# SILVICULTURAL AND MANAGEMENT OPTIONS OF JFM

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## Introduction

Traditional forestry is taken as a venture of large wood production on a long gestation cycle. Even the social forestry plantations could not result into multiple product system, though quicker to mature. Joint Forest Management (JFM) looks for a forestry design that matches and caters to the needs of varied forest produce of local population in the shortest possible time. In fact, JFM is the management of degraded but potentially productive resource. At different stages of improvement, the forest resources may be able to give different forest produce and a desired management and silvicultural initiative should be capable of matching the product-basket with the needs of local population.

The regeneration of degraded forest land has also to be cost effective in the JFM system. Therefore, more and more emphasis is laid over natural regeneration than planting. It is expected that community protection of forests will stimulate natural regeneration. Improvement of existing rootstock through coppicing is one of the most trusted technologies. Multiple Shoot Cutting (MSC) adds to the crop improvement as well as provides intermediate supply of fuelwood. Non-Timber Forest Produce (NTFP) would sustain the interest and stake of local communities in JFM through augmentation of their income at quick duration and regular frequency. It is these considerations that call for a new set of silvicultural and management options in case of JFM.

In Gujarat, JFM in the present form too, is more than a decade old. We have results and failures to assess the various alternatives as well as to develop desirable silvicultural and management options. Traditional forestry practices have been widely influenced by two divergent views based on degree of emphasis on 'Yield Regulation' (management-aspect) and Silviculture. The German school of thought holds a rigid concept of sustained yield permeating all economic and technical aspects of organised forestry. The French school of thought holds that all management consideration (yield regulation) is secondary to good silviculture. The French forester Broillard was inclined to think that mathematics and formulae never take into consideration the secret of living forests and may lead silviculture to serious errors. In the present case of Joint Forest Management, an equilibrium is sought between the silviculture, i.e., biophysical condition of trees and treatments given to them, and the management, i.e., need based harvest-regimes such that multiple forest products are available to the community without reducing the productive potential of the resource. Obviously, the desired system would be site specific. In this paper,

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the various forestry interventions in the have been examined in light of the foregoing background.

**Protection and Plantation**

Community protection of the local forests is the first and foremost activity the community takes up in JFM. The protection prohibits the operations of degrading agents like forest-fire, grazing and illicit removal of trees. This induces the natural regeneration and regrowth, resulting into increase in the productivity of the degraded forest. The species diversity in such regenerated patches has been found better (Poffenberger *et al.*, 1992). It has been recognised that with substantially less investment as compared to afforestation, natural regeneration can produce moderate to high biomass growth rates along with promotion of biodiversity (Ravindranath, 1998). In fact, the science of growing trees/ plants is not developed enough to cover the entire realm of naturally growing plant kingdom and therefore biodiversity consideration looks for natural regeneration methods. However, if the forest patch is degraded below a threshold productive potential, the protection alone may not work as well as the community may find it not-remunerative. Therefore, highly degraded patches should be kept outside the JFM system.

The community may require a few species more and others less; therefore, incidence of such indigenous species should be increased in the crop. Hence, gap- or patch-plantation should necessarily supplement the protection activity.

**Rootstock and cutback**

Degraded forest areas with rootstock are taken to be the most suitable patches for implementing JFM. As most of the plantation models presently envisage 1,000 -2,000 plants per hectare, the areas supporting around 1,000-1,500 rootstocks per hectare are ideal ones. On cutting back the existing, struggling or stunted vegetative stems flush to the ground, new vigorous shoots come-up in case of coppicing species. The deciduous forests of Gujarat are full of coppicers. The JFM belt of Gujarat is basically a Teak (*Tectona grandis*) bearing zone. On cutting back the old but failing plantations of Teak, Khair (*Acacia catechu*) and Bamboo (TKB) strong and promising shoots of Teak have regenerated over the area [Nagatpur in Rajpipla (East) Forest Division]. In areas where plantations failed, and patches were supporting busy growth, the coppice crop is dominated by *Terminalia tomentosa* and *Butea monosperma*. The patches nearer to villages have less incidence of Teak coppice compared to those farther from the habitation; probably the Teak rootstocks had been dug out in the past for firewood, or *T. tomentosa* and *B. monosperma* are hardier species. The stem density in such regenerated patches, at times, is as high as 10,000 stems per hectare and needs heavy thinning. The thinning provides firewood to the local community as well as opening for enrichment plantation of other important species such as Bamboo, *Madhuca indica* and Teak (Vyara Scheme Range area in Vyara Forests Division).

