Assessing the Value of Our Forests: Quantification and Valuation of Revegetation Efforts

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Abstract: While implementing a project of regenerating degraded lands (forests or otherwise), one often faces the question of justifying the benefits that would accrue from the initiative. Contrastingly, when a natural forest is destroyed one faces with a very minimal compensation based on the timber available or just on the value of land with a small premium for the existing biomass or as compensatory afforestation of a barren landscape. This leaves us in a situation where answering only the value of the total flow of benefits from the forests does not give a true picture. There is a need to look for mechanisms to value the forests in entirety.

This paper is an attempt at valuation of forests using Natural Resource Accounting System (NRAS) framework through a case study from Gujarat. The framework looks beyond the conventional system of accounting the direct investment vs. flow of benefits to include existing stock and environmental benefits. This system attempts to calculate the total value or contribution to society at a given point of time. The framework helps us estimate the change in this value if a conservation action/ destructive action are undertaken, how this change affects different stakeholders—that is, who are the benefited and who are the losers, and therefore help in decision making. This also can help us in calculating the actual costs and benefits for taking up such an activity or even for the valuation/compensation for the damage in case of a change in the land use.

Introduction

"How valuable is our forest?" is a question that can have several answers depending on how one perceives the resource. The dominant perception in the Forest Department (which manages most of the country's forests) is as a source of economic wealth, be it from timber or other forest produce. All that matters are yields and revenues, be it from timber or NTFP. Of late, a very light voice in the department seems to accept the need for conservation and biodiversity (Forest (Conservation) Act, 1980 and National Forest Policy, 1988). In the local community's perceptions forest means source for clean, pure drinking water, meeting the day to day needs of food, fuel, fodder, shelter and culture i.e. a steady stream of returns but regulate the needs, no final harvest - ensuring that over-extraction does not take place and conserve for generations to come (Singh 2003). To an urbanite, forests mean aesthetics – places for recreation, needed for fresh air, places for weekend solitude, reference areas for research and study etc.

While implementing a project of regenerating the degraded lands (forests or otherwise) one often faces the question of justifying the benefits that would accrue from the initiative. We immediately tend answer the question in terms of the total value of the current flow of benefits provided by that forest or about the value of future flows of benefits like fuel-wood, fodder, timber, leaf-litter etc. or in terms of the value of conserving the forests for ecological benefits like fresh water, protecting against soil erosion, a reservoir of floral or faunal

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2 The paper is based on learning from the Tree Growers' Cooperative Project being implemented in the state.

biodiversity, refuges for rare plant, wildlife and fish species or it may be in abstract terms as beauty, shade or as habitats for important species etc (Reddy et al 1997 and Perrings & Gadgil 2003). We more often than not tend to answer in terms of the direct flow of benefits from the resource or in terms of our relationship to the resource. Similar questions arise in situations when a natural forest is to be destroyed and the value of the standing resource is to be compensated. The major reason for excessive depletion and conversion of forest lands is the failure to account adequately for their non-market environmental values in decision making relating to alternative use of the lands.

METHODOLOGIES FOR VALUATION

Faced with a similar question of justifying our work on revegetation of degraded lands in terms of cost benefit analysis, we wanted to search for methodologies to capture the total value of the forests regenerated – to include and monitor the inflows and outflows, the total stock and also attempting to value the ecological goods and services it provides to humankind. The conventional accounting frameworks answered only a part of the question – the accounting for the inflows and outflows, more specifically the transaction in terms of money (Reddy *et al* 1997). This method is a gross underestimation of the value of the small plot of forest as it tends to consider natural resources as free unless extracted for production or sale.

As an extension to the conventional accounting is the valuing of the forest in terms of the forecast of the potential benefits the forest could provide, especially timber (Reddy *et al* 1997). The method tried to calculate the expected stock at the end of a particular period and some of them tried to report on the growing stock each year. However, there are no specific references to any methodology in the literature that includes the existing stock to the inflows and outflows.

Of late there has been an attempt to comprehensively value the forests for the services using various frameworks/methodologies (Hulkrantz 1992, National Research Council, 1994, Barbier et al, 1997, Costanza R. et al.1997, Saxena R et al 1997, Adamowicz 2003, Pagiola 2004, The International Bank for Reconstruction and Development 2004). Usually the methodologies have attempted to consider the stock and inflows to the communities with an economic valuation of the ecological services it provides. Broadly two types of valuation methods – contingent valuation and economic valuation method are used depending on the issue. It can be used to estimate both use and non-use values, and it is widely used method for estimating non-use values. It is called “contingent” valuation, because people are asked to state their willingness to pay, contingent on a specific hypothetical scenario (Cooper, Poe and Bateman, 2004) and description of the environmental service. The contingent valuation method involves directly asking people, in a survey (Whittington 1998), how much they would be willing to pay for specific environmental services or are willing to accept compensation to be willing to give up specific environmental services. Though the contingent valuation method is used to estimate economic values for all kinds of ecosystem and environmental services it is also the most controversial of the non-market valuation methods.

The economic valuation is by far the most accepted method for valuation of natural resource services. The economic valuation is an attempt to assign quantitative values to the goods and services provided by environmental resources, whether or not market prices are available. The economic value of any good or service describes the value of the resource in providing such commodities, whether or not we actually make any payment. Thereby, economic

valuation takes into account the current stock, the direct costs, the inflows to the communities and the environmental services provided by the resource.

Though we know intuitively that such resources may be important, in most cases we fail to describe the value of the resource nor that we can ensure their wise use. This is because the environmental resources we are dealing with are complex and multifunctional, and it provides innumerable goods and services to nature and the human beings in particular. Further, we are talking of forest resources, which no longer remain only as local resource but is being treated more as national and global commons for the valuable services that it provides to humankind making the resource irreplaceable or to be replaced at a premium/ compensated for the value provided to humankind and other organisms that depend on the same. Various methodologies have been suggested by different researcher for specific needs/ objectives to value the forests, where some of them have attempted to reflect the values in the national account[3] while others have attempted to do on a case-to-case basis to look into the cost and benefit of the activity.

