajasthan	170068	1608700	273588
Sikkim	1155200	335900	388032
Tamil Nadu	262555	2362500	620286
Tripura	259573	797700	207061
Uttar Pradesh	76728	1433800	110013
Uttarakhand	76728	2449600	187953
West Bengal	332712	1299500	432359
Grand Total	6612832	69202725	7147251

Appendix 14 - Forest type group wise economic value of gene-pool conservation from forests

Forest Type Group	Total forest area (Ha)[44]	Total value of gene-pool conservation (₹Millions)[45]	NPV of gene-pool conservation (₹ /ha/)
Tropical Wet Evergreen Forests – North East	628029	₹ 99,289	₹ 1,58,096
Tropical Wet Evergreen Forests – Western Ghats	1464702	₹ 3,30,812	₹ 2,25,856
Tropical Semi Evergreen Forests - North East	8259244	₹ 6,93,757	₹ 83,998
Tropical Semi Evergreen Forests - Eastern Deccan	38935	₹ 18,975	₹ 4,87,340
Tropical Semi Evergreen Forests - Western Ghats	1568714	₹ 2,81,866	₹ 1,79,680
Tropical Moist Deciduous Forests	14118585	₹ 14,81,609	₹ 1,04,940
Littoral & Swamp Forests	496419	₹ 1,49,822	₹ 3,01,806
Tropical Dry Deciduous Forests	29957425	₹ 20,32,660	₹ 67,852
Tropical Thorn Forests	1612384	₹ 2,12,961	₹ 1,32,078
Tropical & Subtropical Dry Evergreen Forests	112407	₹ 18,477	₹ 1,64,378
Subtropical Pine/Broadleaved Hill Forests	3804396	₹ 8,03,819	₹ 2,11,287
Montane & Moist Temperate Forest	3442608	₹ 6,00,776	₹ 1,74,512
Sub Alpine & Dry Temperate Forest	1947352	₹ 3,14,484	₹ 1,61,493
Alpine Scrub	475620	₹ 1,07,944	₹ 2,26,953

Appendix 15 - Data and calculation steps for valuation of pollination and seed dispersal services from forests

Forest Type Group	%to Ideal Regeneration[46]	Regeneration after adjustment of regeneration in plantations (%)[47]	Value of pollination & seed dispersal services (₹ /ha/yr)[48]

[44] Data source: Atlas of Forest Types of India (FSI 2011a).

[45] Based on % of different forest types in each state (FSI 2011a) and Appendix 1.

[46] Data source: Forest Inventory, Forest Survey of India (FSI 2013c)

[47] Adjusted according to the regeneration estimates of 62.6% in plantations according to Forest Inventory, Forest Survey of India (FSI 2013c)

Forest Type Group	%to Ideal Regeneration[46]	Regeneration after adjustment of regeneration in plantations (%)[47]	Value of pollination & seed dispersal services (₹ /ha/yr)[48]
Tropical Wet Evergreen-North East	65.3	104.2%	₹ 8,913
Tropical Wet Evergreen-Western Ghats	87.2	139.2%	₹ 11,907
Tropical Semi Evergreen-North East	62.4	99.7%	₹ 8,529
Tropical Semi Evergreen-Eastern Deccan	60.0	95.8%	₹ 8,195
Tropical Semi Evergreen-Western Ghats	88.3	141.0%	₹ 12,054
Tropical Moist Deciduous Forests	77.2	123.3%	₹ 10,548
Littoral & Swamp Forests	60.5	96.6%	₹ 8,257
Tropical Dry Deciduous Forests	74.4	118.9%	₹ 10,167
Tropical Thorn Forest	54.5	87.1%	₹ 7,448
Tropical & Subtropical Dry Evergreen Forests	61.8	98.7%	₹ 8,441
Subtropical Pine/Broadleaved Hill Forests	60.8	97.0%	₹ 8,298
Montane & Moist Temperate Forest	53.2	85.0%	₹ 7,268
Sub Alpine & Dry Temperate Forest	50.4	80.4%	₹ 6,879
Alpine Scrub	75.5	120.6%	₹ 10,311

Appendix 16 - Relative weights for canopy cover density classes compared to VDF for estimation of soil conservation from forests

Particulars	Ratio	Remarks
Ratio of erosion loss prevented by MDF to VDF	0.647	Calculated as ratio of 0.55 (0.40+0.70/2) and 0.85 (0.70+1.00/2)
Ratio of erosion loss prevented by OF to VDF	0.294	Calculated as ratio of 0.25 (0.10+0.40/2) and 0.85 (0.70+1.00/2)
Ratio of erosion loss prevented by LTF to VDF	0.059	Calculated as ratio of 0.05 (0.00+0.10/2) and 0.85 (0.70+1.00/2)

Appendix 17 - Concentration of major nutrients in run-off (A. N. Pandey et al. 1984)

Concentration of nutrients in run-off	Estimate
Nitrogen	2.320 mg per gram
Phosphorus	0.044 mg per gram
Potassium	8.250 mg per gram

Appendix 18 - Price of fertilizers in India (DoF 2013)

Nitrogen	Phosphorus	Potassium
Urea (46% N)	DAP (18-46-0-0)	Muriate of Potash (60% K_2O)
₹ 5.36/kg	₹ 20.10/kg	₹ 20.00/kg

[48] Based on the assumption that only 50% of regeneration can be attributed to pollination and seed dispersal services provided by wildlife including insects, birds, and other animals, accounting for seed dispersal that happens naturally due to wind and water; costs for artificial regeneration assumed on the basis of model costs of ₹ 17,100 per hectare as recommended by the National Afforestation Programme Guidelines (NAP 2009).

Appendix 19 - Data and calculation steps for valuation of soil conservation services from forests

Forest Type Group	Canopy cover density class	Average weight of soil (tonnes/ha)[49]	Average soil loss prevented (tonnes/ha/yr)[50]	Value of nutrients conserved (₹ /ha/yr)[51]
Tropical Wet Evergreen-North East	VDF	14360	143.60	₹ 25,590
Tropical Wet Evergreen-North East	MDF	14360	92.91	₹ 16,557
Tropical Wet Evergreen-North East	OF	14360	42.22	₹ 7,523
Tropical Wet Evergreen-North East	LTF	14360	8.47	₹ 1,510
Tropical Wet Evergreen-Western Ghats	VDF	10907	109.07	₹ 19,436
Tropical Wet Evergreen-Western Ghats	MDF	10907	70.57	₹ 12,575
Tropical Wet Evergreen-Western Ghats	OF	10907	32.07	₹ 5,714
Tropical Wet Evergreen-Western Ghats	LTF	10907	6.43	₹ 1,147
Tropical Semi Evergreen-North East	VDF	14387	143.87	₹ 25,638
Tropical Semi Evergreen-North East	MDF	14387	93.08	₹ 16,587
Tropical Semi Evergreen-North East	OF	14387	42.30	₹ 7,537
Tropical Semi Evergreen-North East	LTF	14387	8.49	₹ 1,513
Tropical Semi Evergreen-Eastern Deccan	VDF	12000	120.00	₹ 21,384
Tropical Semi Evergreen-Eastern Deccan	MDF	12000	77.64	₹ 13,836
Tropical Semi Evergreen-Eastern Deccan	OF	12000	35.28	₹ 6,287
Tropical Semi Evergreen-Eastern Deccan	LTF	12000	7.08	₹ 1,262
Tropical Semi Evergreen-Western Ghats	VDF	9493	94.93	₹ 16,917
Tropical Semi Evergreen-Western Ghats	MDF	9493	61.42	₹ 10,946
Tropical Semi Evergreen-Western Ghats	OF	9493	27.91	₹ 4,974
Tropical Semi Evergreen-Western Ghats	LTF	9493	5.60	₹ 998
Tropical Moist Deciduous Forests	VDF	11827	118.27	₹ 21,076
Tropical Moist Deciduous Forests	MDF	11827	76.52	₹ 13,636
Tropical Moist Deciduous Forests	OF	11827	34.77	₹ 6,196
Tropical Moist Deciduous Forests	LTF	11827	6.98	₹ 1,243
Littoral & Swamp Forests	VDF	14253	142.53	₹ 25,400
Littoral & Swamp Forests	MDF	14253	92.22	₹ 16,434
Littoral & Swamp Forests	OF	14253	41.90	₹ 7,468
Littoral & Swamp Forests	LTF	14253	8.41	₹ 1,499
Tropical Dry Deciduous Forests	VDF	7827	78.27	₹ 13,947
Tropical Dry Deciduous Forests	MDF	7827	50.64	₹ 9,024
Tropical Dry Deciduous Forests	OF	7827	23.01	₹ 4,101
Tropical Dry Deciduous Forests	LTF	7827	4.62	₹ 823
Tropical Thorn Forest	VDF	7187	71.87	₹ 12,807
Tropical Thorn Forest	MDF	7187	46.50	₹ 8,286
Tropical Thorn Forest	OF	7187	21.13	₹ 3,765
Tropical Thorn Forest	LTF	7187	4.24	₹ 756
Tropical & Subtropical Dry Evergreen Forests	VDF	11320	113.20	₹ 20,173
Tropical & Subtropical Dry Evergreen Forests	MDF	11320	73.24	₹ 13,052
Tropical & Subtropical Dry Evergreen Forests	OF	11320	33.28	₹

[49] Data source: Forest Inventory, Forest Survey of India (FSI 2013c)

[50] Based on the assumption that it will take 100 years to complete erode the soil and relative weights for different canopy cover density classes as estimated in Appendix 16.

[51] Based on average nutrient concentration of N, P and K in runoff (Appendix 17) and respective fertilizer prices in India (Appendix 18)

Forest Type Group	Canopy cover density class	Average weight of soil (tonnes/ha)[49]	Average soil loss prevented (tonnes/ha/yr)[50]	Value of nutrients conserved (₹ /ha/yr)[51]
				5,931
Tropical & Subtropical Dry Evergreen Forests	LTF	11320	6.68	₹ 1,190
Subtropical Pine/Broadleaved Hill Forests	VDF	8187	81.87	₹ 14,589
Subtropical Pine/Broadleaved Hill Forests	MDF	8187	52.97	₹ 9,439
Subtropical Pine/Broadleaved Hill Forests	OF	8187	24.07	₹ 4,289
Subtropical Pine/Broadleaved Hill Forests	LTF	8187	4.83	₹ 861
Montane & Moist Temperate Forest	VDF	8000	80.00	₹ 14,256
Montane & Moist Temperate Forest	MDF	8000	51.76	₹ 9,224
Montane & Moist Temperate Forest	OF	8000	23.52	₹ 4,191
Montane & Moist Temperate Forest	LTF	8000	4.72	₹ 841
Sub Alpine & Dry Temperate Forest	VDF	7933	79.33	₹ 14,137
Sub Alpine & Dry Temperate Forest	MDF	7933	51.33	₹ 9,147
Sub Alpine & Dry Temperate Forest	OF	7933	23.32	₹ 4,156
Sub Alpine & Dry Temperate Forest	LTF	7933	4.68	₹ 834
Alpine Scrub	VDF	12080	120.80	₹ 21,527
Alpine Scrub	MDF	12080	78.16	₹ 13,928
Alpine Scrub	OF	12080	35.52	₹ 6,329
Alpine Scrub	LTF	12080	7.13	₹ 1,270

Appendix 20 – Runoff rates assumed for different forest canopy cover density classes

Category	Average Canopy Cover (%)	Runoff as percentage of rainfall[52]	Difference in run-off rates with respect to bare soil
Bare soil	0	19.60%	0.00%
LTF	0.05	18.56%	1.04%
OF	0.25	14.42%	5.18%
MDF	0.55	8.21%	11.39%
VDF	0.85	2.00%	17.60%

Appendix 21 - Data and calculation steps for valuation of water recharge services from forests

Forest Type Group	Canopy cover density class	Precipitation (mm)[53]	Differential Run-off avoided (mm)[54]	Total differential water recharge (m3/ha)	Value of differential water recharge (₹ /ha/yr)[55]
Tropical Wet Evergreen-North East	VDF	1755	308.8	308.8	₹ 3,993.3
Tropical Wet Evergreen-North East	MDF	1677	191.0	191.0	₹ 2,469.8

[52] The run-off rates for bare soil and VDF are based on estimated from GIST Monograph 7 (P. Kumar et al. 2006). Those for Scrub, OF and MDF are estimated based on linear relationship between average canopy cover and runoff.

