# Making forestry in India sustainable

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*Being largely dependent on natural forest stands, India's forestry even today is mostly in hunter–gatherer stage. This is going to be increasingly untenable because of the escalating demand for wood and wood products much beyond the mean annual increment of India's natural and man-made forests. Self-sufficiency in forestry is no less important than in food, space science, atomic power, drugs and military hardware. In fact it is equally if not more important because with forestry is tied India's long-range ecological and economic security. To achieve this, leadership in forestry must pass from the present-day so-called self-proclaimed social and management experts, to the professional foresters who are sound in science and technology. Wood imports will become increasingly difficult on environmental considerations, therefore, the country has to swing into action and plan to achieve self-sufficiency in wood in the next 30–50 years. To be sustainable, it would involve considerable inputs of upstream hardcore S&T, rather than mere social palliatives at present being supported by most international funding agencies.*

ESCALATING wood demand, faulty implementation of the forest policy coupled with undue political and public interference at the local level, and 'caving in' of the Indian Forest Service under populist and political pressure, have, over the years, turned India into a wood-deficit and wood-importing country. This has led to a situation where populism dominates in the area of forestry in place of forest science and technology. Associated with this is the decline in forest cover, accompanied by considerable environmental, social and economic decline. If this decline is not halted, its pace will increase with time. The ultimate result would be that the country may head towards an irreversible desertification on a large scale in the Gangetic Plains which is our bread-basket.

In recent years there have appeared a plethora of publications on Indian forestry. The most notable of these is Gadgil and Guha's[1] treatise written from a historical perspective. Many seminars have been held, and projects sanctioned by international funding agencies to several organizations. A typical example of this is a seminar with 'five-star' lavish hospitality held in India with the support of a foreign agency[2], the outcome is a report that is pedestrian in content. The irony is that such five-star seminars in air-conditioned rooms deliberate on India's poor and poverty! The underlying science and technology of forestry has seldom if ever been mentioned even by default. Furthermore, the vacuum in Indian forestry has created many shades of 'foresters'. This is indeed an unfortunate state of affairs. It appears as though forestry in India is being subtly undermined by international organizations and funding agencies.

The basic problem in forestry in India is the widening gap between supply and demand of wood on account of over-population as compounded by low-productivity of the planting stock. The result is that yields are dismally low: the lowest in the world per unit of area and time. This aspect has never been discussed. On the contrary, the present day forestry crisis has been shown to be a result of wrong management and non-involvement of the people at large. It is claimed that people have all the knowledge to make forestry work. However, no one doubts the importance of the *local technical knowledge and wisdom*, but there is considerable 'chaff' from which 'grain' has to be separated. This knowledge needs to be systematically unearthed, checked for its veracity and then dovetailed in an overall forest strategy.

The most pressing problem is the enhancement in productivity which can be raised only by application of forest tree genetics and breeding together with some aspects of biotechnology and supported by appropriate silvicultural practices. These aspects have never been discussed. As in agriculture, people's action will follow only when improved and highly productive varieties of forest trees become available. There can be dramatic increase in yield if such cultivars are used in place of plantations raised from seed from the unselected wild stock. Thus for the same effort, money and time, there would result tremendous gains for the poor. The most

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pressing need, therefore, is that Indian forestry needs heavy scientific and technical inputs for making it sustainable.

Forestry is today a big business outside India. At the root of such success is the strong input from S&T in forestry coupled with relevant social and economic aspects. The best example of this is Sweden[3]. Unfortunately, funding agencies have seldom supported forest tree genetics and breeding in India. Most agencies have supported the so-called social palliatives. It appears as though vested interests both in India and abroad are undermining India's forestry plans so that this country continues to remain a wood-deficit and wood-importing country. Thus the country will continue to be embroiled in populist issues, and be a perpetual buyer of wood and wood products from abroad. Then wood will become a *political weapon* to be used against India at an appropriate time. The country was in a similar situation in food some four decades ago. Thanks to a total understanding between the then enlightened and outstanding political and scientific and technical leadership, India became self-sufficient in food, and today it feeds itself without going round the world with a begging bowl. Associated with this success, there have been some ecological costs. Some environmentalists are concerned about it, but one need not worry on this account, because these costs are entirely manageable. India now needs to ensure high production and productivity in forestry to meet the needs of wood for its increasing population.

There is need to bring about a Forestry Revolution based on lessons from India's Green Revolution. The basic input to Green Revolution was Borlaug's Dwarf Wheats which were specially architectured to give high productivity. These were evolved by the use of genetics and breeding followed by appropriate agronomy, disease and pest control, etc. The leaders of this revolution in India were internationally acknowledged agricultural scientists and technologists. It is time that there is a deep introspection in India about our forestry. Forests in fact guarantee long-range ecologic and economic security, together with soil, water, climate stabilization, biodiversity, etc.

## Facts about India's forestry

Unless the Government functionaries, foresters, scientists and technologists and the people of this country recognize the gravity of the situation in forestry, nothing tangible can be achieved in this area.

There are a lot of myths prevailing in forestry, and the facts are rather grim[4]. Some of these are enumerated below:

- Our close and *effective* forest cover (with a crown density 40% and above) was *only* 11.73% in 1990–91 (FSI, 1993) which is far below our declared national objective since Nehruvian times, i.e. to have 33% of our country under forest cover. The world average is also 33%. In other words, India is expected to have 110 million ha (total land area of India is 329 million ha) under close forest cover but it has only 38.56 million ha. This means that there is a deficit of about 71 million ha. Furthermore, the average forest cover should be 60% in the hilly regions, which, except in Arunachal Pradesh, is not the case in India.
- Open forests with a crown density less than 40% is 25.08 million ha, which needs conversion into close forest cover.
- India's per capita forest is only 0.1 ha, which is the *lowest* in the world; the world average being 1 ha per capita.
- The annual requirement of firewood, timber and paper and pulp of the country is *at least* 280 million $m^3$; but our mean annual increment from the forests is only 52 million $m^3$ (1.24%). The gap (228 million $m^3$) between demand and supply is increasingly widening and needs to be closed.
- Our productivity is 0.7 $m^3$ of wood per ha per year which is also the *lowest* in the world.
- Crisis in forestry in India is largely a crisis of firewood consumption, because firewood accounts for over 80% of wood use in the country. In addition, there are between 200 and 400 million cattle (more often derelict) which cause fodder crisis and compaction of the forest floor by trampling. This in turn also affects forest cover.

