


PROCEEDINGS

EXPERT CONSULTATION ON ENHANCING THE CONTRIBUTION OF TREES OUTSIDE FORESTS TO SUSTAINABLE LIVELIHOODS

Rome, 26–28 November 2001

TREES OUTSIDE FORESTS RESOURCE STUDY AND MANAGEMENT: ASSESSMENT METHOLODGIES AND INSTITUTIONAL APPROACHES IN INDIA

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ABSTRACT

Traditionally, forest inventories in various parts of the world have largely concentrated on assessing growing stock within notified forest areas. With rapid deforestation and loss of cover, there is an increasing interest to understand the role of Trees outside Forests (TOF) in providing ecological goods and services. TOF are playing a major role in carbon sequestration, fuel wood supply, erosion control, climatic stabilization and rural livelihood support. What needs to be ascertained accurately is the quantum of the TOF resource, its distribution and contribution. For this, large area TOF assessments need to be undertaken. The scattered and fragmented nature of the resource makes this task daunting and different from conventional forest inventories

This paper presents an overview of some of the important approaches used in India for TOF assessment. Assessment approaches have been categorized as ground based enumeration approaches or remote sensing aided approaches and discussed in context of their methodological details, merits and demerits. The potential use of remote sensing data has been highlighted as it can add accuracy and speed to certain TOF assessment tasks. A brief discussion on TOF management in India has also been presented focussing on legal issues impacting TOF conservation.

The overview suggests that there is inadequate data on TOF resources in the country and there is a need to evolve standard methods and institutional partnerships to collect data. The need to adopt enabling legislation in order to encourage private landowners and local communities to plant and conserve more trees has been highlighted.

Keywords: Trees Outside Forests, Remote Sensing, Assessment Methods, Sampling, Classification.

INTRODUCTION

In the last two decades, countries like India have experienced massive deforestation. Official estimates in India put total tree cover on forestlands at around 63.73 million ha which is 19.39% of the total geographical area of the country. Out of this 19.39% forest cover, dense forest cover is only around 37.74 million ha or 11.48% (FSI, 1999). Independent sources (non-governmental) on the other hand are more conservative about these estimates. The destruction of forests have led to numerous environmental problems, most notable among them include disturbances in the atmospheric carbon balance, change in water regimes and accelerated soil erosion.

While national and global forest inventories have largely concentrated on monitoring the status of forests on notified forestlands, they have almost completely ignored estimations of Trees Outside Forests (TOF). TOF refer to trees on land not defined as forest or other wooded land and generally include trees on farmlands, in cities and human settlements, orchards, sides of roads, pastures, banks of rivers, streams and canals and as shelterbelts which are less than 20m wide and 0.5 ha area (FAO,1998). It is now being increasingly argued that the role of TOF in providing food and woodfuel to rural masses, carbon sequestration, prevention of soil erosion, biodiversity conservation, checking desertification, establishment of wildlife corridors and microclimatic stabilization, is quite substantial meriting a detailed inventory (Kleinn, 2000; Bhattarai 2000;Rowntree and Nowak 1991;Nowak 1994;Carucci, R, 2000). Ravindran and Thomas (2000) have shown how TOF resources provide livelihood support to local communities.

Notwithstanding the fact that pressure due to the demand for woodfuel has been one of the main factors that has contributed to deforestation, trees outside forests are also playing a significant role in meeting rural domestic fuelwood requirements. With the destruction of forest lands there is a marked shift in the supply of woodfuel for domestic consumption from forest to non forest lands. On an average, almost 50% of the domestic woodfuel in Asian countries comes from non-forest lands. These figures are significantly skewed in countries like Bangladesh, Pakistan, Philippines and Sri Lanka where non-forest land contribute close to 90% fuel wood (FAO, 1997). In India, this figure is around 50% (FSI 1996,FAO 1997). Share of wood energy from non-forest lands used for cooking in rural India is 59% while that of biomass energy is 90% (Saxena, 1997). Table 1 summarizes a comparative shift in supply share in rural household fuel wood in India from forestlands to non-forest lands in the period between 1978 to 1992 (CSE 1999).

Table 1. Rural Household Fuel Wood Collection in India

Fuel Wood Source	Percentage Supply Share	
	1978	1992
Forest Land	35%	17%
Non-Forest Land	59%	78%
Other	6%	5%

Source: Centre for Science and Environment, New Delhi, CSE 1999.

In another study, Rai and Chakrabarty (2001) estimate that of the total fuelwood requirement in India in 1996 (201 Mt), 51% (103 Mt) came from forestlands while the remaining 49% (98 Mt) came from non-forest lands.

In view of the above, it is now being increasingly felt that large-scale assessments and inventory of TOF is crucial to fully understand the role being played by trees outside forests. Such information is also needed to evolve plans for sustainable management of TOF.