[53] Source: UNEP Geo Data Portal and further analysis by FSI.

[54] Estimated based on differential ground water recharge by forests; runoff rates calculated in Appendix 20.

[55] Based on the differential ground water recharge and the economic value of water in agriculture (₹ 12.93/m^3) as estimated by (M. D. Kumar et al. 2008).

Forest Type Group	Canopy cover density class	Precipitation (mm)[53]	Differential Run-off avoided (mm)[54]	Total differential water recharge (m3/ha)	Value of differential water recharge (₹ /ha/yr)[55]
Tropical Wet Evergreen-North East	OF	1775	91.9	91.9	₹ 1,188.4
Tropical Wet Evergreen-North East	LTF	1589	16.4	16.4	₹ 212.6
Tropical Wet Evergreen-Western Ghats	VDF	1918	337.6	337.6	₹ 4,364.7
Tropical Wet Evergreen-Western Ghats	MDF	1795	204.4	204.4	₹ 2,642.8
Tropical Wet Evergreen-Western Ghats	OF	1706	88.3	88.3	₹ 1,141.7
Tropical Wet Evergreen-Western Ghats	LTF	1550	16.0	16.0	₹ 207.5
Tropical Semi Evergreen-North East	VDF	2057	362.1	362.1	₹ 4,681.8
Tropical Semi Evergreen-North East	MDF	1796	204.6	204.6	₹ 2,644.9
Tropical Semi Evergreen-North East	OF	1934	100.1	100.1	₹ 1,294.4
Tropical Semi Evergreen-North East	LTF	2123	22.0	22.0	₹ 284.1
Tropical Semi Evergreen-Eastern Deccan	VDF	1418	249.7	249.7	₹ 3,228.0
Tropical Semi Evergreen-Eastern Deccan	MDF	1207	137.4	137.4	₹ 1,777.2
Tropical Semi Evergreen-Eastern Deccan	OF	2141	110.8	110.8	₹ 1,433.3
Tropical Semi Evergreen-Eastern Deccan	LTF	1589	16.4	16.4	₹ 212.7
Tropical Semi Evergreen-Western Ghats	VDF	1667	293.3	293.3	₹ 3,792.7
Tropical Semi Evergreen-Western Ghats	MDF	1600	182.3	182.3	₹ 2,356.6
Tropical Semi Evergreen-Western Ghats	OF	1461	75.6	75.6	₹ 977.8
Tropical Semi Evergreen-Western Ghats	LTF	1619	16.8	16.8	₹ 216.7
Tropical Moist Deciduous Forests	VDF	1264	222.5	222.5	₹ 2,877.5
Tropical Moist Deciduous Forests	MDF	1391	158.4	158.4	₹ 2,047.9
Tropical Moist Deciduous Forests	OF	1666	86.2	86.2	₹ 1,114.8
Tropical Moist Deciduous Forests	LTF	1444	15.0	15.0	₹ 193.3
Littoral & Swamp Forests	VDF	1169	205.7	205.7	₹ 2,659.9
Littoral & Swamp Forests	MDF	958	109.1	109.1	₹ 1,410.6
Littoral & Swamp Forests	OF	1008	52.2	52.2	₹ 674.4
Littoral & Swamp Forests	LTF	1353	14.0	14.0	₹ 181.1
Tropical Dry Deciduous Forests	VDF	857	150.9	150.9	₹ 1,951.0
Tropical Dry Deciduous Forests	MDF	862	98.1	98.1	₹ 1,268.9
Tropical Dry Deciduous Forests	OF	787	40.7	40.7	₹ 526.6
Tropical Dry Deciduous Forests	LTF	769	8.0	8.0	₹ 102.9
Tropical Thorn Forest	VDF	694	122.1	122.1	₹ 1,578.3
Tropical Thorn Forest	MDF	862	98.2	98.2	₹ 1,269.9
Tropical Thorn Forest	OF	705	36.5	36.5	₹ 471.9
Tropical Thorn Forest	LTF	612	6.3	6.3	₹ 82.0
Tropical & Subtropical Dry Evergreen Forests	VDF	1433	252.2	252.2	₹ 3,261.0
Tropical & Subtropical Dry Evergreen Forests	MDF	1481	168.6	168.6	₹ 2,180.2
Tropical & Subtropical Dry Evergreen Forests	OF	1556	80.6	80.6	₹ 1,041.7
Tropical & Subtropical Dry Evergreen Forests	LTF	1044	10.8	10.8	₹ 139.8
Subtropical Pine/Broadleaved Hill Forests	VDF	954	167.9	167.9	₹ 2,170.6
Subtropical Pine/Broadleaved Hill Forests	MDF	910	103.7	103.7	₹ 1,340.3
Subtropical Pine/Broadleaved Hill Forests	OF	1189	61.6	61.6	₹ 795.9
Subtropical Pine/Broadleaved Hill Forests	LTF	1352	14.0	14.0	₹ 181.0
Montane & Moist Temperate Forest	VDF	858	151.1	151.1	₹ 1,953.6
Montane & Moist Temperate Forest	MDF	847	96.5	96.5	₹ 1,247.2
Montane & Moist Temperate Forest	OF	879	45.5	45.5	₹ 588.1
Montane & Moist Temperate Forest	LTF	889	9.2	9.2	₹ 119.0
Sub Alpine & Dry Temperate Forest	VDF	899	158.3	158.3	₹ 2,046.7
Sub Alpine & Dry Temperate Forest	MDF	799	90.9	90.9	₹ 1,175.9

Forest Type Group	Canopy cover density class	Precipitation (mm)[53]	Differential Run-off avoided (mm)[54]	Total differential water recharge (m3/ha)	Value of differential water recharge (₹ /ha/yr)[55]
Sub Alpine & Dry Temperate Forest	OF	801	41.5	41.5	₹ 536.3
Sub Alpine & Dry Temperate Forest	LTF	862	8.9	8.9	₹ 115.4
Alpine Scrub	VDF	1009	177.5	177.5	₹ 2,295.5
Alpine Scrub	MDF	1165	132.7	132.7	₹ 1,715.9
Alpine Scrub	OF	1125	58.2	58.2	₹ 753.0
Alpine Scrub	LTF	1222	12.7	12.7	₹ 163.6

Appendix 22 - Data and calculation steps for valuation of carbon storage in forests

Forest Type (Carbon stock in tonnes C / ha)	Density	Total Carbon Stock (tC/ha)[56]	Value of Carbon Stock (₹ /ha)[57]
Tropical Wet Evergreen Forests -North East	VDF	183.91	₹ 364,473
Tropical Wet Evergreen Forests -North East	MDF	112.01	₹ 221,981
Tropical Wet Evergreen Forests -North East	OF	95.16	₹ 188,588
Tropical Wet Evergreen Forests - Western Ghats	VDF	202.02	₹ 400,363
Tropical Wet Evergreen Forests - Western Ghats	MDF	151.11	₹ 299,470
Tropical Wet Evergreen Forests - Western Ghats	OF	100.10	₹ 198,378
Tropical Semi Evergreen Forests - North East	VDF	208.83	₹ 413,859
Tropical Semi Evergreen Forests - North East	MDF	125.18	₹ 248,082
Tropical Semi Evergreen Forests - North East	OF	56.39	₹ 111,754
Tropical Semi Evergreen Forests - Eastern Deccan	VDF	191.69	₹ 379,891
Tropical Semi Evergreen Forests - Eastern Deccan	MDF	117.79	₹ 233,436
Tropical Semi Evergreen Forests - Eastern Deccan	OF	79.68	₹ 157,910
Tropical Semi Evergreen Forest - Western Ghats	VDF	181.51	₹ 359,717
Tropical Semi Evergreen Forest - Western Ghats	MDF	117.74	₹ 233,337
Tropical Semi Evergreen Forest - Western Ghats	OF	75.33	₹ 149,289
Tropical Moist Deciduous Forests	VDF	124.98	₹ 247,685
Tropical Moist Deciduous Forests	MDF	95.38	₹ 189,024
Tropical Moist Deciduous Forests	OF	65.25	₹ 129,312
Littoral & Swamp Forests	VDF	185.85	₹ 368,318
Littoral & Swamp Forests	MDF	116.17	₹ 230,226
Littoral & Swamp Forests	OF	52.15	₹ 103,351
Tropical Dry Deciduous Forests	VDF	151.41	₹ 300,064
Tropical Dry Deciduous Forests	MDF	136.26	₹ 270,040
Tropical Dry Deciduous Forests	OF	48.30	₹ 95,721
Tropical Thorn Forests	VDF	51.30	₹ 101,666
Tropical Thorn Forests	MDF	57.38	₹ 113,716
Tropical Thorn Forests	OF	28.33	₹ 56,144
Tropical & Subtropical Dry Evergreen Forests	VDF	143.93	₹ 285,240
Tropical & Subtropical Dry Evergreen Forests	MDF	119.23	₹ 236,290
Tropical & Subtropical Dry Evergreen Forests	OF	93.97	₹ 186,230
Subtropical Pine/Broadleaved Hill Forests	VDF	155.86	₹ 308,883
Subtropical Pine/Broadleaved Hill Forests	MDF	104.54	₹ 207,177
Subtropical Pine/Broadleaved Hill Forests	OF	77.60	₹ 153,788
Montane & Moist Temperate Forests	VDF	176.49	₹ 349,768
Montane & Moist Temperate Forests	MDF	139.76	₹ 276,976

[56] Source: (FSI 2013b)

[57] Based on estimates of carbon stock, IPCC default value of 1tC = 3.67 tCO_2, average social cost of a tCO_2 = US$ 10 (Nordhaus 2011); exchange rate: 1 US$ = 54 INR

Forest Type (Carbon stock in tonnes C / ha)	Density	Total Carbon Stock (tC/ha)[56]	Value of Carbon Stock (₹ /ha)[57]
Montane & Moist Temperate Forests	OF	88.86	₹ 176,103
Sub Alpine and Dry Temperate Forests	VDF	203.59	₹ 403,475
Sub Alpine and Dry Temperate Forests	MDF	125.52	₹ 248,756
Sub Alpine and Dry Temperate Forests	OF	86.78	₹ 171,981
Alpine Scrub	VDF	192.64	₹ 381,774
Alpine Scrub	MDF	117.91	₹ 233,674
Alpine Scrub	OF	69.49	₹ 137,715

Appendix 23 – Adjustment Factor for GDP (PPP) per capita

Country	GDP (PPP) per capita (Intl $)[58]	Adjustment Factor for GDP (PPP) per capita[59]
Australia	42640	0.089
China	9162	0.418
Costa Rica	12606	0.304
Ecuador	10056	0.381
Europe	32021	0.120
Indonesia	4977	0.770
Portugal	23385	0.164
Southern Europe	32021	0.120
Spain	30557	0.125
U.S.A.	49922	0.077
World	11975	0.320

Appendix 24 – Adjustment Factor for currency exchange rate

	Adjustment factor for currency exchange rate (equivalent to 1 INR)[60]
AUD/ha/yr	56
CNY/ha/yr	9
EUR/ha/yr	71
USD/ha/yr	54

Appendix 25 – Extract from a commentary by T. C. A. Anant on social rate of discount

"Discounting involves a concept called the pure rate of social time preference; this rate is a parameter that measures the importance of the welfare of future generations relative to the present. It often stated as percent per year, like interest rates, but in this case instead of referring to the return to capital we are instead comparing future "utility" of welfare. How should we proceed in thinking about this rate? When economists or financial analysts do a cost benefit analysis to assess investment projects they try to place a present day value on costs to be incurred and benefits assumed to be enjoyed in the future. To do this, they discount the future values by an annual percentage rate, a discount rate, which is typically set at around 5-8%. The choice of the rate is typically linked to assumptions about the opportunity cost of capital. Thus, in India the nominal return to savings

[58] Data source: World Economic Outlook Database (IMF 2012)
[59] Adjusted factor estimated as the ratio of India's GDP (PPP) per capita to a country's GDP (PPP) per capita; India's GDP per capita = Intl $ 3830 (IMF 2012)
[60] Data source: Currency converter (XE 2013)

would be around 9-10% and a rate of inflation of around 4-5%. So one may take the real return to capital about 5%. Can one apply the same rate for social time preference in evaluating the benefits from forests? This would be erroneous. Unlike in project planning when one is seeking to compare across alternative uses for investable funds, here one is seeking to provide a weight to the benefits enjoyed by different generations from forests. This is because in ordinary projects, evaluation the horizon is often compatible with the single lifetime or generation. In forest matters, as we have noted earlier, the correct horizon spans several generations. While notions of impatience may be appropriate in comparing benefits in a single lifetime, they are singularly inappropriate in intergenerational comparisons. Intergenerational comparisons of benefits get closely linked to cultural norms of societies and the value of a society places on present benefit to the bequest it leaves for the future. This value on future generations is both an ethical concern for the individual as well as the moral obligation of the state. This has been reiterated by eminent economists over the years. Thus Pigou (1920) notes, "it is the clear duty of government, which is the trusty for unborn generations as well as for its present citizens, to watch over, and if need be, by legislative enactments, to defend the exhaustible natural resources of the country from rash and reckless spoilation"."