Firewood and grazing crises are very serious. Unfortunately, these facts have been pushed 'under-the-rug' particularly by most non-professional forestry actors. They connect forestry crises only to timber extraction by contractors. An objective analysis shows that forest destruction has been both need and poverty-related, and greed and affluence-related. Except in Jammu and Kashmir where firewood has been a part of forestry plans from the beginning, it is only now that firewood has entered the forestry agenda of other states. Furthermore,

- firewood as a source of energy is going to be relevant for the foreseeable future for a large section of economically poor Indians, and
- at present firewood comes to the megacities from far flung areas. More often it is transported by petrol or diesel-driven trucks and railway wagons. In fact the country may be spending far more energy in hauling firewood than it is recovering out of it.

The conclusion that one can draw from the foregoing facts is that unlike agriculture and animal husbandry (partly so in fisheries), in forestry the country is still

in the *hunter–gatherer stage trying to meet the needs of firewood, timber and paper pulp from natural forest stands*. Left to the international funding agencies, the country would remain embroiled in the same state of affairs. There is, therefore, an urgent need for a modern and dynamic outlook in dealing with forestry by taking lessons from a wood-surplus country like Sweden[3] where forestry is treated as ideal renewable resource.

It may, however, be pointed out that the forestry crisis is indeed manageable, and can be solved in the next 30–50 years if we start now chalking out a forestry strategy, based on science and technology and keep the good of the people at heart. This will help the country to prevent desertic conditions that have set in the Indo-Gangetic Plains which, according to M. S. Swaminathan, have the potential to be the bread-basket of the world. If unchecked, it will lead to economic decline. Furthermore, we must allow our forests to regenerate, and alongside we must take to forest plantations of elite varieties in a big way for solving our firewood and industrial wood crises. In addition, as indicated above, the biggest lacuna in forestry is the lack of modern scientific and technological expertise, with the result, there is increasing tendency to take to populist approaches. Thus there is need to raise high-density and short-rotation plantations of elites of location-specific varieties to meet firewood crisis. Equally important is that simultaneously the animal husbandry agencies need to do something very tangible to meet fodder crisis, and replace the present largely derelict livestock wealth by significantly fewer but improved varieties together with their stall feeding.

## Goals of forestry

There is an urgent need for an indepth understanding of forestry problems and then take some short- and long-range practical steps. These would involve some hard non-populist but pro-nature, pro-poor, pro-woman and pro-job-generation decisions. The country has to be clear about the goals of forestry taking into account environmental and economic dimensions. Below are given the important goals in forestry and the type of forestry that emanate from such goals (Figure 1):

- Affording long-range ecological security by having a permanent forest cover for conserving climate, water, soil and biodiversity. This is achievable through *conservation forestry*.
- Meeting the need for goods and services, including firewood, charcoal and fodder of the tribal/rural communities and the urban poor: achievable through different *agroforestry systems*.
- Meeting the wood requirements of the people and industry for timber, pulp, fibre and silvi-chemicals: achievable though *industrial forestry*.
- Ecological amelioration of degraded forest areas and wastelands so as to green and then enhance the productive capacity of such derelict lands and to improve general aesthetics: achievable through *restoration forestry*.

These four types of forestry are *not mutually exclusive but mutually highly supportive* (Figure 1).

### *Conservation forestry*

This is most relevant for conserving all water regimes/watersheds/catchments; representative ecosystems and biosphere reserves, centres of origin and diversity of crop plants and domestic animals; national parks and sanctuaries and fragile and unique ecosystems, together with conservation of the forest cover that exists in these areas. Among other areas, all mountain systems (entire Himalayan belt, Siwaliks, Aravallis, Vindhyas, Eastern and Western Ghats, etc.) would come under the purview of this category. All these mountains are in fact our water reservoirs and climate-stabilizing areas. In these regions, extraction of wood (not more than the mean annual increment) and non-wood forest resources have to be highly selective and only when warranted on scientific and technical grounds for maintaining the health of the concerned forest or ecosystem. Such extraction has to be done based on well-conceived working plans. The restoration and repair of such areas has to