There are several examples of forest resource accounts that include some non-market goods and services (Adamowicz, *et al*, 2004), Hulkrantz 1992, Haener and Adamowicz, 2000, and Kriström and Skanberg, 2001). Kriström and Skanberg (2001) have taken market and non-market accounts over time for forest resource accounting. In their study they define the value of the capital stock of timber and non-timber goods (berries, etc.) and have defined the depreciation in the capital stock arising from environmental change to be included in the Green NNP (Net National Product). They have attempted to compute measures analogous to the appreciation/depreciation in timber accounts, valued recreational trips and the study provides one of the most carefully constructed market and non-market accounting exercises. Anil Agrawal & Sunita Narain (1985) in the Second citizens' report – The state of India's Environment 1984-85 also argued that biomass is the basis for survival, the source of most income, and protector of the environment and therefore must be added to the GDP and be rechristened as Gross Natural Product and include the growing stock of the biomass.

IDENTIFICATION OF RELEVANT INDICATORS

Review of a number of existing literature revealed that different experts/ researcher have opted for a unique set of parameters to suite the quantification needs (Anielski, 1992, Costanza R et al 1992, and Steiner et al, 2004). While all the methodologies have considered the valuation of the existing stock (either as potential timber or as the entire biomass that includes the twigs and leaves too) there are differences in the choice of parameters for the environmental services.

Costanza R et al (1992) in their study have included erosion control, soil formation, nutrient cycling, waste treatment, food production/NTFP, raw material/timber/fuel/fibre, genetic resources/biodiversity regulation, recreation and cultural parameters into the study. Steiner, Achim; Steven J MacCormick and Jan Johnson (2004) in their methodology have attempted to include nutrient cycling, food Production/NTFP, Raw material/timber/ fuel/fibre, genetic resources/biodiversity regulation, recreation, cultural, carbon sequestration/air quality/climate, fresh water, human health, detoxification, natural hazard regulation in the calculation of the value of the forests.

[3] Australia and US have integrated it into their National Accounts, many countries in Africa are attempting integrating the same in their National Accounts (e.g.-Namibia, Zimbabwe Mozambique)

Faced with the need for valuing the regenerated plots for the cost-benefit analysis of the project, we set out to evolve a framework, which can capture the cost and benefits from regeneration not just limited to cash inflow and outflow. Various contexts and the methodology used by different researchers have been reviewed to help us in building our Framework for Natural Resource Accounting System (NRAS)[4]. Extensive review of literature suggested that various parameters have been taken into consideration by different researchers. We attempted to make a global list of indicators that can be considered for valuation of the forests. The economic parameters that have been considered are fodder and other produce like NTFP, increase in biomass, employment, surface water, increased milk/ livestock/ agriculture production, reduction in migration etc. The ecological parameters used are soil formation, nutrient cycle (soil fertility), check soil erosion, increase of biodiversity/variety, rate of natural regeneration, increased wild life population, improvement in micro climate, climate regulation, atmospheric gas balance, pollination, habitation for birds and wildlife, preservation of endangered species, improvement in ground water level, aesthetic value reducing pressure on existing forest etc.

The framework for Natural Resource Accounting System (NRAS) is a framework that explains the interrelationships between the economy and environment. NRAS tries to set right the bias of conventional cost benefit analysis by monitoring the environmental impacts and help develop indicators for valuation of ecological services (Ahmed Y *et al*., 1989). At the present stage of development of the framework, the following indicators have been selected for monitoring. Various parameters/indicators have been classified as direct costs, direct benefits, existing stock, indirect cost and indirect benefits and the methodology of accounting has been indicated. Human intervention/natural events are likely to change the status of the resources which can either facilitate the growth of the resource or disturb the resource. The NRAS framework (Table-I) helps in effectively monitoring these changes (ups and downs) in the status of the natural resource.

[4] This Framework is a result of our continuous effort at improving the methodology through last ten years of practice. We have learnt a lot with our attempts at valuing the plot each year. The initial idea was worked upon by Indira Gandhi Institute of Development Research, Mumbai and Institute of Rural Management, Anand with the advice of Jack Ruitenbeek, Consultant, CIDA.

Table 1: Accounting framework and various parameters covered

Income/exp. head	Conventional Accounting	Economic Accounting	Environmental Accounting
1. Direct Cost			
Land development	*	*	
Area regenerated	*	*	
Protection	*	*	
Institutional Development	*	*	
2. Indirect cost			
Crop foregone		*	
Others		*	
3. Existing Stock			
Standing tree biomass		*	
4. Direct Benefit			
Fodder	*	*	
Fuel wood	*	*	
NTFP		*	
5. Indirect Benefit			
Soil erosion control			*
Soil fertility increased		*	*
Carbon sequestration			*
Aesthetic Values			*

One would agree that there are a lot of other indicators under existing stock like ground cover (vegetation) and indirect benefits such as biodiversity, rate of regeneration, soil formation, habitation for birds and wildlife, water retention, aesthetics etc could have been valued. We are in the process of identifying appropriate methodology for quantifying and valuation of such parameters.

The presentation of the valuation is done on an annual basis through the flow accounts (direct and indirect), stock account and Balance-sheet. The flow account is prepared on yearly basis indicating all cost and benefit and is almost similar to the profit and loss account of financial accounting. The stock accounting indicates the position of stock on a particular date for an individual item like biomass, environment (soil fertility and CO_2) and the balance sheet is prepared in the line of financial accounting to indicate the present status of assets and liabilities on a particular date. This framework, therefore instead of being an one time valuation effort, is an yearly exercise to record the changes and the incremental growth in value of the resource.