References

Pigou, A. C. (1920). The Economics of Welfare. London. MacMillan.

Appendix 26 – Net accumulation and disbursement of CAMPA funds to various states

States/ (Amount in ₹ Crore)	Net accumulations as of 31.12.2012	Disbursements till 2012
Andaman & Nicobar	99	2
Andhra Pradesh	1,996	449
Arunachal Pradesh	370	87
Assam	150	32
Bihar	265	33
Chandigarh	48	0
Chhattisgarh	2,562	471
Dadra& Nagar Haveli	71	0
Daman & Diu	1	-
Delhi	33	3
Goa	192	22
Gujarat	642	113
Haryana	653	54
Himachal Pradesh	1,406	188
Jammu & Kashmir	192	24
Jharkhand	2,006	309
Karnataka	737	195
Kerala	86	3
Lakshadweep	0	-
Madhya Pradesh	1,624	158
Maharashtra	1,676	336
Manipur	32	4
Meghalaya	107	0

Mizoram	20	1
Nagaland	0	-
Orissa	3,984	644
Puducherry	0	-
Punjab	348	101
Rajasthan	883	144
Sikkim	176	27
Tamil Nadu	32	6
Tripura	88	8
Uttar Pradesh	573	113
Uttarakhand	1,375	261
West Bengal	107	16
Total	22,531	3,807

Appendix 27 – List of people contacted during individual consultation meetings

Title	First Name	Last Name	Designation	Organization
Mr.	A. K.	Srivastava	ADG (FC)	MoEFCC
Mr.	M. S.	Negi	IG (FC)	MoEFCC
Mr.	H. C.	Choudhry	AIG (FC)	MoEFCC
Mr.	Anirban	Ganguly	Convenor Forestry and Biodiversity	TERI
Dr.	Rajiv	Garg	Advisor (E&F)	Coal India Ltd.
Dr.	Rekha	Pai	IG	MoEFCC
Dr.	Biswajit	Banerjee	Director (Forestry)	The Planning Commission
Mr.	B. N.	Satpathy	Sr. Adviser (E&F and S&T)	The Planning Commission
Mr.	P. S.	Rao	Expert Member	The National Green Tribunal
Mr.	R. S.	Sajwan	Expert Member	The National Green Tribunal
Dr.	Ranjan	Chaterjee	Expert Member	The National Green Tribunal
Dr.	Rita	Pandey	Professor	National Institute of Public Finance and Policy
Dr.	M. S.	Garbyal		MoEFCC Bhopal Regional Office
Mr.	A. K.	Wahal	Director General	Forest Survey of India
Mr.	Rajesh	Kumar	Sr. Dy. Director (FI)	Forest Survey of India
Dr.	Ruchi	Badola	Professor	Wildlife Institute of India
Dr.	V. B.	Mathur	Dean	Wildlife Institute of India
Dr.	Rajeev	Bhartari	CCF	Uttarakhand Ecotourism Board
Mr.	Govind	Rao	Member	The 14th Finance Commission
Dr.	N. S.	Bisht	Professor	Indian Council of Forestry Research and Education
Dr.	R. B. S.	Rawat	PCCF	Uttarakhand Forest Department
Mr.	D. V. S.	Khati	APCCF	Uttarakhand Forest Department
Mr.	T. P.	Singh	India Coordinator	IUCN
Dr.	Alok	Saxena	Addl. Director	Indira Gandhi National Forest Academy
Dr.	R. K.	Goel	Director	Indira Gandhi National Forest Academy
Mr.	Mohan	Lal	DIG	MoEFCC
Mr.	Pyush	Dogra	Senior Environmentalist	The World Bank
Dr.	B. K.	Singh	Director (FC)	MoEFCC
Dr.	Padam	Rastogi	DG (EA)	MoEFCC
Mr.	Naresh	Kumar	Joint Secretary	Ministry of Mines
Dr.	Pramod	Kant	Director	TERI
Mr.	Suresh	Chauhan	Fellow	TERI
Mr.	Alkesh	Sharma	Joint Secretary	Ministry of Road Transport & Highways

Title	First Name	Last Name	Designation	Organization
Mr.	V. K.	Sharma	CEO	National Highway Authority of India
Mr.	Rajiv	Gupta	Director	Ministry of Power (Hydro)
Mr.	R. M.	Misra	Chief Forest Officer	NTPC
Dr.	Jagdish	Kishwan	Chief Advisor	Wildlife Trust of India
Mr.	K. V. S.	Chauhan	Retd.	Forest Survey of India
Mr.	Prakash	Lakhchaura	Deputy Director	Forest Survey of India
Mr.	A. K.	Sarkar	Executive Director	NHPC
Mr.	Vipin	Kumar	Chief Environment Officer	NHPC
Dr.	T. C. A.	Anant	Chief Statistician of India	Ministry of Statistics
Mr.	Shyam	Divan	CEC Judicial Bench	
Mr.	M. K.	Jiwrajka	Member Secretary	Central Empowered Committee
Hon'ble	Justice P.	Jyothimani	Judicial Member	National Green Tribunal, Bhopal Bench
Dr.	Ajay	Deshpande	Expert Member	National Green Tribunal, Bhopal Bench
Mr.	M. P.	Tiwari	Deputy Registrar	National Green Tribunal, Bhopal Bench
Dr.	Sharad	Lele	Senior Fellow	ATREE
Mr.	R. K.	Bansal	Chief Executive Officer	Federation of Indian Mineral Industries
Mr.	A. K.	Bhandari	Advisor (Environment)	Federation of Indian Mineral Industries
Mr.	R. K.	Sharma	Secretary General	Federation of Indian Mineral Industries
Dr.	Rajesh	Gopal	Addl. DGF (Project Tiger)	National Tiger Conservation Authority
Mr.	S. P.	Yadav	DIG	National Tiger Conservation Authority
Mr.	H. S.	Negi	IG	National Tiger Conservation Authority
Mr.	M. K.	Ranjitsinh	Chairman & Trustee	Wildlife Trust of India
Dr.	Vivek	Menon	Executive Trustee	Wildlife Trust of India
Mr.	K. S.	Achar	Consultant	CAMPA
Mr.	N. C.	Saxena	Member	National Advisory Council
Mr.	Nitin	Sethi	Assistant Editor	Times of India
Mr.	Rahul	Noronha	Senior Correspondent	The Hindustan Times
Mr.	Harish	Salve	Ex-Solicitor General of India & Senior Lawyer, Supreme Court of India & CEC Judicial Bench Member	
Mr.	A. K.	Dharni	Professor	IIFM
Mr.	Anil	Khare	Associate Professor	IIFM
Mr.	Prashant	Jadhav	Associate Professor	IIFM
Mr.	K. K.	Jha	Associate Professor	IIFM
Mr.	Shahbaz	Ahmed	Professor	IIFM
Mr.	Yojneshwar	Sharma	DGDE	Ministry of Defence

Appendix 28 – List of participants in the National Consultation Workshop at New Delhi

Title	First Name	Last Name	Designation	Organization
Shri	K. S.	Reddy	APCCF (C)	MoEFCC Bangalore Regional Office
Shri	P. K.	Sharma	APCCF (FCA)	Andhra Pradesh Forest Department
Dr.	Rajiv Kumar	Garg	Advisor (E&F)	Coal India Ltd.
Dr.	Mohit	Gera		IGNFA
Shri	Manoj	Kumar	Research Officer	FRI, Dehradun
Shri	Neun	Hansjoerg		GIZ

Title	First Name	Last Name	Designation	Organization
Shri	Pradeep	Kumar	Director	MoEFCC
Shri	H. S.	Sohal	Director	Mahatma Gandhi Institute for Climate Change
Shri	Sanjay	Upadhyay	Advocate	Supreme Court & ELDF
Ms.	Eisha	Krishan		ELDF
Shri	Divakaran	Unnikrishnan		GIZ India
Shri	M. S.	Negi	IG (FC)	MoEFCC
Shri	H. C.	Chaudhary	AIG (FC)	MoEFCC
Shri	J. K.	Tiwari	APCCF	MoEFCC Bhuvaneshwar Regional Office
Shri	Pramode	Kant	Director	TERI
Shri	J. V.	Sharma	Sr. Fellow	TERI
Shri	D. V. S.	Khati	APCCF	Uttarakhand Forest Department
Shri	S. M.	Sonashekar	CCF	MoEFCC Bangalore Regional Office
Smt.	Rita	Pandey	Professor	NIPFP
Shri	Ravindra	Singh		GIZ
Shri	E.	Edgar		GIZ
Shri	S. P.	Yadav	DIG	NTCA
Shri	Shiv Pal	Singh	Sr. AIG	MoEFCC
Shri	Anirban	Ganguly		TERI
Shri	B. M. S.	Rathore	Jt. Secretary	MoEFCC
Shri	V. K.	Bahuguna	DG	ICFRE
Shri	M.	Bagra	ARC	Govt of Arunachal Pradesh
Shri	Gopal	Kadekodi	Ex-Director	CMDR
Shri	Swapan	Mehra	CEO	IES
Shri	Sumit	Garg	General Manager	LNJ Bhilwara Group
Smt.	Kakoli	Sengupta	BHS Assistant	LNJ Bhilwara Group
Shri	Sanjeev	Das	Vice President	IMFA Ltd
Dr.	V. P.	Singh	Programme Manager	LEAD India
Dr.	D. V. S.	Pradhan	Project Manager	LEAD India
Shri	Tarun	Kathula		UNDP
Shri	V. M.	Sastri	Advisor (E&F)	JSW
Shri	R. M.	Misra	Chief Forest Officer	NTPC
Shri	Debi	Goenka		Conservation Action Trust
Dr.	I. N.	Rao	AVP	JSPL Delhi

Appendix 29 – List of participants at the Group Consultation Workshop at Bhopal

Title	FirstName	LastName	Designation	Organization
Mr.	Ritesh	Sharma	Technical Expert	GIZ
Mr.	Ravindra	Singh	Senior Advisor	GIZ
Dr.	Prakash	Nelliyat	Environmental Economist	National Biodiversity Authority
Mr.	M. M.	Joshi	Chief Conservator of Forests	Haryana Forest Department
Dr.	G. A.	Kinhal	APCCF	MPMFP Federation
Mr.	A. K.	Bansal	Ex-ADG (FC)	MoEFCC