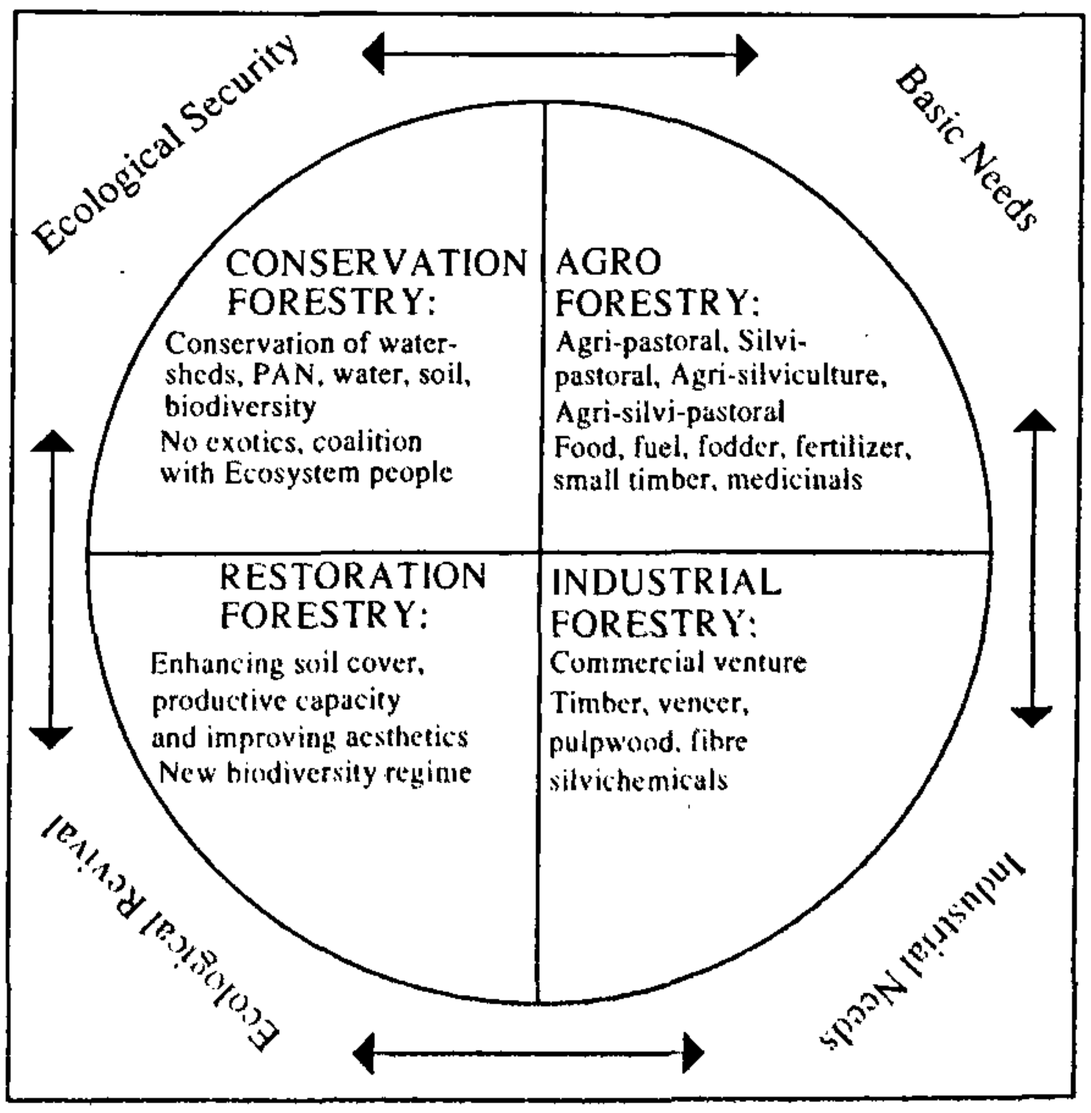



**Figure 1.** Types of forestry together with their ecological and socioeconomic implications.

be done with local and indigenous species, and *on no account should exotics ever be introduced in the Protected Area Network* (*PAN*).

Conservation forestry benefits all people both within and outside a country; because it is linked to the stabilization and conservation of climate, soil, water and biodiversity, and is the source of non-wood products including wild economic medicinal, aromatic and other plants and fruits, and other amenities. Conservation areas need to be circumscribed precisely and their tenurial security guaranteed by appropriate stringent legislation. The centre should have the over-riding power in this regard.

In these areas there is needed a meaningful coalition between local communities, foresters and the relevant scientists. Such coalition does not mean that these forests need to be handed-over to pastoralists like *bakarwals* and *gaddhis*, each one of them own cattle wealth worth millions of rupees. Such populist suggestions should be rejected outright. Instead it should help only those who are really poor and needy, i.e. the real *ecosystem people*. Major ethnobiological and developmental programmes need to be mounted to bring the indigenous people out of the morass of poverty, illiteracy, hunger and want. They also deserve good things of life and on no account should poverty be romanticized as some Indian and foreign NGOs do. Poverty has to be banished, it is a curse.

### *Agroforestry*

Here, the objective is the integration of agriculture, forestry and animal husbandry to meet food, firewood, small timber and fodder needs. Furthermore, villages surrounding a city may also grow firewood for supplying to the adjacent city or cities.

If warranted on the grounds of land-use and end-use to meet the needs, there should be no objection to the use of exotic trees or shrubs in agroforestry systems. After all many of our agriculture crops, including even the holy cow, are naturalized exotics which have undergone artificial selection over the years in this country.

Here, the beneficiaries are the rural (even nearby urban poor) people whose needs of firewood and small timber are to be met. Agroforestry would ultimately relieve pressure on natural forests and thereby help in forest conservation. There can be several permutations and combinations under agroforestry (Figure 1).

### *Industrial forestry*

At the outset a distinction must be made between forests and forestry plantations for industry. In essence the latter is *tree-crop farming*[5]. Here, the objective is to meet the needs of timber, pulpwood, fibre and silvichemicals for industry. It is *exclusively a commercial venture based on wood quality and input–output considerations*. The immediate clients are wood-based industries. Industrial forestry has also to be related to land-use and end-use considerations. Since these are commercial ventures, sustainable production and productivity are the chief objectives, and, if warranted on land-use and end-use criteria, fast-growing exotics are also welcome for this purpose.

*India can afford to be oblivious to the needs of industrial forestry only at the cost of its ecological and economic security. Realism demands that there has to be a crash programme on industrial forestry in order to save our natural forest wealth; in fact industrial forestry itself would become a forest conservation strategy, because there would be lesser demands on the natural forest stands, which would thus be saved.*

According to Central Statistical Organization (CSO, 1995)[6], in 1994 the country imported newsprint and paper board worth about Rs 706.50 crores and, in addition, wood and pulp worth Rs 1147.69 crores. Imports worth Rs 1854 crores ($ 618 million) per year (no doubt a very conservative estimate) is indeed a sizeable amount. Thus, if nothing tangible is planned, this amount would increase progressively, and is expected to touch at least Rs 3000 crores ($ 1000 million) per year by the turn of this century. Import of timber, pulpwood, etc. can help to avert an immediate shortage but, for reasons more than one, it is by no means a permanent solution. Therefore, the best strategy is to give a very high priority to industrial forestry with full back-up support and extend all help by suitable modifications of land laws, etc.

Furthermore, total replacement of wood is not possible. There is increasing realization that use of metals, concrete and plastics as replacements is environmentally stressful and energy-intensive. These create much more environmental damage, which is irreversible and very vicious in character, and above all very costly to depollute. Any damage by silviculturally sound extraction is manageable and cost of ecorestoration is far less than depollution due to manufacture of metals and plastics, and above all plantations grown on sustainable basis are environmentally benign.