METHODS FOR ASSESSING TREES OUTSIDE FORESTS

Globally, there are very few published studies on large-scale TOF assessments. Sylvander (1981), Holmgren et. al. (1994) provide a few notable examples of TOF surveys. Kleinn (1999) provides a pilot study compilation of TOF information for six Latin American countries. In the South Asian region some studies on the estimation of wood resources have been undertaken in India, Pakistan and Sri Lanka (Pandey, 2000).

Approaches to assessment of TOF have been somewhat adhoc and can be broadly categorized into the following two familial groups:

Approaches involving Enumeration through Ground Based Surveys, and
Approaches aided by Remote Sensing

In the past, there has been a dominance of ground survey based approaches to TOF assessment. Although such enumeration provides accuracy, it has limitations in terms of area coverage, time, cost and repeatability. One other factor for increased preference for ground based sampling in the past has been the poor spatial resolution and high cost of data from remote sensing satellites. As a result, assessments attempting to use satellite data for studying TOF have been constrained in varying degrees in terms of accuracy, costs, complexity and technological feasibility. However due to the availability of higher resolution satellite data at increasingly affordable prices, the potential of remote sensing based approaches in aiding large area TOF assessments is generating wider interest.

Kleinn (2000) has highlighted some key knowledge concerns in collecting TOF data. Some of these issues include the need for an appropriate classification system for TOF data, ownership and geometry of TOF, appropriate sampling design, and high heterogeneity of TOF resources. These unique conceptual and methodological impositions make TOF assessments fundamentally different from classical forest inventory approaches. In this context, it is important to note that a number of studies which have been quoted in literature as TOF assessments have been undertaken with very specific and focussed study objectives. They are grossly deficient in the holistic TOF scope both in terms of their inclusion of the total TOF classification span and also in terms of addressing information needs to support the wide range of attributes listed to justify the need for conducting TOF assessments. Examples of focussing on one TOF component include studies concentrating solely on tree enumeration of farmlands or in urban areas or riparian habitats. Examples of focussed objectives include surveys on non-forestland to assess wood stock, woodfuel, and erosion control potential. With TOF emerging as an important area of research interest, it is desirable that TOF surveys cover the totality of the TOF concept in their assessment design.

Due to lack of standardization, suitability of an approach for TOF assessment for a specific situation invariably involves some kind of tradeoff analysis. A number of parameters can be involved in comparing different resource study approaches. Table 2 below highlights some of these parameters and the questions they aim to address.

Table 2. Parameters to compare different TOF methods

No	Parameter	Questions Being Addressed
1.	Area Covered	*How large an area can be covered using this approach? Does it permit large area coverage?*
2.	Time	*How much time does it take to complete?*
3.	Accuracy	*How accurate would the results be?*
4.	Representation	*How representative the results would be of the total Population?*
5.	Cost	*How expensive will it be to implement over large areas?*
6.	Repeatability	*How frequently can the method permit re-assessment?*
7.	Extrapolation	*How easy it is to use or replicate the method at other locations or for larger areas?*
8.	Complexity	*How complicated is the method to use?* ▪ Logistic complexity ▪ Technical complexity
9.	Feasibility	*How feasible is it to apply this method?* ▪ Is it technically feasible? ▪ Organizational feasibility

The following sections present a brief overview of some methods used for TOF assessment with particular reference to India.

GROUND SURVEY METHODS

There are very few published large area studies in India on systematic assessment of TOF. With the notable exception of studies done by Krishnankutty (1992) and the Forest Survey of India, most studies on assessment of trees on non-forest lands have mainly focussed on narrow geographical regions and very specific objectives. In terms of a review therefore, it is difficult to evaluate their applicability in the context of the currently emerging definition and scope of TOF. Nevertheless some of these studies do provide an insight into broad methodological issues involved in the assessment of TOF.

Chaturvedi (1990), focussed on the development of a methodology for fuelwood production from non-forest lands. The study concentrated on two villages spread over an area of 730 ha in the Gurgaon district of Haryana. Trees growing in these villages were classified as belonging to either homestead-planting stratum, commercial tree planting stratum or tree planting on farmland stratum. As the area to be covered was small, total enumeration was done for the first two stratums while random sampling was resorted to for the third (the tree planting on farmland) stratum. Trees below 15 cms at breast height were not considered for this study. Regression equations for volume estimation of different species and local species volume tables were developed to calculate expected yield of fuelwood for the two villages. The methodology developed as a result of this work is deficient for comprehensive TOF surveys on almost all parameters mentioned in table 2 with a possible exception of accuracy. Infact there are few methodological lessons from this study that can be used for a direct large area TOF survey encompassing all TOF classes and issues. It will be fair to mention however that this work did not aim to develop a large area TOF methodology and concentrated specifically on assessing village fuel wood supply.