OPERATIONALISING THE FRAMEWORK

This paper is an attempt to introduce the framework for Natural Resource Accounting for discussion and outlines the process of economic valuation of the forest resource in the process of regeneration of a small patch of degraded grazing land[5]. Data has been collected

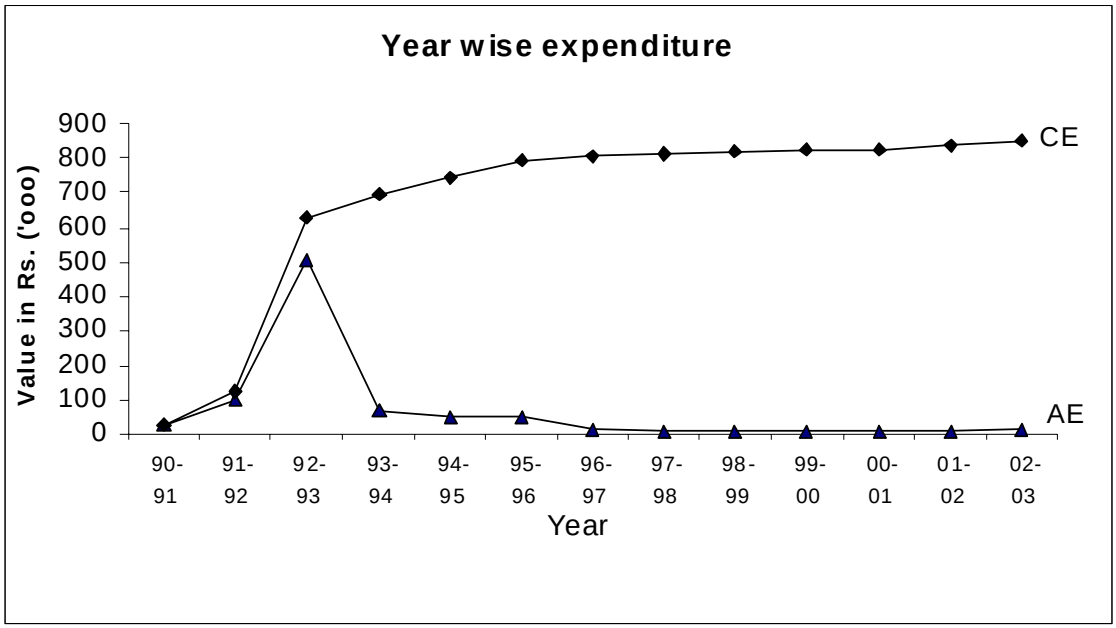
[5] This attempt for valuation was taken up in Namnar Tree Growers' Cooperative Society supported by the Foundation for Ecological Security (FES) under its Tree Growers' Cooperative Project supported by the Canadian International Development Agency (CIDA). The work on the regeneration of the 25 hectares of wasteland was initiated in 1991. Namnar is a village of Lunawada Taluka, District Panchmahals, is on the banks

for various parameters each year since the initiation of the study in 1997 and therefore helps in not only assessing the value of the forests at this point of time but also show the incremental value of the forests each year. The baseline information at the initiation of the regeneration process in 1991 also helped in showing the incremental improvement for certain parameters in 1997 and thereafter.

Accounting inflows and outflows:

The process takes into account the direct costs, the current stock, the inflows to the communities and the environmental services provided by the resource. Regenerating an area/ protecting an area involves certain direct costs like plantation and after-care, protection - in this context we include paying guards and watchman to protect and maintain the area, the institutional costs – involves communities coming together for decision making, conflict resolution and maintenance of the resource. It may be noted that the initial expenditure (Figure – 1) in the process is high in the initial stages and tends to stagnate in most cases, where the investment is limited to protection and recurring expenditure of the institution.

This also includes the value of benefits forgone in the process of regeneration by the community in the initial period of protection. Such benefits are easily identifiable, as they often comprise marketable outputs (e.g., fodder, fuel wood, NTFP etc.) and income sacrificed. The conventional accounting system fails to capture the benefits forgone in the total costs/ investments in the process of regeneration.



The graph shows the expenditure in the initial years (91-96) was high due to investments in regeneration and moisture conservation measures. Thereafter, only nominal recurring expenses were incurred. CE = Cumulative expenditure, AE = Annual expenditure

Figure 1: Year wise annual and cumulative expenditure details

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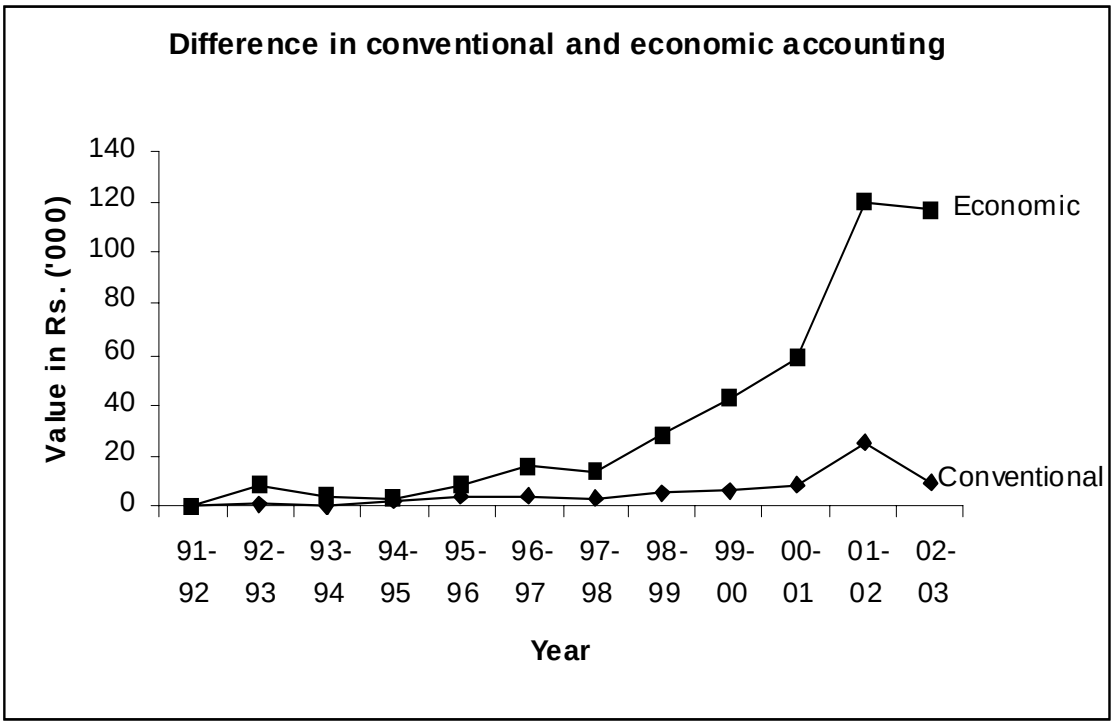
of River Mahi with 267 households. The plot where the regeneration and subsequent study was taken up is a grazing land leased to the TGCS by the Panchayat.