Since industrial forestry is a pure commercial venture, high inputs of science and technology would be needed to reduce ecological and economic costs and make it a profitable venture. High-yielding cultivars of trees have to be selected or bred, and silvicultural practices standardized very precisely. Again, a meaningful coalition between villagers and industry is called for.

### *Restoration forestry (eco-revival)*

Due to paucity of arable land, wastelands have become relevant to meet the escalating demand for diverse

land-uses. However, utilization of such lands poses a major R&D challenge. Here the objective is to green derelict and wastelands in order to ameliorate, and finally restore them ecologically. The process can be started by creating natural wilderness areas by using the principles and practices of eco-restoration and plant colonization. Owing to litter fall, a decomposer chain would start, followed by soil amelioration and increased water retention. This would go a long way in improving the quality of these lands. At the same time wood would be produced which could be used for several purposes. Techniques are now available which can make use of ordinary wood (after proper physical and chemical treatments) for a number of sophisticated end-uses. Wood, like leather, being a natural material, has wonderful properties. Wood is there to stay for all times to come. Therefore, wood from wastelands after appropriate treatments can also be used.

About half of India's land is today wasteland[7] having been degraded on account of over-harvesting of wood and overgrazing of forest floor which has led to deforestation and land degradation with its attendant social, economic and ecological dimensions. The extent and nature of degradation is related to the nature of the concerned forest or ecosystem. Often some forests are highly fragile or even highly resilient which depends on the particular edaphic factors and the composition of the forest itself.

Figure 2 summarizes in general the major states in forest degradation in response to stress and their tolerance ability[8]. Two major trajectories are depicted here, one depicts the extent of forest degradation from natural to degraded condition, and the other depicts the cost of curative action. Three major integrading stages can be recognized.

First stage is reversible on account of self-renewal where *status quo ante* is possible, and composition of forest and its biodiversity can be brought back to old natural state. The central point is that the degradation is light and forest floor has not been destroyed. The resilience of concerned forest ecosystem has not been impaired and can be augmented often simply by closure to grazing and allowing the forest to recuperate. Costs involved are minimal, often negligible in comparison to the gains. There are many examples of this in India, particularly in the Himalaya, where simply by closure to grazing *status quo ante* has been attained within a matter of few years.

The state on the extreme right of Figure 2 represents a situation where forest has been degraded beyond recognition and irreversible changes have taken place on account of loss of soil and soil microflora, biodiversity, water-retaining capacity, etc. No self-renewal or *status quo ante* is possible. Cost of curative action is high and it could lead to new forest composition with new pattern of biodiversity. The change from original

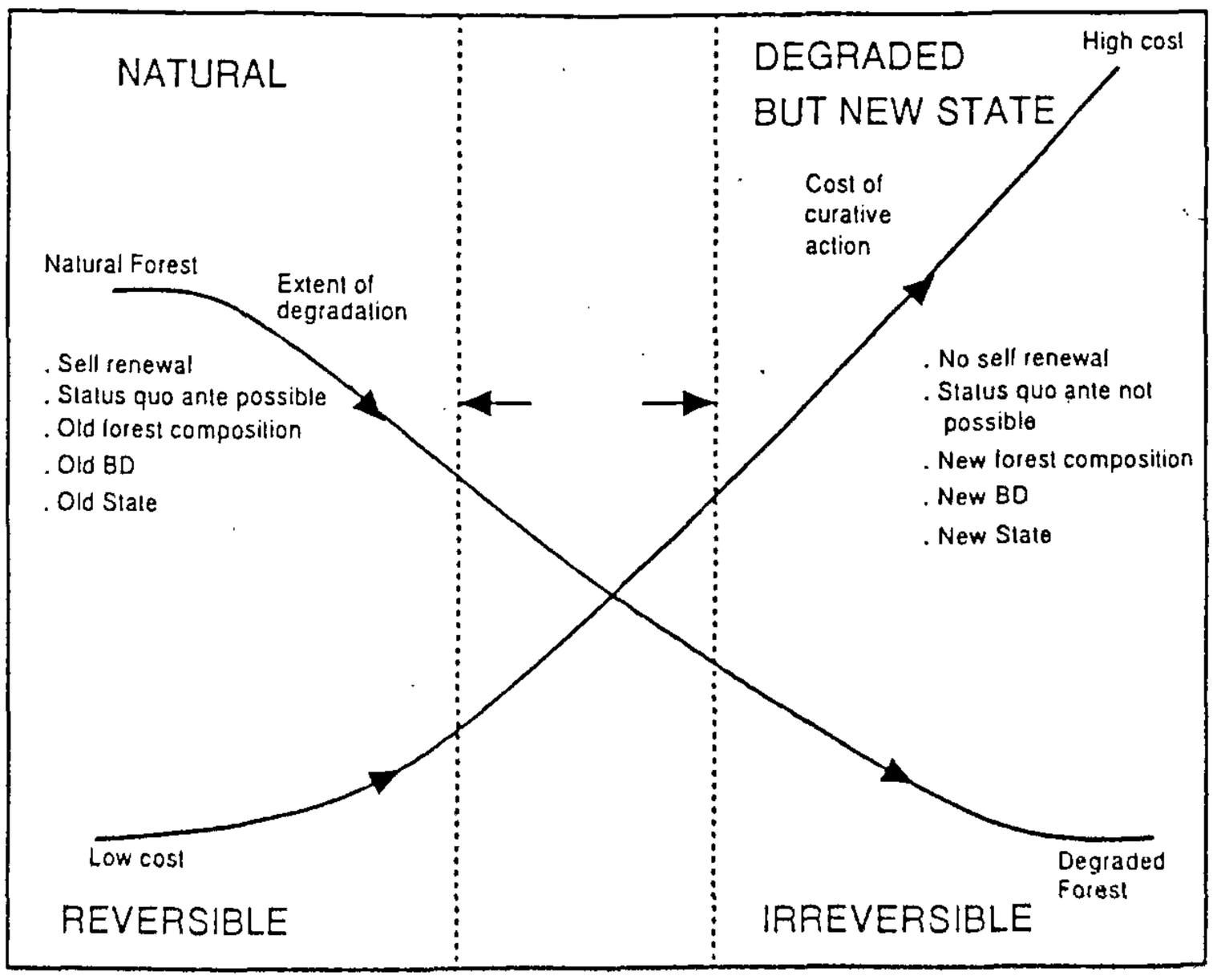



**Figure 2.** Three states of forest degradation and recovery. Source: Maini, 1992 (Modified).

composition is irreversible, but a new state of forest is possible. There are instances that the 'new' forest reverts to its original composition with time.