A study conducted by Krishnankutty (1992) is by far, the first large area TOF assessment done in India. The study estimated volumes of growing stock of trees on the homesteads for the entire state of Kerala. Although the survey excluded from its scope trees grown on non-agricultural areas such as plantations (rubber, tea , coffee),roadsides and public building compounds, it was very comprehensive in covering trees grown on agricultural land of the state for various purposes. Krishnankutty used a three stage stratified sampling procedure to select areas for enumeration of trees. The percentage of dry land area under agricultural use to the total area (dry land area + wet land area) under agricultural and human population density were calculated for all revenue villages in Kerala. Five class groups were created for percentage of dry land to total area under agricultural use while three class groups were created for population density constituting 15 strata in all. Stages of sampling involved - (a) random distribution of 30 villages (2.5 % of total revenue villages) in the above strata ensuring that at least one village was included from each stratum, (b) selecting one census village (several make a revenue village) from each chosen revenue village and (c) considering all households in the selected census village for collection of information. This study estimated that during the period of the survey (88-89), the state of Kerala had 347.23 million trees growing on homesteads. The volume of growing stock of trees above 10 cm dbh was estimated to be 112.685 mcum. The study concluded that homesteads account for 80 percent of the wood supply in Kerala with 15 percent coming from estates and imports and only 5 percent coming from forests. The total contribution of non-forest area (minus imports) was 92.6 %.

The Forest Survey of India (FSI) is the national forest mapping agency in India. With reference to TOF, FSI started an inventory programme in 1991 with an objective to assess the extent of plantation raised under different forest schemes and estimate growing stock & species wise tree numbers of trees outside forests (Kumar, 2001; Pandey, 2000). As detailed by Kumar, the TOF classification adopted by the FSI is quite comprehensive and includes a total of eight TOF categories (Table 3). The sampling design is based on stratified random sampling with agro-climatic zones of the country providing the first stage strata, districts (or groups of districts) providing the second stage strata and villages in districts selected through proportional allocation providing for sampling units. Total enumeration of standing trees is conducted in the villages falling in the sample (the 1999 revision of this method does not stipulate total enumeration).

Using the above method, FSI has completed TOF assessments for Haryana, West Uttar Pradesh (UP) and West Bengal (Table 4). The study for the above areas reports a high positive correlation between village area, population and number of trees. Inventory work for the states of Andhra Pradesh, Gujarat and Rajasthan is nearing completion (Pandey 2000). In all the above FSI surveys, TOF resources within municipal limits of towns and cantonments were not included.

Table 3. FSI TOF Categories

SNO	TOF Category	Explanatory Remark
1.	Farm Forestry	Trees along the farm bounds and in small patches up to 0.1 ha in area
2.	Village Woodlot	Naturally growing trees/planted on community/private land
3.	Block Plantation	Patches covering an area of more than 0.1 ha. and not falling in any of the above
4.	Roadside Plantation	
5.	Pond side Plantation	
6.	Railway side Plantation	
7.	Canal Side Plantation	
8.	Others	Trees not falling in any of the above categories.

Source: Kumar, 2001, Forest Survey of India, Dehradun, India

Table 4. Results of the FSI TOF Study

State	Number of Trees (000)	Volume (000)	Cover [a] (Sq. Km)
Haryana	54,984	10,328	1,375
West U.P.	1,33,982	30,306	3,350
▪ West Bengal	1,96,000	----	4,900 [b]

[a] Notional . Calculated on the basis of 400 trees per hectare.
[b] Includes trees having a girth of 5 cm and above.

Source: Kumar, 2001, Forest Survey of India, Dehradun, India

Although FSI revised its initial methodology in 1999 with a view to optimize time considerations by not stressing on total tree enumeration of sample villages, it would still take considerable time to cover the entire country. In such a scenario, it is likely that by the time a national picture emerges, part of the data may become dated and possibly unrepresentative of the prevalent ground situation. Management plans using such data may have to offset possible discrepancies due to timeliness of data. Revision of the existing method to include remote sensing based techniques might provide a viable mechanism to counter time lag problems.

Some other studies, particularly Ravindranath and Someshekar (1995) and Malhotra and Kumar (1987) use alternative sampling schemes for TOF assessment in rural and urban settings respectively. These studies have been briefly reviewed by Prasad et.al (2001).

As these studies concentrate on very small areas, it may be difficult to extrapolate techniques used for large area surveys.