The crops resulting from coppicing are dominated by a few species only. However this method is supposed to be highly productive in JFM system. It was estimated that cut-back can yield 0.5 tonnes/ha of firewood, which can be given to the local community free of cost and thus initial interest will be satisfied. It was also estimated that the first thinning in seventh

year will be giving 100 lops and 2 tonnes of firewood/ha. While the 2nd and the 3rd thinnings in 15th and 23rd years will be giving 200 poles and 4 tonnes of firewood and 100 poles and 8 tonnes firewood per ha. respectively. The final felling in 30th year will bring 200 poles and 20 tonnes of firewood per hectare. Thus, the regeneration through coppicing will be providing small timber and firewood at regular intervals. Grass production also, for initial three years is quite high.

If 10% of the cut-back area is regenerated through the plantation then the cost-benefit accrual would be as given in Table 1. This is financially a viable proposition as the current return is negligible from this area.

The availability of the produce, particularly small timber and firewood will be abundant. Fruit bearing and Minor Forest Produce (MFP) yielding trees will add to the total output. Grass is the quickest benefit available during initial years.

## Employment opportunities and wage labour

The emphasis on cost effective methods of regeneration i.e. through protection only or through coppicing, produces less mandays of employment compared to the employment created by raising of plantations. In most of the successful JFM areas, initially large-scale wage labour was created by the Forest Department, and the local people were engaged in forestry works.

**Table 1**

*Cost benefit accruals if 10% cut-back area is regenerated through plantation*

| Benefit/ha (B) | | | Cost / ha (C) | |
|---|---|---|---|---|
| Operation | Produce | Value (Rs.) | Operation | Value (Rs.) |
| I. Cutback | Firewood 0.5 MT | 500 | 1. Cut-back operation | 600 |
| II. Grass Cutting | Grass 1.0 MT | 1000 | | |
| III. Grass Cutting | Grass 0.75 MT | 750 | | |
| IV. Grass Cutting | Grass 0.5 MT | 500 | | |
| V. First thinning | Lops 100 nos. | 1000 | 2. Gap plantation | 2000 |
| | Firewood 2.0 MT | 2000 | | |
| VI. Second thinning | Poles 200 nos. | 8000 | 3. Live hedge fence/soil & moisture conservation works | 3000 |
| | Firewood 4.0 MT | 4000 | | |
| VII. Third thinning | Poles 100 nos. | 10000 | 4. Patrolling by one person for every 25 ha for 30 yrs. | |
| | Firewood 8.0 MT | 8000 | $\frac{60x30x12x30}{25}$ | = 25920 |
| V. Final Felling | Poles 200 nos. | 50000 | | 31520 |
| | Firewood 20.0 MT | 20000 | IRR = 10% | |
| | | 105750 | | |

During the scarcity years, the employment opportunities in forests become most important for the people living near forests. The engagement in forestry activities in such area provides employment at the doorstep. The cost-effective regeneration methods may not fully satisfy the employment needs of local community. This issue should not be ignored while planning for the JFM areas, and alternative opportunities on Soil and Moisture Conservation (SMC) works can be thought of.

**Soil and Moisture Conservation works**

Soil and Moisture Conservation structures like 'vantalavadies' (forest ponds) and checkdams are widely demanded by the local communities which have either organised into FPCs or show preparedness to take up JFM. In fact, SMC structures serve as technological initiatives to enlist people's participation. Such structures provide large-scale employment, pull up the water table and reduce moisture stress in forests as well as in nearby private fields, increase the availability of water for irrigation, recreation, drinking by animals etc. It improves the fertility and stops degradation of the private agricultural land too. On occasions, it reclaims the fallow land (as in Nanchhal village of Vyara Forest Division). It is a good source of periodic income generation for villagers through pisciculture, as happened in Dhanturi and Palavadi villages of Vyara Forest Division.