Obviously, costs involved in restoration of such areas are rather high, but should be acceptable because of the permanent greening and halting of erosion that ensues from such an operation. Degradation can take place within a matter of a few years as happened in Uttar Pradesh. Here, with the abolishment of *zamindari* (land lordism) after independence in 1947, the *zamindars* (land lords), out of vengeance, literally clean-shaved the forest on their lands. Thus they made a fast buck and returned the land to the Government. Restoration of such forest will take a long time and curative action would be rather costly. An example of such a rehabilitation process is Banthra. In 20 years, it did lead to the creation of a new man-made forest and new agro-ecosystem[9].

Between the two extremes, is a state, where depending upon the extent and nature of forest degradation and extent of human intervention, the forest could recover to near-original sate or to a new state (Figure 2). This intermediate state is indeed labile. The famous case of Sukhomajari (Siwaliks of Haryana near Chandigarh) by R. P. Misra would more or less fall in this category. This may be called as the Indian version of Canadian Model Forests where imperatives of production and consumption were dovetailed on a sustainable basis. This would involve a partnership between Village Council and the people on the one hand, and scientists and technologists, relevant industry, State and Central Government Forest Departments and Wildlife Managers on the other. The idea is socio-economic revitalization of the local communities by improving the health, and productivity of forests and plantations through application of science and technology and participatory resource management.

Some excellent models of development of wastelands are already available in this country. The eco-restoration strategy must involve an intimate study of the ecological aspects and socio-economic costs.

## What needs to be done?

A reorganization of forestry is needed in real terms so that the same matches the stupendous tasks awaiting before it. This is only possible if the *leadership in forestry is reverted to technocrats*. In the meantime the following aspects need consideration.

Conservation Forestry needs to be fortified by appropriate laws together with a set of credible and implementable measures to better the lot of indigenous or the *ecosystem people*. Centre must have over-riding powers in this regard.

Agroforestry has to be strengthened by appropriate R&D and location-specific models of agri-silviculture, agri-pastoral, silvi-pastoral, agri-silvi-pastoral so as to increase the production of food, fodder, fuel, fertilizer, medicinals, etc. on a sustainable basis (Figure 1).

Industrial Forestry needs strong inputs of R&D so as to make it a commercial success. Unfortunately, this type of forestry is a *red rag* to ecological fundamentalists. They do recognize the need of wood for timber, paper pulp and fibre, but their populist strategies can never lead to self-sufficiency in wood needs. This type of forestry has to be an industrial venture where genetically superior high-yielding strains have to be used. Obviously it will require back-up support by changing land laws, and inputs of genetics, tree breeding, biotechnology, updated silvicultural practices, use of mycorrhizae, protection from diseases and pests, etc. One of the options is to privatize this venture after plugging the possible 'holes' in the system, where involvement of people (not in populist sense) is ensured. People and industry have to develop an equal stake.

Restoration forestry needs to be taken up with the help of people by warranting and guaranteeing their rights as long as they do not clash with our long-range ecological security. The objective is to green these areas with tree/shrub cover with anything that can grow under these harsh ecological conditions. There are many instances when after 15–20 years, natural forest composition takes over in such areas. Help of some internationally known Indian and may be even foreign forest ecologists needs to be elicited. Even today the country has some good forest ecology schools with very good traditions.

In essence, there is needed a well thought-out programme of enhancement of productivity from the dismally low level of 0.7 $m^3$/ha year. Productivity enhancement goes well with the concept of forest tree-crop farming. It is also in line with the contemporary developments that are taking place in the industrial countries.

Speaking biohistorically, human beings met all their wood needs from natural forests because forests were far in excess of the human numbers and their needs. This stage was akin to the foraging, hunting and gathering food, fuel and fibre needs from the wild, which has been abandoned by human being some 6000–10,000 years ago except by the *ecosystem people* who are very few in number and their wants very limited. The result has been that there are today well-organized agriculture, animal husbandry and fisheries systems. Such a change in forestry in India is long overdue to meet the wood needs through agroforestry and production/industrial forestry. This would help to create alternative resources and employment and thus help in saving the natural forests.

### *Trees as crops*

Another urgent need is to breed special *ideotypes* for timber and pulpwood, fuelwood and fodder trees[5]. Trees

have to be cultivated as crops under agroforestry and industrial forestry. This means that there has to be a period of domestication involving conscious selection of trees for specific end-use, e.g. firewood, fodder, timber, pulp, etc. On account of their high yield, the tree crops would out-do the ancestral species. This change has become necessary. Furthermore, there is a mistaken notion about multipurpose trees. A tree can be multipurpose at the taxonomic level, e.g. different genotypes for fuel and charcoal, timber, pulp, fibre, latex, etc. *One cannot use a tree for all these uses at the same time*. For instance, if leaves are constantly used as fodder, there would be reduced photosynthesis leading to reduced wood output. This means trees have to be selected and bred for specific uses. Thus the concept of tree-ideotypes must come in. This concept has been followed intuitively by foresters but never by a deliberate design. There is needed a good deal of coordination among tree physiologists, geneticists, breeders and silviculturists to design specific tree-ideotypes for timber plantations, fuelwood and as fodder. Again, there would be difference if tree-crops are grown in plantations, or under agro-forestry conditions.