The Indian Institute of Forest Management (IIFM) has also been working to evolve institutional partnerships in assessment of TOF. IIFM organized a workshop involving thirty Non-Government Organizations in June 2000 to assess TOF in India. As a prelude to this workshop, secondary data was collected from a variety of sources such as district rural offices, land record offices, district statistical offices, village interviews, municipal corporation offices and other similar sources. Primary data was also collected through sample field surveys conducted in the state of MP in urban, semi-urban and rural settings. Using the above data sources, an attempt was made to assess the total number of trees outside forests in India. This exercise resulted in estimating 24 billion trees outside forests in India (Prasad et. al. 2000). Pending a detailed inventory for the country, this figure has been suggested as a rough TOF estimate for India.

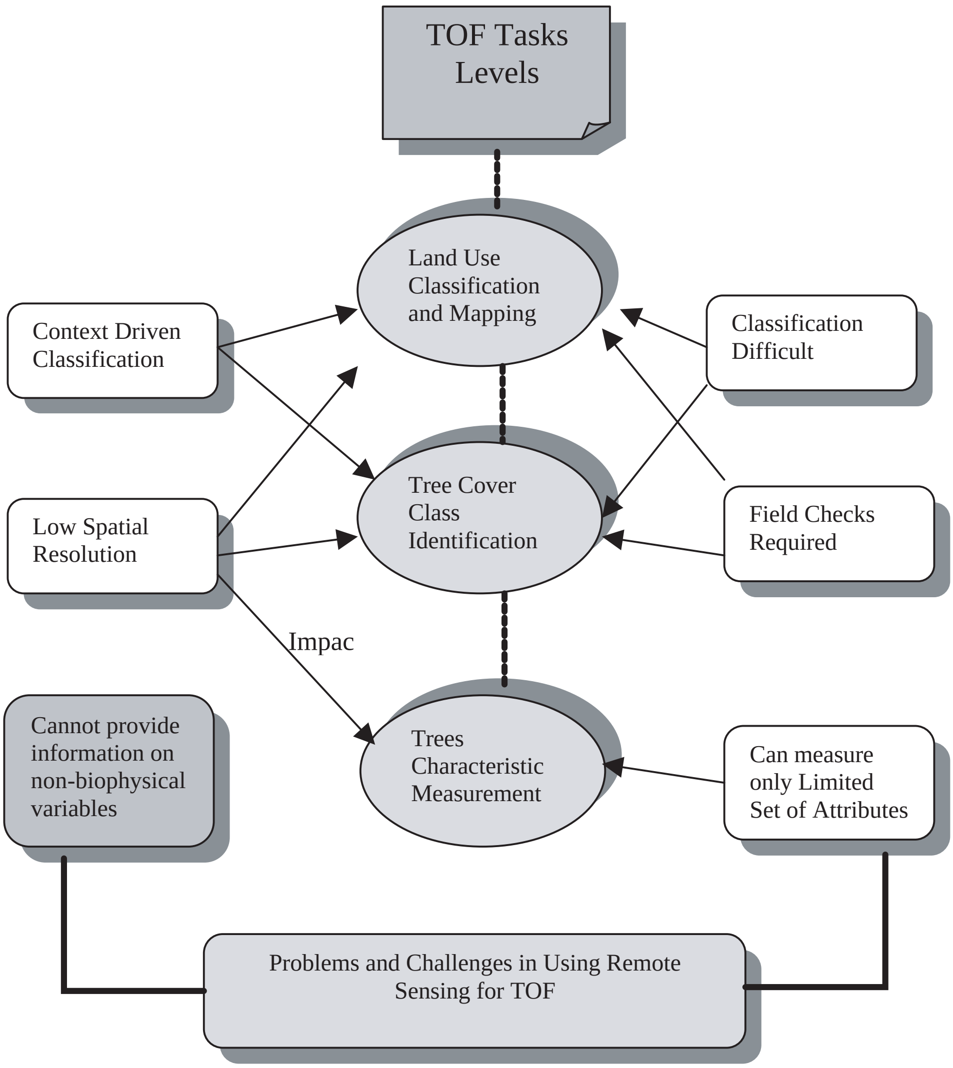
A study was also undertaken by IIFM to develop a methodology for assessing TOF in urban areas. This study resulted in the development of the Cardinal Grid Method (CGM) which was tested in the city of Gwalior, in Madhya Pradesh (MP). The CGM is a ground survey based method, which essentially divides the urban landscape into residential, institutional, roadside and other (garden/pond/park/temple) cover categories. Four quadrants are laid in each of the east, west, north, south and central zones of the city. Tree information in these quadrants for all the categories is collected by total enumeration. Different sampling distributions are employed for different landscape categories. Collected data includes number, species, girth and height of trees. Using this method, an estimation of the tree population in the city of Gwalior was made. The CGM is currently under development and the test experience at Gwalior has provided important inputs for the further refinement of this method.

IIFM with support from FAO also organized a National Workshop on the information analysis on TOF. One of the major focus of this workshop was to bring together a diversity of institutions to evolve partnership and standardize TOF assessment methodology. Most desirable methodological scenarios for TOF assessment were developed during this workshop, which have been summarized in Prasad et al. 2001.

