SOCIO-ECONOMIC POTENTIAL OF MINOR FOREST PRODUCE IN MADHYA PRADESH

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PREFACE

The term **"Minor Forest Produce"** includes a large volume and variety of edible, industrial and commercial products which have multifarious uses and meet indispensable requirements of the population living in and around forests. Even in the earlier times during the Mauryan rule a Kupyadhyaksha (a superintendent of forest products) was appointed to classify minor forest produce like medicinal herbs, collection of poisonous snakes and worms, bamboos, canes and fibrous plants.

The classification of forest products into 'major' and 'minor' were based on their monetary values. Forests were generally managed for getting timber and fuelwood and thus were called major produce. Products other than these two were only incidental and thus lumped together as minor forest produce. Revenue wise too minor forest produce were not valued very high. The situation is however quite different today.

The volume and quantum of contribution of these products to our daily life is tremendous. Half of all the medicinal prescriptions dispensed owe their origin to vegetation occurring in forests.

The life of the tribal and rural population are intimately linked to many of these products. Their basic needs and livelihood earnings are from collection and processing of these items.

Madhya Pradesh is richly endowed with a variety of forest types and diverse forest products. Unfortunately reliable statistics are not available about the outturn of various Non-Nationalised MFP.

Many MFP trees like Mahua, Chironji and Tendu are frequently lopped, pollarded and felled for ensuring higher collection by tribals. So the very resources which have sustained them for generation are being destroyed.

The primary objective of this publication is to list out the minor forest produce occurring in the State, their production, distribution and collection, revenue earned and employment generated.

Eleven chapters of this publication list important MFP species wise occurring in the State. The last chapter on Research needs spells out area and is in fact a summary of this. Authors wish to acknowledge their colleague scientists and foresters who helped them in bringingout this publication.

Jabalpur,
1 Jan., 1991.

Ram Prasad
Pratibha Bhatnagar

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SOCIO-ECONOMIC POTENTIAL OF

MINOR FOREST PRODUCE

IN MADHYA PRADESH

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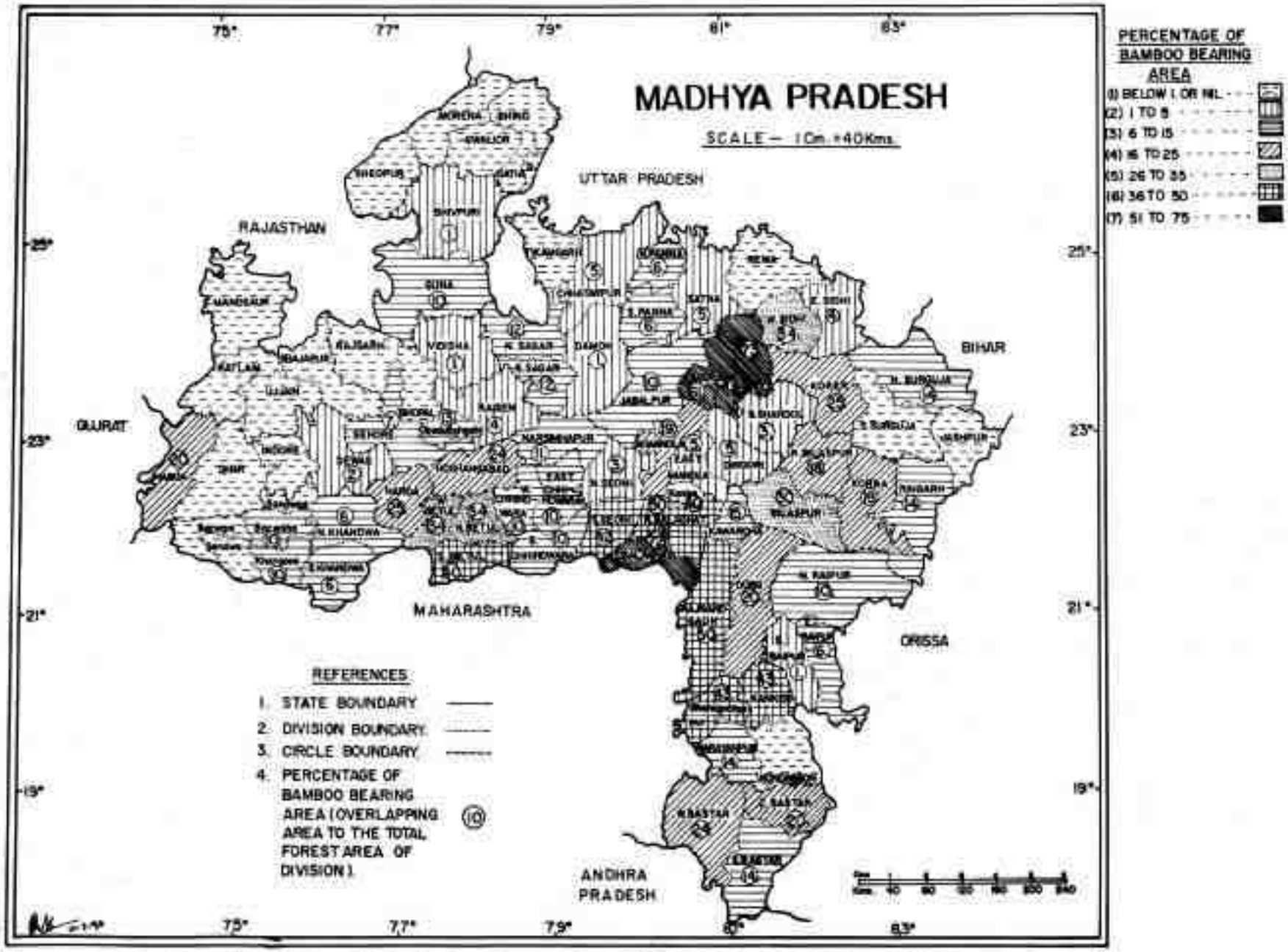

FIG. 1. Map showing the Bamboo bearing overlapping of Forest Divisions in Madhya Pradesh.

CHAPTER I

BAMBOO RESOURCES

Introduction

Bamboo is the most versatile among minor forest produce and has multiple uses - commercial, industrial and as rural construction material. It is extensively used as a raw material in Newsprint industry. Besides commercial and industrial uses, numerous articles of daily use, such as ladders, fences, handicrafts, tool handles, beds, sticks, tent poles, brushes, pipes, fans, umbrellas, toys, musical instruments, containers, drinking vessels, rods are made of bamboo species. It is the main raw material for basket and wicker work (Anon., 1972).

For the poor bamboo is indespensible as raw material for handicrafts, house construction, agricultural implements and basket weaving. The tender shoots of bamboo boiled in water are used in curries and for making pickles. The sap of these shoots contains hydrocynic acid and possesses antiseptic and larvicidal properties (Verma, 1986)

1.2 Occurrence and Extent

Bamboo occurs mostly as an understorey in the dry deciduous and moist deciduous forests especially on the slopes of hills in well drained valley's heads. The bamboo forests are found in Teak, Sal and mixed miscellaneous forests of the State.

The two most important bamboos of India are Dendrocalamus strictus and Bambusa arundinacea. They are sub-continental in distribution. The former occurs over a large area coming up naturally in tracts receiving as low as 750 mm of rainfall. Bambusa arundinacea prefers rich moist soil and grows on banks of perennial rivers and moist valleys. It attains its best development in moist deciduous forests receiving nearly 2000 to 2500 mm of rainfall (Kondas, 1982). There are other bamboo species but they are not encountered frequently.

In Madhya Pradesh, the commonest bamboo species are Dendrocalamus strictus, which is very important commercially and Bambusa arundinacea which occurs over limited areas along the rivers and streams in Bastar Balaghat, Betul, Jabalpur, Seoni, Mandla, Sagar, North and South Raipur

and Jhabua Divisions. The bamboo area estimated in 1960 was 15,004 sq km, approximately (Dutta and Tomar, 1964) and 14,846, sq km (Anon., 1965). Most of the Bamboo stocks occurred in Hoshangabad, Betul, Khandwa, Shahdol, Balaghat and Bastar Forest Conservancies. Another assessment of Bamboo production was done in Bori, Hoshangabad Forest Division in 1963 (Chacko, et al., 1965). The best bamboo forests occur in East and West Lanji Range of South Balaghat Division. The percentage of bamboo overlapping forest area ranges between 83 to 87 per cent. Balaghat, Umaria and North Shahdol Division constitute the maximum per cent of dense bamboo. Almost entire North and West Madhya Pradesh does not have bamboo except for Jhabua and Khargone Divisions.

Recent estimates by Prasad (1988) showed bamboo bearing areas as 20,825 sq kms. Bamboo bearing Divisions have been shown in Fig.1.1. In recent years however, the areas under productive bamboo forests have shown declining trend mostly on account of gregarious flowering and consequent drying.

1.3 Production

The bamboo production in the State rose from 113,168 N.T. in 1976 to 349,000 N.T. in 1986 an increase by 47 per cent in a decade (Table 1.1). The production of commercial bamboo increased by 18 per cent and industrial bamboo about 41 per cent.

Annual supply of industrial bamboo to paper mills was 167,499 N.T. in 1980-81, as against the total production of 188,379 N.T. (MPFD, 1981). The production of commercial and industrial bamboos has been shown in Fig.1.2.

Perusal of data pertaining to the total bamboo production reveals that after 1981 production has been showing declining trend. Sudden spurt in production during 1984-85 and 1985-86 was mainly on account of gregarious flowering in Shahdol, Umaria, Jabalpur and some other areas which necessitated clearfelling of flowered clumps. Flowering in Kawardha and part of Bilaspur Divisions during 1986-87 and 1987-88 also necessitated large scale clearfelling of bamboo clumps. These events kept the production figures static. However, when we see the total bamboo area of the state it showed declining trend.

1.4 Employment

Madhya Pradesh has definite policy to supply bamboo to the rural population living in and around forests to meet their bonafide requirements. Taking current bamboo production as 349,000 N.T. and assuming that harvesting one tonne of bamboo requires 7.5 person days (Pant, 1979) the current employment in this activity is estimated as 26.17 lakh person days considering that bamboo is mostly used by rural population and a significantly large portion of this use, goes unrecorded. But it cannot be overlooked that the social value of bamboo is high.

Since bamboo was an understorey species the management also mostly subordinated to the management of the principal species. Working of bamboo is presently departmental. Overworking of bamboo is commonly noticed near villages or along main roads and light working in remote and inaccessible areas. However, the overworking is on account of excessive biotic pressure and not due to any selective fellings during departmental working.