SMC structures add to the cost of regeneration. In the present benefit distribution arrangement, net proceeds are shared between the FPC and the Forest Department on 50-50 basis. Therefore, the cost of construction of these structures should not be charged to the total cost of formation of plantation to avoid negative tangible profit to the local community.

**Non-Timber Forest Produce**

For a forest dweller, a living tree, which annually gives NTFP, is more important than a timber tree such as Teak that gives timber to a far off industry once in several years. The important NTFP in the forests of South and Central Gujarat are *Madhuca indica*, *Diospyros melanoxylon* leaves, *Buchanania lanzan*, *Butea monosperma* leaves *Casia tora* seeds etc. Individual plants of all these species deserve separate sets of tending and hence individual plant manipulation is necessary.

Sometimes *B. monosperma* grows extensively in bushy from. Along with tending of these stems their density per hectare should be maintained below an optimum to allow other species to grow. Alternatively, a silvicultural design can be evolved to cater firewood needs of local community and to add to income through its leaf collection or leaf-cup making. Some of the patches support extensive bushy growth of *Wrightia tinctoria* too. Normally for developing these areas, they are cleared. They provide initial firewood quota to the local community. A silviculture system can be designed to maintain a smaller portion of such patches for firewood production. The South and Central Gujarat forests have higher potential productivity as well as the communities have multiple product needs, so large patches can not be left under *B. monosperma* or *W. tinctoria* growth.

*M. indica* and *B. lanzan* are comparatively better protected by the people. Therefore, their survival is more dependable. Their incidence in the species-mix should be increased. *D. melanoxylon*

trees need skillful pruning. During the advance-works, root suckers can be promoted by injuring roots of *D. melanoxylon* in concentric circles. Oil seeds like Jatropha should be encouraged to give quick results.

**Bamboos and grasses**

As far as the quick and considerable intermediate benefits are concerned, Bamboo and grass hold the key for the success of JFM. Though grazing and grass are persisting as items available without incurring any cost in the forest areas, during scarcity situation or with increasing dairy-consciousness, their importance is now better appreciated. Disputes over grass collection in JFM villages have surfaced noticeably (in Vyara Scheme Range). Similarly in the year 1997-98, there was a tough competition among different villages for collecting grasses from plantation areas of Uchhal taluka. Grasses come up vigourously during the first 3-4 years of plantation activities. Thus, they are capable of creating and sustaining initial interests of the local community.

Though heavy thinning of densely coppiced area provides lops and poles too, the major output is firewood. Bamboo is the only species having the highest economic value at very short duration. Just after 5-6 years of protection Soliya village could get Bamboos as 25% of the share worth Rs. 100,500. In many other JFM villages Bamboos have been exploited and distributed. Otherwise also, Bamboo is a multipurpose item and is highly demanded by the local community for house repairs, basket and mat weaving, fencing of homestead, etc. Hence, a suitable JFM system must concentrate on Bamboo production.

**Seeding**

Seeding is one of the most cost affective methods of regeneration. It is comparatively quicker also. Normally on the fence, seeds of Jatropha, Khair and Bamboo should be sown. Jatropha seeds grow very fast and after 1-2 years fruiting also starts. Thus, it becomes an income-generating source for the local community. Apart from the seeding on the fence, seeding should be resorted to regenerate refractory areas on the slopes. Plantations in the most refractory patches/ blanks do not come up easily. Repeated attempts are needed.

Most of the forestry plants other than timber species are such whose silviculture or method of regeneration is still under the process of understanding and development. Hence, it is desirable that seeds of such species are collected, mixed and dispersed in the areas to develop biodiversity and keep the natural character of forests.