Equally important is to relate yield parameters to morphological, anatomical, physiological, genetical, chemical, canopy architecture and silvicultural requirements. Furthermore, yield parameters have to be related to phenology, photosynthesis, sink dynamics, competition, ageing, etc. These characteristics are often strongly correlated. *The objective is to develop tree ideotypes for specific end-uses.*

Eucalyptus provides an interesting case of a total mismatch between end-use and its ideotype. Ideally eucalyptus can be used for pulpwood and/or timber, and not as a firewood crop. The latter is a total waste of the valuable biomass.

Khoshoo[5] has worked out the ideotypic characteristics of timber, fuelwood and fodder trees. For timber and pulpwood the characteristics are: partitioning of nutrients in favour of wood in the mainstem rather than for branch-wood, bark and even reproductive parts which should be small with few flowers. Other characteristics should be: straight stem, narrow green crown, thin bark, good quality timber, rapid growth, thin branches arising at about 90° to the trunk, more leaf area per unit of branch wood weight, longer lasting foliage, few flowers, tolerant to environmental stress and high survival value under specific agro-ecological conditions. The advantages of such an ideotype are the elimination of expensive thinning operations; and easier pruning (Figure 3). All these characteristics also apply to pulp-wood species together with appropriate chemical parameters.

Fuelwood ideotypes would be most relevant to the rural subsistence sectors, and for this marginal wastelands with low-nutrient soils would be available for a long time to come. Trees should have rapid growth, wood with medium to high density, high calorific value, straight grain, wood that burns steadily without any toxic smoke and sparks, stem thin and of medium length, thornless, not excessively branched, ability to coppice and pollard, easy vegetative propagation, minimum bark, ability to tolerate competition and amenable to high density/short rotation for high wood biomass production (Figure 4).

Fodder trees with leafy shoots, twigs and fruit were very popular in historical times, but down the ages, attention shifted to fodder grasses and legumes. In the recent times there has been revival of interest as a component of agro-forestry systems, although tree fodder is less nutritive. A desirable ideotype should be a small tree or a shrub, highly branched, possessing the capacity of regrowth after periodic lopping and leaf-stripping without affecting phenology and metabolism, palatability