Title	FirstName	LastName	Designation	Organization
Mr.	N. S.	Dungriyal	CCF	MP Forest Department
Dr.	B. K.	Tiwari	Professor	NEHU
Mr.	Aswini	Mohanty	Resident Executive	Tata Steel Ltd.
Dr.	V.	Parameswaran	Deputy Director General	CSO
Mr.	Sandeep	Rai	Manager - Forestry & Regulatory Affairs	Suzlon Energy Ltd
Mr.	Vinod	Pandya	Vice-Precident & Head - Forestry	Suzlon Energy Ltd
Mr.	Tejinder	Singh	APCCF	HP Forest Department
Mr.	Lakhwinder	Singh	APCCF	MoEFCC Bhopal Regional Office
Mr.	K. S.	Reddy	APCCF	MoEFCC Bangalore Regional Office
Mr.	A. K.	Dharni	Professor	IIFM
Mr.	Shahbaz	Ahmed	Professor	IIFM
Mr.	Rajesh	Kumar	Sr. Dy. Director	Forest Survey of India
Dr.	Gopal	Kadekodi	Hon. Professor	CMDR
Dr.	Rekha	Singhal	Dean	IIFM
Mr.	Anoj	Choudhary	Dy. Manager (Env & Forests)	
Dr.	R. B.	Lal	Ex-Director	IIFM

Appendix 30 – A small concept note on NPV circulated before consultation meetings and workshops

In pursuance of SC judgment dated 26.09.2005 in IA No. 826 in IA No. 566 of 2000 in Writ Petition (Civil) 202 of 1995, a 3-member expert committee was formed to work out the Net Present Value (NPV) for forest land diverted for non-forest use on economic principles. Under the chairpersonship of Dr. Kanchan Chopra (IEG), the committee in 2006 recommended a12-step procedure at the forest range level to estimate NPV. The Kanchan Chopra committee internalized in its recommendation, the methodology suggested by the Study Commissioned by her from IEG to Dr. Madhu Verma (IIFM) in 2005 on "Estimating Economic Value of Forest Land: A Methodology", which prescribed estimation of benefits and costs of various ecosystem services as listed below:

The NPV estimated consisted of six key goods and services from forests apart from biodiversity. These goods and services were estimated based on parameters tabulated below.NPV was calculated as present value of the net flow accruing over 20 years at 5% social rate of discount. It was further argued that simply adding up services would be incorrect as different forests yield different services. Thus percentage values were developed for each goods and services valued based on the type of dominant forest practices. Ground rent for land was also recommended to be approximated by prevailing rents in the region, subject to a minimum of INR 10,000 per hectare.

Good or service	Basis of estimation
Timber	Long run stumpage value and stumpage price of mature timber
Carbon storage	Carbon content and market rate of carbon
Fuel wood & fodder	Total quantity collected, market price of collection, and cost of collection
NWFP	Total quantity collected, market price of collection, and cost of collection
Ecotourism	No. of people visiting forests, average expenditure per person
Watershed services	Value per hectare of soil conservation and hydrological services
Biodiversity	Based on relative weighing pattern between biodiversity and other services

The NPV amount collected was to be paid by the user agency into a centralized fund called "CAMPA". It was also recommended that the amounts collected in lieu of NPV and other charges should be divided as per methodology described between those accruing to local, state and national level stakeholders.

Following the report submitted by the expert committee, the Central Empowered Committee (CEC) filed a supplementary report in pursuance of the SC order dated 28.11.2006 in IA No. 826 in IA No. 566 after considering technical inputs from Forest Survey of India, MoEFCC officials, Chairperson and Members of the Kanchan Chopra Committee. Based on Champion and Seth classification, the forests were categorized into 6

eco-classes. Equalization value of forests belonging to different eco-classes and forest cover density was worked out on the basis of value judgment and experience.

Eco-value class (₹ /ha)	VDF	MDF	OF
Class I	10,43,000	9,39,000	7,30,000
Class II	10,43,000	9,39,000	7,30,000
Class III	8,87,000	8,03,000	6,26,000
Class IV	6,26,000	5,63,000	4,38,000
Class V	9,39,000	8,45,000	6,57,000
Class VI	9,91,000	8,97,000	6,99,000

The CEC more or less borrowed the values estimated by the expert committee. In addition, it estimated the carbon sequestration value, value of flagship species and bio-prospecting on the basis of state-wise details as assessed in the Green India States Trust (GIST) report. The total value of per hectare of forest based on these goods and services was thus estimated to be INR 7,77,597 and was approximated to be INR 8 lakhs per hectare. Based on equalization value of forests, the CEC recommended the tabulated NPV rates (in INR). While keeping the time period of 20 years for NPV, the CEC reduced the social discount rate to 4% in calculating these values.

The Kanchan Chopra Committee also gave its recommendations on certain types of projects which may be given partial or full exemption from NPV. The CEC generally accepted those recommendations. Public good projects such as schools, hospitals, rural infrastructure, among others were granted full exemption. Other project categories which were also believed to result in public good benefits were given partial exemption. CEC also recommended that use of forest land falling in protected areas will be permissible only in totally unavoidable circumstances for public interest projects by obtaining permission from SC and paying up to 10 times the NPV rate. The CEC recommended that NPV rates should be revised every 3 years.

Appendix 31 – Minutes of NPV National Consultation Workshop held at New Delhi

TOR 1 – NPV Recalculation

- Include soil indicators in estimation of water flow regulation and soil erosion regulation
- For timber estimation, do not use royalty rates as they are gross underestimates. Biomass should be used for its estimation
- The NPV rates should be specific to type of land-use change.
- The rates should consider whether there are any adjoining forests available where local communities can derive their resources they current use from area to be diverted.
- Disbursement of CAMPA fund should be done at the local, state and national level in a 3-tier arrangement.
- Human development index of area to be diverted should form an integral part of NPV.
- Alternative livelihood opportunities available in an area should also be included in NPV estimation.
- Forests have a locational value also e.g. forests in the periphery of a forested area. This should be included in NPV estimation
- Special characteristics of an area should be considered in calculating NPV.
- Ancillary activities of a project should also form a basis of NPV calculation. For e.g. while mining has its own set of impacts, related impacts such as impact on aquifers, impact due to transportation, etc are not accounted.
- Differential land rent based on proximity to population centres should be the basis of determining ground rent.

- Land around highways is a tricky proposition because the land has been notified as protected forests based on plantations done by highway authorities. Charge on NPV on such areas needs reconsideration.

- NWFP values should be weighed according to population estimates of an area.

- Effect of mining on water regime and its related downstream pollution impact should be considered in NPV.

- Critical areas for wildlife outside protected areas are currently charged very less as compared to a protected area. This needs some consideration. Areas adjoining to national parks should be treated differentially.

- It is all good to talk about very many services to value but we should restrict to only those services which we can value reliably. All ecosystem services have complementarity and care should be taken to avoid double counting. This is net present value and cost is to be always subtracted from the price.

- A part of CAMPA fund should be specifically used to compensate local communities in real terms. For e.g. If water services are lost, then fund should be targeted to provide clean drinking water.

- There should be a high ground rent for unproductive land to incentivize handing back of land. Restoration and reclamation should also be encouraged by refunding a part of NPV originally collected.

- Positive externalities from any project should be considered in NPV calculation.

- Costs and benefits of ecosystem services to various stakeholders should be weighed appropriated for calculation.

- NPV may include costs for some goods but for services, NPV should actually be called PV.

- Marginal values may be considered in estimation NPV. It would also be great if uncertainty in valuation can be quantified.

- With regards to discount rate, a declining discount rate may be used. A hyperbolic declining discount rate may be used starting with 4% which declines gradually to 2% by the end of calculation period.

- For carbon sequestration services, estimate only for the additional carbon.

- Pricing of carbon is an important aspect in current situation when the prices are very low.

- Impact of diversion on adjacent areas should be studied through some case studies. Different kind of projects (e.g. mining, hydro, cement, thermal, etc may be considered). Based on these findings, some estimate (say 20%) may be developed as an additional premium on NPV.

- For projects that have permanent change in land use, 3 times NPV should be charged.

- Forest land is not eligible for 0% discount rate as it produces renewable resources with some exceptions such as biodiversity loss. Only those stock which produce exhaustible resources may be eligible for 0% discount rate.

- Right regime on the forest area diverted also needs greater attention.

- NPV value should be such that it acts as a deterrent in using easily available forest land. It will encourage projects to be based on other types of land as much as possible.

- An annual correction factor should be included in NPV calculation according to which the value revised is automatically updated every year. This would not mean that it will not require further revision.

TOR 2 – Exemptions from NPV payment

- Profit making organizations should not be given any exemptions. Non-profit making organizations may be given some exemptions. Criteria: Sec 25 of Companies Act.

- The land taken for CA should actually be linked to density class rather than type of land for doing CA. For e.g. if it is very dense forest, the area to be afforested should be 3 times the area diverted. For MDF, it should be 2 times and should be equal for OF and LTF.

- The mechanism should encourage land improvement through some form of financial incentives.

- With regards to defence, although ecologically that may be good, it hinders access and thus has a social cost. So at least that component should be collected in the form of NPV.

- Projects for temporary diversion need careful consideration because the land often never comes back. Reclamation is mostly agreed but never happens.

- Monitoring mechanism needs to be strengthened to ensure agreements are complied with.

- For some projects, it is a requirement that 30% of diversion area should be kept under plantation (e.g. greenbelt). This is over and above the CA. This should be considered for refund while paying NPV.

- If land is returned before the expiry of lease period, it expedites the process of eco-restoration and hence a fraction of NPV should be returned as an incentive.

TOR 3 – Validity of NPV

- Can be based on the soil expectation value

- It should be charged for the complete project life.

- It should be charged again after 20 years.

- The land rent should be collected at the district level.

- If rotation period ‹ life of the project, charge NPV for the complete rotation period. Else charge it for the complete life of the project.

Other issues

- How to deal with shifting cultivation.

- Give GPS coordinates to FSI and you will be able to get the Forest Type Group and Density Class.

- NPV payments may be allowed in some cases to be collected through deferred payments. Scale and NPV payment as % of total project cost may be used to make eligible projects for deferred payments. For e.g. in H. P. CAT Plans are charged in instalments.

- It should be monitored that CAMPA fund is used mainly for restoration purposes.
- Cumulative impact of projects in a region should be reflected in NPV.
- NPV is not charged during renewal if the project proponent is the same. However, if the project proponent changes, NPV is charged again. This needs a relook.
- Land rent is charged twice. Some states also collect the land rent. This needs to be clarified.
- NPV for everything should be collected and then refunded back according to the situation. A deposit-refund mechanism will take care of the worst possible scenario along with encouraging handing back of land. This has been successfully used in EU for pollution control.
- For mining, renewal is now to be applied even for unbroken areas. These should not be charged for NPV.

Appendix 32 – Survey instrument (Form A) used for provider agency

Net Present Value (NPV) of forests for diversion to non-forestry purposes

Q1. Are you aware of NPV charged for diversion of forests to non-forestry purpose? *

○ Yes ○ No

Q2. Do you currently deal or in recent past have dealt with issue of NPV of forests for diversion to non-forestry purpose? *

○ Yes ○ No

Estimation of NPV

This section deals with the value of NPV as is currently estimated and related issues.

Q3. What is your take on the value of NPV as is currently estimated? *

Based on the forest type and forest cover density classes, the value varies from INR 4,38,000 to 10,43,000 per ha of forest diverted.

○ Highly underestimated ○ Slightly underestimated ○ More or less accurate

○ Slightly overestimated ○ Highly overestimated ○ I don't want to comment

Q4. According to you which of the following issues currently not addressed by NPV needs to be urgently incorporated in its calculation? *

☐ Change of extent in land-use by the proposed non-forest activity

☐ Dependency of local communities on forest area diverted

☐ Site quality of area in terms of its biodiversity

☐ Issues of threatened or endangered species

☐ Critical wildlife corridors and breeding habitats

☐ Trees outside forests (TOF)

☐ Differential land rent based on proximity to urban area

☐ Fragmentation of forest area at a landscape level

☐ Others

Q5. Kindly provide any other views related to estimation of NPV which you feel are important to consider.