**Harvest Regimes**

Time, duration, method and intensity of harvesting constitute a matching device between resource and users' need. Therefore, harvest regimes are the most important management tools in JFM system. In a coppice regenerated JFM area, cut-back material, multiple shoot cuttings, removal of stems on account of cleaning in 5th year and 1st, 2nd and 3rd thinning, in 10th, 15th and 20th years along with final felling in 25th year could arrange for regular supply of firewood and small timber. The growing Bamboo clumps may supply every year after 7-8 years of formation. Similarly, flow of NTFP in form of grass would continue from the very 1st year to 3-4 years in good quantity. After that the area could be opened for rotational grazing. Jatropha

would start giving income after 3-4 years. If old *M. indica* trees exist, they would be giving annual income. Similarly, *D. melanoxylon* and *B. monosperma* root-stocks, if existing, will start giving income from the 1st-2nd years.

A need-assessment exercise of the community must be conducted with people at the planning stage. This would throw light on the harvest-regime. If a tree is managed for the firewood or fruit, the spacing between two trees will have to be increased. Similarly, for meeting the large-scale demands of small timber of pole sizes, the distance between trees would be small. Hence, the nature and intensity of needs will decide the management options.

Grazing needs of the community and availability of the extent of area will govern the size of area to be treated annually or the fallow to be left out for grazing. The system of grazing would also depend upon the size of area and quality and quantity of grass production.

**Silvicultural model and ecosystem**

The silvicultural and management design of JFM will depend upon types of ecosystem too. If JFM is practised in grassland ecosystem of Saurashtra or Panchmahals, the design may be based on maximising the production of commercial surplus of grass, availability of sufficient amount of grass for local cattle population, accommodation of traditional users of the command area at some cost or mere participation, improvement of nutritive value of grasses, employment opportunity in cutting and bailing of the grass and maintenance of the fire protection intensity and design. Thus the design will be site specific depending upon resource, resource environment and user community.

**A typical model (South Gujarat type)**

As mentioned earlier the silvicultural and management design of the JFM system will be site specific and hence any specific model can not be prescribed for all kinds of areas. However, a typical model as optimised in South Gujarat Forests is described as under :

*0 - Year (Nov.- Jan.)*

(i) Identification of allotted area and phasing of area for 4-5 years (depending upon the size of the area).
(ii) Participatory transecting exercise to estimate the number of species and existing root-stock and species status.
(iii) Participatory exercise to assess needs of the community.
(iv) Participatory exercise to develop the work plan and treatment map giving details of cut-back, SMC works and individual and manipulation such as
  (a) root cutting of *Diospyros melanoxylon*,
  (b) tending of *Butea monosperma*
  (c) cleaning of Bamboo clumps
  (d) grafting in *Zizyphus mauritiana* and deciding species-mix for seeding.

*(Feb. - March)*

(v) Cutting back and individual tree manipulation
(vi) Trench digging along outer boundary
(vii) Design and estimates of SMC works and construction (March-April-May)
(viii) Seed collection (Jan-May).

*1st Year*

(i) Seeding on fence and in blanks (May-June)
(ii) Soil working if necessary on the regenerated shoots (July to Dec.)
(iii) Multiple shoot cutting, retaining almost two vigorous shoots per plant. (July-Dec.)

If the area is wind prone, the shoot cutting should be after the end of monsoon.
(iv) Survey of area and assessment of growth of various species (Nov.- Dec.)
(v) Planning for gap plantation species, number and methods (Dec.-Jan.)
(vi) Raising of Nursery.
(vii) Pit digging etc. (Feb.-March)

*2nd Year*
(i) Planting of seedling in gaps followed by weeding and soil working (June-Dec.)
(ii) Singling of coppice shoots (Nov.-Dec.)
(iii) Replacement of dead shoots followed by soil working and weeding (July-Nov.)

*3rd Year*
(i) Replacement of dead shoots and soil working (July-Nov.)
(ii) Removal of unwanted and malformed shoots etc. (Nov.-Dec.)

*4th Year*
(i) Replacement of dead plants and soil working etc. (July-Nov.)

The harvest regimes and flow of forest produce could be as under :

*0-Year*
(i) Cut back material for firewood.

*1st Year*
(i) Grass
(ii) Firewood from multiple shoot cutting.
(iii) *D. melanoxylon* and *B. monosperma* leaves.
(iv) *C. tora* seeds.