Table 1.1: Production and Net Revenue from Bamboo in Madhya Pradesh

Year	Production in 1000 N.T.	(Bamboo) Net Revenue (Rs. in lakh)	Revenue (per N.T.)
1973-74	113.168	202.62	179
1974-75	371.222	186.34	50
1975-76	326.391	440.44	134
1976-77	392.179	458.00	140
1977-78	359.035	592.00	164
1978-79	400.621	793.00	197
1979-80	761.741	750.00	207
1980-81	267.961	716.00	267
1981-82	289.127	1187.00	442
1982-93	280.064	1204.00	429
1983-84	237.378	1400.00	589
1984-85	336.283	1825.00	542
1985-86	349.000	1954.00	559
1986-87	325.216	NA	-
1987-88	360.629	NA	-
1988-89	321.641	NA	-
1989-90	333.068	NA	-

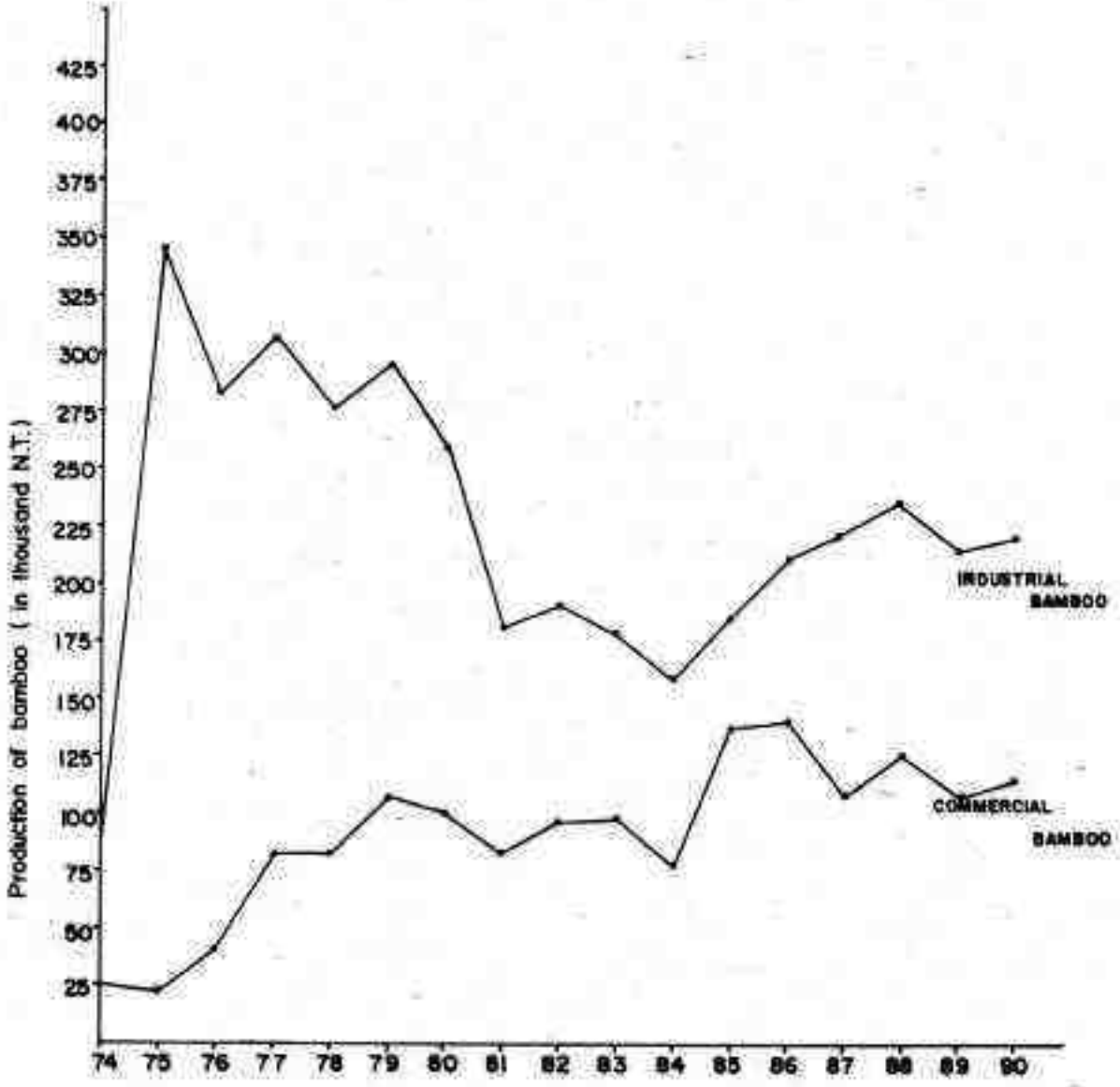

Fig.1-2 Showing production of Commercial and Industrial bamboo in thousand metional tonnes.

Between 1975-76 and 1985-86 the revenue from bamboo increased from Rs.134 per N.T. to Rs.559 per N.T. an increase by 31 per cent (Table 1.1).

Although in terms of revenue bamboo contributes 10-15 per cent of revenue realised from timber, but the fact remains that bulk of the commercial bamboo production of the State is distributed to the villagers on highly subsidised rates. Basket makers ('**Basods**') are also supplied a lot of bamboo on concessional rates (10-20% of the market rate).

1.5 Declining Bamboo Resources

Bamboo flowers sporadically almost every year; flowering in small groups generally remains unnoticed. Gregarious flowering occurs at an interval of 25-40 years. After gregarious flowering a large number of young germinants come up but due to intense biotic pressure these are not allowed to establish. Excessive grazing, recurring fires and over exploitation of bamboo forests make the establishment difficult.

Dutta and Tomar (1964) reported bamboo forests over an area of 14,845 sq km represented in old Forest Conservancies of Hoshangabad, Balaghat, Raipur, Jabalpur, Bastar, Bilaspur, Rewa, Gwalior and Indore. Although no precise data on current bamboo bearing areas of the State is available, observations and reports indicate that bamboo forests have more or less disappeared from Forest Divisions of Gwalior, Indore, Rewa, Jabalpur, Khandwa, Sagar and Ujjain circles. Gregarious flowering has also resulted in the loss of bamboo resources from part of Harda, Betul, Kawardha, Umaria and Shahdol Forest Divisions. As would be seen from Fig.1.1, bamboo bearing areas are fast depleting.

Decline in the bamboo areas have primarily been on account of gregarious flowering and consequent drying of bamboo clumps. Although a large quantity of seeds falling on the ground produced innumerable young germinants, for want of protection against fire, grazing and other forms of biotic pressures, these have not been able to reestablish.

Study of flowering pattern of bamboo therefore assumes great importance in managing the forests optimally and for providing adequate and appropriate treatments for retrieval of bamboo forests. On the basis of past records of flowering, the future pattern of gregarious flowering

could be anticipated. Factors associated with the gregarious flowering and management considerations have been discussed in the following paras :

1.6 Types of Flowering

1.6.1 Sporadic Flowering Two types of flowering are observed in Dendrocalamus strictus viz., (a) sporadic flowering and (b) periodical gregarious flowering (Brandis, 1906; McClure, 1966). Sporadic flowering takes place in isolated clumps and only few culms flower. The culm which flowers may or may not die. Sporadic flowering in D. strictus takes place almost every alternate year practically in all bamboo areas during November to May. Important characteristics of sporadic flowering are (i) scattered nature of flowering, only few clumps are involved in flowering, (ii) only a few culms flower in a clump, (iii) the culms may or may not die after flowering, (iv) the clump does not die and (v) usually it takes place irregularly almost every alternate years.

1.6.2 Gregarious Flowering Gregarious flowering in D. strictus is a well established physiological phenomenon. The characteristics of gregarious flowering are (Prasad, 1986; Dwivedi, 1988) : (i) flowering occurs almost in the entire area, (ii) it involves almost all or some portion of clumps, (iii) flowering takes place in all the culms in clump, (iv) flowering is followed by the death of the clump, (v) it follows cycle which occurs after a long but 'variable' period, (iv) it progresses in a definite direction like an epidemic wave beginning at one definite age of an area and (vii) it takes a few years, generally 2-4 years to complete flowering in the compact area of a Division or Range.

The period between two gregarious flowerings over the same area is believed to be somewhat constant and is called physiological cycle.

Gregarious flowering in Dendrocalamus strictus has been following definite cycle of 35-75 years (Prasad, 1986, Dwivedi, 1988). On the basis of past record of gregarious flowering the expected years of next gregarious flowering in some Forest Divisions of Madhya Pradesh has been indicated and given in Table 1.2

Table 1.2 : Records of Gregarious Flowering in some areas of Madhya Pradesh

S.N.	Area/Forest Division	Periods of Gregarious Flowering				Physiological cycle (years)
		I	II	III	Expected	
1.	Balaghat (North and South)	1916	1963	-	2110	47
2.	Bastar North	1948	1981	-	2014	33
3.	Betul	1940	1968	-	1996	28
4.	Bilaspur and North Bilaspur	1915	1960	-	2005	45
5.	Harda	1942	1976	-	2000	34
6.	Jabalpur	1935	1965	1985	1985	25
7.	Khandwa (North and South)	1910	1954	-	1998	44
8.	Mandla (South)	1900	1921	1946	1987	2[illegible]
9.	Hoshangabad	1948	1976	-	2004	28
10.	Mandla (North)	1930	1967	-	2002	36
11.	Seoni	1921	1939	1965	1990	23
12.	Seoni South					
13.	Raipur	1924	1960	-	1996	36
14.	Raigarh	1945	1985	-	2025	40

It would be thus clear from Table 1.2 that the cycle of gregarious flowering in D. strictus varies from 25 to 47 years in this State. However, this cycle has also been reported to be 50 years in DehraDun (planted) to 57 years in Taiwan for which seeds were procured from Bihar.

Gregarious flowering have been related to injury, nutrition, climatic conditions, genetical constitution, soil factors etc. (Nicholson, 1922; Patil and Panchal, 1980; Hussain, 1980). Dwivedi (1988) studied gregarious flowering in Shahdol district of Madhya Pradesh and found definite correlation with age of the crop, site quality, management practices and biotic interferences.

As often believed, the age of clump should determine the time for flowering. It is generally based on the logic that most of the clumps

are from the seeds of previous gregarious flowering and therefore all culms in the same clump should flower simultaneously. However, many researchers are of the view that since bamboo is harvested in a selective manner, therefore each clump is expected to have culms of varying ages. Similarly, the clumps which fall in the inaccessible areas and are not worked are older to the culms in worked areas. However, such difference in age is not likely to be pronounced so as to cause varying flowering swath.

Site quality is known to be related to gregarious flowering. Dwivedi (1988) has reported that I quality bamboo had delayed flowering than II and III quality bamboo. From Table 1.2 also it is quite clear that bamboo forests (Balaghat, Bilaspur, Bastar) in relatively moist areas take relatively longer period than bamboos of drier localities. However, more data is necessary to conclusively establish the relationship between gregarious flowering and site quality.

Two other factors viz., Management practices and biotic interferences appear to be positively correlated with the flowering pattern in D. strictus. In many areas, where clumps are properly worked according to the silvicultural requirements, the flowering is reported to be delayed by 3-5 years (Prasad, 1986; Dwivedi, 1988). However, in areas where clumps remain unworked, congested and unhealthy the flowering is hastened. Similarly, hacked clumps are seen to have flowered earlier than the clumps occurring in moist, well drained places away from habitations. From the above account, although nothing positive can be recommended to accelerate or retard flowering to any great extent, knowledge of gregarious flowering can definitely help the foresters to manage the forests appropriately. Supply of excess harvest of bamboo on account of clearfelling, seed collection and plantation activities, protection measures and desirability of cultural practices etc. could certainly be planned in advance for sustained productivity of bamboo forests. Gregarious flowering is an inevitable physiological phenomenon. Bamboo being a crop of understorey it has tremendous ecological role in keeping the site healthy. This ecological function of bamboo understorey should invariably be kept in mind while prescribing a treatments.

1.7 Rehabilitation of Flowered Bamboo Areas

It has been found that except in extreme cases where vegetation has entirely disappeared due to misuse for a very long time, it is possible to rehabilitate many of these forests at a comparatively low cost (Prasad, 1966). Mishra and Shrivastava (1961) gave the details of the scheme to be followed for rehabilitation of over-exploited ex-proprietary forests in Madhya Pradesh. In Maharastra, fire protection and spacing of bamboo seedlings were reported to have beneficial effect on clump formation in Chanda (Kirpekar, 1956). Rehabilitation of flowered bamboo areas of Mandla have been described by Prasad (1985). Similarly, Hakeem (1985) described the bamboo rehabilitation efforts in Kundam areas of Jabalpur Division. These efforts included protection against grazing, strict fire protection, opening of tree canopy etc.

Earlier experience of rehabilitation efforts of flowered bamboo forests pertain to South Seoni Division where special area treatments were carried out during 1965-66. Dense weed like bamboo seedlings were cleared in a strip of 20 m after every 10 m width left. The areas were protected from grazing and fire. Clump formation was noticed in 3-4 years of the above treatments applied. Some of these forests have now established. The results of various treatments viz., Protection against grazing (A) Grazing Closure,(B) Fire control, (C) Combination of both and Control, (D) have been given in Table 1.3. These results clearly bring out the beneficial effects of these treatments on seedling survival, establishment and clump formation. As against 27 and 31 culms in protected areas there were only 6 established culms in unprotected areas. In respect of height and basal girth also, the protection measures showed positive results.