Exemptions from NPV

Q6. Kindly provide your views on full exemptions given to following type of projects on NPV *

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Schools, hospitals and children playgrounds (upto 1 ha)					
Community centres in rural areas (upto 1 ha)					
Minor irrigation schemes (upto 10 ha of storage area)					
Municipal water supply					
Drinking water supply pipelines					
Rural infrastructures such as village road, over-head tanks (upto 1 ha)					
Relocation of villages from protected areas					
Tribal rehabilitation					
Activities required for ecological or wildlife management					
Regularization of eligible encroachments – pre 1980					
Overhead power transmission lines					
Laying of underground optical fibre cables					
Laying of pipelines for underground gas transportation					
District and rural roads					
Shifting cultivation					
Defence road in border areas					
Electric distribution line upto 22 kV in rural areas					
Collection of boulder/silts from the river belts					
Field firing ranges for defence purpose					

Q7. Kindly provide your views on partial exemptions given to following type of projects on NPV *

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Major irrigation and hydel power (30% exemption)					
Non-conventional energy (50% exemption)					
Wind energy (50% exemption)					
Underground mining (50% exemption)					

Q8. Kindly provide your views on no exemptions given to following type of projects on NPV *

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Mining (other than underground)	○	○	○	○	○
Regularization of encroachments other than pre 1980	○	○	○	○	○
Thermal power projects	○	○	○	○	○
Temples, religious centres and associated infrastructures	○	○	○	○	○
State and national highways	○	○	○	○	○
Salt manufacture (if converted from mangroves post 30.10.2002)	○	○	○	○	○
Defence production units	○	○	○	○	○
Steel, cement and chemical industries	○	○	○	○	○
Special export zone projects	○	○	○	○	○

Q9. According to you, what has been the impact of exemptions on forest in terms of conservation? *

	1	2	3	4	5	
Highly negative	○	○	○	○	○	Highly positive

Q10. According to you, what has been the impact of exemptions on local communities in terms of their dependency on forests? *

	1	2	3	4	5	
Highly negative	○	○	○	○	○	Highly positive

Q11. According to you, what has been the impact of exemptions on user agencies in terms of getting projects approved? *

	1	2	3	4	5	
Highly negative	○	○	○	○	○	Highly positive

Q12. Kindly provide references to any situation where exemptions from NPV have had a positive or negative impact on forests, local communities or user agencies.

Other related issues

Q12. Kindly provide your views on the validity of NPV. *

It is currently charged for 20 years. If you differ, kindly suggest a suitable time period in "Other"

- ○ I feel 20 years is too short a time period for estimating NPV
- ○ I feel 20 years is an appropriate time period for estimating NPV
- ○ I feel 20 years is too long a time period for estimating NPV
- ○ Other:

Q13. Kindly provide your views on the collection mechanism of NPV value. *
Kindly do not hesitate to suggest any other collection mechanism in "Other"

- ○ I agree with one-time collection of NPV for 20 years
- ○ I think NPV should be charged on an annual basis apart from one lump sum amount at the beginning
- ○ Other:

Q14. According to you, what are the difficulties faced by Forest Department in estimation and collection of NPV for forests.

Q15. Would you suggest a separate agency for estimation, verification and monitoring of NPV? *

○ Yes ○ No

Q16. Do you agree with the current mechanism of collection of NPV in a central fund (CAMPA) at the national level and then its redistribution at the state level? *

○ Yes ○ No ○ I don't want to comment

Q17. What according to you are strengths or limitations of collection of NPV at a central level?

Q18. Would you like your answers to be recorded as anonymous? *

○ Yes ○ No

Name *

Designation *

Organization *

Email *

Q19. If required, would you like to be contacted for a further discussion on issues? *

○ Yes ○ No

Q20. Would you be willing to attend our national level consultation workshop in New Delhi on 18 March 2013? *
If you would be unable to attend but can recommend any other official to represent your organization views, kindly provide their details in "Others"

○ Yes ○ No ○ Others:

●●●

Appendix 33 – Survey instrument (Form B) used for user agencies

Net Present Value (NPV) of forests for diversion to non-forestry purposes

Q1. Are you aware of NPV charged for diversion of forests to non-forestry purpose? *

◯ Yes ◯ No

Q2. Do you currently deal or in recent past have dealt with issue of NPV of forests for diversion to non-forestry purpose? *

◯ Yes ◯ No

Q3. Kindly select the option that best describes your user-agency category *

◯ Mining ◯ Road ◯ Defence ◯ Irrigation

◯ Hydro power ◯ Thermal power ◯ Wind power ◯ Railways

◯ Transmission line ◯ Other:

Q4. Kindly briefly describe activites undertaken by your organization/company for which proposal(s) for forest diversion is submitted *

Q5. What is your take on the value of NPV as is currently estimated? *

Based on the forest type and forest cover density classes, the value varies from INR 4,38,000 to 10,43,000 per ha of forest diverted.

◯ Highly underestimated ◯ Highly underestimated ◯ More or less accurate

◯ Slightly overestimated ◯ Highly overestimated ◯ I don't want to comment

Q6. Kindly provide your views on why you feel that the NPV value is overestimation or underestimated *

Q7. Are you satisfied with the process of calculation and collection of NPV for diversion of forests in terms of time taken? *

◯ Yes ◯ No

Q8. Are you satisfied with the process of calculation and collection of NPV for diversion of forests in terms of transparency? *

◯ Yes ◯ No

Q9. Do you feel that once you pay the forest department for compensatory afforestation, you should not be charged additional NPV? *

◯ Yes ◯ No

Q10. Kindly select options from below which you feel should be incorporated in calculation of NPV? *

- ☐ NPV should be charged in instalments apart from one lump sum amount at the beginning.
- ☐ There should be project-specific NPV estimation based on its impact on forests.
- ☐ Positive externalities of a project should be incorporated in NPV calculation.
- ☐ If land is handed back to forest deparment before expiry of lease, a part of NPV collected should be refunded back.
- ☐ Local activities undertaken through CAMPA in which NPV amount is collected should involve user agencies.
- ☐ The land for compensatory afforestation should be decided and finalized by the state forest department.
- ☐ Projects that lead to permanent land-use change should be charged more than those cause temporary land-use change.
- ☐ NPV charged should be linked with the productivity of land diverted and expected profits.
- ☐ Others

Q11. Kindly provide your views on the criteria for partial or full exemption from NPV for activities undertaken by your organization/company, if any. *

Kindly also provide your suggestions on additional criteria you would like to recommend for your project category.

Name *

Designation *

Organization *

Email *

Q12. If required, would you like to be contacted for a further discussion on issues? *

○ Yes ○ No

Q13. Would you be willing to attend our national level consultation workshop in New Delhi on 18 March 2013? *

If you would be unable to attend but can recommend any other official to represent your organization views, kindly provide their details in "Others"

○ Yes ○ No ○ Others:

●●●

Appendix 34 – Survey Instrument (Form C) used for local communities

Net Present Value (NPV) of forests for diversion to non-forestry purposes

Date: _____

Q1. Are you aware of NPV charged for diversion of forests to non-forestry purpose? *

○ Yes ○ No

Q2. Was your/Gramsabha's approval taken for diversion of forests on which you depended upon? *

○ Yes ○ No

Q3. According to you which of these benefits that you earlier received from forests have been lost as a result of diversion? *

☐ Timber for household building, furniture and agriculture equipments

☐ Fuel wood for basic energy supply

☐ Fodder for livestock

☐ Non-timber forest produce

☐ Others _____

Q4. Is Gramsabha consulted on how money used from CAMPA is utilized for activities supposed to compensate for the loss of forests diverted that you depended upon? *

○ Yes ○ No

Q5. According to you, what has been the impact of NPV collection on forest in terms of conservation? *

	1	2	3	4	5	
Highly negative	○	○	○	○	○	Highly positive

Q6. According to you, what has been the impact of NPV collection on local communities in terms of their dependency on forests? *

	1	2	3	4	5	
Highly negative	○	○	○	○	○	Highly positive

Q7. According to you, what has been the impact of NPV collection on user agencies in terms of getting projects approved? *

	1	2	3	4	5	
Highly negative	○	○	○	○	○	Highly positive

Name * _____

Village * _____

New land-use of forest diverted * _____

●●●

Appendix 35 – List of survey respondents

Name[61]	Designation	Organization
Paresh Kumar Sharma, IFS	Addl. PCCF (FCA)	Andhra Pradesh Forest Dept.
B S Chadha	IFS	Govt. of India
J D Sharma	PCCF (WL)	Orissa State Forest Department
A. K. Dwivedi	Chief Conservator of Forests	UP Forest Department
SS Rasaily	Conervator of Forest	Forest Department,Uttarakhand
SUDHANSHU SEKHAR MISHRA	DIVISIONAL FOREST OFFICER	FOREST AND ENVIRONMENT DEPT.GOVT OF ODISHA
PRADEEP RAI KARAI	CONSERVATOR OF FOREST(WILDLIFE)	FOREST DEPARTMENT
JD SHARMA	PCCF(WILDLIFE)	ORISSA
Dr R.M.Misra IFS	Addt,PCCF ,CFO	NTPC Ltd
N.MOHAN REDDY	SENIOR MANAGER	LOVA ECOLOGICAL SOLUTIONS
H.C .CHAUDHERY	ASST.INSPECTOR GENERAL OF FOREST	MOEFCC
MOHIT GERA	ADDITIONAL PROFESOR	IGNFA,DEHRADUN
H.S.SOHAL	DIRECTOR	MAHATMA GANDHI INSTITUTE FOR COMATING CLIMATE CHANGE.GOVT OF DELHI
S.P.YADAV	DIG	NTCA,MOEFCC,GOI
N. Mohan Reddy	Senior Manager	Iora Ecological Solutions
J V Sharma	-	-
Dr. R. B. S. Rawat	PCCF	Uttarakhand Forest Department
Dr. J. K. Sharma	Chief Conservator of Forests	Uttarakhand Forest Department
Rajendra Singh	CF	Uttarakhand Forest Department
Dr I N Rao	Associate Vice President	Jindal Steel & Power Limited
Prabhakar Rout	Advisor	Naresh Kumar @ Company
Debi Goenka	Executive Trustee	Conservation Action Trust
A. K. Sarkar	Executive Director (Planning)	NHPC Ltd.
Dr. R. M. Misra, IFS	Chief Forest Officer	NTPC Ltd

Appendix 36 – Excerpts of views from few user agencies and experts

Organization	Views in relation to NPV estimation and collection
NHPC	In NHPC's view NPV is grossly overestimated in view of several additional payments and double payments are being made to forest departments.Even after making payment of NPV rates, following additional compensations/ costs/ expenses are paid/ made to concerned Forest Departments by the Corporation in lieu of diversion of forest land: a. Cost of trees, poles, etc. standing within the required forest area/ land. b. Cost of any other structure of Forest Department. c. Cost of Compensatory Afforestation is paid for raising plantation over double the degraded area in lieu of diverted forest land. This includes cost of plantation, cost of soil treatment works as well as cost of infrastructure for implementation of Compensatory Afforestation. d. In addition to above, the cost of Catchment Area Treatment Plan is also being released in favour of Forest Departments which is required to be prepared and submitted alongwith the forest proposal. Under CAT plan major work carried out is afforestation, hence it should also be credited against NPV. e. Moreover, certain State Govts. are also demanding lease rent for the diverted forest land.

[61] 5 respondents wanted their response to be recorded as anonymous and hence are not included in the list.