Valuation at market price:

As a result of the intervention, when the benefits begin to flow and are shared among the community, the outflow is monitored. The community, which has incurred costs in forgoing benefits during the initial stages, often has been observed to fix a very nominal price for the inflows/benefits shared or distributed within the village. In such a case the conventional accounting tends to take into account only the price paid by the community as the actual value of the produce, which may not be true. The NRAS methodology tries to include the actual price of the commodity in the nearest market. For example, a bundle of fodder may cost Rs. 0.50 in the village but the nearest market price of the same quantity could be Rs. 2.00. The market price is taken into the accounting framework as the economic value (Figure – 2) of the produce to give the actual representation of its worth.

There are certain benefits enjoyed by the community for their use/consumption and therefore are not accounted under the conventional accounting methods as it does not involve any cash transaction - example could be – open grazing of cattle in the plot during summer, collection of fuel wood etc. But, the framework incorporates the economic value of the fodder/cattle feed consumed by cattle in the process of grazing. Similarly, the value of dry twigs as fuel wood, other NTFP (like gum, *Acacia nilotica* pods, fruits etc.) have also been included as having economic value.



The graph shows the difference in value of the resource when calculated in conventional and economic methods. In case of conventional accounting, the value of the resource has been calculated at the nominal price fixed by the members while in case of economic accounting for the same resource the prevailing market price has been taken into account.

Figure 2: Year wise value of the resource under different accounting system

Estimation and Valuation of Existing Stock:

Valuation of the existing resource is an integral part of the accounting framework. The conventional accounting does not consider the value of the standing resource and tends to consider elements of nature-air, water, soil, plants etc to be free until they are converted into marketable products. Valuation of the forests involves the process of estimation of the existing biomass through standard methodologies taking 1% of the total area using 20X20 sample plots. The amount of standing tree biomass (Figure –3) has been estimated by the weight and volume of timber and fuel wood.

The weight for single stemmed trees are estimated using the formula $W=a+(bxD^2xH)$ (Chaturvedi, AN and Khanna, LS- 1982) and for multiple stemmed trees using the formula $W= a+(bxNSx\ D^2xH)$ where W is weight in kilograms, D is diameter in decimeters measured at 50 cms above ground, H is height in decimeters, NS is number of shoots and a and b are species specific constants[6]. The volume of the timber is calculated using the formula $V = \pi r^2 h$ where V is volume of the tree, r is the radius at breast height and h is height of the tree. The value from the sample plots is extrapolated for the total area to get the standing biomass in the entire plot. The estimation is repeated each year in the select plots to calculate the incremental growth (Figure – 4) of biomass.

