

# Economic Analysis of Biodiversity Conservation: A Case Study of Tropical Forests in the Western Ghats

K N Ninan

*Institute for Social and Economic Change, Bangalore*

## Introduction

Tropical forests cover 14 percent of the earth's land surface (8 mil.sq.km). They are rich in biodiversity. Half of all vertebrates, 60 percent of known plant species, and possibly 90 percent of the world's total species are found in tropical forests. The Western Ghats of India spread over five states of South and Western India (i.e. Kerala, Karnataka, Tamil Nadu, Maharashtra and Goa), is one of the eighteen biodiversity hotspots listed in the world. The Nilgiri Biosphere Reserve is located in this region. It is a treasure house of several known and unknown flora and fauna, including several endangered species such as the Lion-tailed macaque, Nilgiri Thar, Nilgiri Langur, Malabar Civet, Malabar giant squirrel and Asiatic Elephant among others. Due to demographic and economic pressures, market failures and inappropriate policies, the biodiversity of the region is under various stages of degradation and therefore, needs to be conserved through appropriate policies and adequate measures.

## Objectives

The objectives of the study are to:

- Assess the benefits of biodiversity conservation as against alternate land use options of forests.
- Assess the socio-economic and institutional factors inhibiting or promoting biodiversity conservation, and people's perceptions and attitudes towards biodiversity conservation and wildlife protection.
- Estimate the Willingness to Pay or Willingness to Accept compensation for participatory biodiversity conservation.
- Assess the institutional alternatives and mechanisms for conserving biodiversity without retarding growth.

## Data and Methodology

The study is based on both secondary as well as primary data collection. Secondary data was gathered to provide basic information on the biodiversity of the Western Ghats and of the study regions. Analyses of the changes in land use pattern, human and livestock pressure on land and forest resources over time in the selected districts are also carried out so as to serve as a backdrop to the in-depth study based on primary investigation.

For the present study a cluster of tribal villages/hamlets in Mysore district were selected, which are in the vicinity of the Nagarhole Wildlife Sanctuary which has witnessed considerable tribal unrest due to the establishment of the sanctuary, covered under the World Bank aided Ecodevelopment project. These included a coffee-growing village in Kodagu district of Karnataka and two farming villages in Uttar Kannada district having close interaction between agriculture, livestock and forests. These villages were selected purposively, after consultations with forest department and village officials.

The data for the in-depth study has been collected through a sample survey of households/respondents. Data has been collected on the following:

- Socio-economic data of sample households, covering demographic particulars, operational holdings, income, etc..
- Cropping pattern.
- Cost and returns from crop production and other allied activities such as livestock rearing and forest-based activities.
- Extent of dependence on forest resources (land, timber and NTFPs) and value of forest products extracted.

- On-farm consumption and marketing of forest products.
- Respondents' perceptions and attitudes towards biodiversity conservation.
- Respondents' Willingness to Pay (WTP) or Willingness to Accept (WTA) compensation for forest conservation / protecting wildlife species (e.g. elephants).

The survey covers 303 households/ respondents from the selected villages to elicit information about the extent of their dependence on forests for various socio-economic activities, their production activities and income, on-farm consumption and marketing of forest products and also to elicit their value preferences for diverse forest products and services.

### Sampling Design

A two-stage sampling design was followed to conduct the in-depth study. Maldari village in Virajpet taluk of Kodagu district, which is close to a reserve forest, where coffee growing is predominant, and where man-animal conflicts are conspicuous, was selected. This village has a mix of coffee plantations of different size groups including some managed by large companies. Households in this village were listed and selected on stratified random sampling based on land holding categories and other criteria such as coffee growing, etc.

In or near the Nagarhole sanctuary, due to the small size of tribal villages or hamlets (some having just 10 or 15 households), a cluster of tribal villages or hamlets were selected in order to have a reasonable sample size. Eight tribal villages or hamlets, viz., Nagapura, Dammankatte, Sungattkatte, Kaimara, Nannachi, Kolangeri, Ganakoor and Majjighalli were selected for an in-depth survey. Of these, Nagapura is a rehabilitated village outside the sanctuary, whereas Dammankatte is a non-rehabilitated village near the periphery of the sanctuary. The remaining six tribal villages or hamlets are located within the sanctuary. All the households within the selected cluster of villages were surveyed. A total of 100 households were covered out of 250 households in this cluster of tribal villages.