REMOTE SENSING AIDED APPROACHES

A search of literature reveals that the use of remote sensing for TOF assessments has not been widespread. In a large part, low spatial resolution data from satellites, high cost of aerial photographs and the inability of the hitherto available remotely sensed data to provide TOF specific information have been some of the limiting factors in the use of remote sensing for TOF work. Kleinn (2000) argues that of the three levels of tasks involved in TOF assessments namely Land use classification and Mapping; tree cover class identification and measurement of tree characteristics, remote sensing is particularly suitable for the first two. Figure 1 summarizes some of the important limitations and challenges suggested by Kleinn for using remote sensing for TOF assessments. The cost of high-resolution satellite data and equipment and expertise required for analysis can also be prohibitive in using remote sensing techniques for TOF surveys.

Inspite of these inherent limitations, remote sensing has been used for TOF assessments. Wood sources in non-forest areas have been estimated in Sri Lanka during 1981-83 using aerial photographs and satellite data (Pandey, 2000). The study was successful in assessing non-forest areas having good crown cover but could not isolate sparsely vegetated patches or isolated tree clumps.



After Kleinn, 2000.

Figure 1. Some of the important limitations and challenges for the use of remote sensing for TOF assessments.

In the Indian context however, there have been no major attempts in the past to use remote sensing in TOF surveys. Recently Ashutosh (2001) has attempted to use IRS I-C LISS III & PAN data in the Bijnor district of Rajasthan for mapping TOF and analyzing the tree cover map in GIS for suggesting an inventory design.

The methodology essentially uses satellite data to identify TOF patches through digital classification. Principal Component Analysis was used to first segregate tree vegetation from agricultural vegetation. The remaining area (minus the agricultural vegetation) was then classified using a hybrid classification strategy involving isodata clustering and maximum likelihood classification to map TOF patches. Out of the total 338 Sq. km of forest area for Bijnor (which is 7.4 % of the geographical area of this district), this study estimated that TOF resources in the district occupy 2360.2 ha. The TOF distribution (coverage/occupancy) assessed in these areas included 1.91% area of 60m buffer along canal, 17.10% area of 40m buffer along road and 5.42% area of 1 Km radial buffer around villages.

The analyzed data (raster) was vectorized into a GIS layer to facilitate development of an inventory design. The minimum size of the TOF patch considered for mapping (and vectorization) was 0.2 ha. The TOF patch size was then used as a basis for generating three homogenous strata and assigning patches to different strata (Table 5).

Table 5. Stratums and polygons identified after considering TOF Patch Sizes

Strata Number	Strata Criteria	Number of Patches Qualifying for this Strata
Stratum I	Patches of size between 0.25 – 0.1 ha	12088
Stratum II	Patches of size between 0.1 – 1 ha	3321
Stratum III	Patches of size >1 ha	214

Source : Ashutosh, 2001.

Samples were then drawn from these strata and enumeration work using ground survey techniques was undertaken for the selected patches. The ground enumeration and data analysis work is currently under progress and is likely to be completed soon. As results of the enumeration come, it will be useful to see how successful and accurate the classification has been to identify TOF patches. As the Bijnor district of Rajasthan is a relatively dry area with sparse vegetation cover, classification success in locating TOF patches may not be replicable in more vegetated areas where spectral confusion could be substantial.

Although not specifically directed towards TOF assessments, Rathore (1999) has demonstrated the potential of a model aircraft fitted with an ordinary camera for rapid low cost qualitative aerial surveys of tree resources distributed in a relatively small area. A model aircraft having a five feet wing span (figure 2), was fitted with a simple auto focus, auto film advance camera (Minolta AF-E) loaded with a Kodak 400 ISO colour film. The camera was placed in the belly of the aircraft looking vertically down at the nadir.

Photographs taken from this craft (figure 3) show that identification of species and count of trees can be easily done for sampling units spread in a local area. As photographs generated from this platform lack the geometric qualities of conventional aerial photographs, quantitative estimation of individual trees is not possible. The aircraft can also easily support small sized camcorders, which can provide instant results on completion of a survey sortie. The aircraft is very economical to operate with the cost of obtaining 36 colour photographs in about 10 minutes of flying time being around 7 US dollars (inclusive of fuel, film and processing in India). The craft can be launched by hand and its flight is controlled using a remote controlled device from the ground. The use of this technique can provide accurate tree counts, approximation of girth classes based on canopy cover and species identity serving as an invaluable TOF survey aid. It can also be used to support satellite data analysis by providing excellent ground truth information and aiding signature extraction.