Table 1.3: Effect of Grazing and Fire Protection on Regeneration and Growth of Bamboo (Dendrocalamus stictus)

Treatments	No. of established seedlings culms (Total 8 squares)	Average Height in m	Average Basal Girth in cm
A (Grazing Closure)	31	3.64	3.81
B (Fire Protection)	27	3.55	3.46
C (A + B Both)	31	2.94	3.52
D (Control)	6	2.30	2.45

Bamboo forests in Betul Divisions flowered during 1974-76. Elaborate scheme was drawn up to protect these areas from biotic pressures. Closure to grazing and strict fire protection helped to revive bamboo forests in Betul district. However, in certain areas of Harda where such operation have not been done, the bamboo have completely dried up. Loss of bamboo undergrowth has telling effect on site factors which is reflected by absence of ground flora and teak trees with top drying.

1.8 Bamboo Plantations

Re-introduction of bamboo is needed in areas where it has disappeared on account of gregarious flowering and lack of rehabilitation efforts. Since the root-stock of bamboo has disappeared from these areas, revival of bamboo is possible through plantation efforts only. A detailed account of bamboo plantation has been given by (Prasad, 1986).

Rhizome Bank — For raising large scale bamboo planting stock! Regular availability of bamboo seed is not assured. Gregarious flowering yields huge quantity of seed which is much in excess of the planned annual requirement. This huge bamboo seed stock can also not be stored for a long time as its viability reduces with storage period. After one year of storage, the germinative capacity drops down from more than 80 per cent in freshly collected seed to less than 40 per cent in seed stored for a period of one year or so. If the seed is stored for eighteen months to two years, the viability is further reduced to less than 10 per cent and after this period, the seeds fail to germinate. Storage of huge stock of bamboo seed is also not possible as not many well equiped godowns are available with Forest Department. Cold storage would not be feasible on account of non-availability of fund and lack of storing facility for this product. Damage in storage due to rats is also enormous and therefore, most useful method of utilising the huge bamboo seed stock is to sow its stock for 3-5 years period. This method of utilising bamboo seeds has been experimented at State Forest Research Institute, Jabalpur. In this method, instead of bamboo seedling its rhizome is used for planting. Such areas are called bamboo rhizome banks.

Bamboo forests are important as a substitute for small timber as much as it is needed for manufacturing items of cottage industries. Large scale bamboo supply to paper mills from natural forests may not be possible if the forests have to meet ever growing demand of rural population. An alternative is to popularise bamboo plantations by farmers on their field bunds, in their backyards and other village and farm wastelands. Bamboo could be a good component of farm-forestry and can supplement the income of poor farmers.

Bamboo 'Hitgrahi Yojna' has been implemented in various districts of the State. However, on account of poor response from local people and inbuilt deficiency in the programme it has not been very popular. The bottlenecks recognised in the scheme need to be overcome by educating the rural masses about the benefit of such schemes. Another alternative could be to popularise Bambusa vulgaris among farmers as it establishes fast, recruitment rate of new culm is relatively more and is easy to work. Although the species is common in eastern Madhya Pradesh, it can be grown throughout the State. Bambusa arundinacea is another species which has great potential in light textured well drained soils. Productivity of these two bamboos on field bunds and in village wastelands is more than Dendrocalamus strictus. Advantage of this eco-adjustment of these bamboo need to be exploited fully.

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CHAPTER II
LEAVES

Introduction

Leaves of a number of trees, shrubs, herbs and climbers are of great economic value. Leaves of D. melanoxylon are used as beedi (country cigerette) wrapper and are thus important item of commercial value. Leaves of Butea monosperma (tree) and Bauhinia vahlii are used for making leaf plates. Leaves of some climbers are used as spices. Apart from the fact that the leaves of many forestery plants are of commercial values, they also provide year-round employment to local inhabitants more particularly the tribals and other forest dwellers. Use of leaves as roof thatching material also enhance the value of many forestry species. Many of these aspects have been discussed in this section of the bulletin.

2.1 Tendu Leaves

Tendu leaves are obtained from small trees and wildly growing bushes of Diospyros melanoxylon. The leaves are used as wrapper of beedi. In various states the leaves are known by different names viz., 'Tumri' or 'Tendu' in Marathi 'Karai' in Tamilnadu, 'Kendu' in Bengal and Orissa, 'Kari' in Kerala, 'Tembru' in Gujarat.

Manufacturing of 'bidies' is believed to have started in Madhya Pradesh sometimes in 1906 in Jabalpur. It is now a well established and important cottage industry in the State. This industry at present, provides employment to about 60 per cent of rural population in certain tracts of Madhya Pradesh. This State produces the largest quantity of tendu leaves and it is estimated that about 60 per cent of the total production of the country comes from Madhya Pradesh. About 75 per cent of this production is consumed within the State for manufacture of bidies and the balance is exported to adjoining States for meeting the requirement of bidi industry.

The tree largely occurs in Madhya Pradesh, Orissa, Maharastra, Andhra Pradesh, Bihar, Uttar Pradesh, Rajasthan and Gujarat. It also occurs in small quantities in Tamil Nadu, Karnataka and Kerala. It is found in Sal Forests often replacing Sal in areas having poor site.

2.1.1. Silvicultural Features

There are two forms of the species a) D. melanoxylon and D. tomentosa, the main distinction being the slight difference in leaves.

A moderate sized to large tree, attaining a height of 20-25 m and a girth upto 2m with a straight cylindrical bole of 5-6 m under favourable conditions. It bears coriacious leaves varying in size and form. In its natural habitat the maximum shade temperature varies from 40°C to 48°C, and the minimum from -1°C to 13°C. The normal annual rainfall varies from 500 mm to 1500 mm. Seedlings and young poles stand moderate shade but for later development more light is required. Seedlings are resistant to frost and drought but are often susceptible to excessively moist conditions. The tree coppices well, but the coppice shoots grow slowly, it pollards better though the growth of pollard shoots is also slow. It reproduces easily through root suckers (Ghosh et al., 1976; Prasad and Mishra, 1976).

This species regenerates profusely from root suckers, which makes it difficult to eradicate from wastelands. The leaves are not browsed. Trees are deciduous, new leaves come out from middle of March to May.

The leaves from bigger trees are not suitable for Bidi making as they are tough. It is the small bushes from root suckers that yield most of the tendu leaves for bidies. Leaves are also collected from small trees, but they are never collected from trees having a girth more than 1 m.

Apart from the leaves most other parts of this tree species have high economic and social value. Its timber is used for making posts, rafters, shafts and carts, plumbers, tools, agricultural implements and sports goods. Tendu sapwood has been considered as one of the best Indian woods for the manufacture of textile shuttles. The dark coloured heartwood is famous source of Indian ebony. Its fruit is edible. The bark, fruit and the leaves possess medicinal properties. The dried flowers of tendu have curative powers in treating urinary, skin, and blood diseases. The bark has astringent properties and its decoction has been used to treat diarrhoea and dyspepsia. The bark also contains tanin upto 19 per cent (Paul, 1982).

2.1.2 State Trading

Before the abolition of proprietory rights by the then Madhya Bharat Government in 1951, 'malguzars' and ex-zamindars gave contracts to individual traders for the rights of harvesting of tendu leaves. The abolition of proprietory rights in 1951 vested all proprietory rights with the State government.

In 1964, the Madhya Pradesh Tendu Patta (Vyapar Viniyaman), Adhiniyam was enacted. Then 'tendu patta' on government forests were auctioned by Divisional Forest Officers.

The act empowered the government to divide specified area into units, to appoint agents on its behalf, registration for growers of 'tendu patta', registration of manufacturers of bidi etc. This empowered the State government to dispose off tendu leaves purchased in any manner, and to make rules etc.

The State was divided into units, numbering 972 in 1965. However, these units were further reorganised to 1826 in 1986. These units were formed according to their production capacity calculated in terms of standard bags.

Prior to the year 1968, no quality classes of Tendu leaves were recognised in the State. In the year 1969, on an adhoc basis, the entire State was divided into two quality classes. Subsequently in 1972 five quality classes came to be recognised.

The specificiations laid down for the various qualities are given below (Lahiri and Hazari, 1974).

Quality One	- Fairly large sized leaves, thin, smooth textured, weight of leaves being over 80 kg per standard bag.
Quality Two	- Large sized leaves, thin, smooth textured, weight of leaves being 65 to 80 kg per standard bag.
Quality Three	- Medium sized leaves (i.e. smaller than those of qualities one and two) fairly thin, fairly smooth textured, weight of leaves being 50 to 65 kg per standard bag.
Quality Four	- Small sized leaves, thin to medium in thickness, texture being fairly smooth, weight being 40 to 50 kg per standard bag.
Quality Five	- Small sized leaves, thin to medium in thickness, texture being smooth or rough, weight being below 40 kg per standard bag.

Table 2.1: Classification of units by quality classes in different years

Quality Classes	1968	1969	1970	1971	1972	1973	1974	1975	1976
First	291 (25.48)	52 (4.55)	52 (4.54)	78 (6.24)	77 (6.14)	96 (5.64)	89 (18.72)	327 (18.91)	337
Second	82 (7.18)	229 (20.05)	229 (20.00)	114 (9.12)	122 (9.76)	203 (13.0)	216 (13.69)	140 (8.01)	149 (8.36)
Third	740 (64.79)	830 (72.69)	831 (75.57)	822 (65.81)	813 (65.0)	1047 (67.07)	1035 (65.63)	1033 (57.44)	999 (56.06)
Fourth	-	-	-	-	151 (12.98)	152 (9.73)	161 (10.20)	190 (10.88)	199 (11.16)
Fifth	-	-	-	-	52 (4.16)	50 (3.20)	63 (3.99)	71 (4.06)	82 (4.60)
Unproductive	29 (2.55)	31 (2.71)	33 (2.88)	35 (2.80)	34 (2.72)	13 (0.83)	13 (0.82)	15 (0.85)	16 (0.89)
Total	1142 (100.00)	1142 (100.00)	1145 (100.00)	1249 (100.00)	1249 (100.00)	1561 (100.00)	1577 (100.00)	1746 (100.00)	1782 (100.00)

Figures in parenthesis give per cent to total units.

Table 2.2: Tendu leaves collection (1965-1986)

(In standard bags)

Year	No. of Units	Total Collection
1965	972	2,145,524
1966	962	2,143,612
1967	981	2,101,799
1968	1131	2,684,468
1969	1111	2,008,987
1970	1112	1,943,362
1971	1215	2,143,362
1972	1215	2,425,118
1973	1549	2,594,461
1974	1564	2,614,671
1975	1731	2,400,381
1976	1766	2,552,965
1977	1806	2,796,270
1978	1806	3,074,828
1979	1806	3,080,454
1980	1806	3,022,776
1981	1806	4,573,948
1982	1806	3,054,861
1983	1795	4,850,405
1984	1826	5,291,649
1985	1826	3,877,970
1986	1826	5,557,733
1987	1826	6,072,000
1988	1826	7,006,000
1989	1826	4,361,000
1990	1826	6,115,000

Table 2.3: Production of Tendu Leaves in different Forest Conservancies

S.No.	Circle	Collection (Standard bag)	Revenue	Revenue in Rupees (Per St. bag)
1.	Balaghat	68002 (1.41)	134.61 (3.33)	198=00
2.	Betul	74279 (1.54)	40.71 (1.00)	55=00
3.	Bhopal	285338 (5.91)	384.35 (9.51)	135=00
4.	Bilaspur	880341 (18.24)	544.59 (13.4)	62=00
5.	Chhindwara	80626 (1.67)	108.45 (2.68)	135=00
6.	Durg	377325 (7.82)	109.49 (2.71)	29=00
7.	Gwalior	56332 (1.17)	43.92 (1.08)	78=00
8.	Hoshangabad	69091 (1.43)	88.94 (2.45)	130=00
9.	Indore	134512 (2.79)	127.93 (3.16)	95=00
10.	Jabalpur	368857 (7.64)	328.58 (8.13)	89=00
11.	Jagdalpur	67883 (1.41)	66.20 (1.68)	98=00
12.	Kanker	585063 (12.12)	444.17 (10.99)	76=00
13.	Khandwa	75657 (1.57)	89.70 (2.22)	119=00
14.	Rewa	390287 (8.08)	255.89 (6.33)	66=00
15.	Raipur	304039 (6.30)	256.32 (6.34)	84=00
16.	Sagar	467248 (9.68)	332.69 (8.23)	71=00
17.	Shahdol	224308 (4.65)	239.32 (5.92)	107=00
18.	Surguja	189005 (3.92)	214.80 (5.31)	114=00
19.	Seoni	119693 (2.48)	227.61 (5.63)	156=00
Total		**4827688 (100.00)**	**4038.45 (100.00)**	

Tendu leaves units were assigned these quality classes. The proportion of units belonging to a particular quality class have been given in Table 2.1. It would be seen that bulk of the units (56 to 75%) were assigned class III and only a small number of units were given first and second class. Simflarly, class IV and V also accounted for a few units only. Another interesting observation is about the variability of per cent units coming under different quality class in different years (Table 2.1). These classes appear to have been determined on the basis of weather conditions prevailing in a particular year and the price of units offered by the traders.