Organization	Views in relation to NPV estimation and collection
	f. In majority of hydro projects, areas diverted for non forest use are mostly river bed, flood zone, rocky surface, etc. which are mostly devoid of any vegetation. As such there are no goods and services being provided by these areas completely devoid of vegetation, but NPV is charged for these areas also. g. NPV is paid for forest land diverted for underground structures with high cover, although the forest on surface is not getting affected at all. h. The State Govts. demand for Rights and Privileges (R&P) for forest land / community forest diverted for projects, over and above NPV payment. i. In some States areas are designated as forest land, but on the same areas tribal population is living and practicing 'jhum' cultivation. NPV as well as compensation towards R&P is demanded for these areas. j. In some cases, additional payments are required to be paid to State Govts. For carrying out forestry/ wildlife activities (eg. In case of Subansiri Lower HE Project 0.5% of the hard cost of Project is demanded for wildlife related activities). k. In addition, payment towards biodiversity management plan is done at projects. All such additional charges, in general, amount to double counting / taxation and may be avoided under principles of public finance. In view of this, these additional payments alongwith NPV should not be demanded. It is proposed to rationalize the issue and bring above separate items (which are applicable for most of the States) under the umbrella of NPV, with clear indication that no separate payment is required for above mentioned activities. The NPV payment rates are to be increased suitably to cover above items.
Suzlon Energy Ltd.	Wind power projects, developed on diverted forest land, use forest land in a very sustainable way, without harming the natural landscape of the area. We develop wind farms on forest land based on real time land footprint. Any excess land is returned to the forest department on completion of the project. Compared to mining and other intrusive activities, our contribution to environment conservation is long lasting, as we produce green energy, avoiding greenhouse gas emissions. Request to consider giving Special Status to Wind Power Projects for forest land diversion applications. Request to consider that CA land should not be linked to density class as land is a scarce natural resource. Moreover, the principle of providing CA land states that equivalent non-forest land is to be provided by the user agency in lieu of the diverted forest area. Tree density is given consideration in the existing Eco class value. Alternatively, if one studies the compensatory afforestation scheme proposed in the FC Act proposals, it will be seen that the cost per hectare (Ha) is much higher that the plantation scheme taken by the forest department. At times it is three times costlier than the scheme of the forest department. Hence, in effect, the project proponents are actually paying three times the normal cost of plantation. It has been also noted that high wind zones, sometimes falling in notified forest area, do not have any vegetation except some bushes. Also, there is no displacement and no issue of rehabilitation in WPP's in forest land, unlike other infrastructure projects. Request, for special status for wind power projects.
M. M. Joshi, CCF Haryana Forest Department	**(1) Special characteristics of Aravallis to be considered in computing NPV** A significant portion of Aravallis in Haryana falls in urban areas and these built up areas are slowly expanding at a steady pace. Aravallis being the only forested patch in these urban areas , the value of ecological services extended by these forests is very high .These hills have become prime target of real estate activity surrounding Delhi, Faridabad and Gurgaon for making windfall gains and are most sought after for diversion of forest area for non-forest activity. The legal status of these areas, which are covered under section4 and 5 of Punjab land preservation act,1900 is " Forest" as per order of Hon'ble Supreme Court of India irrespective of ownership. The strategy employed in computing NPV in the DrKanchan Chopra committee was eco-value class based, giving thrust on the density ,quality and species composition of forests. Such an analysis can give an underestimated value for the NPV calculated for these dry tropical thorn forests which is having less species diversity. Thus Aravallis and

Organization	Views in relation to NPV estimation and collection
	itsecological services should be viewed in Urban context as a special case. **(2) Nature of change of land use involved in Diversion case is to be accounted while calculating NPV.** The proximity to NCR and associated pressure for colonization and real estate development is a persistent problem in these hills which need to be discouraged to ensure that these hills remain intact for providing ecological services such as fresh air, greenery, hydrological regime and bio diversity to the high population density areas of national capital and NCR and also for posterity. Diversion involving colonisation /construction/commercial/residential/industrial/recreational/institutional which is a permanent land use change for meeting private interest should not be allowed except for public purpose for minimum possible area. Even in such situation, prevailing rent in the locality should also be included in addition to NPV. Thus to discourage such a trend the NPV calculation in the diversion cases involving forests in Aravalli hills should be made flexible to include the land value(as per the circle rates) in addition to the the NPV fixed for such forest. This will deter the diversion of forest lands in Aravalli hills for colonization and such other projects taken up in private interests. The inclusion of the land rent can be done away with for public utility projects. Based on the spirit of rulings of the Hon'ble supreme Court and facts regarding the Aravalli Ranges the following need to be considered regarding NPV of Aravalli hills in general and Aravallies of NCR region being in High population density zone and most sought after by real estate developers and mining agencies for making windfall gains. That the amount of water recharged as per the conservative estimates of 35% percolation rate is ₹ 2 crore a year per hectare which cannot be substantiated by any kind of NPV levied. As of now it is responsibility of the State to enact rules as per provisions in Article 48A of the Indian constitution which protect the environment and thereby protect the water regime maintained by the Arravali hills in the NCR for future generations to be read with Article 14 of Indian constitution. It also has to be considered that the areas with slow growing species have to have higher value of NPV. The natural forest cover in xeric region is very slow growing and difficult to replenish.
Sharad Lele Senior Fellow, ATREE	**NPV cannot be calculated without context:** The whole idea that the Supreme Court or CEC or some committee can a priori determine the economic NPV of an area of forest that is to be converted to non-forest is incorrect. Ecosystem value does not exist independent of the social, technological and economic context, and this context changes from site to site. Remote sensing only gives us (in an approximate manner) the floristic type and canopy cover of the forest. It doesnot tell us who is using the forest, to what extent, for what."Economic impact analysis" has to be an integral of the process of the process of applying for forest clearance under FCA. **Invaluable cannot be valued** Economic analysis has many limitations. One of them is that certain goods or benefits are invaluable and simply cannot be monetized. Flagship species such as tigers are one such value. Religious or sacred value is another. The decision whether or not to convert a forest which is sacred or has flagship species must be left to the FAC or some other such process that has the mandate to weigh non-economic values. It is highly inadvisable to bring it into the economic calculation. **Double-counting must be avoided, trade-offs must be made explicit** The Chopra committee explicitly addressed the question of trade-offs (see Tables 12-13 in their report). The CEC erred grievously by ignoring this aspect of their report. They (like many other NPV studies) take the value of one benefit (say timber) and add it to the value of another benefit (carbon sequestration). This is incorrect. Recommendation: The entire goal of the process has to change from estimating NPV to estimating change in

Organization	Views in relation to NPV estimation and collection
	economic flows to different stakeholders due to conversion. Ecological models that explicitly incorporate such dynamics and trade-offs, when coupled to site-specific data collection will address this problem. **Economic compensation must be distributed proportionately to users and rights-holders** The Chopra committee made a major recommendation that NPV amount, when paid, must be distributed between local, state and central funds. The rationale was that economic compensation must be paid to those who actually lose out from the conversion of the forest. So not only must part of the funds be released to local users, but in fact the quantum of funds they get must be proportionate to their rights, not just level of use and the rights must be factored into the process.
Federation of Indian Mining Industries	Social discount rate instead of 4% should be 10% as prevalent for developing countries like India. The value of the flagship species in respect of forest area outside the National Park and Wildlife Sanctuary were taken as a very significant part of the NPV earlier. It is submitted that such species occur only in a very limited geographical area and should be restricted to those areas rather than making them applicable for the entire country. The NPV rates should be revised every 5 years, on the basis of forest cover assessment done by the FSI and the change in the wholesale price index. Identification of land for compensatory afforestation has become the biggest stumbling block and reason for delays in forest clearances. We submit that provision for compensatory afforestation should be done away with. The user agency should be incentivized and encouraged to undertake adequate reclamation and return the land early to the forest department. In mining areas, in most of the cases, the actual breaking (tree felling) happens gradually over the life of the mine. It is thus requested that the collection of NPV should be done in instalments as per the requirements of the tree felling. Period of NPV estimation should be 20 years or life of mine, whichever is less.
Mr. Harish Salve, CEC Judicial Bench Member	The NPV amount collected should be channelized to finance activities such as construction and establishment of tribal centres and organizing vocational trainings to compensate for job loss associated with forest diversion.
Dr. Rekha Pai, IGF(EAP), MoEFCC	North-Eastern states to be looked in a different perspective and through a different lens as they are different geographically and constitutionally (as FCA is not applicable in some such states and they have been given special status under article 371. Economic opportunities are different and they have greater dependence on forests.Further forests near waterholes and foothills have to be looked differently
Mr. Nitin Sethi, The Times of India	Project activities such as those that lead to permanent change in land-use (permanent forest diversion) should be charged for land value in addition to the NPV. This may be viewed in the context of the proposed Land Acquisition Bill.
Shyam Divan, CEC Judicial Bench	To further institutionalize the system of collection and distribution of NPV amount and to bring transparency into the system, a citizen charter may be placed at District Collector's office showing how NPV fund is being utilized in various developmental activities in the particular district.
Mr. N. C.Saxena, Member,National Advisory Council	Rather than going about doing compensatory afforestation in an ad-hoc manner, it may be useful to target compensatory afforestation on scrub land and open forest to improve the quality of degraded forests in the country.
National Tiger Conservation Authority	The areas in the periphery of protected areas are equally important for conservation of forests and wildlife as they serve as corridors for movement of wildlife. In the light of this, buffer areas around National Parks and Wildlife Sanctuaries should not be looked as any other forest area. These have special significance for conservation of wildlife with their significance increasing with their vicinity to the protected areas.
Hon'ble Justice P. Jyothimani,	Suggested that compensating affected parties as a result of forest diversion is an important aspect of environmental justice.

Organization	Views in relation to NPV estimation and collection
Judicial Member, National Green Tribunal, Bhopal Bench	
Shri Rajesh Gopal, Addl. DGF (Project Tiger), National Tiger Conservation Authority	Areas in the vicinity of National Parks and Wildlife Sanctuaries are very important for ensuring flow of forest goods and services, reducing disturbance to movement of wildlife and biodiversity and minimizing defragmentation of forest landscapes near protected areas thereby disturbing wildlife corridors.
Dr. G. A. Kinhal, APCCF, MPMFP Federation	Suggested a more appropriate term "Possession Value"with regards to charging for using the space value of forest land.
Shri Debi Goenka, Executive Trustee, Conservation Action Trust	High real estate rates in urban and peri-urban areas are very high compared to the NPV and hence an additional component may be added to charge fro using the space value of this forest land.
Shri Rajeev Bhartari, CCF, Uttarakhand Ecotourism Board	CAMPA fund may also be utilized for development of nurseries including indigenous palatable grasses and other important species

Appendix 37 – Excerpts from discussions on charging for possession value of land

For executing this instrument to all forest areas irrespective of their location i.e. besides the urban and peri urban areas, many stakeholders felt that although "possession value" or "space value" charge would be a useful instrument, it requires scrutiny of legal provisionsas it is important to identify where does one derive the power to levy a charge. Examining the Forest Conservation Act, 1980 for which land may be diverted by the State, subject to Central Government permission, following four scenarios t are likely to emerge:

1. Use of forest for non-forest: This may be short term or long term
2. De reservation of reserved forest: this may lead to reverting of the said land to its original or previous land categorisation. So a reserved forest land typically would either be a forest land or waste land prior to its upgradation as a Reserved Forest. There are some exceptions such as Uttar Pradesh where, any land could have been reserved as reserved forest.
3. The third category deals with leasing of forest land to a private individual or corporation. This could again be for short term or long-term.
4. The fourth category relates to clear felling of forests. This is essentially a land use change which again could be for long term or short term.

The stakeholders were of the view that the applicability of possession value to all forest lands needs to be viewed in a much more nuanced way by considering the above four scenarios under the FCA for diversion of forest land. Such an analysis may assist in deciding on the legal basis for levying such a charge and the associated amount.