In the case of Uttara Kannada again due to the small size of villages and the requirement of a reasonable sample size, a cluster of two agricultural villages, viz., Kegdal and Badakanasirada in Haliyal taluk of Uttar Kannada district were selected for our sample survey. Of them, Kegdal is within the Dandeli wildlife sanctuary and Badakanasirada is outside the sanctuary. All the households in these two villages were surveyed for an in-depth study. This included 32 households from Kegdal village and 48 households from Badakanasirada village, making a total of 80 households from this region.

Thus, in all, the study covered about 303 households from these villages or cluster of villages located in Kodagu, Mysore and Uttar Kannada districts.

### Analytical Techniques Used

While collecting data the following analytical techniques were used:

- Cost benefit appraisal, contingent valuation method (discrete choice methods), logit or probit models, descriptive cum tabular statistics, and averages and proportions.
- Survey method and Contingent Valuation Method (CVM) to estimate the use and non-use values of the tropical forests.
- The dichotomous method or discrete choice method, which seeks simple "yes" or "no" replies to an offered bid, was used for the contingent valuation method (CVM) study. The discrete choice method is preferred over other methods (e.g. open ended methods) since it would be easier for villagers to understand and respond to the question. Also households could respond keeping some budget constraint in view i.e. the upper bound on bids could be controlled. This method also minimises any incentive to strategically overstate or understate WTP. Dichotomous choice methods require the use of parametric (typically logit or probit) probability models relating yes or no responses to offer amounts, the computation of an expected mean, and relating the WTP or WTA response to relevant socio-economic and other variables.

## Major Findings

The following are the major findings of the study:

- An analysis of land use and crop pattern changes in the selected regions between 1960-61 to 1996-97 reveals that the net area sown and total cropped area as a proportion of the reporting area has risen for Karnataka and selected districts and Taluks in Kodagu, Mysore and Uttar Kannada. This increase in net area sown has largely come due to reductions in area of other land use categories such as permanent pastures and grazing lands, land under miscellaneous tree crops, cultivable wastes, etc. Total forest cover in the country and Karnataka seems to have increased slightly over the time period under review. Across districts it is seen that while Kodagu and Uttar Kannada report a marginal decline in their forest cover in recent decades, Mysore district interestingly records a marginal rise in the forest cover. This however, doesn't tell us anything about the forest and biodiversity in these three districts, which are degraded in many parts due to encroachments and other human interventions. An analysis of crop patterns and changes over the same time period, reveals that the relative share of crops like rice and banana which are highly prone to attacks from wildlife like elephants and wild boar have declined in the selected areas, which may be a coping strategy by farmers to reduce losses arising from damage to these crops by wildlife. Area under coffee cultivation has increased rapidly in Kodagu district and Virajpet Taluk in particular.
- The population pressure on forests and other natural resources are increasing over time. This trend is more conspicuous in Karnataka and the three districts under review.
- The livestock pressure measured in standardised animal units per hectare of forest and other natural resource has increased from 1961 to 1990 in Karnataka as compared to all-India figures/trends. Among the three districts, Mysore reported relatively greater pressure per hectare of forest area as compared to Kodagu and Uttar Kannada districts. However, a rising trend in livestock pressure per hectare of forest area is seen in Uttar Kannada over the last three decades.
- The opportunity cost of biodiversity conservation in terms of the foregone coffee benefits among the sample farmers in Maldari in terms of net present value (NPV) would be about Rs.1,94,900 per acre at 8 percent discount rate, and Rs.1,38,500 per acre at 10 percent discount rate, assuming a time horizon of 50 years. When the external costs of coffee production such as damage due to wildlife and preventive costs are also added, the NPV declines to Rs.1,88,500 per acre at 8 percent discount rate, and Rs.1,33,300 at 10 percent discount rate. Across land holding groups these benefits in terms of NPVs are positive and significant for all strata of holdings. Sensitivity analysis revealed that even if the expected benefits from coffee were to decrease by 20 percent and costs rise by a similar proportion, the benefits from coffee would still be positive and significant (IRRs range between 19.5 to 20 percent). Out of the total external costs incurred by coffee growers, 57 percent is due to damage caused by wildlife. The average damage cost due to wildlife attack was estimated at Rs.331.2 per acre, and the cost of preventive measures at Rs.196.5 per acre.
- The foregone benefit due to biodiversity conservation from Non-Timber Forest Products (NTFP) in terms of Present Value among sample Nagarhole tribals was estimated at Rs.67,123 at 8 percent discount rate, and over Rs.57,076 at 10 percent discount rate, assuming a time horizon of 25 years.
- The foregone benefit of biodiversity conservation in terms of paddy and cotton production among the sample farmers in Uttar Kannada in terms of NPV was estimated at over 29,400 per acre at 8 percent discount rate for paddy (excluding external costs), and Rs.23,400 (including external cost), assuming a time horizon of 25 years. For cotton, the NPV was Rs.56,801 per acre at 8 percent discount rate. The external costs of agriculture due to damages from wildlife were estimated at Rs.566 per acre.