2.1.3 Collection

The leaves are plucked from the natural vegetation. The suitability of leaves for bidi depends upon the texture, venation and the relative thickness of the mid rib and lateral veins of the leaves are of great significance. The leaves are plucked after they have turned crimson to bright green colour having leathery texture. Good quality leaves are produced from coppice shoots and root suckers. Pollarding also gives good results. The leaves from bigger trees are not suitable for 'Beedi' making as they are tough. It is the small bushes from root suckers that yield most of the leaves for 'Beedies'. Leaves are also collected from small trees, but they are never collected from trees having a girth more than 75 cm or so.

The collection time generally commences in the second week of April and continues till the onset of monsoon. This may however, vary from locality to locality. Good leaves are available after the first week of June, but collection is discontinued about a week ahead of the expected time for drying these leaves.

The leaves are plucked manually from standing trees and bushes. This activity provides work, during the lean agricultural season, and is, therefore, particularly important to landless agricultural labourers in the vicinity of tendu growing areas. The process of plucking tendu leaves essentially of four closely related steps: (i) walking to and from the tendu growing areas; (ii) plucking of leaves, (iii) sorting and tying the leaves in small bundles called 'pudas' and (iv) delivery of the bundles at the collection centres or 'phads' (Gupta and Guleria, 1982).

In Madhya Pradesh tendu is found in 44 of the State's 45 districts (barring Bhind). The leaves are plucked, stored and tied into bundles known as 'pudas' of about 50 leaves in each. These bundles are spread on open grounds with the dorsal side up for about 4 days. Then these bundles are turned upside down. Drying is complete in about 8 days. These are then packed into gunney bags. One standard bag contains about 1000 bundles of 50 leaves each.

2.1.4 Production

The production of tendu leaves in Madhya Pradesh increased from about 2 million standard bags in 1965 to 5.5. million standard bags in 1986 (Table 2.2). The eighties witnessed a sharp increase in collection of tendu patta. Data show the yearwise production of tendu patta for two decades. The state accounts for nearly 41 per cent of the annual production in the country, Maharastra and Orissa accounting for 15 per cent each (Paul, 1978).

Production of tendu leaves in different conservator's circle has been given in Table 2.3, perusal of which will reveal that districts of eastern Madhya Pradesh and some parts of Bundelkhand and erstwhile Vindhya Pradesh contribute maximum to the total earning from this trade. These areas are characterised by high summer temperature, extensive wastelands and open scrub-forests (excepting eastern Madhya Pradesh) all of which support good growth of Tendu (Diospyros melanoxylon). These areas also support higher plant population of Tendu bushes which yield maximum amount of good quality leaves. Generally, areas devoid of dense forests support good concentration of Tendu plants.

2.1.5 Employment

Collection and processing of tendu leaves generate substantial employment to rural and tribal population. Women and children also find good employment in this operation. They usually start very early in the morning to the forest and come back carrying headloads of leaves by mid-day. The afternoon is mostly spent in sorting leaves and tying in bundles. The operation of plucking, sorting, bundling, drying and packing these leaves is quite tedious. An average labour is able to make around 100 bundles each containing about 50-60 leaves, which

means that about 5000-6000 leaves have to be plucked, then sorted and tied in bundles since the collecting season is short lasting about 45 days. The supply of these leaves is effected to a considerable extent on the availability and efficiency of labour force. At the survey site in Kundam block, Jabalpur district the women labour informed that they got up at 3.00 a.m. in the dark and walked several hours before they came across tendu growing wild. So the distance also effects the quantity of collection. Generally all family members help in plucking of these leaves. The average collection of these labour depend upon the supply of leaves and varies between 100-200 bundles per day. They are paid Rs.25/- for every 100 bundles.

2.1 Village women in Kundam (Jabalpur district) tying bidi bundles.

Assuming that the collection per labour per day is 100 bundles and given the annual production of 5.5 million standard bags per annum each containing 1000 bundles in the State, the employment generated in collection activity alone is 55 million person days per year.

2.1.6 Revenue

Apart from the fact that Trade of tendu leaves provide seasonal employment to the landless and poor during most critical period of the year when the rural work-force is without any work, it also contributes substantially to the State exchequer (Table 2.4). The average annual contribution of about 30 per cent to the total revenue realised

from the sale of wood and non-wood forest products. The revenue contribution by this trade has although been varying year after year it has now stabilised at about Rs.400 millions. It is probable that the requirement of Tendu leaves for bidi manufacture within the State and in other parts of the country might have stabilised. Moreover, practically all States where Tendu trees are found have organised collection and disposal of bidi leaves and therefore not much could be expected over and above the present level of production and net revenue to the State.

2.1.7 Consumption within the State

Bidi manufacturing is a well established and most important cottage industry in the State. It provides large scale employment to rural unemployed and landless labourers. It provides employment to women, children, adult persons and old people many of whom are immobilised at home. The rural people during their leisure prepare beedies on behalf of local manufacturers. Practically each district in the State has beedi manufacturing unit of one manufacturer or the other. Factual informations pertaining to the manufacturing units (factories), annual production of Beedies and approximate annual requirement of beedies in the State have been given in Table 2.5 (Tiwari, 1981).

2.2 Standard bags of Tendu patta outside a unit.

Table 2.4: Revenue from Tendu Leaves

Year	No. of Std. bags collected (in lakhs)	Profit Rs. (in lakhs)
1970-71	1943	698.60
1971-72	2184	898.59
1972-73	2425	1003.13
1973-74	2594	1281.65
1974-75	2615	1449.11
1975-76	2400	1468.00
1976-77	2553	1483.00
1977-78	2740	1829.00
1978-79	3370	2115.00
1979-80	3080	2243.00
1980-81	3032	2178.00
1981-82	5091	2772.59
1982-83	4851	3491.08
1983-84	5079	4800.00
1984-85	5300	4370.73
1985-86	3900	3735.00

2.2 Bauhinia vahlii (Mahul)

Bauhinia vahlii is a gigantic climber and one of the most abundant of Indian climbing Bauhinia sp. It is distributed in the sub-Himalayan region ascending to 3000 m and also in Assam, Central India and Bihar (CSIR, 1948). Though it is a fibre producing climber, it is usually looked upon as enemy due to the damage it can do to healthy trees by climbing all over them. It is the leaves, however, which are used extensively as leaf plates, cups and it is also used in 'pan' shops as a wrapper.

2.2.1 Occurrence

It occurs in almost all the forest types of the State, but most of the collection is reported from sal region - Betul, Bilaspur, Durg, Raipur, Jabalpur, Surguja and Shahdol are the main Mahul

Table 2.5: Consumption of Tendu Leaves in Madhya Pradesh

District	No. of Factories	Annual Production of Beedies (in lakh)	Approximate annual requirement of bidi (in tonnes)
Bastar	7	4,300	430
Balaghat	21	41,529	4,153
Bilaspur	21	8,920	892
Bhopal Sehore	26	13,302	1,330
Bhind	2	6	1
Chhatarpur	4	127	13
Damoh	42	48,391	4,839
Dewas	9	693	69
Datia	16	1,466	147
Durg	11	1,274	127
Gwalior	9	1,740	714
Guna	25	12,681	1,268
Hoshangabad	6	1,535	153
Indore	8	5,096	510
Jabalpur	100	119,730	11,973
Jhabua	2	12	2
Khargone	7	2,117	212
Khandwa	28	10,479	1,048
Mandla	3	9	10
Mandsaur	4	14	2
Morena	7	533	58
Narsinghpur	21	6,549	655
Panna	2	317	32
Raipur	29	9,729	973
Raigarh	19	2,895	290
Ratlam	5	1,848	185
Raisen	22	7,797	780
Rajgarh	4	11,467	1,147
Rewa	26	15,221	1,522
Rajnandgaon	16	5,772	577
Sagar	56	312,342	31,234
Satna	85	14,742	1,474
Shahdol	3	412	41
Shajapur	2	98	10
Surguja	3	1,038	104
Sidhi	1	20	2
Shivpuri	3	258	26
Tikamgarh	4	4,490	449
Ujjain	2	601	60
Vidisha	13	1,725	172
Total	675	3769,177	7756,042

producing forest circles in the State (Table 2.6).

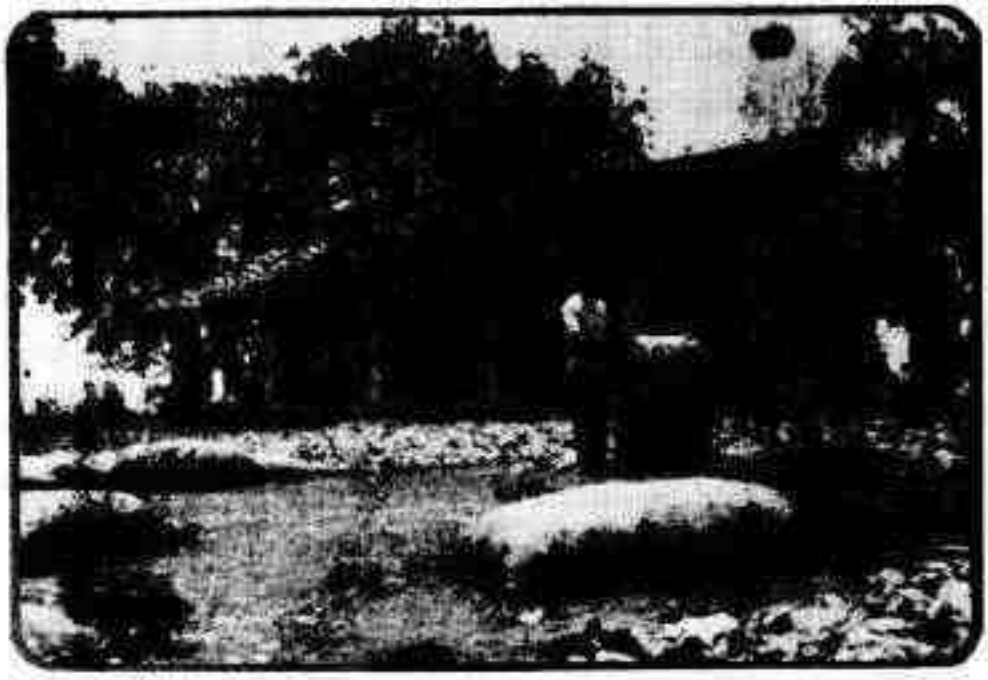
A survey of Karanjia Range of Dindori division was conducted (Bhatnagar, 1989). This is an important area for the collection of Mahul leaves. Some forest villages were selected, and the local collectors were interviewed with the help of a structured questionnaire to find out the socio-economic composition, the total collection per person and the wages paid to him. The firms dealing in this produce were also interviewed.