With the availability of IRS PAN data having 5.8 meter resolution and IKNOS Panchromatic and Multispectral data having 1 and 4 meter resolutions receptively, many constraints faced in the use of remote sensing techniques for TOF could now possibly be resolved. Leatherman (2001) reports on a project underway to map trees in the Washington metropolitan region covering an area of 634 square miles. The project proposes to use IKONOS data to map every tree in the region. It is suggested that the information through the survey would provide thematic layer information in a GIS permitting tree information to be viewed with other planning parameters. The methodology developed as part of this project will be replicated at other sites.

In the near future, new and emerging remote sensing technologies may lend themselves for TOF assessments. For example, in the last few years, there has been considerable interest in the Lidar (Light Detection and Ranging) remote sensing. Lidar data has been found very useful for forest inventory and volume estimations. Means et. al.(2000) have used Lidar based techniques on 50m by 50m experimental plots in Oregon USA. These plots had all developmental stages of vegetation, which included shrub dominated, young, mature an old growth cover. They were able to accurately estimate stand characteristics such as height & volume using regression analysis based on lidar and ground data. Means et. al. have estimated that on a comparable basis, an inventory involving 14 weeks and $32,000 could be done using lidar methods in 10 weeks costing $15,000. They have indicated that the technology has good potential for non-forest cover estimations such as mapping vegetal cover along streams. The availability and costs of the use of this technology may however be prohibitive for large area TOF studies currently.

With particular reference to India, the cost of using high-resolution satellite data like IKONOS (or even IRS PAN) for large area TOF assessment is currently prohibitive.