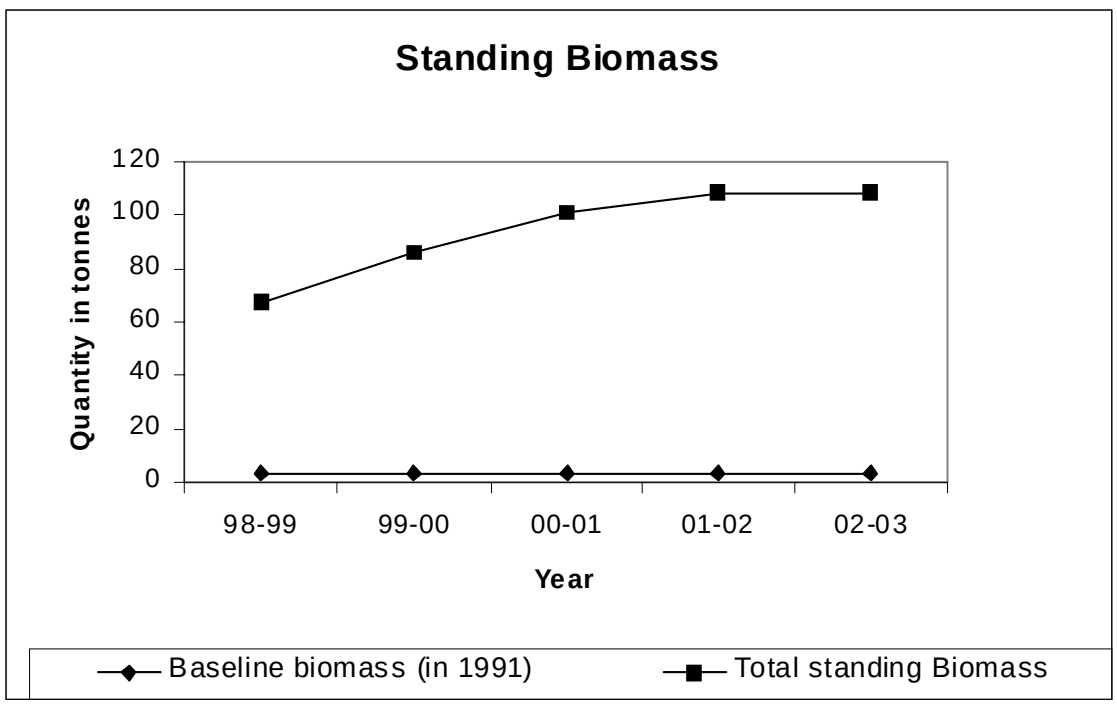


Figure 3: Year wise stock of standing biomass

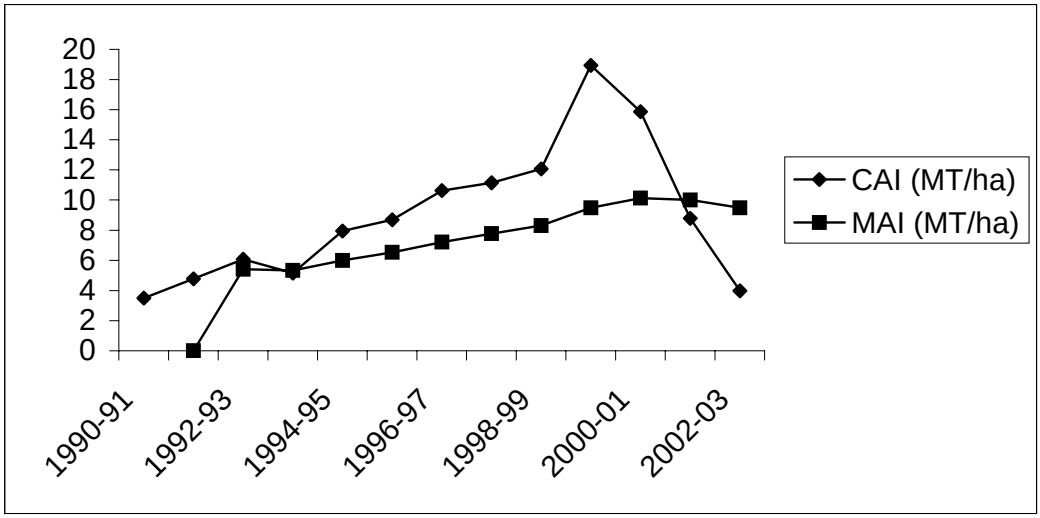
[6] For example the value of a & b for Acacia nilotica (Stem + branch + twigs) is 0.0110 and 0.3928 respectively when oven dry and 0.0281 and 0.6872 respectively when measured green.

The valuation of the existing stock has been done through the market price method, where the resource is taken as equivalent to the market value of timber and fuel wood. All the trees above the circumference of 45 centimetres have been considered as timber tree of which only 65% has been valued at timber price and the rest 35% is considered to be fuel wood. Further, all the trees of circumference less than 45 centimetres have been valued at the market price of fuel wood.

As the wasteland regenerates, the biomass shows an increasing trend unless disturbed because of human interference or natural factors. A decline in the biomass is observed in 2001-02 and 2002-03 because of harvests at the community level. The Current Annual Increment (CAI) indicates the annual growth rate of the biomass, which is subject to variation due to a variety of natural factors such as droughts, spread of rain days, etc or human factors such as harvests, excessive grazing, lopping etc. The Mean Annual Increment (MAI) is a derived value taking into account the average CAI between two consecutive years and is more likely to show the average growth rate of biomass.

Valuing Environmental Services:

The NRAS framework also includes valuing the environmental services that the plot of regenerated lands provide. As one observes, the regeneration helps in controlling soil erosion, improving soil fertility, soil formation, improved biodiversity, increased moisture retention, sequestration of carbon and helps in regulation of micro-climate. The forests also act as habitat for birds and wild life, provide shade and have aesthetic values. Economic valuation of all these parameters is a difficult process and a variety of valuation techniques (Table –2) are used for the purpose.



CAI = Current Annual Increment MAI = Mean Annual Increment

Figure 4: Year wise change in incremental growth of standing biomass

Table 2: Existing Valuation Methods for Environmental Services[7]

Sl.	Valuation Methods	Brief Explanation of the methodology
1	Market Price Method	Estimates economic values for ecosystem products or services that are bought and sold in commercial markets.
2	Productivity Method	Estimates economic values for ecosystem products or services that contribute to the production of commercially marketed goods
3	Hedonic Pricing Method	Estimates economic values for ecosystem or environmental services that directly affect market prices of some other good. Most commonly applied to variations in housing prices that reflect the value of local environmental attributes.
4	Travel Cost Method	Estimates economic values associated with ecosystems or sites that are used for recreation. Assumes that the value of a site is reflected in how much people are willing to pay to travel to visit the site.
5	Damage Cost Avoided, Replacement Cost, and Substitute Cost Methods	Estimate economic values based on costs of avoided damages resulting from lost ecosystem services, costs of replacing ecosystem services, or costs of providing substitute services.
6	Contingent Valuation Method	Estimates economic values for virtually any ecosystem or environmental service. The most widely used method for estimating non-use, or "passive use" values. Ask people to directly state their willingness to pay for specific environmental services, based on a hypothetical scenario.
7	Contingent Choice Method	Estimates economic values for virtually any ecosystem or environmental service. Based on asking people to make tradeoffs among sets of ecosystem or environmental services or characteristics. Does not directly ask for willingness to pay—this is inferred from tradeoffs that include cost as an attribute.
8	Benefit Transfer Method	Estimates economic values by transferring existing benefit estimates from studies already completed for another location or issue.