As per information supplied by forest conservancies Bilaspur is the most significant area with an average annual collection of about 40 per cent of the total collection. The other important forest conservancies are Durg and Surguja. The average revenue accruing from Bauhinia vahlii was about 20 lakhs whereas the market value stood more than 235 lakhs in a year on the basis of survey conducted where prevailing average market rate was Rs.3/- per kg. More than half the revenue earned come from Bilaspur. Circle-wise average produce and revenue earned are given in Table. 2.6. Wherefrom it is clear that the revenue per quintal is not uniform in the State. It is higher in Jabalpur and Bilaspur circles whereas it is low in tribal dominated circles like Shahdol, Surguja and Bastar. These are less developed districts of the State. On the whole Govt. was earning Rs.26.57 per quintal against the market price of Rs.300/-.

Of the respondents interviewed 88 per cent were male and 12 per cent were female. Most of them belonged to scheduled caste/tribes (94 per cent) and the remaining were from backward classes. The average household size was 5.3 persons and the primary occupation was farming. The average livestock holding was 8.4. The secondary occupation of these people was collection of MFP like Mahul, 'Phool Bahari'(Thysanolaena maxima) and Aonla (Emblica officinalis). Details on quantity of leaves collected per day, per season, number of days of collection and wages paid to collectors were ascertained during the survey. Thereafter the firms dealing with this business were interviewed (at Pendra Road and Amarkantak). The cost of collection of these leaves, the marketing cost and price spread were estimated.

Table 2.6: Average Collection and Revenue from Bauhinia vahlii

Name of Circle	Average Yearly Collection (in quintals)	Per cent of Collection	Revenue (in yearly) average '000 Rs.	Per cent Share	Revenue per quintal (Rs.)
Betul	560.75	0.79	15.6	0.75	27.82
Bilaspur	31283.79	39.93	1155.23	50.50	36.93
Durg	17327.50	22.12	251.55	12.08	14.52
Jabalpur	3193.00	4.08	150.55	7.23	47.15
Raipur	6093.00	7.78	105.38	5.00	17.29
Shahdol	6694.77	8.55	125.38	6.02	18.73
Surguja	12771.00	16.30	272.40	13.09	21.33
Kanker	415.00	0.53	5.44	0.26	13.11
Total	**78338.81**	**100.00**	**2081.53**	**100.00**	**26.67**



2.3 Drying of Tendu leaf bundles in a phad.

The collection period of Bauhinia vahli lasts for 2-3 months and average collection by a person per day is 5-6 kg. The rate at which the firms at Pendra Road (Bilaspur) purchase Mahul leaves from tribals of the surrounding forest villages varied from Rs.1 to Rs.1.50 per kg during the past five years. Thus, the tribals are getting only 6 to 8 rupees per day from this collection. The market rate of the produce is Rs.2.11 per kg at Pendra Road (inclusive of transportation and labour charge).

Table 2.7: Price spread in marketing of Bauhinia vahli leaves (December, 1988)

Particulars	Percentage
Net Collectors' share	33.33
Marketing cost	20.00
Marketing margin for consumer's price	46.67
	100.00

Table 2.8: Cost of collection of Mahul leaves (Bauhinia vahlii) in Karanjia Range, Dindori Division, Madhya Pradesh (December, 1988)

S.No.	Description	Cost per quintal (Rs.)	Per cent to total charges
I.	Collection cost		
	a) Collection charges (leaves)	100.00	49.82
	b) Packing and tying with ropes	15.00	7.48
	c) Loading/unloading	0.70	0.34
	d) Transport from site to rail head	8.00	3.99
	e) Repacking and sorting	12.00	5.97
2.	Storage and warehousing (including collection agent)	15.00	7.48
3.	Transport and freight (prepaid by actual buyer)	40.00	19.93
4.	Misc. & Contingencies	10.00	4.99
		200.00	**100.00**

Potential annual employment generated in collection of this produce is about 15 lakh person days per annum taking the figures for collection of an average 5.5 kg/day as reported during the survey. But this employment is not attractive because they are getting only Rs.5 to Rs.8 per day from the contractors. The major portion of the income is going to the middlemen as is clear from Table 2.7. The marketing margin for the middlemen is 46.67 per cent which is almost half the price of Mahul leaves. The Collectors (tribals) are getting only 33.33 per cent. Through cooperatives of these tribals, Govt. can provide gainful employment to these poor (Table 2.8), people.

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CHAPTER III

TREE BASED OIL SEEDS

Introduction

Besides the annually cultivated oilseed crops, India possesses about 86 different oil seed bearing trees. These occur naturally in the forests and are principally managed for the timber they yield. A few are planted as avenue trees on roadsides or in village groves or farm woodlots. These are collectively grouped under the term 'non-edible minor oil seeds'. These have assumed importance in recent years due to the shortage of vegetable oils for home consumption. According to some estimates about 10 lakh tonnes of minor oil seeds can be collected annually (Anon., 1972).

Tree Based Oil Seeds in Tribal Economy

The oils obtained from forest trees are of varying commercial importance. Some of these oils or 'butters' as they are often called, have already established a good market for themselves, but the majority are of local importance only, although some of these deserve better attention on account of their richness and quality. Owing, however, to the scattered nature of most forest trees and the consequent high cost of collection of their seeds on a large scale, forest oil seeds can seldom compete with oil seeds produced as field crops, such as linseed, sesamum, mustard, and rape. They are used nevertheless by tribals and other forest dwellers for multitudinous purposes, of which the chief are cooking and lighting.

Tree based oil seeds which are commercially important and also important from the view point of tribal economy have been given in this section.

A. SAL SEED

This tree (Sal) has a wide distribution in central, eastern and southern parts of the State. The cotyledons of its seed yield the well-known sal butter. The seeds are husked and boiled and the oil is skimmed off. The oil soon solidifies to a white butter. It is used for cooking and lighting and for

adulterating of ghee. It is a suitable confectionery fat and may also be used in soap making. The seeds are sometimes eaten whole, especially in times of famine.

Sal fat has been used by tribals for lighting and edible purposes. Commercial collection of sal seed for fat production started in 1968 although, till then it was considered uneconomical on account of low fat content (12.6%) in Sal Kernels. However, subsequently with the paucity of traditional oil seeds for industrial purposes, collection of Sal seeds gained momentum. As a result, Sal seed oil contributes substantially to the total tree based oils.

3.1 Method of Sal Seed Collection

Sal seeds are collected from the time ripe fruits start falling in May and continues till the onset of monsoon. After the rains have set in, collection is discontinued as many areas become inaccessible. Due to favourable moisture conditions the fallen seeds start germinating on trees or as soon as they fall on the ground. Such germinated seeds on storage deteriorate fast.

The most common method of collection is either by hand picking from trees or by picking from ground after sweeping the forest floor and more frequently by burning the area. During this period the season is driest (May and June) and therefore forest fires play havoc. There is moisture stress in the soil, the trees get damaged, the early regenerations are burnt and fire is inimical to natural regeneration. Fire scars on the tree stems are result of burning at the time of Sal seed collection. Also the collection is more concentrated near habitation while the interior forests are less frequently burnt and visited for seed collection. Intense biotic pressure around human habitations has thus greatly contributed to the site deterioration, lack of regeneration and receding of Sal forests. If this trend is not stopped effectively, we may lose one of the most majestic tree forests of Central India.

In the State, the Minor Forest Product Federation gets the collection done through primary cooperative societies like LAMPS/PACS.

The National Commission on Agriculture (Anon., 1976) while commenting on collection of MFP was not in favour of any elaborate

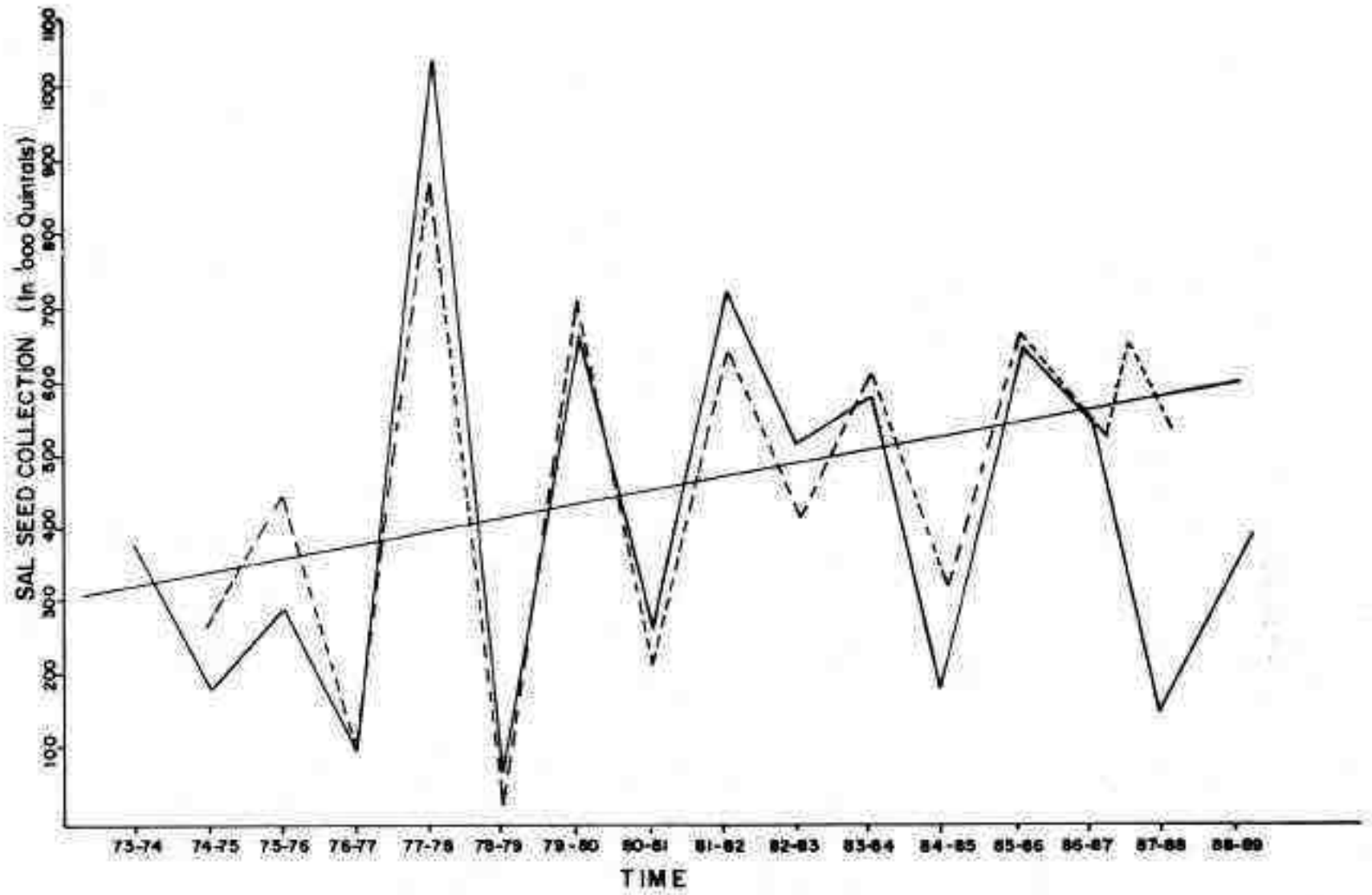

FIG. 31 TRENDS IN SAL SEED PRODUCTION (1973-89)

field setup whatever be the organisational arrangement. It suggested that the services of the normal field staff should be utilised for collection of MFP by the tribals and for disbursing the payments for the material collected, , suitable honoraria should be paid to these field personnel for undertaking this work and the State governments should permit acceptance of honoraria by them. The Commission also stated that the labour should be trained in proper and methodological collection. Training camps need to be organised to ensure proper training for collection without damage to plants and for quality and grading.

In Madhya Pradesh the trade in Sal seed was nationalised in 1977, and the task of collection and disposal was entrusted to State Forest Department and MFP Federation. There are a total of 188 sal seed units in the State which have been alloted to the Federation for collection and delivery of Sal seed to various industries (Anon., 1985).

In the absence of any training to labour, indiscriminate methods of collection have been used which are inimical to sal ecosystem. It is therefore, suggested that a correct approach to create favourable conditions for the economy, the local tribals and for the ecology of the area be adopted. Collection of sal seeds should be done in a scientific manner. Action also needs to be taken to improve and develop methods of collection.