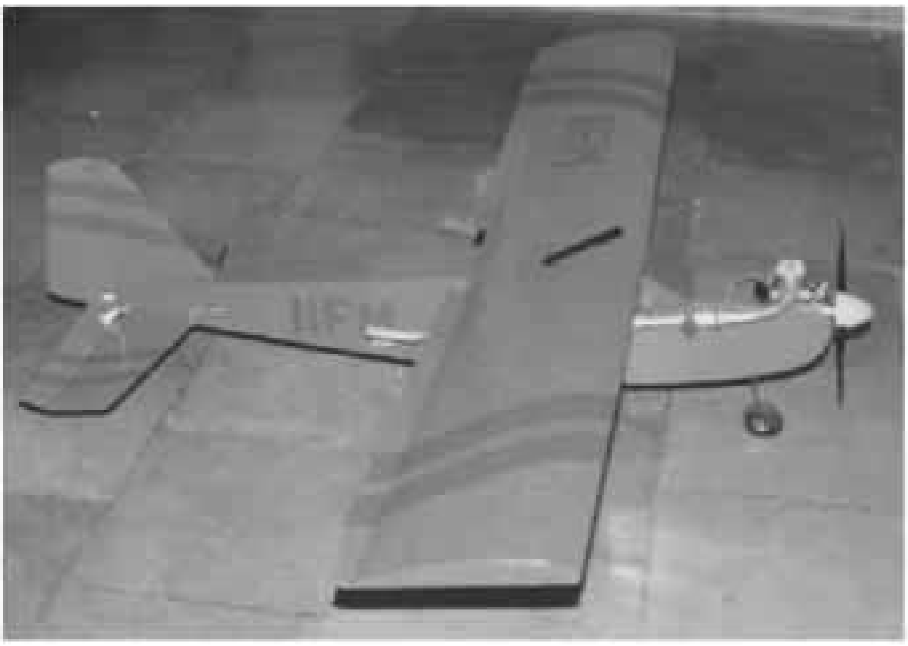


Figure 2. Model Aircraft developed at IIFM for taking low cost pictures

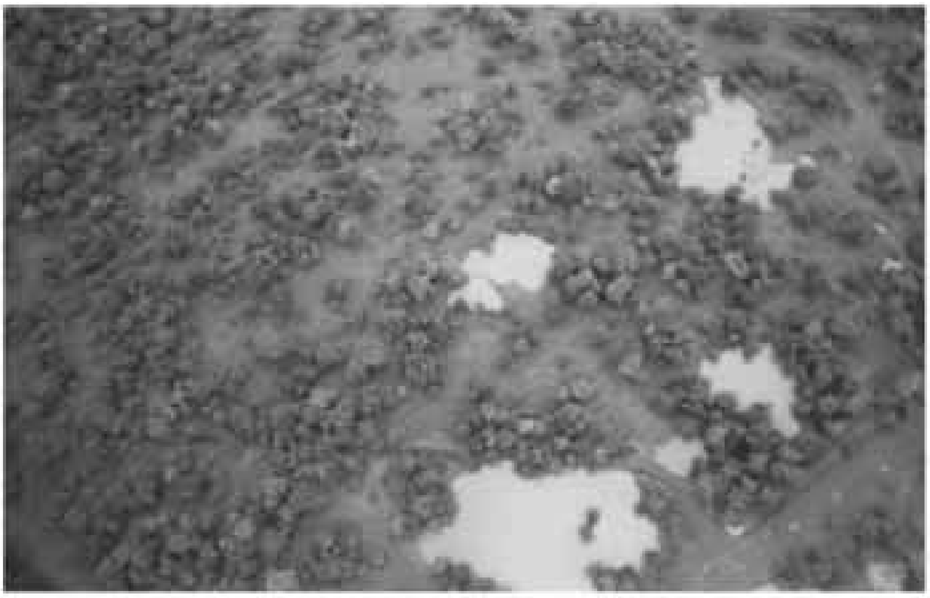


Figure 3. A picture taken from the model craft showing individual trees

As field studies cannot be avoided altogether even with the use of remote sensing, ground based sampling is currently a cheaper and more accurate option. Although, the combination of IRS PAN and LISS-III data has potential for TOF assessments, more studies would be required to standardize and integrate remote sensing techniques with ground based information collection methods to cover the full range of TOF information issues. The use of GIS to view TOF information with other data will also prove useful in preparing management plans.

EMERGING PERCEPTIONS ON TOF MANAGEMENT IN INDIA

In a large part, TOF resources in India are distributed over community lands, revenue lands, common village land and private land. Traditionally, the provisions of the Indian Forest Act of 1927 have largely influenced TOF management in India. With reference to implications on TOF conservation and management, Chapter V of the Indian Forest Act (1927) details instruments for 'control over forest and lands not being property of the government' (Table 6). This act has provided the basic framework for enactment and adoption of forest acts and rules in different states in India. Through many legal and executive provisions under this legal ambit, tenural rights to own, fell, transport and dispose TOF resources are defined and enforced by state governments. Provisions of the Land Revenue Codes of different states also govern tenural rights of TOF resources on revenue lands. For a long period, these tenural laws and regulations have not provided much incentive for growing trees on private lands being regulatory in nature. Rather in some ways, they have created disincentive for tree cultivation on private land.

Table 6. Sections of Indian Forest Act 1927 for control over Non-Government forests and lands

Section	Provisions
Section 35	Protection of forest for special purposes.
Section 36	Power to assume management
Section 37	Expropriation of forest in Certain purposes
▪ Section 38	Protection of forests at request of owners
Section 41	Power to make rules to regulate transit of forest produce.

Srivastava (2001) provides an excellent and detailed analysis of the legislation in India for non-forest lands. This detailed analysis of the legislation of various state governments reveals that most laws have been extremely regulatory in their legislative intent.

In the recent past however, there has been a perceptional shift drawn out of the above scenario where state forest departments are envisioning a change in their role of being regulators to enablers and facilitators. The Lok Vaniki Act (M.P. Act No. 10 of 2001), adopted recently by the Madhya Pradesh (MP) Government epitomizes this perceptional change that aims to substantially improve management of private forest lands and encourage management of TOF resources on community lands through participatory effort.

The objective of the Lok Vaniki act "is to regulate and facilitate management of tree clad-private and revenue areas in the state of Madhya Pradesh and matters connected therewith or incidental thereto." In summary, the act empowers farmers to manage and extract benefits form their land by selling forest produce and timber. As an enabler, the role of the government is to dilute prohibitory laws , encourage participation of people and pull out once the system is set. As part of the Lok Vaniki scheme, it is required that private holdings be brought on record and a management plan be prepared by a chartered forester. The plan has duration of 15-20 years and stipulates prescriptions for scientific management of trees on private lands. Some salient features of such management plans include provision for felling only those trees that are above a certain girth, trimming of branches to open tree canopy and provision to fell upto four to five percent of trees annually (CSE, 2001). Another notable feature of the Lok Vaniki act is that the landowner is required to submit an annual 'Self Assessment Return' to the Divisional Forest Officer providing status of the implementation of the management plan & comparative assessment of actual and estimated. The act also prescribes that all land for which management plans have been prepared under the Lok Vaniki scheme will remain out of the purview of the land revenue code of MP with respect to permissions for felling of trees thus creating a single permission interface. Some specific provisions of the Lok Vaniki Act as highlighted by Srivastava (2001) are summarized in Table 7.

While the Lok Vaniki initiative can be considered a milestone act with reference to the TOF conservation, it needs to be seen how effectively deviations (stated in 'Self Assessment Returns´) from management plans would be monitored and how corrective action for such deviations would be implemented on private land. The Indian Supreme Court's decision on it's December 1996 interim order suspending felling of trees (including private land) would also be a determining factor in the long term success of the Lok Vaniki scheme. There is an opinion that the penal clauses in the Lok Vaniki act outlined in sections 8 and 9 are quite stiff and in some way retain the bureaucratic legacy of earlier acts. The major penal clause in section 8 mentions that "any person who acts in contravention of the provisions of this act or rules made thereunder or who after having approved management for tree-clad areas, fells trees or removes trees or any logs of the trees from the holding included in the approved management plan shall be liable to such penalty which may extend to twice the value of the trees involved but not exceeding One Lakh (0.1 Million) Rupees " (MP Government, 2001). There in no provision in the Lok Vaniki act for individual trees or isolated small tree clumps.