Appendix 38 - Market-based instruments for incentiving communities for conservation of forest resources (Ekpe 2012)

Group of instruments	Examples
Market-based	Markets for carbon sequestration, markets for watershed services, biodiversity offsets and mitigation, conservation banking, markets for recreation
Non-market-based	Global environment facility, debt-for-nature swaps, conservation trust funds or environmental funds, taxes, compensation to communities for opportunity costs and damages
Property rights innovations	Conservation easements, covenants and deed restrictions, stewardship exchange agreements
Market-oriented institutions	User fees, ecotourism, eco-labelling and certification, mitigation banking, conservation banking, transferable development rights, ecosystem services markets
Financial incentives	Compensation programs, insurance, cost-share incentives, land and water rental leases, conservation contracts, debt forgiveness
Public tax incentives	Income tax incentives, property tax incentives, estate tax incentives, capital gains tax

Appendix 39 - SECTION-WISE COMMENTS AND RESPONSES FOR THE NPV REPORT

SECTION	Sr. No.	Comments received	Response
1. FOREST CLASSIFICATION – FOREST TYPES	1.	Champion and Seth classification was developed in 1960s and since then there is much greater understanding of forest ecology which should have been considered	While acknowledging that the understanding on forest ecology has advanced, Champion and Seth classification still holds good and is capable of embedding and understanding the new knowledge. Data is collected and available largely based on this classification across the country.
	2.	Category for other types of forests such as DLC (Odisha), GMJJ (Jharkhand), Orange Forests (Chhattisgarh) which are not forest types as per Champion and Seth should be clarified.	Such areas have legal forest status and have different types of forests within which are already included in Champion & Seth classification.
	3.	No separate classification is proposed for plantations. This may discourage social forestry and discourage voluntary plantation in long run.	NPV is applicable only on legally designated forests and does not include social forestry. A separate classification for plantations will increase complexity. As plantations are generally carried out with a commercial perspective, the timber values and the associated NPV rates are likely to be higher in plantations than otherwise.
2. FOREST CLASSIFICATION – CANOPY DENSITY CLASSES	4.	Category of less than 10% canopy cover should not be included	Inclusion of this category accommodates forest areas where physical and ecological conditions are not conducive for supporting large forest canopy e.g. arid regions of Rajasthan and Gujarat. The rates for this category are less than the associated rates for Open Forests.
3. ROTATION PERIOD / FELLING CYCLE	5.	Tree-species based rotation period increases the complexity	These calculations are not to be performed every time. Estimated NPV rates have already internalized the rotation period calculations.
	6.	The proposal for changing the rotation period from 20 years to 63 years should be rejected since it assumes that the forests are in nascent stage	Natural forests have stands of different age classes and hence are dynamic characterized by regeneration.
	7.	It is suggested to continue with 20 years as currently used and lower if the life of the mine is less than 20 years	The rotation period relates to the time required by similar vegetation to re-establish the lost ecological and economic benefits due to diversion. It has nothing to do with the period of the project related to forest diversion.

SECTION	Sr. No.	Comments received	Response
	8.	In-case a rotation period of 63 years is implemented, the forest lease period should be increased to 99 years	Same as above.
4. STAKEHOLDERS CONSULTED	9.	Representation from industry was inadequate and hence the recommendations may be skewed	A large number of representatives from user agencies were invited during the consultation process. The list of people invited from various user agencies can be found in Annexure 1.
5. TIMBER	10.	The rotation period should only be considered for 20 years as the timber is taken away by the forest department. Continuation of rootstock can be considered after 20 years on plantations (compensatory afforestation)	The value of standing timber is not considered at all in NPV calculation. The economic value only relates to potential timber values and revenues foregone.
	11.	The calculations for potential timber production do not hold good for a mature forests	Discussed above in comment no. 6
6. BAMBOO	12.	Gregarious flowering has not been considered	A valid concern. The economic value of bamboo is however less than 1% of the NPV rate.
7. FODDER, FUEL WOOD AND NWFP	13.	A maximum of 10 years of rotation period should be considered as these can be procured from new stock planted	Calculations for fuel wood and fodder are not based on rotation period but on actual consumption estimates. The estimates of NWFP are based on potential production.
	14.	VDF, MDF, OF and LTF cannot have an equal value for fuel wood and fodder	The regeneration capacity of forest land is linked to the forest type group.
	15.	Including fuel wood and timber both leads to double counting	The growing stock for fuel wood and timber differ. Assumptions have been used in estimation of timber to exclude the growing stock for fuel wood & foliage.
	16.	Several important NWFPs have not been considered	Only important NWFPs for which data are available at the required scale have been estimated.
	17.	All local services such as fuel wood, fodder and NWFP have been underestimated	Valuation has been conducted based on accepted methodologies. There is a trade-off in suggesting values at regional scales for avoiding complexity and having site-specific values.
8. CARBON SEQUESTRATION & STORAGE	18.	The market value of carbon is decreasing and going to decrease further	Many studies, including the influential Stern Review of Climate Change have suggested using social cost of carbon as against the market value of carbon.

SECTION	Sr. No.	Comments received	Response
	19.	A significant portion of carbon stored in timber is locked in furniture and building materials which is ignored by the study	On account of paucity of data at state or national level, this assumption has been made.
	20.	The social cost of carbon should be further adjusted on the basis of purchasing power parity	A valid concern that may be incorporated.
9. WATERSHED SERVICES	21.	Apart from canopy cover, slope, soil characteristics, and rainfall are important determinants of watershed functions which have been ignored	On account of paucity of data for all the mentioned characteristics for each classification unit, only canopy cover has been used as a proxy.
POLLINATION AND SEED DISPERSAL	22.	No scientific data to establish pollination and seed dispersal are affected due to diversion of forests	There are several studies that have demonstrated the link between these services and forests. See Annexure 2 for an indicative list.
10. ECOSYSTEM SERVICES EXCLUDED	23.	Economic value of flagship species is important and its value needs to be considered	While wildlife, not only flagship species, have enormous economic value (both instrumental as well as intrinsic), on account of lack of reliable methodologies to capture its value, this has not been considered. The flagship species considered earlier are generally found in PAs for which a premium is already suggested.
	24.	The religious and cultural values of the forests seem to have been ignored	The study did make an attempt to value such intangible services but on account of lack of reliable methodologies and their site-specificity, their values were not estimated.
	25.	Relevance of the importance of grassland and complex agricultural production also seem to have been ignored	A valid suggestion. This is included in one of the canopy density classes; however it is acknowledged that their potential values are not realized due to lack of relevant information.
	26.	Forests as habitats for humans, wildlife and forests as an opportunity for employment seems to be unaccounted for	A valid suggestion. However this could not be included due to lack of relevant information.
	27.	The eco-tourism benefits from forests have been ignored	Eco-tourism in India is limited primarily to protected areas which do not directly qualify under the ambit of NPV calculations. The report has also suggested premium for protected areas where most of the eco-tourism benefits are currently accrued.

SECTION	Sr. No.	Comments received	Response
11. ASSUMPTIONS FOR AVOIDING DOUBLE COUNTING	28.	It prima facie appears to be subjective and the assumptions considered are not clearly listed	This has been largely borrowed from 2006 NPV Expert Committee report and minor modifications have been made based on suggestions received during the consultation process.
12. DISCOUNT RATE	29.	In place of 4%, the discount rate used should be higher, ideally in the range of 8-10% which is more practical	Based on the principle of welfare economics, the social rate of discount of 4% as suggested 2006 NPV Expert Committee, and further approved by the Hon'ble Supreme Court (SC) has been retained.
13. PREMIUM ON HILL TALUKAS, FORESTED WETLANDS	30.	We do not agree with any premium on such areas as they will have automatically been built in to the various factors constituting the NPV estimation	These add-on factors are not automatically built in. The rates suggested in the matrix consider general conditions and the add-on factors attempt to internalize specific local factors.
14. PROTECTED AREAS, WILDLIFE SANCTUARIES AND ESZ	31.	The premium suggested for NPs, WLS and ESZs is unreasonably high and do not have substantial merits	10 times and 5 times for NPs and WLS is according to the Hon'ble SC judgment. Along the continuum, it is suggested that 5 times and 3 times the NPV rate should be charged for ESZs in PAs and WLS respectively.
	32.	It will be an unnecessary burden for those developers whose projects fall within 10 kilometre radius of the PA but outside the proposed eco-sensitive zone which is under consideration. The user agency will have to make NPV payment at the enhanced rate if it cannot wait for the notification of the eco-sensitive zone	A valid concern. In such cases, a rider may be inserted to address this concern.
15. EXEMPTIONS	33.	As in the case of underground optical fibres, underground transmission lines should be fully exempted from paying NPV	A valid concern. However, during the consultation workshop it was brought out that unfair advantage was being taken by some agencies in this aspect and a rider may thus be inserted for such cases.
	34.	For Wind Energy Projects, the proposed change in exemption from 50% of applicable NPV rate as against the current 50% of minimum NPV rate irrespective of forest type should be rejected	More detailed matrix has been proposed for making the NPV rates reflective of losses according to local conditions. Thus, the exemption should be based on applicable NPV rates and not minimum rates.
	35.	The suggested tree felling limit of 5 trees should be increased to 5000 trees for availing 50% exemption for wind energy projects	For the consideration of MoEFCC. This has been suggested based on consultation with various officials of the forest department.

SECTION	Sr. No.	Comments received	Response
	36.	For underground mining, the proposed change from 50% to 20% exemption for underground mining should be rejected (3). On the contrary, the exemption should be increased to 75%	This has been suggested based on concerns over damages to underground aquifers and hydrological regime by such projects. Some exemption may still be provided as an incentive.
	37.	For underground tunnelling, the proposed change from 50% to 20% exemption should be rejected	
	38.	For open cast mining, 20% exemptions should be given as mining is possibly the only industry wherein diverted forests can be reclaimed and biodiversity and ecosystems regenerated unlike other sectors	The record of effective mine reclamation in the country is poor to say the least. Rather than providing a blanket exemption, a mechanism that incentivizes positive actions by a user-agency on case-by-case basis may be implemented.
	39.	A 50% exemption should be considered for low-value industrial and fertilizer mining	For the consideration of MoEFCC.
	40.	For hydropower projects, it needs to be clarified that what would be the basis of calculation of NPV for areas such as river beds which are devoid of any forest cover	These are legally defined forest area. Impacts of diversion of river beds are often much greater.
16. POSSESSION VALUE OF LAND	41.	Should only be charged for projects that permanently divert the land-use	A charge should be levied for exclusively possessing the resource (asset) for a particular period of time and deriving value out of it.
	43.	Noteworthy that rental value of land has been considered for urban areas. This charge should also be considered in the rural contexts	It was envisaged that for rural areas the NPV rates would be high enough and possession value would not contribute very significantly to the final charge.
17. DISTRIBUTION OF NPV ON SPATIAL SCALE	44.	The largest chunk of benefits considered is what local communities use but the utilization pattern of the funds show that the NPV money is mostly used at state/national level and local stakeholder are deprived of their share	The study has already suggested that institutions need to be urgently put in place to compensate local losses. The study has also suggested that 50% of the NPV amount should be earmarked for compensating losses at the local level.
18. FREQUENCY OF REVISION OF NPV RATES	45.	Should not be updated every 3 years. A longer time frame should be used	To accommodate evolving and improved methodologies as well as rich datasets being generated to capture benefits from forests, NPV rates should be updated every 3 years as suggested by the Hon'ble SC.