The present method of burning the ground litter for easy collection of seed is not only harmful ecologically but it is infact destroying the very basis of survival of tribals. For effecting optimum collection of sal seed the ground is burnt during the hottest part of the year i.e. May and June. Invariably this does not remain a mere surface fire but engulfs the tree canopy and stems of mature trees as well. The bark of the tree stems get charred and in due course of time develop many deformities like epicormic branches and wounds, which ultimately invite, pathogen and insect attacks (Prasad, 1988).

Fire has also been recorded to affect adversely natural regeneration, besides burning leaf litter and other ground flora necessary for conserving soil moisture. If this practise continues unabated, there may not be sal forests and absence of sal forests would mean loss

of many edible mushrooms, bulbils, rhizomes and medicinal plants which supply food and medicine to tribals during the lean period.

3.2 Seed Cycle and Variations

The present knowledge of seeding cycle in sal is quite vague and uncertain. Most authors are of the view that there is a 3 year seeding cycle in Sal. First year as good, second year as medium and third year as poor. There is evidence both physical and oral in support of cyclical seeding behaviour of Sal (Bhatnagar, 1989).

Champion and Seth (1968) have also mentioned that seed production in Sal varies from year to year and from tree to tree. Chakravarti (1948) studied the cyclical behaviour of sal seeding from Sambalpur forests of Orissa and tested good, moderate and bad seed years.

3.3 Sal Seed Production

The sal seed production shows regular fluctuations at periodical intervals. These fluctuations signify every alternate year as a bad year (Table 3.1). With these fluctuation it is very difficult to judge the trend in sal seed production. Therefore, two-yearly moving average has been calculated. From this it is clear that the sal seed production has shown increasing trend only upto 1982-83. On the whole it has increased at the compound growth rate of 4.90 per cent per annum. But if we break the series into seventies and eighties, it is surprising to note that the seed production has increased at the rate of 10.13 per cent while it has decreased at the rate of 5.34 per cent during the eighties. Thus at present sal seed production is in declining phase.

The graph (fig.1) shows that sal seed production varies from year to year. The highest collection being in 1977-78. The co-efficient of variance for the last two decades was 85.5 per cent for seventies thereafter stabilised at 39.22 per cent depicting that the eighties as compared to seventies is relatively stable mainly because of the declining trend in eighties. Since sal seed production has shown a lot of fluctuations even the 2-yearly moving average has not averaged the fluctuations. Therefore, it is difficult to estimate the over-all growth in sal seed production. For this least square trend line was used to show the direction of change. The co-efficient of the trend is positive and high which shows significant growth in sal seed production during this period.

Table 3.1: Trends in Sal Seed Production in Madhya Pradesh

Year	Sal Seed (In '000 qt.)	2-Yearly moving Average	Fluctuations
1973-74	374.256	-	-
1974-75	184.300	259.077	-74.770
1975-76	293.451	213.331	+80.119
1976-77	82.125	373.645	-291.5
1977-78	1036.880	552.246	+483.754
1978-79	53.100	460.192	-407.192
1979-80	697.689	425.346	+272.343
1980-81	253.153	485.298	-232.145
1981-82	737.443	560.248	+177.192
1982-83	512.796	587.281	-74.486
1983-84	585.930	470.685	+115.245
1984-85	198.083	402.397	-204.31
1985-86	627.495	489.191	+138.304
1986-87	503.691	458.785	- 44.906
1987-88	200.280	306.107	+105.827
1988-89	336.400	386.669	-50.269
1989-90	673.596	-	-

Since every alternative year is a bad year in sal seed production, therefore it is difficult to link this cyclic behaviour with weather factors. However, the correlation of sal seed production with rainfall and one year lag in rainfall in sal production estimates are - 0.43 and + .11. This shows that rainfall and sal production are negatively related but in-significant with one year lag in rainfall, the correlation turned out to be positive but again insignificant. It can also not be explained by the onset time of rain in the first week of June during these years. It is thus difficult to explain the fluctuations in sal seed production to have any definite relation with weather factors.

Sal seed oil is a major non-edible tree based oil. The per cent contribution of sal oil to other minor tree based oils rose from 5.45 per cent in 1970-71 to 25.64 per cent in 1978-79 (Table 3.2).

3.1 Sal seed trees in flowering.

Table 3.2: Per cent contribution of Sal oil to other minor tree based oils

Year	Other oil seeds (in '000 tonnes)	Sal (In '000 t.)	Total Production	Sal as per cent to other oil seeds
1970-71	55.9	3.1	59.0	5.54
1978-79	87.0	30.0	117.0	25.64

3.4 Employment Potential

A substantial proportion of rural population reside in villages in or near the forests. It is this population which collects the seeds on behalf of Government and earns wages for about 2 months. Sal tree start flowering between 10-15 years in the months of February-March and fruits ripen in May-June. The seeds mature just before

the onset of monsoon and are collected under the trees. This activity provides employment during the lean period. Moreover, these seeds are collected mostly by women and children of the weaker sections of the community, larger collections would, therefore go a long way towards providing gainful employment to the labour force particularly to landless agricultural workers.

Employ-ment generated has been estimated with sal seed collection in 1985-86 which was 627.495 thousand quintals. Assuming that a labour can collect approximately 15 kg per day, employment generated is 41.83 lakh person days (Bhatnagar and Kawadia, 1989). The employment through collection activity thus alleviates seasonal unemployment and increases the income level of rural house holds.

Table 3.3: Sal Seed Collection, Revenue and Expenditure in Madhya Pradesh

		1985-86
1/	Sal seed collection ('000) quintal)	627.495
2/	Revenue at the rate of Rs.2,500/- qt. (in lakh rupees)	1568.73
3/	Employment generated at the rate of 15 kg per person day (in lakh person days)	41.83
4/	Expenditure (in lakh rupees)	711.16
5/	Net revenue	857.57

B. MAHUA (MADHUCA LATIFOLIA)

A large ever-green or semi-ever green tree with numerous branches. It flowers from end of February to April. The fleshy cream-coloured, sweet petals fall soon after the flowers open out. During the flowering season large quantities of the petals are collected. The fruit ripen from June to August. The season for collecting Mahua flowers is short and in the absence of organised harvesting, a considerable portion of the crop is lost-during monsoon.

Mahua oil is hard in nature and constitutes 35 per cent of the seed. The yield of oil from seeds, however, depends on the type of equipment and method employed for crushing. Oil contains (%): Oleic (41.0 to 51.0); Stearic (20.0 - 25.1) and 16.0 to 28.2 per cent of Palmitic acid (Nagarajan et al., 1988).

Almost the entire production of this oil is used in the production of washing soaps (Awasthi, 1971). Soaps made from mahua oil tend to go rancid in course of time due to the presence of oxidizable constituents in the unsaponifiable fraction. Therefore, mahua oil is not recommended for toilet soap production.

However, this fat, properly refined can be utilised for cooking and in confectionary and chocolate making (CSIR, 1962). Refined oil finds use in the manufacture of lubricating greases. The oil is also used for candles, as a bathing oil, in jute industry and as a raw material for the production of fatty alcohols and stearaic acid. Mahua oil has emmollient properties and is reported to be used in skin disease, rheumatism and headache. It is considered as a good laxative in habitual constipation, piles and haemorrhoids (Nagarajan et al., 1988).

2.5 Previous Works

An interesting correspondance between H.A. Farrington CCF, Central Provinces and A. St. V. Beechey, C.F. Northern Circle, C.P. in 1924 is being reproduced here:

Beechey wanted the cutting of Mahua to be spared which occured in Forest Reserves bordering villages and claimed that this species supplemented the food of the people. He recorded, "I would suggest that spreading Mahua trees be reserved both in simple coppice and coppice with standard areas in those portions of the Reserves, where the flower and seed is easily collected by the villagers but where such is not the case Mahua be removed if interfering with more valuable species."

To this the Chief Conservator replied, "In many parts of the C.P. there are large areas outside Reserved Forests which grow Mahua or might grow Mahua very little fruit is collected from forest trees ..... even a Mahua standard in a coppice coupe only bears fruit to any extent for 3 years or so after the coupe is cleared ..... trees in isolated positions will not be felled ..... a large Mahua affect the development not only of trees under its direct shade but also of those surrounding it."

The timely warning by Beechey was not heeded. However, a note by Sagrieya (undated) as Silviculturist, C.P. & Berar states "The importance of Mahua to the people has not been lost sight of by the Forest

Department, and in prescribing fellings care is taken to reserve all healthy and vigorous Mahua and Achar (Buchnania lanzan) trees against fellings, so long as they do not interfere with the growth of other more valuable species."

In Madhya Pradesh, a survey carried out (Sethi, 1964) indicated a potential of 2,01,445 tonnes of Mahua concentrated mainly in Raipur, Durg, Raigarh, Bilaspur and Shahdol. Another project known as Dandak-aranya estimated availability and prospects of Mahua (Awasthy, 1971). It comprised of Bastar district in M.P. and Koraput and Kalahandi district of Orissa (SFRI, 1990).

The collection of Mahua seeds in 1970-71 was 78,990 quintals. The total number of Mahua trees estimated by the Central Oilseeds Committee in the state were 22,23,513 tree.

Production of Mahua Flower and Fruit per Tree

In general the per tree production of Mahua flower and fruit may vary according to the size of the tree, site conditions, age etc. However, in order to make a general assessment of productivity of trees of Mahua an experiment was initiated by State Forest Research Institute, Jabalpur. In its campus of about 100 hectare a large number of Mahua trees of varying sizes are found growing wild. These trees are well protected for the last about twenty years. Production of fruit from trees of different girth classes (representing different age) was undertaken for 4-years (1987-1990). The fruit yield from trees of different girth classes are summarised in Table 3.4. From these results it would appear that the yield of Mahua fruit was invariably higher in trees of higher girth classes.

Table 3.4: Production potential of Mahua fruits per tree from 1987 to 1989

Week	Collection of Fruit from trees of different Girth Classes				
	61-90 cm	91-120 cm	121-150 cm	151-180 cm	Over 180 cm
	Yield of Mahua fruit Kg/Tree				
			1987		
I	0.140	0.969	0.629	1.323	1.435
II	0.330	0.943	1.021	2.170	0.717
III	0.480	0.300	0.673	0.497	1.420
IV	0.000	0.450	0.550	0.507	1.400
Total	0.950	2.390	2.873	4.498	4.972

1988

I	0.295	0.222	0.172	0.502	0.261
II	1.275	0.563	0.725	0.964	1.099
III	1.320	1.117	0.394	0.796	2.279
IV	0.000	0.137	0.246	0.561	1.570
V	0.000	0.000	0.000	0.265	0.230
Total	2.890	2.039	1.537	3.088	5.429

1989

I	0.290	0.374	0.240	0.781	1.133
II	1.475	1.214	1.131	1.509	3.081
III	1.270	0.929	0.944	0.900	3.323
IV	0.160	0.156	0.141	0.108	0.228
Total	3.195	2.673	2.456	2.298	7.765

The number of Mahua trees in the State (2223,513 tree) assessed by Central Oilseeds Committee appears to be a gross estimate. As have been calculated in Chapter XII (Edible Products - Mahua Flower), there are about 3.11 million trees of Mahua in the State. Presuming that atleast 50 per cent trees bear good fruits every year and that each tree yields about 3.00 kg seed, the total production of Mahua seeds in the State could be somewhere 6,000 tonnes annually.

Employment Potential

Despite the fact that a substantial portion of the total Mahua seed oil is used for industrial purpose, a good part of it is locally used by tribals and other forest dwellers for edible and cooking purposes. It is also used as an illuminant and hair oil, especially in rural parts in the neighbourhood of production centres. With the increasing price of ghee, Mahua oil is also being used as an adulterant, for which it can be purified with butter-milk to mark the disagreeable odour. The oil finds use in medicine also.

Experiment at State Forest Research Institute, Jabalpur showed that on an average each person can collect upto 2 kg of Mahua seed. Thus the total annual collection of Mahua seeds is capable to generate 3 million person day every year.