Valuation of change in soil fertility, carbon sequestration, soil erosion, improved biodiversity, shade and habitat for birds and wild life as environmental services are being undertaken[8]. Valuation studies have been completed for two parameters – change in soil fertility and

[7] Adapted from the Economic Valuation of wetlands: A Guide for Policy Makers and Planners By Edward B Barbier, Mike Acreman and Duncan Knowler Department of Environmental Economics and Environmental Management, University of York, Ramsar Convention Bureau Institute of Hydrology, IUCN-The World Conservation Union, 1997

[8] Change in soil fertility uses the replacement cost and substitute cost methods, the valuation of carbon sequestered uses the market cost method, soil erosion is calculated using damage cost avoided method and contingent valuation method (willingness to pay) is used for the valuation of improved biodiversity, shade and habitat for birds and wild life as environmental services.

carbon sequestration. It is common knowledge that as the vegetation improves, there is an improvement in the quality of soil because of the decayed organic matter (humus), but it is difficult to value the improvement normally. The fertility of the soil (Table – 3) is measured based on the nitrogen, phosphorus and potassium (NPK) content, electrical conductivity and the pH value of the soil and any change in the soil fertility is calculated based on the replacement value method for NPK. It means for the changed amount of NPK if one wants to replace the same quantity of nutrient by applying equivalent amount of fertilizer purchased from market[9]. Sample from various parts of the plot[10] are taken each year and tested scientifically to estimate the changes.

Table 3: Year wise change in Soil quality

Particulars	**1991**	**98-99**	**99-00**	**00-01**	**01-02**	**02-03**
Nitrogen (kg/ha)	419.56	1388.8	1452.80	1361.92	1913.79	1501.44
Phosphorous (kg/ha)	41.00	61.84	87.02	82.52	52.50	48.33
Potash (kg/ha)	496.82	775.29	592.16	945.60	780.00	1035.42
Ph	7.75	7.65	7.67	7.36	7.31	7.78
EC (m. mhos/cm)	0.13	0.20	0.25	0.31	0.18	0.20
Total Replacement Value of NPK (Rs) for 25 hectares		18736.00	18679.72	22823.63	26919.21	24264.20

The valuation of carbon sequestered uses the market cost method. There is a growing discussion on forests being carbon sinks through the absorption of carbon dioxide from the atmosphere in the process of photosynthesis. Article 3.3 of the Kyoto Protocol (UNFCCC) created the opportunity to establish new planted forest as carbon sinks and the carbon market is growing as Clean Development Mechanisms (CDM). The valuation of the carbon sequestered has been calculated based on the formula C=0.272 X where C is the quantity of carbon sequestered and X is the wood biomass (green) above the ground. The coefficient 0.272 is derived from the relation given below:

Wood biomass (green) above the ground	X
Total (green) tree biomass	Y= 77% of X
Total (dry) tree biomass	Z=46% of Y
Amount of carbon sequestration	C=45% of Z

The total annual increment of carbon sequestered is given below in the Table – 4. The total carbon sequestered in the plot is 714 tons which when valued at Rs. 168/- per metric ton (the average prices at the international level) is worth Rs.1.2 lakhs.

[9] For the purpose of valuation of NPK the subsidized rate of fertilizer has been considered.

[10] Collection of soil samples: A total of 5 plots are marked for collection soil sample. From a soil sample plot, the soil is collected from 4-5 points, at each point a pit is dug up to 1 ft. in the shape of V and the soils are collected from slices. From each pit around .5 kg of soil is collected and then mix all five samples and retain .5 to 1 kg soil in a paper bag for testing. Each sample is tagged with date, time and collection point and sent for analysis.

Table 4: Year wise status of carbon sequestration

Particulars	**1991**	**98-99**	**99-00**	**00-01**	**01-02**	**02-03**
Quantity of carbon sequestration (tons/ha)	0.04	18.15	23.00	26.82	28.39	28.57
Amount of carbon sequestration (Rs '000)	0.17	76.23	96.60	112.64	119.23	119.90

Total Value of the Resource

The graphs (Figure – 5) below show the increase in the value of the forests with the quantification of each of the variables. This methodology therefore provides a means for measuring and comparing the various benefits of the forests and helps in improving the use and management of the resource.

The total value of the resource is the summation of the market value of the direct benefits, the value of the existing stock and the environmental services. As one would observe, the conventional accounting records only a very small portion of the total benefits the regenerate plot provides. As we value the benefits used by the communities at the market price, the value of the standing stock and the value of the environmental services it provides, the value of the benefits from the resource becomes multifold. The statement of accounts derived through the NRAS framework – Flow account and the Balance Sheet are attached in the annexures for reference. The total value of the resource as on 31st March 2003 is about Rs. 37.83 lakhs.