*2nd Year*
(i) Grass
(ii) Firewood from MSC
(iii) *D. melanoxylon* and *B. monosperma* leaves.
(iv) Bor fruits
(v) *C. tora* seeds

*3rd Year*
(i) Grass
(ii) Firewood from MSC
(iii) *D. melanoxylon* and *B. monosperma* leaves.
(iv) Bor fruit
(v) Jatropha seeds
(vi) *C. tora* seeds.

*4th Year*
(i) Grass
(ii) *D. melanoxylon* and *B. monosperma* leaves.
(iii) Bor, Jatropha seeds, *C. tora* seeds
(iv) Bamboo from clump cleaning.

*5th Year*
(i) Grazing
(ii) *D. melanoxylon* and *B. monosperma* leaves.
(iii) Bor, Jatropha seeds, *C. tora* seeds
(iv) Bamboo
(v) Lops from cleaning
(vi) Firewood from cleaning

If old *M. indica* trees exist, seeds and flower will be a available from the first year itself. If matures trees do not exist and plantation is done, the availability of seeds and flower could be only from the 15th years afterwards.

Phasing of area into 4 to 5 parts would continue to augment the above described series till 9 - 10th years. The 10th year would see 1st thinning and that would continue till 15th year. The first plot will be due for 2nd thinning in 15th year and thus the series will continue.

The gap plantation should keep 5-10% of fruit bearing trees of high yielding variety, *Emblica officinalis, Tamarindus indica, Pithecellobium dulce, Limonia acidissima* etc. and that will add to the income annually. With the growth of biodiversity and over all vegetative cover in the area, the flow of medicinal herbs, tubers, and nuts will start. After a period of five years, ethnobotanical survey of the area can be done with help of local people and Vaidyas (local men having knowledge about herbal medicines). In the 20th year, it could be third thinning; in 25th year 4th thinning and finally the crop can be harvested at 30th year leaving only NTFP and fruit giving trees (Table 2).

**Table 2**

*Cost Benefit Analysis*

| Year | Benefit (Rs.) | Cost (Rs.) | Net Income (Rs.) |
|---|---|---|---|
| 0 | 500 | -2700 | -2200 |
| 1 | 1000 | -3764 | -2764 |
| 2 | 750 | -864 | -114 |
| 3 | 500 | -864 | -364 |
| 4 | | -864 | -864 |
| 5 | | -864 | -864 |
| 6 | | -864 | -864 |
| 7 | 3000 | -864 | 2136 |
| 8 | | -864 | -864 |
| 9 | | -864 | -864 |
| 10 | | -864 | -864 |
| 11 | | -864 | -864 |
| 12 | | -864 | -864 |
| 13 | | -864 | -864 |
| 14 | | -864 | -864 |
| 15 | 12000 | -864 | 11136 |
| 16 | | -864 | -864 |
| 17 | | -864 | -864 |
| 18 | | -864 | -864 |
| 19 | | -864 | -864 |
| 20 | | -864 | -864 |
| 21 | | -864 | -864 |
| 22 | | -864 | -864 |
| 23 | 18000 | -864 | 17136 |
| 24 | | -864 | -864 |
| 25 | | -864 | -864 |
| 26 | | -864 | -864 |
| 27 | | -864 | -864 |
| 28 | | -864 | -864 |
| 29 | | -864 | -864 |
| 30 | 70000 | | 70000 |
| Internal Rate of Return (IRR) | | | 10% |