- The foregone grazing benefits of biodiversity conservation among the sample farmers in Uttar Kannada in terms of Present Values was estimated at Rs.19,481 per standardised animal unit at 8 percent discount rate, and Rs.16,566 per standardised animal unit at 10 percent discount rate assuming a time horizon of 25 years. Aggregating over the animal units owned by the sample farmers this worked out to about Rs.6.43 million (at 8 percent discount rate), and Rs.5.47 million (at 10 percent discount rate) for the same time horizon.
- As regards attitudes towards biodiversity conservation and wildlife protection, majority of the sample households had a positive attitude. Regarding biodiversity conservation, the sample farmers in Kodagu felt that biodiversity should be conserved due to its value for future generations, its ecosystem functions, and use value for developing new products. The Nagarhole tribals emphasised its livelihood functions, importance for future generations, aesthetic and recreation values as well as its ritual and cultural values. The sample farmers in Uttar Kannada emphasised its ecological functions and livelihood aspects for biodiversity conservation.
- Elephants, which are a keystone species, and are vulnerable in the study area, were the focus of the study. Sample farmers in Kodagu, Nagarhole and Uttar Kannada emphasised the existence value of elephants, their beauty and use value for domestic work.
- A CVM study revealed that sample farmers in Kodagu were willing to spend 25.8 human days on an average per household per year for participatory elephant conservation, which amounted to over Rs.6,003 per household per annum in terms of the opportunity cost of income foregone.
- A logit function which related the “yes” or “no” responses to Willingness to Pay for Participatory Elephant Conservation in Maldari, Kodagu district, to a number of variables revealed that land ownership, age settlers and a dummy variable for decentralised government institutions were the significant variables influencing the yes or no responses of the sample farmers.
- In Nagarhole and Uttar Kannada, Willingness to Accept (WTA) Compensation was found to be more relevant. A probit function of Nagarhole respondents which related the “yes” or “No” responses to WTA to selected variables revealed that age, sex and income were the important variables influencing the “yes” or “no” responses. Nagarhole tribals, who report more income from work in neighbouring coffee estates, are reluctant to move out of the sanctuary due to uncertainty about their future, especially if relocated far from the coffee estates. Older people and women are also less likely to prefer to move out of the sanctuary. Those not willing to accept the rehabilitation package to relocate outside the Nagarhole sanctuary cited difficulty and uncertainty in coping with new surroundings, protests from community leaders, etc., as major reasons.
- A majority (96%) of the sample farmers in Uttar Kannada were willing to participate in participatory conservation. On an average, the villagers were ready to spare 85 hours in a year for activities related to elephant conservation. In terms of the opportunity cost of time of foregone labour benefits, this was estimated at Rs.585 per household in a year (assuming a wage rate of Rs.7 per hour).