C. KARANJ (PONGAMIA PINNATA)

The tree is evergreen or nearly so under favourable circumstances and may be completely leafless for varying periods of time between March and May where conditions are adverse. Flowers appear between April and July in Central India and pods ripen from February to April the following year. The tree is found growing naturally along water courses under the shade of other trees although it is not a shade demander as it does well with full head light even in the early stages.

The tree is primarily valued for its seeds. The oil content of Karanj seed is about 27 per cent. It has a peculiar pungent smell and a bitter taste and has the following fatty acid composition: (%): Oleic acid (61.30); Linoleic acid (9.72); Palmitic acid (6.06); Dihydroxystearic acid (4.36); Arachidic acid (4.30); Lignoleric acid (3.22); Stearic acid (2.19); and Myristic acid (0.23). The oil is chiefly used for leather tanning, soap making, lubrication and in medicine (Vimal and Naphade, 1988).

Both the seed and oil are poisonous and possess remarkable medicinal properties. The seed is carminative, purifies and enriches the blood and is used in cases of inflamation, earache, lumbago, chest complaints etc. The oil is styptic anthelmintic, good in rheumatism, cutaneous inflections and is highly spoken of as a remedy in scabies and herpes. The oil cake is a good fertilizer (Mathauda, 1988). It is of great value in indigenous medicine as a stimulant and for the treatment of skin diseases. The juice of leaves, stem and roots are considered a remedy for gonorrhoea. Externally the leaves like the root and seeds are used for the treatment of parasitic skin diseases; a poultice of leaves is used for the treatment of maggot infested ulcers. Its flowers are useful in diabetes (Dastur, 1988).

Undistilled variety of oils can be used in the manufacture of high quality laundry soap and the distilled variety in the manufacture of toilet soap (Lakshmi-kanthan, 1988). Some research studies have been cited by Vimal and Naphade (1988) which show that Karanj cake can be used as an organic nitrogenous manure. In a study on the nitrification of five oiled and deoiled cakes Karanj showed the highest nitrate nitrogen. Its seed extract proved to be the most effective nitrification regulator followed by bark and leaf extracts.

According to the survey carried out by Central Oilseeds Committee (ICOC, 1964a), Madhya Pradesh has 89,261 Karanj trees, the production potential is 12,050 quintals assuming that yield per tree is 13.5 kg.

D. KUSUM (SCHLEICHERA OLEOSA)

It is a large deciduous tree and bears minute yellow green flowers. The fruit or the hard skinned berry contains one or two ellipsoidal seeds with a brownish coat. These trees serve as hosts for lac insects and are generally found in compact blocks; this facilitates the collection of seeds.

The tree usually flowers during February-April, and the fruits are harvested in June-July. Kusum oil or Macassar oil is a yellowish white semi solid fat with the following fatty acid composition (%): Oleic acid (60); Arachidic acid (20-25); Palmitic acid (5-8); Linoleic acid (3-4); Stearic acid (2-6); and Myristic acid (1). It has a faint odour resembling that of bitter almonds, (SEPC, 1950). A yield of 25 to 27 per cent oil is reported from Kernel pressed in 'ghanis', repressing of the cake with hot water is said to yield nearly 33 per cent (SEPC, 1959, ICOC, 1964 b, c & d; Gupta and Guleria, 1982).

A major part of the Kusum oil produced is utilised by the soap industry in the unorganise sector. The oil compares favourably with other oils in softness and lathering. It has been used for long in hair dressing and in some medicinal preparation for skin diseases, rheumatism and headaches. The tree is lopped for fodder and flowers yield a dye. In Madhya Pradesh, it is naturally found scattered in mixed forest mostly near the banks of rivers and streams.

Information regarding the availability of Kusum seeds received from forest conservancies (1982 to 1985) where it occurs is given in Table 3.5.

Table 3.5: Average annual collection of Kusum Seeds

Forest Conservancies (Circles)	Average Yearly Collection (in Qts.) (1982-1985)	Per cent
Hoshangabad	26.66	0.38
Shahdol	125.00	1.79
Chhindwara	53.22	0.76
Raipur	1276.66	18.33
Kanker	5416.85	77.80
Indore	16.33	0.26
Jagdalpur	47.33	0.67
Total	**6962.05**	**100.00**

Kanker and Raipur are the most significant areas contributing 96 per cent of the total collection of the State. Average yearly revenue per quintal works out to Rs.26.25 in the State.

Kusum seed collection has not been well organised. The seeds are collected by local population. The bunches of fruit are collected by climbing into the trees. They are usually collected before they are fully ripe. This is done because the collection of ripe fruits fallen to the ground is laborious on account of the under growth. The collected fruits are heaped for 2 to 4 days during which period their pericarp decays. The pulp is then removed by rubbing the fruit in water. The wet-depulped seeds are spread out to dry.

The average collection of Kusum seeds per labour day is 10 kg (Anon., 1971) and given the current collection which is 6962.05 quintals, this activity is a resource of gainful employment of 69.62 thousand person days per annum.

E. PALAS (BUTEA MONOSPERMA)

Commonly known as 'the flame of the forest', it is a medium sized tree found throughout India except in very arid parts. It is scattered in mixed forest alongwith Sal (Shorea robusta) or Saj (Terminalia tomentosa), tendu (Diospyros melanoxylon), Khair (Acacia catechu).

It bears a profusion of bright orange red flowers in Feb.-March before the appearance of new leaves. The pods are 12 to 20 cm long by 2.5 to 5 cm broad usually contain a single reddish-brown, flat, oval or somewhat kidney-shaped seed. The seeds ripen in April-May/June.

3.1 Palas (Butea monosperma) on road side.

Under a project conducted by Directorate of Oil Seed Development in Madhya Pradesh indicated that six districts in the State have about 26,000 trees each and two districts have about 1 lakh trees. The seeds yield 81 per cent oil in expeller and 16-17 per cent by solvent extraction method. Yield per tree is about 1 kg (Lakshmikanthan, 1988).

In the early sixties, information regarding the occurrence of 'palas' in all Forest Divisions of the State was enquired in view of its suitability as a raw material for newsprint. The Divisional Forest Officer, Dhar reported 62,000 trees, Bilaspur Forest Conservancy reported 4,22,017 trees. In Raipur, palas occurs sporadically in patches in wastelands and on the field bunds.

It was reported that 'palas' was being used intensively for lac propagation. The reason for low percentage of exploitable size of 'palas' trees was its use as fuel. Many Divisions reported that it was not available in commercially exploitable quantities and was just sufficient to meet the local nistar demands. Since roots of this tree were used in rope making there was little chance of its growing.

The yield and characteristics of the oil from Butea monosperma seeds have been reported in literature, but account of seed collection for oil extraction is however lacking. The oil should find good use in soap making and the deoiled meal has good potential in industry on account of the high protein content of the seed.

Data on collection of palas seeds was enquired from all forest conservancies in the State which has been summarised in Table 3.6.

Table 3.6: Collection of Palas (Butea monosperma) seeds

Circle	Average yearly collection (1982-85) (in Quintals)	Per cent
Shahdol	38.65	0.41
Seoni	435.00	4.65
Balaghat	18.33	0.19
Raipur	213.00	2.27
Kanker	45.00	0.48
Durg	8604.00	91.97
Total	**9354.23**	**100.00**

Durg is the most significant area having 91.97 per cent of the total collection. The current revenue (1985-86) ranges between Rs.200,000 to Rs.500,000 annually.

F. NEEM (AZADIRACHTA INDICA)

"A very special feature of the forest which I have seen nowhere else was the presence of many Neem trees - sapling, palas and larger trees - all over, to the extent of 20 to 30 per acre or even more. Apparently this species

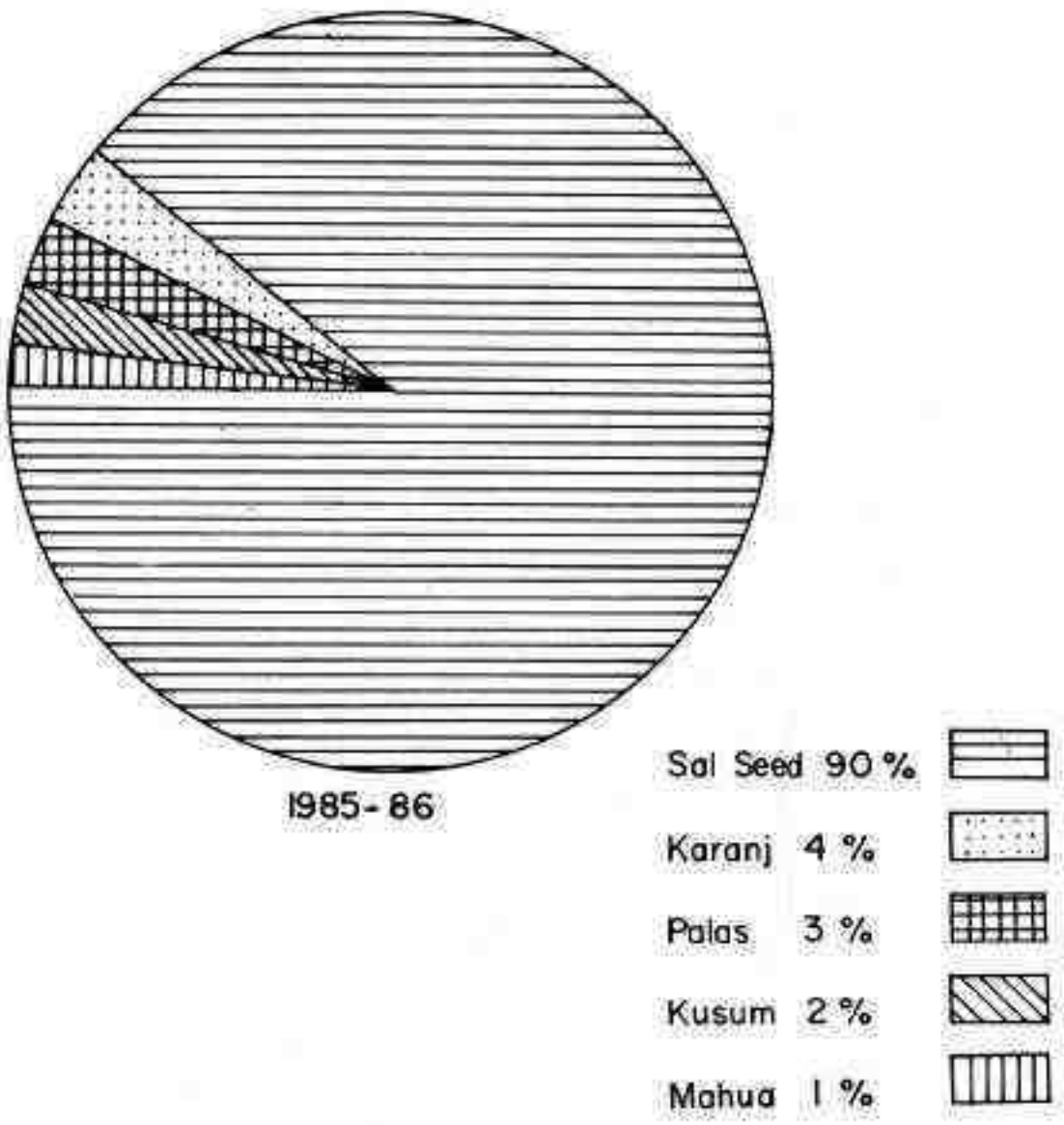

Fig. 3.1 Showing percent production of Tree based oil Seeds.

has run wild and is regenerating itself naturally ....." noted K.P. Sagrieya, then C.F., Northern Circle, Jabalpur in 1956 while visiting Hardua via Kailwara and Kymore. Such was the profusion of Neem then.

Neem is a moderate to large sized tree, usually evergreen upto 12 to 18 metres (40 to 60 ft) in height. This tree sheds its leaves in Feb.-March but is never completely leafless except in dry localities. The flowers appear in February to May with the new leaves. Neem fruits usually ripen in May to August. One Neem tree gives on an average 30 kg seed per year which on extraction yield 6 kg Neem oil and 24 kg Neem cake. Dried Neem fruit contains about 30 per cent Kernel, which yields 50 per cent oil. Neem oil contains (%) Oleic acid (50-60), Palmitic acid (13-15), Stearic acid (14-19), Linoleic (8-16) and Anachidic acid (1-3), Vimal and Naphade, (1988).