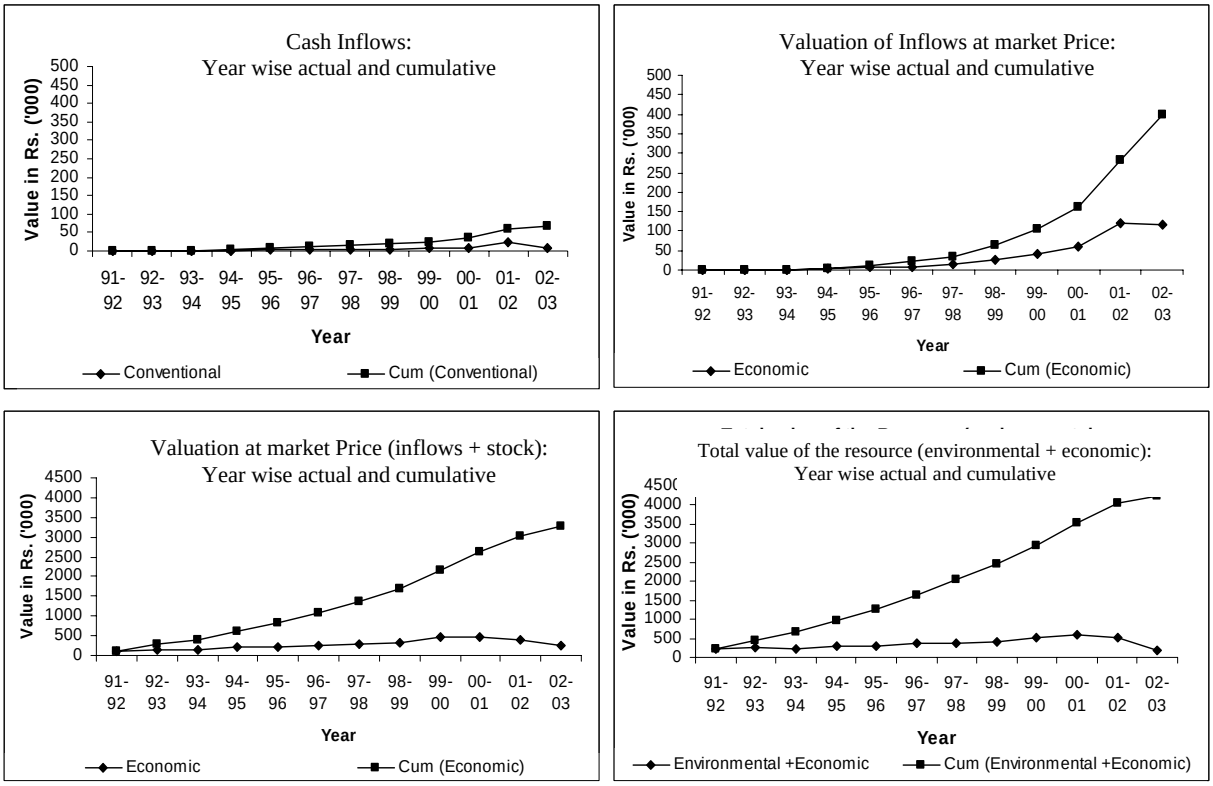


Figure 5: Year wise comparison of value of the resource under different accounting procedure

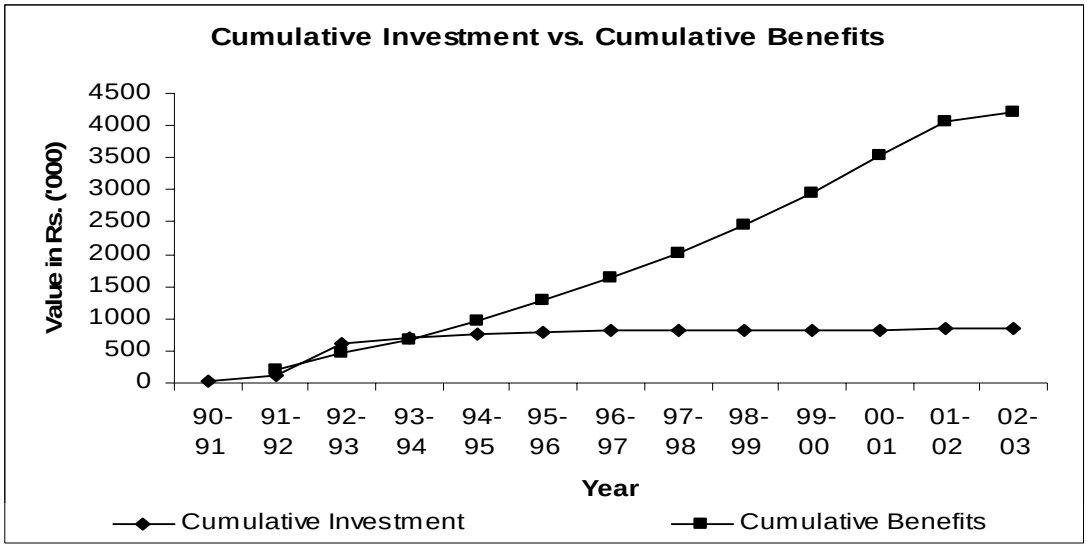


Figure 6: Year wise details of investment and benefits

The resource management institutions (TGCS in this case) often therefore face difficulty in cost-benefit analysis through the conventional accounting methods. The cumulative investment (Figure – 6) in the 25 hectares of land is 8.51 lakhs for regeneration and protection of the resource and the benefits according to the conventional accounting is Rs. 42.77 thousand only indicating a massive loss making proposition. The accounting through the NRAS framework puts the value of the total benefit at 37.83 lakhs which is about four times the investment made in the plot. The valuation is still less as only a few parameters have been considered for valuation. The other parameters like soil formation, erosion control, biodiversity, habitat and aesthetic value are yet to be considered.

CONCLUSION:

Natural Resource Accounting is evolving in India and many researchers and institutions are attempting to value the natural resources for the benefits they provide. The Framework for Natural Resource Accounting System (NRAS) is an attempt to further the discussion regarding the relevance of valuing the natural resources. By providing a means for measuring and comparing the various benefits of forests, NRAS can be a powerful tool to aid and improve decision making[11] and the use and management of the forest resources.

As we observe in the case mentioned in the paper, accounts maintained only in physical units do not enable policy makers to understand the impact of economic policies on natural resources and thereby integrate resource considerations into economic decisions. The valuation of the resources using NRAS helps decision makers to take into consideration the actual value of the resource and not only the cash inflow and outflow. In this methodology,

[11] To illustrate the use of the methodology, the District Registrar (Cooperatives) served liquidation notices to a few Tree Growers' Cooperatives taking into the fact that the cooperatives were at a loss or did not have any/less monetary transactions, while in reality, the institutions were doing well to protect the forest resource and meet their subsistence needs. On the presentation of the NRAS accounts to the Registrar, the department reverted back the orders of liquidation and instructed the auditors to give special consideration to the Tree Growers' Cooperatives.

there is no conflict between accounting in physical and economic units because physical accounts are necessary prerequisites to economic accounts. NRAS therefore can be effective to help decision-makers to decide on the conversion or conservation of the resource.

In addition, NRAS can be an effective tool to calculate the compensation for the resource when a particular piece of land is allocated or diverted for a particular purpose (say- industry or any development project). The present procedures in case of such diversion especially, forest resources are to provide the cost for compensatory afforestation which would be quite low in comparison to the actual value of the forest destroyed. This information could also be important for the community to effectively bargain for the loss.