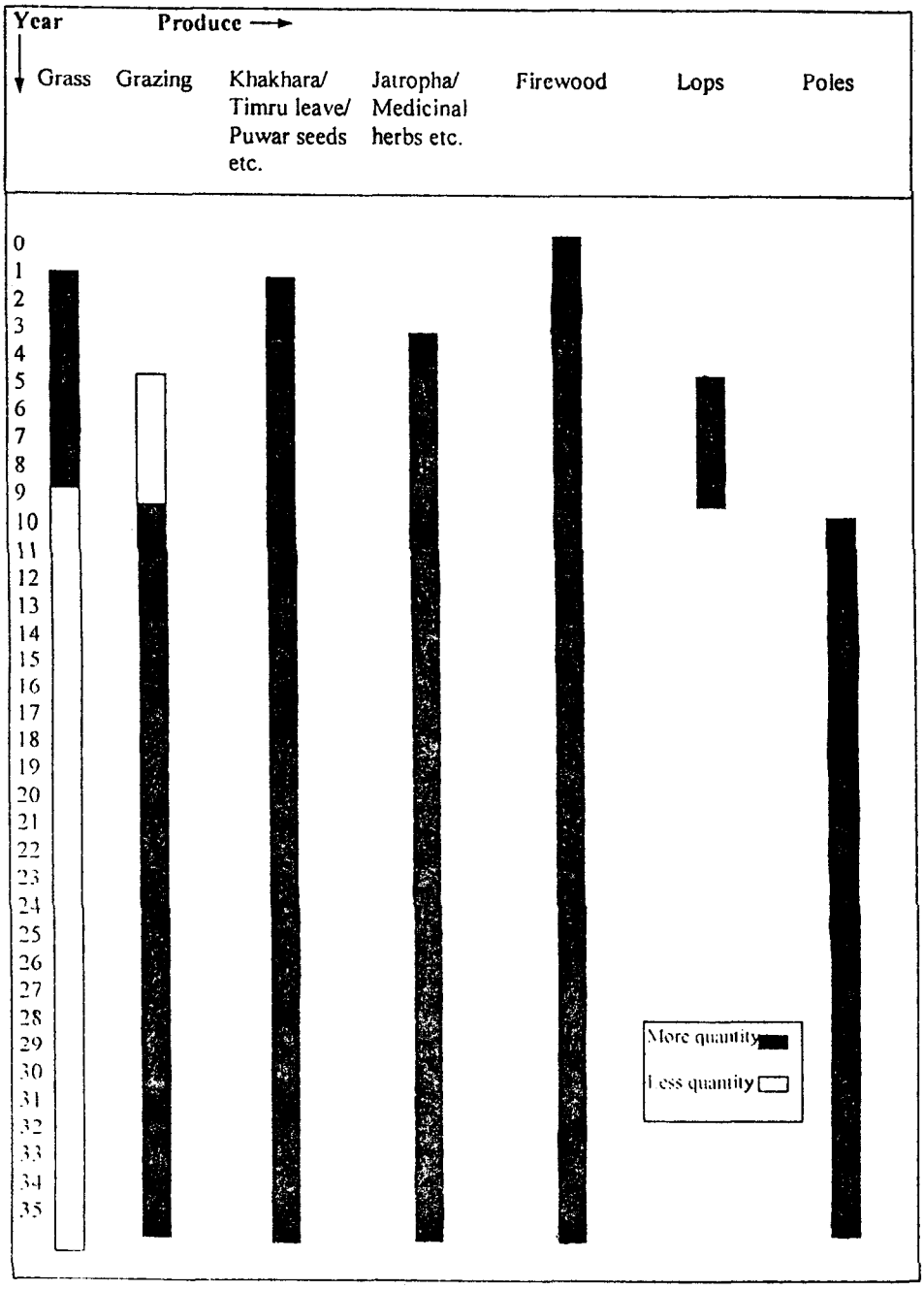
Many variants of this model are possible. For example, in order to meet the pressing needs to the firewood, one fifth of the area can be kept under bushy growth of *W. tinctoria* and *B. monosperma* until four-fifths of the area starts giving sufficient firewood.

Alternatively, if the resultant coppice crop goes to the top canopy, with the passage of time the middle storey can be utilised for the growth of *W. tinctoria* to satisfy firewood needs.

The above model is an illustrative one. The actual model can be decided only with real site situation and participatory involvement of users' community and local forest officials. The flow of forest produce from 1st to 35th years (for 5 plots) is briefly shown in Fig. 1.

This typical model of regeneration through coppicing with gap plantation is not the universal one. If the site is more degraded and incidence of root-stock is less, the area should be regenerated through plantations supplemented by coppices from cut-back. The vigour and growth of coppices decrease with rotations. After two-three rotations, the area must be regenerated through seed origin either by natural regeneration or artificially with plantations.

