Technology and Forest Management (Group C)

The Need for Multi-tier Technologies

Forest plantations generally provide a uni-tier tree crop. In contrast, irrespective of climatic conditions, the natural forests are multi-tiered with canopies differentiated into grass, shrubs, herbs, and ground vegetation. When the social forestry programme was started in India, the bias for trees continued. Even short rotation silviculture meant a fairly long gestation period for the beneficiaries, and an early and regular flow of benefits to the beneficiaries that could act as incentives to involve them in protection and management hardly took place.

A uni-tier plantation vis-a-vis a multi-tier one has other drawbacks, namely, the former does not fully mitigate the reasons for degradation and does not introduce a technology that would improve site productivity. To remove the drawbacks it is necessary to: (a) grow or restore vegetation (which is also cheaper than structures); (b) establish all vegetation on contours; and (c) differentiate the vegetation into trees, shrubs, legumes, and grasses in separate tiers that will be multipurpose, satisfy local ecological practices, and provide a character akin to a natural forest.

-- Prabhir Guhathakurta, "Switch-over from Uni-tier to Multi-tier Plantations". Paper delivered at Hattiban.

Social forestry's overwhelming concern with supplying fuelwood, together with deeply ingrained forestry training, led to the use of only slightly modified traditional plantation and forest management models. Budgetary constraints, the need to show quick results, and the desire to maximise fuelwood production on relatively short rotations frequently led to monocultures of easily established species such as eucalyptus in the plains and pine in the mountains. Partly in response to NGO criticism, these monocultures were gradually reduced in favour of multipurpose tree species more responsive to perceived community needs -- although farmers continued to plant these species in response to perceived high-market returns. Technology concerns in community forestry focussed on the selection of the right tree species.

However, even the multipurpose species currently used, and the silvicultural models for natural forest management, most often advocated and continued to emphasise uni-tier tree species planted at close intervals to maximise tree product production. Although attempts were made to reduce harvesting rotations from the traditional 40 to 120 year cycles to between seven to 20 years where possible, many years of no returns are interspersed between the bounties of a cutting year. In the meantime, canopies of growing forests close and the grass and other non-timber forest products which sustain communities with annual benefits tend to decrease radically. From traditional forestry perspectives, the mean annual growth increments are being maximised; from the community's perspective the mean annual returns are being minimised. Their motivation to protect the forest is frequently low and the amount of trees ready for harvest at the end of the rotation far less than anticipated.

Concurrently, heightened scientific and public concerns with environmental impacts also lead to a questioning of current community forest management technologies. Exclusive reliance on tree production for fuelwood, poles, and fodder leaves in community forests, especially in the fragile Himalayas and also in the sloping areas of much of India, has blinded practitioners to the often heavily eroding ground underneath. A combination of people and livestock trying to collect whatever leaves and grass they can while the trees grow, and the close spacing often used, results in the loss of ground cover which is the primary cause of surface erosion and soil loss. Trees are deprived of the moisture which could have hastened their growth and the poor people are deprived of the non-timber forest products upon which they depend for up to 20 to 40 per cent of their income (N.S. Jodha, *Common Property Resources: A Missing Dimension of Development Strategy*. World Bank Discussion Paper No. 169, 1992). The biodiversity of species is reduced.

Fortunately, inspirational examples of new directions are emerging in West Bengal (see boxes) and other areas of JFM in India. It is being increasingly recognised that **technology is the social, economic, and environmental heart of community forestry; that new technologies which build on traditional forest use patterns are as necessary – and easier to introduce -- as appropriate community institutions.**

Short Rotation Sal Coppice for Community Forestry

Research on the technology for the management of short rotation coppice **sal** had been carried out and was adopted successfully. If managed with the close involvement of user communities, the coppice system holds prospects of being a very cheap and widely replicable technology that could revegetate much of India's 18 million hectares of degraded forest lands, although with **teak** more expensive artificial regeneration can be resorted to in case of the failure of the coppice system or want of denovo (natural seeding) regeneration. If right management practices are pursued, there is little chance of declining sustainability with **sal**.