SECTION	Sr. No.	Comments received	Response
	46.	The NPV rates should be revised according to an economic index and new methodology should not be used to estimate the rates	WPI / CPI reflect commodities which are marketed but a large number of forest ecosystem services are actually never traded in the market. Hence revision of NPV rates in this manner is not recommended.
19. MISCELLANEOUS	47.	The study is focused on monetizing forest resources	NPV charge is levied only once the forest clearance is given to a proposal after careful analysis of costs and benefits from forest diversion. The focus of the study has been to estimate the economic value for compensating those affected.
	48.	It takes millions of years for formation of minerals deposits, but forests can be rejuvenated within 10 to 15 years	As suggested by the Hon'ble SC, natural forests can never be replaced by plantations.
	49.	NPV rates should be correlated with the taxes and cess on the mineral sector in different states and by various agencies	Taxes & cess are unrelated to NPV.
	50.	Positive externalities from the project should be included in NPV calculations	A valid concern already suggested in the report for future consideration.
	51.	The impact of increased NPV rates on unemployment should also be considered as many projects may become unviable	For the consideration of MoEFCC.
	52.	Deferred payments should be considered for mining projects	Already suggested in the report for future consideration. However, feasibility as well as proper checks-and-balanced will need to be worked out.
	53.	The role of a particular forest in a particular ecosystem cannot be restored by creating forests in some other location. The experience of CA across the country also needs to be taken into account. So can't realistically expect CA to provide comparable benefits to natural forests.	It is agreed that compensatory afforestation can never provided benefits comparable to a natural forest. However, for estimation of Net Present Value of future benefits, a time period had to be assumed and this was done through rotation period of dominant species in each forest type group.
	54.	Enhanced NPV rates will be detrimental to young states trying to match other parts of the country towards development	For the consideration of MoEFCC.

SECTION	Sr. No.	Comments received	Response
	55.	Only a portion of money collected from NPV is currently utilized and hence there is no justification for increasing the NPV rates	Absence of proper institutions, delay in execution of CAMPA and checks-and-balances have limited higher amounts of collected NPV to be used. Mechanisms and institutions are currently in development which will enable appropriate utilization of NPV funds for which they are charged for.
	56.	There are several other charges apart from NPV such as safety zone charges, catchment area treatments, etc. All these charges should be clubbed under one charge and a single clearance window system should be adopted	Not all charges are applicable to all diversion projects. Based on project activity, forest area to be diverted and its characteristic, only applicable charges are levied. Thus useful as this suggestion may be, it is difficult to be implemented due to practical reasons. However, more clarity may be provided to user-agencies on specific charges.

Based on the comments received from the following:

1. Society for Promotion of Wastelands Development.
2. Federation of Indian Mineral Industries (FIMI).
3. Goa Mineral Ore Exporters Association.
4. Panduronga Timber Industries.
5. Suzlon Energy Limited.
6. Indian Wind Energy Association.
7. ACC Limited.
8. Ministry of Coal.
9. National Hydroelectric Power Corporation (NHPC).
10. Wind World.
11. NMDC Limited.
12. Indian Wind Turbine Manufacturers Association (IWTMA).
13. Wolkem India Limited.
14. Udaipur Chamber of Commerce & Industry.
15. Apex Mintech Consultants.
16. SuveeraPc Associates.
17. Gudli Chamber of Commerce & Industry (Sans.).
18. Office of the Principal Chief Conservator of Forests (Mizoram).
19. GODAWARI (Power & Ispat Limited).

THE PROJECT TEAM

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Dr. Madhu Verma is a Biological Science graduate with Masters, M.Phil &Ph.D in Economics and works as a Professor of Environment & Developmental Economics and Coordinator for the Centre for Ecological Services Management, Indian Institute of Forest Management, Bhopal. She has been a Visiting Professor at the University of Massachusetts, Amherst and a Visiting Scholar at the University of California, Berkeley, USA (2001) for her Post Doctoral research work. She is a Lead International Fellow(2007) and a Fulbright Fellow (2012). She does action and policy research in the areas of valuation & environmental modelling of forest, wetland and agriculture ecosystems and biodiversity; green accounting; PES, livelihoods economics; conservation finance. In her career of 30 years she has worked with various Ministries and Commissions of Govt. of India and several national and international funding and research organisations.She has large number ofpublications to her credit and her many research recommendations have been internalised in the decision making process of the government and creation of conservation instruments.

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With Post-Graduate Diploma in Forestry Management and Erasmus Mundus Master's in Environmental Science, Policy and Management from three universities across Europe, Dhaval Negandhi possesses a multi-disciplinary and macro-level understanding of environmental concerns. His research interests, publications and areas of expertise include valuation of ecosystem services (especially those from forest, wetland and agriculture ecosystems), spatial analysis, climate change, carbon accounting and statistical analysis.

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With M.Sc. (Mathematics) and Post Graduate Diploma in Remote Sensing Application (ITC Netherlands), Shri. A. K. Wahal joined the Indian Forest Service in 1978. Since then he has served at many high-level positions in various forest departments including Head of State Forest Department of A&N Islands, Goa and Union Territories of Dadra Nagar Haveli and Daman & Diu. He has also worked as DDG at ICFRE and Additional Director at IGNFA. Shri Wahal currently heads the Forest Survey of India as the Director General, the premier institution of country mandated with the responsibility of forest resource assessment. His areas of interest and expertise include general forestry, wildlife conservation, remote sensing applications in forestry, participatory forest management and policy issues in forestry.

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With M.Sc. (Statistics) from Allahabad University, Shri Rajesh Kumar joined the Indian Statistical Service in 1986. Since then, he has worked in various capacities at premier institutions for forest management in India including Forest Research Institute, Indian Council of Forestry Research and Education, NSSO and CSO. Shri Rajesh Kumar currently serves as the Senior Deputy Director (Forest Inventory) at the Forest Survey of India and is an expert in the area of forests and Tree Outside Forests (TOF) Inventory and Forest Statistics.

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Dr. G.A. Kinhal, a 1980 batch Madhya Pradesh cadre IFS officer, has approximately 33 years work experience in managing forests of the country. After obtaining Post Graduate Degree in Agricultural Science with the specialization in Plant Breeding and Genetics, Dr. Kinhal received AIFC degree in Forestry, obtained Master of Professional Studies degree in Natural Resource Policy Analysis and Management from the State University of Environment and Forestry, Syracuse University, USA. He is a Ph.D. holder in Joint Forest Management with special reference to Participatory decision making and management with respect to medicinal plants and NTFP. Dr. Kinhal has spent substantial part of his career working with national and international organizations in the area of Natural Resource Management. He has published several papers and case studies related to bio fertilizers, rehabilitation of degraded forests, sustainable NTFP management, conservation of medicinal plants and biodiversity, human resource management in forestry sector at national and international journals. His article on 'Technical and financial evaluation of Green Equities' published in Indian Forester 1996 was awarded the Brandis Memorial Prize. The edited book on 'Adaptive Management of Medicinal Plants - NTFPs strategies, implications and policy for sustainable harvesting' is his well received academic contribution in this sector.

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Dr. Anmol Kumar is an IFS Officer of 1982 batch from Maharashtra Cadre. Presently, he is working as Director General, Forest Survey of India, Dehradun. While working as Dy. Inspector General of Forests, he has been deeply involved with Wildlife Institute of India, Ministry of Environment & Forests, Govt. of India; Wildlife Action Plan and its Implementation; Wildlife (Protection) Act – Application and amendments; Management of natural resources in Protected Areas; National Board for Wildlife and Standing Committee of National Board for Wildlife; Critical examination of different proposals recd for the consideration of the Standing Committee of the National Board for Wildlife; International Co-operation and International Conventions – Convention on Migratory Species, (International) Convention on Heritage, International Union for Conservation of Nature, International Whaling Commission; Wildlife Institute of India, Central Zoo Authority and National Zoological Park at New Delhi; Eco-tourism and others. In addition to PhD in Botany from Meerut University, he successfully completed Post Graduation in Rural Social Development from the University of Reading, UK and advance professional programme in Public Administration from IIPA, New Delhi. He has published more than 20 research papers and articles in various journals and seminars.

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Gopal K Kadekodi is currently an Honorary Professor, and earlier a Research Professor for five years at the Centre for Multi-Disciplinary Development Research, Dharwad. He was formerly the Director of the Institute for Social and Economic Change, Bangalore and a Professor at the Institute of Economic Growth, New Delhi for twenty five years, a Visiting Professor at Erasmus University, Rotterdam, and Technical University, Twente in the Netherlands. He holds Ph.D. in Economics `from Univeresity of South California, Los Angeles, USA and his areas of research include Common Property Resources, Energy. Ecology, Environment, and Economic Development. In the past, he was the President of the Indian Society for Ecological Economics, a Woodrow Wilson Fellow and a Fulbright Fellow, Member of NTCA and currently on several Boards and Commissions. He authored 14 books and more than 100 articles in national and international journals.

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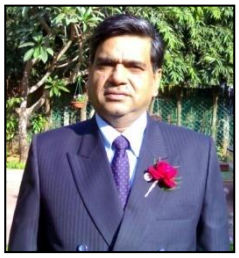
A. K. BANSAL



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Arun K. Bansal is a Gold Medallist at post graduation in Physics (1974) and at graduation (1972, with 3 gold medals in Physics, Mathematics, and overall) from Rajasthan. He took an M.Sc. in Forestry / Remote Sensing in 1988 from the University of British Columbia, Canada as a Canadian Commonwealth scholar. Shri Bansal joined the Indian Forest Service in 1975 and was allotted to Odisha Cadre. He served in various posts in the rank of ACF, Dy CF, CCF, Addl. PCCF and PCCF in the State. He worked as Addl. Director General of Forests in the Ministry of Environment and Forests from January 2011 until his superannuation from government service in November 2012 and was associated with all aspects of conservation of forests, and development of forest sector in the country including evolution of forest policy and legal framework, and international collaborations. He has 70 scientific /research paper papers to his credit and has presented a number of papers at various conferences, seminars and workshops. Shri Bansal received the prestigious Brandis Prize in the field of Silviculture for the year 2004 for the paper entitled "Indian Timber Imports – an Analysis" published in Indian Forester.

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Sanjay Upadhyay is the founder and managing partner of the India's first environmental law firm, Enviro Legal Defence Firm. He also established the charitable arm of the Law firm through the Environment Law and Development Foundation. Sanjay has been practicing environment and development law since 1993. An India Visiting Fellow at the Boalt Hall School of Law, University of California, Berkeley (Fall 1996) and a legal intern to the Earth Justice Legal Defense Fund, San Francisco, he started his professional career at the World Wide Fund for Nature– India at the Centre for Environmental Law. Sanjay has served as an environmental and development law expert to most well known International, Multilateral, national and state Institutions including World Bank, IUCN, FAO of United Nations, UNDP, AFD, DFID, ILO, SDC, IC, IIED, ODI, WWF, Green Peace, HBF, TERI, WINROCK, MOEFCC, MOPR, MOTA, MNRE, IIFM, ICFRE, IEG, WII, IIPA, NIRD, University of Cambridge, Duke University to name a few. He has been part of Drafting Committees of several forest, wildlife and biodiversity Rules both at the national and state level.

ABOUT THE REPORT

Forests provide numerous goods and services that support life. The importance of forests in a country such as ours is even more significant considering the large amount of marginalised communities that depend on forests. When a patch of forests is diverted for non-forestry purposes, it's implications on human well-being are felt at various spatial and temporal scales on account of loss of goods and services that the patch of forests provided. In addition, livelihoods and subsistence needs of rural and tribal communities dependent on forests are severely compromised. While developmental activities are essential for economic development of the country, it is necessary to ensure that this development does not come at the cost of India's invaluable natural capital – its forests. However, a common denomination to scientifically evaluate both these aspects simultaneously is often unavailable. This report is an attempt to bridge this gap by revising the Net Present Value (NPV) of forest diversion for non-forestry purposes.

Indian Institute of Forest Management has been forthcoming in providing useful policy suggestions for improving forest management in the country since its establishment. Following a rigorous research process in collaboration with the Forest Survey of India, team of experts and a thorough consultation process with all concerned stakeholders of forests, the estimates of economic value of forest diversion have been calculated in this report. It is hoped that the economic value of loss of forests is duly reflect in the report and it will find wide recognition among all stakeholders. The findings of the report will assist the policy makers in particular and all stakeholders of forests in general to understand the economics of forest diversion in the country such as ours which in turn will help sustainable management of our forests.

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