**Fig. 1**




Flow of Forest Produce

## SUMMARY

**The Joint Forest Management looks for a forestry design that matches and caters the needs of varied forest produce of local population in the shortest possible time. The suitable management and silvicultural initiative should be capable of matching the product basket with the needs of local people. Their income generation and employment opportunities are also to be looked after. As the regeneration of degraded land should be cost effective and remunerative, emphasis is laid on coppicing and cut-back of existing rootstock, inducement of natural regeneration, seedling, gap plantation, soil and moisture conservation works as well as enrichment with Non-Timber Forest Produce yielding trees. At the same time tending operations, thinning and harvesting regime are adjusted such that multiple forest products are available to the community without reducing potential of the resource. It has also been found that JFM in degraded forest land is a financially viable proposition, however highly degraded patches should be kept outside the JFM system. Silvicultural models and management design of JFM are site specific and depend upon resource, resource environment and use community. Care has to be taken for bio-diversity conservation as well as enrichment of native species required locally. With these consideration an illustrative typical silvicultural and management model applied in JFM areas of South Gujarat has been detailed. The basic concepts for designing the site-specific options are discussed and substantiated with examples from Gujarat.**


## संयुक्त वन प्रबन्ध के वनसंवर्धन और प्रबन्ध विषयक विकल्प

ए०के० वर्मा


### सारांश

संयुक्त वन प्रबन्ध को ऐसे वानिकी आकल्प की तलाश है जो सबसे कम संभव समय में स्थानीय जनता की विभिन्न वनोपजों की जरूरतों से मेल रख सके और उन्हें पूरी करा सके । यह उपयुक्त प्रबन्ध और वनसंवर्धन स्वरूप प्राप्त होने वाले पिटक को स्थानीय लोगों की जरूरतों के बराबर तक ले जाने में समर्थ होना चाहिए । उनकी आमदनी बढ़ाने और रोजगार के अवसर जुटाने की चिन्ता भी इसे करनी है । चूंकि व्याहसित जमीनों का पुनर्जनन करना लागत प्रभावी भी होना चाहिए और आमदनी कराने वाला भी इसलिए स्थूण रोपण और खड़े जड़ समूहों को भूमिसात् काट प्राकृतिक पुनर्जनन प्रेरित करने , पौध लंगाने, रिक्त छुटे स्थान भरने, मृदा और नमी संरक्षण करने वाले कार्यों के साथ-साथ उन्हें प्रकाष्ठेतर वनोपज प्रदायी वृक्षों से सम्पन्न बनाने पर जोर दिया जाता है । इसके साथ-साथ देखभाल करने के कार्यों, विरलन और फसल कटाई क्षेत्रों को इस तरह से समायोजित किया जाता है कि संसाधनों की संभावित क्षमता में किसी तरह की घटत लाए बिना समुदाय को बहुविध वनोत्पाद मिलते रह सकें । यह भी देखा गया है कि व्याहसित वन भूमियों का वन प्रबन्ध करना वित्तिय दृष्टि से किया जा सकने वाला उपाय है किन्तु अत्यधिक व्याहसित हुए क्षेत्रों को संयुक्त वन प्रबन्ध प्रणाली से बाहर ही रखना चाहिए । संयुक्त वन प्रबन्ध के वनसंवर्धन और वन प्रबन्ध आकल्प विशिष्ट स्थलों के लिए होते हैं तथा संसाधन, संसाधन पर्यावरण और समुदाय पर निर्भर होते हैं । इस बात की सावधानी बरती जानी चाहिए कि स्थलों की जैवविविधता बनी रहे तथा इसके साथ स्थानीय जरूरतों वाली देशज जातियों से वह स्थल सम्पन्न भी बनता रहे । इन विचारों को ध्यान में रखते हुए एक उदाहरणात्मक प्रारूपिक वनसंवर्धन एवं प्रबन्ध मॉडल दक्षिणी गुजरात के संयुक्त वन प्रबन्ध क्षेत्रों में शुरू किया गया तथा उसे यहाँ विस्तार से बताया गया है । आधारभूत विचारों को स्थल विशिष्ट विकल्प अपनाते हुए विवेचन किया गया है और गुजरात से प्राप्त इस उदाहरण से उन्हें प्रमाणित भी किया गया है ।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