-- P. Guhathakurta, "Is Management of Coppice Sal (Shorea robusta) Forests on Short Rotations Sustainable?" Paper presented at Hattiban.

Technology Alternatives for the West Bengal Forestry Project

The incorporation of social, economic, environmental, and productivity concerns into the specification of available technical treatments has resulted in some significant changes in the treatment models proposed for the project over those used during the past decade. Previous plantation models were designed to maximise timber and fuelwood production. Planting densities of 2,500 to 15,000 or more seedlings (including dense sowing) per hectare were used to increase production and to ensure some survival after inevitable human and cattle damage. Even with 50 per cent survival, such densities ensured that crown cover eliminated most grass growth within five years, and the competition between closely spaced trees has frequently retarded growth in both private and public plantations. The species selected by the Forest Department and individual farmers, primarily eucalyptus and acacia, provided no by-products except leaves. No inputs were provided to increase the production of any other annually harvestable NTFPs. As documented by the IBRAD studies and field observation, such plantations not only fail to arrest erosion effectively, but they fail to provide local people with the flow of annual benefits which encourages better protection and management.

The treatment models proposed for selection (and suitable modification), by the FPCs and farm households in the project, are designed to redress these problems by the application of the following basic changes.

- Recommended **spacing** between planted seedlings has been substantially increased (usually to 4m x 1.5m) to allow for perennial vegetative production between rows and increased plant productivity.
- The **variety of species** to be made available for local selection has been markedly increased, with greater reliance placed on indigenous multipurpose coppicing and pollarding species which increase NWFP production and reduce reinvestment costs.
- Provisions for **intercropping** of legumes, fodder grasses and shrubs, edible crops, and other income-producing perennial understory plants, by participating FPC members and individual farm households, have been made for most treatments.
- Recommended management prescriptions have been changed to favour the development of **different age FPC forest blocks** in order to promote the continuous availability of a variety of NTFPs, including those which require young plantations (e.g., grasses and legumes) and those which are produced in more mature forests (e.g., seeds and fruit).

Each of these technology changes has been checked with existing and potential future FPC members (i.e., in North Bengal). A surprising unanimity of opinion supporting these changes was found not only among local villagers but also among local range officers and forest guards who deal most closely with the local people.

The need for **intercropping treatments** and **multiple-objective forest management** providing a flow of NTFPs is greatest on forest or other public lands that are used or claimed by both the government and the local people. It is in these areas of overlapping and ambiguous tenure, or **commonly used resources**, that joint management provides the best-known method for increasing the chances of forest (including plantation) survival. Equitable benefit-sharing arrangements, which provide sustained motivation for all parties involved to protect the forest, are partly a function of the technologies selected and partly a result of policy decisions. Where tenure and use is less ambiguous and overlapping, such as on the large tracts of interior forest areas and on private lands, the social need for multi-tier forests and significant benefit sharing is less imperative. However, there may still be compelling environmental and technical reasons for encouraging this kind of treatment and the challenge to the project will be to extend such treatments into production forests managed exclusively by either the Forest Department or individual farm households.

-- J. Gabriel Campbell, "West Bengal Forestry Development Project Appraisal Report", Annex, World Bank, 1991.

Participants on the panel on technology and forest management focussed on the technology development process which can work and the changes needed to support such environmentally sound community-oriented forestry. This was developed into a matrix organised around the key issues and objectives (see matrix).