It also makes a case for the inclusion of Natural Resource Accounting in the calculation of the Gross Domestic Product (GDP). Various countries have successfully integrated natural resource accounting to calculate National Income. Though there is no consensus on how and what parameters and methodology could be used for accounting the environmental capital and the degradation and depletion of natural resources. However, we believe that setting in place such accounting mechanism would help us value our resources better and take decisions according to the merit of the case.

However, a major difficulty facing valuation of a complex environmental system, such as forests, is the insufficient information on and appropriate methodology for valuing different ecological benefits/parameters like biodiversity, habitat for wild life etc. Equally, it is difficult to provide realistic value of the non-market environmental benefits or to get consistent results for the users of the resource using contingent valuation methods.

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Annexure : STATEMENT OF ACCOUNTS

Annexure A: Direct Flow Account of Namnar TGCS, 2002-2003

Items	Physical	Financial (Rs.)	Economic (Rs.)		Environmental (Rs.)
			Internal	External	
BENEFIT					
Fuelwood sales (tons)	18.85	9425.00	18850.00	0.00	0.00
Profit (from Tree biomass a/c)		0.00	315945.54	0.00	0.00
Grant for Revegetation		7510.00	7510.00	0.00	0.00
Illegal Harvest (tons)	34.35	0.00	0.00	34774.98	0.00
Minor forest produce (MFP)					
Babul pods+open grazing (tons)	540.00	0.00	0.00	54000.00	0.00
Ber collection (kg)	95.00	0.00	0.00	475.00	0.00
Babul gum collection (kg)	120.00	0.00	0.00	4800.00	0.00
Babul stick brush (no.)	54750.00	0.00	0.00	2737.50	0.00
Green foliage collection (tons)	9.00	0.00	0.00	1350.00	0.00
EXISTING STOCK					
Tree biomass a. Fuelwood (tons)	-391.43	0.00	-391425.96	0.00	0.00
b. Timber (tons)	408.37	0.00	510456.91	0.00	0.00
Total-(a)		16935.00	461336.49	98137.48	0.00
Direct Net loss-(c)=(b-a) if b>a		0.00	0.00	0.00	0.00
Grand total-(a+c)	**-**	**16935.00**	**461336.49**	**98137.48**	**0.00**
COST					
Land revenue	-	2315.00	2315.00	0.00	0.00
Audit fee	-	0.00	0.00	0.00	0.00
Stationary	-	746.00	746.00	0.00	0.00
Plantation & Aftercare	-	0.00	0.00	0.00	0.00
Salaries	-	4350.00	4350.00	0.00	0.00
Misc. exp.	-	1325.00	1325.00	0.00	0.00
Biogas exp.	-	4500.00	4500.00	0.00	0.00
Dead stock exp.	-	1597.00	1597.00	0.00	0.00
Economic loss due to formation of TGCS	-	0.00	9425.00	98137.48	0.00
Total-(b)		14833.00	24258.00	98137.48	0.00
Direct Net benefit-(d)=(a-b) if a>b	-	2102.00	437078.49	0.00	0.00
Grand total-(b+d)		**16935.00**	**461336.49**	**98137.48**	**0.00**

Annexure B: Indirect Flow Account of Namnar TGCS, 2002-2003

Items	Physical	Financial (Rs.)	Economic (Rs.)	Environmental (Rs.)
BENEFITS				
Environmental gains				
SOIL QUALITY				
Nitrogen (Kgs)	-10403.75	0	0	-110596.39
Phosphorous (Kgs)	-105.13	0	0	-2089.36
Potash (Kgs)	6444.16	0	0	45699.85
Carbon sink (tons)	4.55	0	0	765.05
Soil loss (tons)	126.15	0	0	47053.95
Employment -men		NE	NE	NE
-women		NE	NE	NE
Total-(a)	0	0	0	-19166.89
Indirect Net loss-(c)=(b-a) if b>a		0.00	0.00	0.00
Grand total-(a+c)		**0**	**0**	**-19166.89**
COSTS				
Firewood loss (tons)				0
Open grazing lost (tons)	0	0	0	0
Total-(b)		0.00	0.00	0.00
Indirect Net benefit-(d)=(a-b) if a>b	0	0.00	0.00	-19166.89
Grand total-(b+d)		**0**	**0**	**-19166.89**

NE= Not Estimated

Annexure C: Balance sheet of Namnar TGCS as on 31 th March, 2003

Items	Physical	Financial (Rs.)	Economic (Rs.)	Environmental (Rs.)
ASSETS				
Bank balance		21388.19	21388.19	0.00
Dead stock	-	4704.00	4704.00	0.00
Closing balance	-	183.60	183.60	0.00
Fuel wood-advance		14295.00	14295.00	0.00
Investment	-	2200.00	2200.00	0.00
Standing trees biomass (tons)	2681.22	0.00	3054449.55	0.00
Environmental gains				
Soil quality (NPK-tons)	65.25	0	0	612190.32
Carbon sink (tons)	720.80	0	0	121093.64
Soil loss (tons)	-126.15	0	0	-47053.95
Employment days	7644	0.00	NE	NE
Direct net loss		0.00	0.00	0.00
Indirect net loss		0.00	0.00	0.00
TOTAL ASSETS	**-**	**42770.79**	**3097220.34**	**686230.02**
LIABILITIES				
Share capital	-	4660.00	4660.00	0.00
Reserve fund	-	466.00	466.00	0.00
Depreciation	-	3552.50	3552.50	0.00
Direct net benefit		34092.29	30885441.84	0.00
Indirect net benefit	-	0.00	0.00	686230.02
TOTAL LIABILITIES		**42770.79**	**3097220.34**	**686230.02**

NE= Not Estimated

Total Value of the Regenerated Resource is 37.83 lakhs