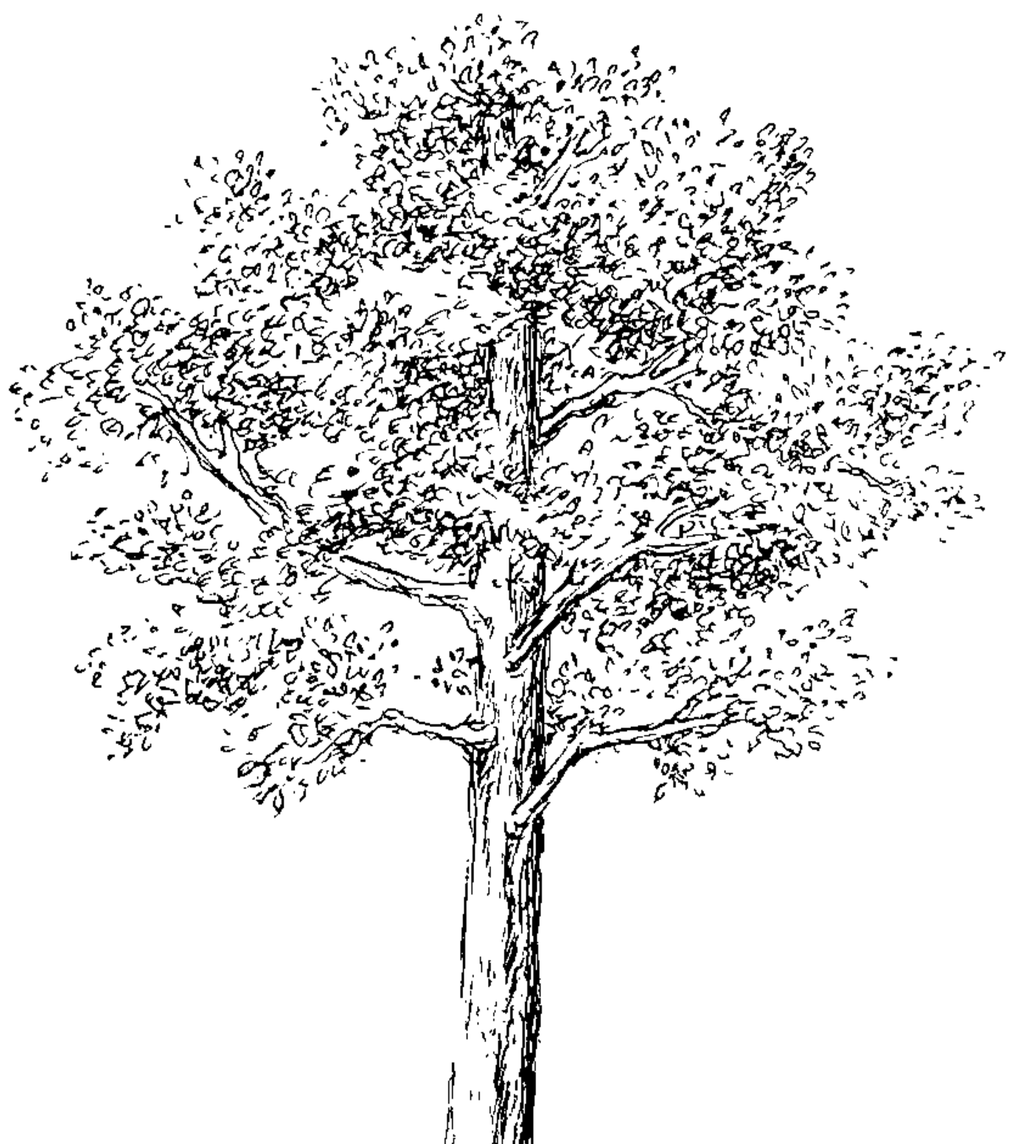


**Figure 3.** Ideotype of a timber and pulpwood tree.

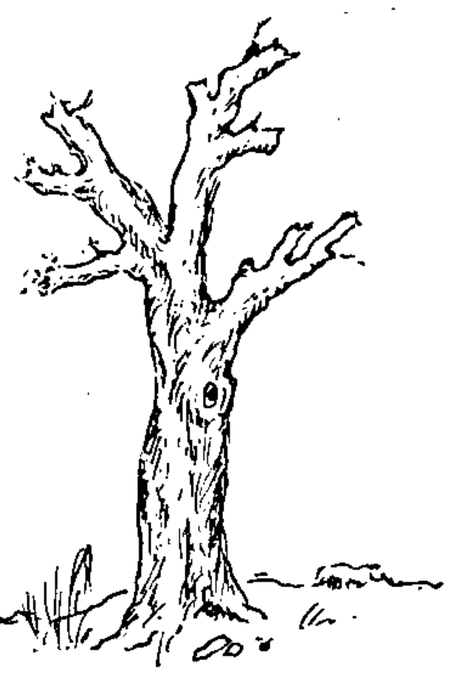
with specific livestock, digestibility and proper chemical characteristics, particularly high protein content (Figure 5).

The foregoing characteristics have to be looked for, while making selections from the natural and man-made variants for a specific end-use, so as to maximize the productivity of the end-product. With time these can be refined. Having identified or bred elites, there would follow a strategy to enhance their productivity further. The following six components are indeed interconnected and can be taken up simultaneously:

- Application of advanced forest tree breeding methodology and selection procedures for evolving superior genetics strains.
- Clonal propagation of elites and planning of a 'genetic mix' so as to simulate conditions in nature.
- Judicious use of tissue culture and biotechnology.
- Optimizing silvicultural and nutritional requirements, including use of fertilizer, irrigation and bacterial and mycorrhizal inoculatons.
- Disease and pest control, and
- Weed control.

Forestry, unlike agriculture, has a long gestation period nd affects intergenerational equity. Therefore, it is ecessary to take a long range view of R&D and policies ı forestry. Funding has to be ensured on a long-term asis. This would also help in bridging the gap between ıe techniques developed in the research establishments nd the technologies needed for large-scale application.

The basic rationale of the strategy for fore tions of the future is summarized in Figure other things, boosting productivity in forest function of nature of genetic status and geneti the planting stock used, its vulnerability to dis pests, its yield and management costs. From of view, the present day forestry in India fa right hand bottom square where we use unsele with wide genetic base, and obtain low y nerability is low and management costs are The present day outlook is to move to left square where it is intended to use selected stock (half sibs and clonal material) with rather genetic base, and relatively high yield. Obviou ces of vulnerability are high and so will be the ment costs. However, the future goal (top ri square) is to go in for full sibs, synthetics a planting stock. This would have wider genetic yields would be very high, vulnerability woul low because the genetic diversity would be v the management costs would also be relative This would be a step towards future sustainabl



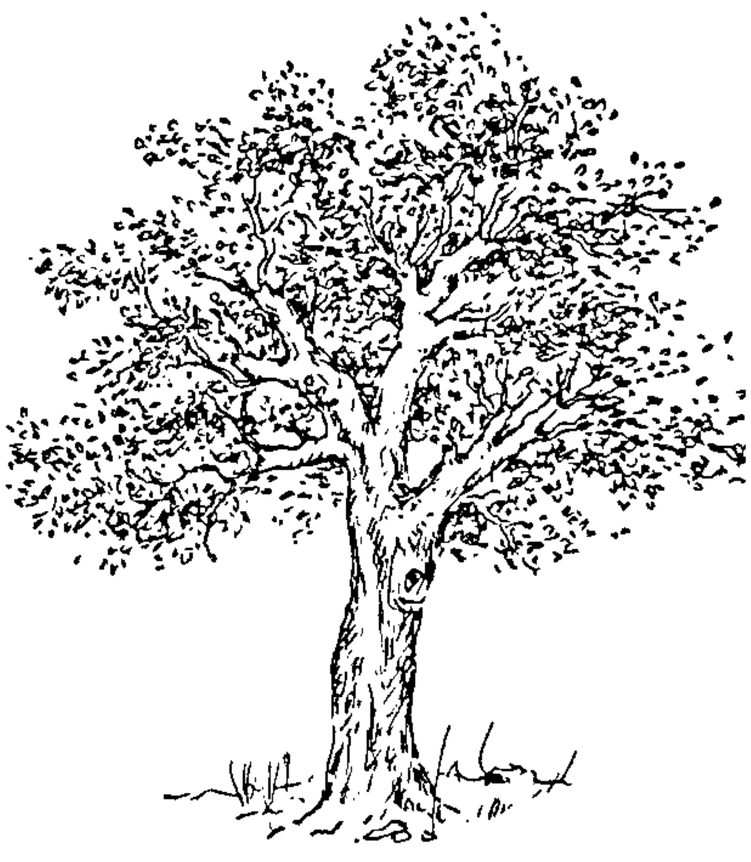


Figure 4. Ideotype of a firewood tree after and before pruning.

Figure 5. Ideotype of a fodder tree after and before l

with higher wood yield at relatively lower maintenance cost.

## Summing up

If serious view of the existing crisis situation in forestry is not taken, India will be a perpetually wood-importing country and lose heavily in the long-range on ecological and economic security. Furthermore, the country would also lose the opportunity of being a quality-timber exporting country. Already a small country like Costa Rica is taking steps to raise large-scale scientifically well-managed plantations of teak (an Indian timber tree) as an export earner. Indeed it has been both pleasure and pain for this author to see these well-managed plantations in Costa Rica.