TECHNOLOGY AND FOREST MANAGEMENT MATRIX

	ISSUES	WHAT WORKS/ CAN WORK	CHANGES NEEDED
1.	Technology and management depends on people's needs and expectations.		
a.	assessment of indigenous technologies and management systems	PRA/PRA techniques, ground observations, use of secondary data, historical data	training for forest officers, field staff in methodology
b.	screening of new technologies • individual species level • multiple species mixture • silvicultural practices • area management	literature review, demonstration, analysis of packages	user orientation which is location specific, flexible, promotes diversity, and offers both early and regular benefits
2.	Rapid Research and Experimentation		development of methodology, identification of appropriate persons, field networking
3.	Incorporating economic aspects	PRA/PRA techniques, extrapolation, coefficients	studies of yield and mensurational data, cost-benefit analysis, market analyses; use of valuation technique, including environmental values
4.	Training/Education (of Forest Dept., Communities, NGOs)	workshops, cross visits, field demonstrations	upgrade curriculum, offer follow-up training, encourage integration between departments
5.	Processing and marketing of forest resources	appropriate technologies, market linkages, low levels of capital inputs based on sustainable resources	encourage marketing of non-timber products, training in local value-added processing, bank credit and infrastructural support services
6.	Forestation/Natural Forest Management	regeneration	promotion of high-value, market-oriented products grown in both vertical and horizontal strata

Since technology and management depend upon peoples' needs and expectations, a variety of methods are needed to ensure that **indigenous techniques and forest management practices are adequately assessed**. This will require developing an appropriate package of methods using new techniques of rural appraisal, together with traditional ground observation and the analysis of secondary data. A long-term training effort will be required to transfer these skills to the staff and officers who need to implement them in the field.

New technologies need to be screened at a variety of levels. In contrast to traditionally used criteria, these technologies need to be user-oriented and locale-specific. These technologies must provide diverse and flexible options with early and regular benefits. Suggested examples of such technologies for the eastern Himalayas are provided by P. Guhathakurta in the attached graphs.

The **gestation period for obtaining research results need be shortened** by developing an appropriate methodology and identifying specific personnel to carry it out. **A far greater emphasis is needed to incorporate economic considerations into technology research and evaluation.** Currently, communities, rangers, and farmers do not have adequate information, particularly economic information upon which to base wise management decisions. Mensurational studies, community forest yield data, market studies, and cost-benefit analyses are urgently needed and sadly lacking. Valuing environmental costs and benefits within the analyses -- a field which is just developing --is especially critical to sound technology choices.

Given the greater resources and time that traditional research studies consume, and the urgent need for immediate decision-making at the ground level, **participatory (or rapid) rural appraisal (PRA/RRA) techniques are becoming increasingly important as a tool for community forestry.** As recently developed and refined, this approach to rapid, participatory data collection and analysis makes use of a variety of interactive and graphic tools diagnosing problems and identifying solutions. In PRA/RRA the medium is part of the message: in the process of interactively identifying and analysing forest management issues, the group undergoes a self-learning experience which itself can engender better community management.

To widely introduce the new technologies needed, improved **training and education for forest department personnel, NGOs, local communities, and donors** will be required. So far, workshops, field demonstrations, and exchange visits have proved most useful. These need to be supplemented by upgrading curriculum, continued in-service training and follow-up activities, more feedback (two way arrows again), and integration among departments.

Increase Status of Training

There is a consensus that reorientation and training are perhaps the most essential elements in implementing the attitudinal and institutional changes necessary to support JFM over the long-term. Unfortunately, training is not accorded a high priority in the government bureaucracy, so any structural changes in status and content will need to be supported by policy revisions.

-- Betsy McGean, ed., "NGO Support Groups in Joint Forest Management: Emerging Lessons". Ford Foundation Sustainable Forest Management, Working Paper Series No. 13, New Delhi. 1991.

Technology has an important role to play in increasing the **benefits from processing and marketing of forest resources**. The appropriate technology for this task has easily established market links, low capital inputs, and increased local value-added benefits. Many of these technologies will be based on non-timber forest products. However, high quality ecological research will be required to make sure that it is based on sustainable resources.

Similarly, the plantation and natural forest management regimes to be established need to reflect the market-oriented product requirements of the community. Silviculture needs to examine the specific regeneration needs of the community forest's most important products, which, in many cases, is not the timber production for which most management systems have been developed. The multiple, vertical, and horizontal strata of multi-tier forests require new mensuration techniques and new harvesting and regeneration technologies.