Table 7. Summary of some highlights of the Lok Vaniki Act

Act Highlight	Details
An Enabling Law	▪ Removes regulatory intent. ▪ Reposes trust in people. ▪ Provides a legal framework suited to the requirements of an independent, democratic and modern India. ▪ Encourages owners of private forests and other tree clad areas to manage their natural resource on scientific lines. ▪ Encourages owners to assume responsibility of management themselves. ▪ discourages clearing and conversion of area for non-forestry purposes. ▪ Strengthens village institutions, empowers people.
Provides Technical Forestry Knowledge to People	▪ Chartered Foresters bring in scientific management expertise.
Provides for Self Assessment by the Owner of Private Forests	▪ Individual Assess himself through an annual Self Assessment Return. ▪ Assessment records status of implementation of management plan, estimated & actual yields. ▪ Encourages owners to invest in management of their forest exclusively as a private enterprise without any burden of sharing with the Government, anything from their profit.
Provides a Single Window	▪ areas covered by management plan under Lok Vaniki to remain outside the purview of the MP Land Revenue Code 1959. ▪ No need to go to multiple agencies for permission to fell trees.
Impetus towards Collective Mobilization and Organization Building	▪ Promotes organization and coming together of owners to from associations to influence policy makers and cope with market fluctuations.

Summarized from Srivastava, 2001.

Another facet of the enabling process to facilitate better TOF management in India is through a move to include community forestlands in the ambit of Joint Forest Management (JFM). The Indian forestry sector in tune with the Indian National Forest Policy of 1988 has been an active proponent of JFM. Most states in

India have adopted JFM resolutions and have implemented JFM on a large scale with a view to encourage village and community based institutions in managing forests.

There are however institutional and operational concerns that have been raised by a number of workers in context of JFM that may have some bearing on the success of similar initiatives for TOF management and conservation. Jeffry and Sundar (1999) challenge some of the assumptions in community participation particularly focussing on the manner in which 'community' and 'participation' are being perceived by the forestry sector in India. Supported by a number of cases by noted workers, Jeffry and Sundar have expressed a view that the manner in which JFM is being operationlized is resulting in the creation of a new 'moral economy'.

Such a situation according to them stands to further curtail customary and legal rights of the least privileged sections in the village society to natural resources. Long and Nair (1999) have examined some sociopolitico-institutional constraints to TOF development as widely adopted systems. The absence of a national policy on common lands has also been attributed by some as a possible reason for management problems for TOF resources.

CONCLUSION

This paper has attempted to present an overview of the resource assessment and management scenario for TOF resources with a focus on India. Like many other countries of the world, there is insufficient data on TOF resources in India. Looking at the role that TOF is playing as provider of environmental goods and services, there is an urgent need to develop institutional partnerships for carrying out large-scale TOF assessments. It is our view that TOF assessments on a national level require a strong collaborative framework of institutions and organizations working together for collecting TOF data. Such a framework is currently lacking in the country. It is strongly felt that if work of this magnitude has to be completed and systematized on a timely periodic basis, a partnership programme involving FSI, state forest departments, research organizations, academic institutions, NGO's and other related agencies would have to be created.

There is also an urgent need to standardize TOF resource assessment methods. The integration of remote sensing techniques with ground surveys will provide wide area coverage in shorter time spans saving costs. It is however felt that it may not be possible to altogether eliminate ground based data collection looking at information requirements of TOF assessments. Higher resolution data in the near future coupled with new remote sensing technologies like lidar will add accuracy to assessments and reduce survey time spans.

TOF management so far in India has been governed by largely regulatory forest legislation. With acts like the MP Vaniki act, a noteworthy effort has been initiated by the MP state government to express its intentions as an enabler and facilitator in TOF management. Strengthening of such legislation and adoption of similar schemes by other states in the country could have a marked impact on TOF conservation.

In conclusion, it will be worthwhile to stress that TOF assessments should be designed to include information collection over the full range of TOF issues that are used to justify the importance of TOF as a resource. Such a focus will help in creating a comprehensive TOF information structure that can be used to provide inputs for policy making.

ACKNOWLEDGEMENTS

The authors would like to thank Dr. D.S. Ravindran and Dr. R.K. Singh, Associate Professors at the Indian Institute of Forest Management Bhopal, and Mr. Pankaj Srivastava of the MP Forest Department for helpful discussions and comments.

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TC/D/Y4374E/1/12.02/1000