Wood self-sufficiency is possible only when research and development, education and training, and demonstration and extension in forestry are strengthened in *real terms*. A comprehensive report submitted to the Government of India in 1983 by the then Science Advisory Committee to the Union Cabinet (SACC), presided by M. G. K. Menon made specific recommendations in this regard. The underlying intention was to make Inspector General of Forests (IGF) ex-officio Secretary, so as to revert the leadership to technocrats in charge of the Department of Forestry (DoF). Furthermore, a well-known forestry scientist/technologist should take over as the Director General, Indian Council of Forestry Research and Education. If such a person is not available in India, he/she needs to be hired from abroad. Let us not forget that the first four or five IGFs and Presidents of Forest Research Institutes were Germans and not British, because the latter did not have good expertise in Britain. Secretary DoF should report to the Minister directly as is the case in Department of Scientific and Industrial Research (DSIR) and Department of Agricultural Research and Education (DARE).

Some of these changes need to be undertaken in *real terms*. These are long overdue and would enable the country to: depend less on present standing forestry stock and plantations of low genetic quality, but more on future quality plantations with high yield (Figure 6) where the country needs to depend only on the sustainable allowable cut. This is what Sweden has done. Its export of timber and paper pulp helps that country to buy oil, food, chemicals and clothing[3].

A quantum jump in wood production through well

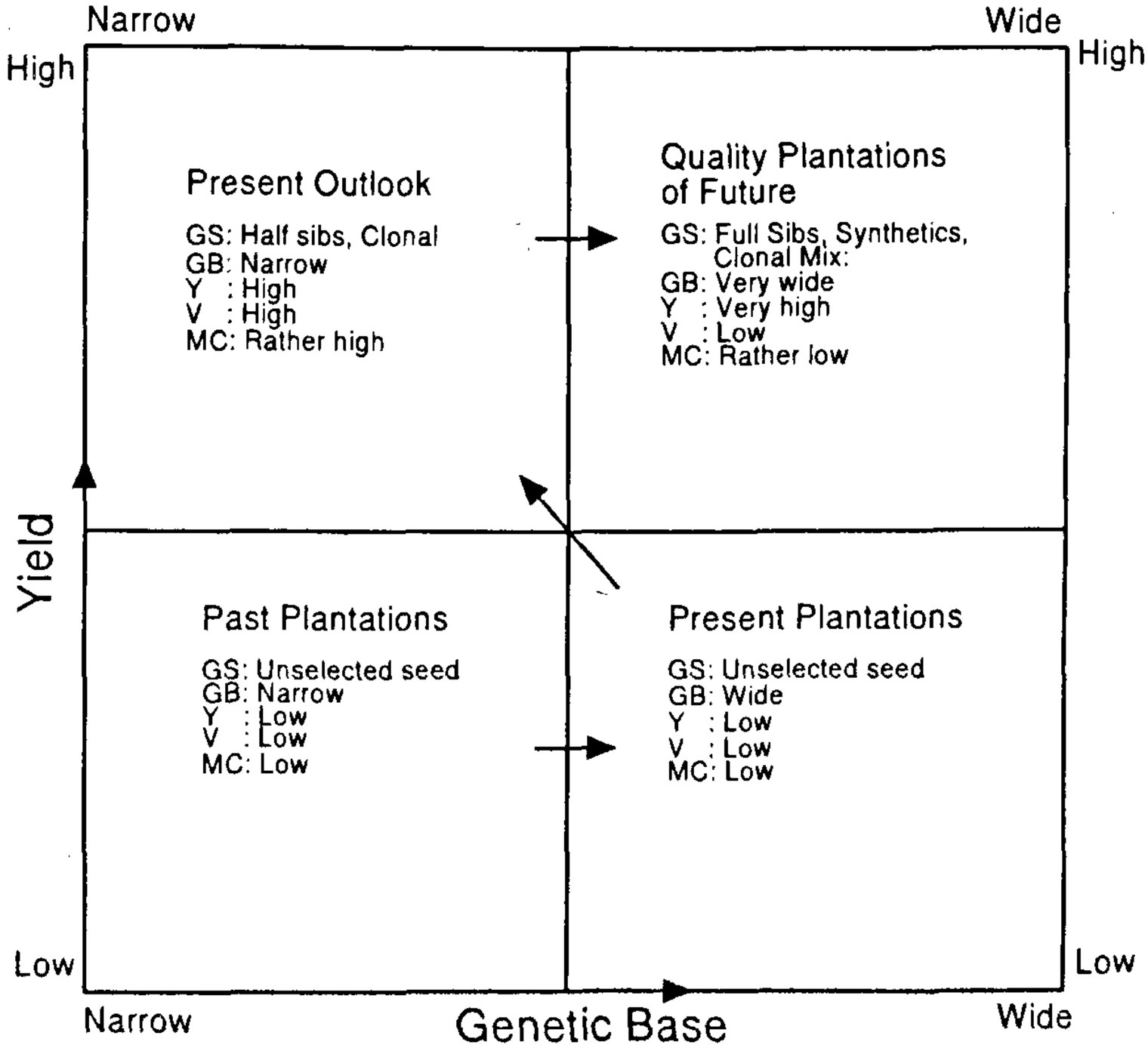



**Figure 6.** Strategy for future plantations.

thought out production strategy would become the best form of conservation of our natural forest wealth. The country should not be averse to the use of exotics as far as production of timber, paper pulp, fibre and firewood are concerned. However, *such introductions should not be allowed to enter our natural forests*. There is need to evolve a special protocol for forest introductions[10].

India needs a meaningful R&D-based forestry without losing sight of socioeconomic aspects. By planting genetically superior stock in agro-forestry and industrial forestry programmes, there would accrue significantly higher yield with the same effort, money and time. This would change the whole scenario for the better both for the poor and the industry. But where is the expertise to raise such superior stock! It may exist on paper because somebody somewhere issued a Government Order regarding this. Such expertise has to be built up by a technocrat secretary of the Department of Forests. This would not only help to save our natural forests, but also ensure our long-range ecological security with clean air with its correct chemistry, water, soil and land flora, fauna and microorganisms.

The Indian forestry has to rid itself of populism which is abetted by some international agencies and many of their cohorts floating around in this country. Many symposia and seminars are held not with the idea of helping forestry in India but keeping India in *permanent bondage* to import wood, paper pulp and fibre. They only help to romanticize poverty[2] because such ideas are exotic to westerners. One often wonders if these agencies and their cohorts are India's friends or foes!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