MULTI-TIER MODELS

Fig. 1: Lower Mountains: (a) Eastern Himalayas/Hills

Spatial distribution %

- Trees (80)
- Shrubs (10)
- Grasses & Legumes (90)

Plantation Elements

Trees (top)	Shrubs lower	Legumes lower	Grasses
Option 1: Short rotation			
Acrocarpus fraxinifolius Albizia procera Ailanthus excelsa	Murraya koeniggi Hibiscus sabdorffa	Leucaena leucocephala Crotolaria juncea Stylosanthes scabra/hamata	Penisettum pedicellatum Cynadon dactylon Vetiveria zizanioides
Option 2: Long rotation			
Shorea robusta Schima wallichii Michelia champaca Terminalia tomentosa	Tabernaemontana coronaria Coffea bengalensis	Albizia amara Cassia occidentalis Stylosanthes scabra/hamata	Chrysopogon montanus Cenchrus ciliaris Vetiveria zizanioides

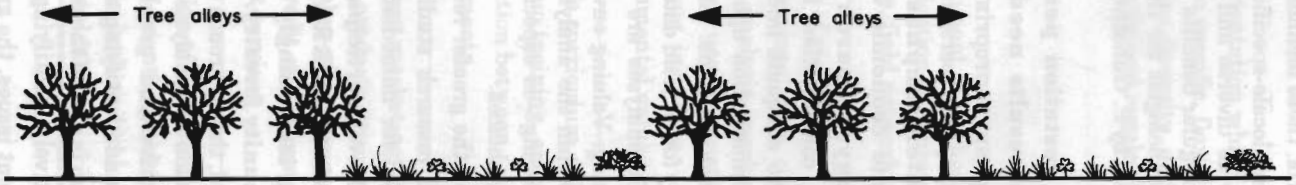
- Trees
- Shrubs as hedgerow
- Legumes
- Grasses

(b) Western Himalayas – Alternative I

- Trees (40)
- Shrubs (5)
- Grasses & Legumes (65)

Acacia catechu Albizia lebbek Grewia oppositifolia Celtis australis	Vitex negundo Dodonia viscosa	Indigofera spp Desmodium gyroides	Setaria anceps Penisetum (Napier) Vetiveria zizanioides

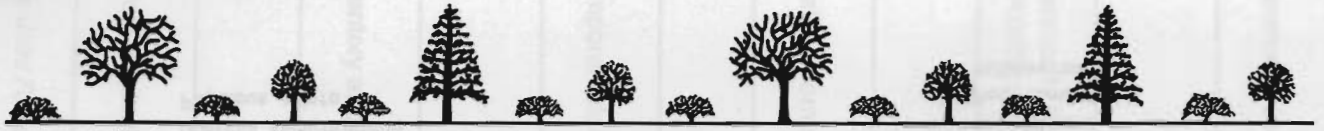
Alternative 2



- Trees (50)
- Shrubs (5)
- Grasses & Legumes (45)

Bauhinia purpurea Dalbergia sissoo	Carissa spinarum Capparis spinosa	Cassia occidentilis Sesbania bispinosa	Chloris guayana Eragrostis curvula Vetiveria zizanioides

Fig. 2: Middle Mountains: (a) Eastern Himalayas/Hills – Alternative I



Spatial distribution %

Trees tall (25)
Trees medium (25)
Shrubs (50)

Plantation Elements

Trees (top)	Trees (middle)	Shrubs (lower)	Legumes (lower)	Grasses including bamboo
Symingtonia populnea	Eurya japonica	Berberis lycium		Penisettum pedicellatum
Betula cylindrostachys	Symplocos craetigioides	Rosa macrophylla		Cynadon dactylon
Cupressus		Daphne cannabina		
Cashmeriana				
Pinus kesiya				

Trees (broadleaved)
Trees (conifer)
Trees (medium broadleaved)
Shrubs as hedgerow
Legumes
Grasses (tall)
Grasses

Alternative 2

Trees tall (25)
Trees medium (25)
Grasses tall (50)

Betula cylindrostachys	Ficus (the fig group)	Buddleia paniculata	Thysanolaena agrostis
Alnus nepalensis	Sauraria nepalensis	Quercus serrata	Arundo donax
Populus gamblei			

(b) Western Himalayas

Trees (40)
Shrubs (20)
Grasses & Legumes (40)

Populus ciliata	Quercus incana	Trifolium	Festuca spp
Ulmus wallichiana	Rhus parviflora	Subterraneum/	Phalaris tuberosa
Robinia pseudoacacia		pratense	Lolium parenne

Fig. 3: Upper Mountains: (a) Eastern Himalayas

Spatial distribution %

Trees (30)

Bamboo (70)

Plantation Elements

Trees (top)

Betula utilis
Populus ciliata
Abies/Pinus/Tsuga

Grasses including bamboo

Arundinaria maling/ falcata

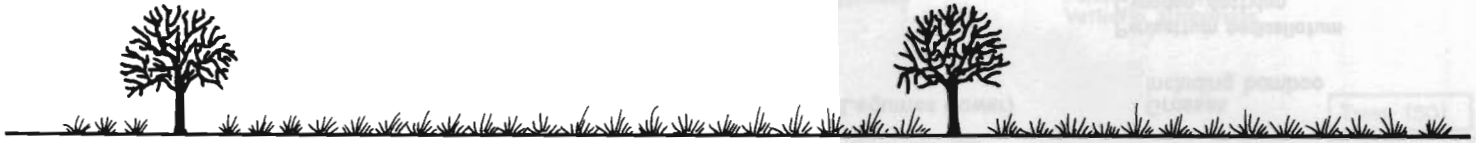
Trees (broadleaved)

Trees (conifer)

Bamboo

Grasses

(b) Western Himalayas



Trees (15)

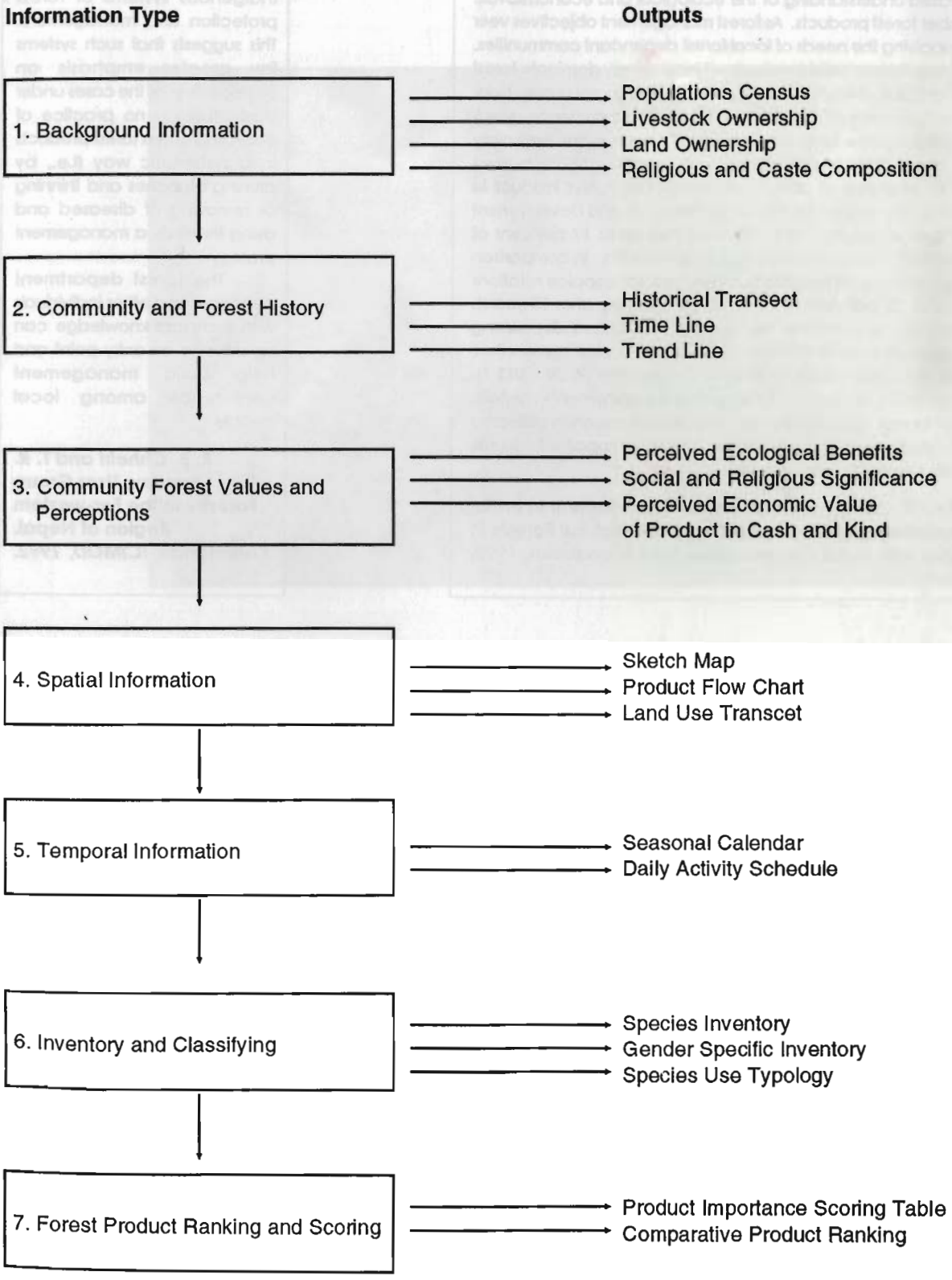
Grasses & Legumes (85)

Acer pictum/oblongom
Quercus semicarpifolia
Populous ciliata

Festuca rubra/ arundicacea
Poa compressa/ bulbosa/ampla

Source: P. Gahathakurta. Switch-over from Uni-tier to Multi-tier Plantations, New Delhi: World Bank, 1992.

PRA Steps for Profiling Community-Forest Relationships



Source: *Joint Forest Management Field Methods Manual, Vol. 1: Diagnostic Tools for Supporting JFM System. SPWD*

Non-timber Forest Products

To maximise benefits for multiple uses innovative silvicultural systems, will need to evolve with the input of traditional knowledge and increased understanding of the ecological and economic role of non-timber forest products. As forest management objectives veer towards supplying the needs of local forest dependant communities, the role of non-timber forest products will increasingly dominate forest management and silvicultural decision-making in many areas. Non-timber forest products play a vital role in meeting subsistence needs and providing income to forest-dependant communities, especially tribals. A major study of non-timber forest products (NTFPs) in West Bengal (K.C. Malhotra et al. *Role of Non-timber Forest Product in Village Economy*. Institute for Bio-social Research and Development Working Paper, Calcutta, 1991) indicates that up to 17 per cent of tribal household economies were made up of NTFPs. In comparison to a share in polewood harvests from ten-year sal coppice rotations (calculated as 25 per cent of Rs 16,500 per hectare after 10 years), which works out to Rs 412 per hectare per year before discounting the annual returns from NTFPs from a forest after five year's protection, calculated at a mean value of Rs 2,700 per hectare (Rs 28 = US$ 1). Furthermore, NTFPs are seasonal; they provide employment in periods when other labour opportunities are scarce; they are often collected and marketed by women and children; and have important cultural, religious, and aesthetic values as well.

-- *Jeffrey Y. Campbell*, Joint Forest Management in India: Regenerating and Managing Degraded Natural Forests in Partnership with Local Communities. *Ford Foundation, 1992.*

Silvicultural conservativeness certainly is present in the indigenous systems of forest protection and management. This suggests that such systems lay greater emphasis on protection. In all the cases under study, there is no practice of collecting green forest products in a systematic way (i.e., by pruning branches and thinning or removing of diseased and dying trees) as a management strategy.

The forest department personnel and other individuals with technical knowledge can take this as an entry point and help build management confidence among local people.

R. B. Chhetri and T. R. Pandey*, User Group Forestry in the Far-western Region of Nepal. *Kathmandu: ICIMOD, 1992.

Hypothesis No. 18

Management of natural forest is more cost- and time-effective than plantations and is more likely to be successful from both an internal and external perspective.

Messerschimidt et al.* Forest User Groups in Nepal: Perspectives on What Works and Why. *1992