The oil is used in soap manufacture. Practically every part of the Neem tree is bitter and used in indigenous medicine. The bark is good bitter tonic and astringent, and also useful in skin diseases. The dried flowers are considered purgative and emollient.

Neem fruits are beaten down from the tree and then swept from the ground which is kept clean before hand in order to keep the collection as free from refraction as possible. Certain problems are encountered in collection, processing and refining of the byproducts. Often storage losses are high on account of its being a pulpy fruit and since its collection coincides with rainy season losses are quite a bit.

Among the oil cakes, Neem cake is sometimes preferred for manuring certain crops as sugarcane (Gupta, 1944, Agarwal, 1955 and Sharma, 1977) for its fertiliser and higher yield of cotton when neem cake was applied in Paddy, Sethi et al., (1952), observed better response with Neem cake than with castor and groundnut cakes during the drought periods particularly in Tamil Nadu and Madhya Pradesh.

G. BHILWA (SEMECARPUS ANACARDIUM)

The seed is used as a marking nut and has application in Ayurvedic preparations; of late the seed has come into limelight for its liquid commercially known as BNSL (Bhilwa Nut shell Liquid) which is used in manufacture of varnishes, lacquers enamels, paints, moulding compositions, water proofing and insulating materials. The BNSL is obtained from the shell while the fixed oil

from the Kernel can be obtained separately. The Kernel obtained after extraction of BNSL gives 20-25% oil. The oil is used as a preservative against white ants and as a lubricant (Lakshminathan, 1988).

Although Bhilwa is well distributed in almost all forest types of the State, average figure of yearly collection is available from only four Forest Conservancies (Table 3.7). According to a compilation, this figure for four conservator's circles need to be tripled to get the total production of the State.

Table 3. 7: Average Yearly Collection of Bhilwa in Madhya Pradesh

Circle	Average Yearly collection(1982-85) (in quintals)	Per cent
Chhindwara	970.00	51.79
Kanker	311.00	16.60
Jagdalpur	72.66	3.88
Seoni	519.00	27.73
Total	**1872.66**	**100.00**

From the above figures it would be observed that Chhindwara is the most significant conservancy contributing 51 per cent to the total collection of four conservancies. Even taking a very conservative estimate of 5,500 quintals production of this forest produce, Chhindwara circle contributes to about one-fifth of total annual production in the State.

Other Oil Seeds

1. **Chironji (Buchanania lanzan):** This species is found scattered in the Government Reserved Forests of all Forest divisions. Fruiting takes place in April-May. Although no reliable statistics is available on the total annual seed collection of this species, oral enquiries and field surveys put the figure to 10 metric tonne from the entire State.
2. **Munga (Moringa oliofera):** Though occasionally met with, it is not a common forest species in the Government Reserved Forests. It is mostly cultivated for its flowers and fruits. Fruiting takes place from february to June.

3. **Mogli (Jatropha spp.):** This species is not at all common in the Government Reserved Forests. It is cultivated more as a hedge plant in village lands from where it has run wild at places on waste grounds adjoining village sites. Fruiting takes place from October to December.
4. **Gongal (Cochlospermum gossplum):** Not common but is met with in poor dry localities in the government Reserved Forests of all Forest Divisions. Fruiting takes place from March to June.
5. **Aonla (Emblica officinalis):** Common to all Government Reserved Forests of all Forestry Divisions. Fruits ripen from October to April.
6. **Behera (Terminalia belerica):** This is found scattered in the Government Reserved Forests at all Forest Divisions. Fruits ripen from January to April.
7. **Dikamali (Gardenia gummifera):** This species is met with mostly along nala and open eroded areas in the Government Reserved Forests of all Forest Divisions.
8. **Hingan (Balanitis roxburghii):** This species is found scattered in Government Reserved Forests of all Forest Divisions except Mandla. Fruiting takes place in November.
9. **Malkangni (Celastrus paniculata):** This climber is found in the Government Reserved Forests of all Forest Divisions. Fruits ripen from October to December.

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CHAPTER IV

ESSENTIAL OILS

Introduction

Essential oils are mostly liquids and possess a pleasant taste and strong aromatic odour. Any part of the plant viz., flowers, fruits, leaves, bark, root, wood or seeds may be the source of the oil. The utility of this oil to the plant is non-existent. They occur in small concentrations in special cells, glands or ducts, either in one particular organ of the plant or distributed over many parts.

Since essential oils possess odour and are highly volatile they are mostly used in making perfumes, soaps and other toilet preparations. Many find use as flavouring materials or essences for tooth pastes, tobacco etc. Many have therapeutic and antiseptic properties and so are valuable for medicine. Several oils are used as solvents in the paint and varnish industries, as insecticides and deodorant, and in the manufacture of various synthetic odours and flavours (Anon., 1972).

The important essential oils produced in India are Sandal-wood oil, lemongrass oil, palmrosa oils, Eucalyptus oil, Khus oil, Linaloe and turpentine oil etc.

Estimated production of some of the essential oils in India have been given in Table 4.1.

Table 4.1: Production of Essential oils in India

Essential Oil	Production (in tonnes)
Turpentine oil	2,000
Lemongrass oil	1,300
Sandalwood oil	150
Palmrosa oil	90
Vetiver oil	50
Eucalyptus oil	50
Cinnamon oil	33
Deodar wood oil	2
Linaloe oil	3
Cinnamon leaf oil	2
Total	**3,680**

Earlier Attempts

Pioneering efforts were made when two large companies were started about seven decades ago to distil palmrose oil, one each in Madhya Pradesh and Bombay. The state government of Gwalior had setup the Scindia Chemical Laboratories in 1923, but these closed down due to some technical and organisational difficulties.

The second important attempt was made by Puran Singh, the late chemist at Forest Research Institute who acquired from the Punjab Government a lease of about 231 acres of land at Jaranwala (now in Pakistan) to cultivate the pure 'motia' variety of the palmrosa grass and also to distil the essential oil from it. The oil distilled by Puran Singh was perhaps the best ever produced anywhere and continued to enjoy a world-wide reputation for its fineness of odour, purity and gerniol content of about 93 per cent (Singh, 1960).

The Industrial Survey Committee (Anon., 1939) paid only lip service to Rosha Oil commenting that it had hardly any local demand and was chiefly used for making 'Otto of Roses'. Nimar, Melghat and Betul Forest Divisions in erstwhile C.P. and Berar Province had this grass growing wild. The Committee stated that as far as the Forest Department is concerned its duty will end with the sale of 'rosha grass'. Thus Rosha oil was largely an export item moving to Europe and United States (Trotter, 1925). The NCA (1976) also recommended cultivation of rosha grass being quite remunerative and capable of generating rural employment. However, they noted that the crude system of distillation which produces inferior quality of oil needs to be improved. This much desired improvement on field scale has yet to come.

Demand for the Indian palmrosa oil has declined a good deal on account of other countries having taken up the cultivation of citronella grass as a source of geraniol. The palmrosa oil is, however, of superior quality and fetches a higher price. But inspite of this advantage, India appears to be gradually losing to overseas market (Singh et al., 1985).

4.1 Grass Oil

4.1.1 Palmrosa Oil

(1) Distribution and Habitat : In Madhya Pradesh, among oil producing grasses palmrosa occupies the most important place from point of view of the total oil production. This tall perennial and sweet scented grass occurs wild in drier tracts of Khandwa, Betul and Indore Divisions. It is also found occurring in drier tracts of Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh, Bihar, Rajasthan, Maharastra, Gujarat, Andhra Pradesh and in some parts of South India. However, the principal centres of production of the oil are in Madhya Pradesh, Maharastra, Andhra Pradesh and Karnataka.

Palmrosa oil, obtained from Cymbopogan martinii (rosha grass), popularly known as 'motia', is a tall (1.5 to 4 m high) grass species. It grows naturally and is also regularly cultivated. It thrives in regions with an annual rainfall ranging from 81 to 89 cm. The harvesting period is October-November when the plants are in flower. The grass when mature is cut near ground level. In this State, the top one-third of the plant consisting of leaves and flower heads is cut during Sept.-Oct., tied in bundles of about 250 gm and stacked for 10-25 days before distillation. Production of Rosha grass in past about 5 years in Betul, Indore and Khandwa districts of Madhya Pradesh is given in Table 4.2

Table 4.2: Production of Rosha grass in Madhya Pradesh

	Production of Rosha grass (in quintals)				
	1981-82	1982-83	1983-84	1984-85	1985-86
Betul	534.51	332.25	230.14	217.30	3051.00
Indore	205.00	98.00	40.97	68.00	23.00
Khandwa	12.25	13.36	9.40	7.40	4.62

The oil obtained after distillation is a pale yellow liquid with a characteristic geranium odour. The oil which is normally exported has 90 per cent or more geraniol content.

(2) Uses : Palmrosa oil is used as a base for perfumes and in cosmetics, particularly in soap where its great tenacity is highly valued. It is also used for flavouring tobacco. It forms an ingredient of mosquito-repellent ointments. It has several applications in medicine. It is the best natural source of high grade geraniol. It blends well with other soap perfume materials (Anon., 1972). Oil of Palmrosa contains chiefly 75.0 to 95.0 per cent of alcohols, calculated as geraniol, a small but varying amount of esters of the same alcohol, principally acetic and caproic acids and traces of methyl-heptenone and dipentence.

(3) Cultivation : Karira and Beri (1966) studied cultivation of palmrosa at DehraDun. Seeds sown in July started germinating after a week and all germination was complete in another fortnight. The seedlings were transplanted in September in the field at a spacing of 60X90 cm, with occasional weeding and hoeing. Manuring of any kind was not done. The plants started flowering in the mid-July of the second year and were in full flower by the middle of October. Only one weeding and hoeing was done in winter and fortnightly irrigation was done in the hot, dry season every year. The plantation was maintained for a period of eight years. The harvested material was spread out in shade for a day prior to distillation.

The yield of grass was the highest in the second year (11,670 kg/ha). It diminished to 8,380 kg/ha in the fifth year and only 4,120 kg/ha in the seventh year. The oil content was found to be higher at full flowering stage rather than at advanced full flower stage.

The grass raised through root cuttings by Gulati et al., (1961) also gave good results. During two year's study of plantation four crops were obtained; one crop during the first year and three crops during the second year. The economic viability of Rosha grass cultivation was studied by Singh et al., (1985) at Indore. The two month old seedlings were planted at the onset of monsoon. In the first year only one crop was harvested and that too for seed collection only. In the subsequent year one more harvest was taken in the month of October. This yield averaged 35 quintals per hectare. Second harvest was taken in May/June, 1985.

(4) Economics of Rosha grass Cultivation : Some experimental data on economic viability of its cultivation is available. In one such field trial, the result of which has been summarised in Table 4.3, a gross return of Rs.18,000/ha and a net return of Rs.38,740/ha over a period of 4 years have been obtained by Singh et al., (1985) at Indore. Once the cultivation of rosha grass is taken on large scale the profit may swellup on account of savings in many items. Even for small and marginal farmers, the grass can be cultivated on field bunds or on any surplus land. This could be an item of cottage industry and supplement to the already meagre agricultural income particularly in rural areas. Its cultivation can also provide job during lean period and being an agricultural produce no special technique is required on its cultivation.

4.2 Root Oil

4.2.1 Khus (Vetiveria zizanoides) :

The roots of vetiver or Khus (Vetiveria zizanoides) and the oil derived have been used for long in the country. The other uses of vetiver are making hot-weather thattis, mattresses,

Table 4.3: Economics of Rosha grass (Cymbopogon martinii) cultivation in Malwa Region of Madhya Pradesh

Items of Expenditure	Expenditure in Rs/ha				Total
	1st Yr.	2nd Yr.	3rd Yr.	4th Yr.	
1. Seedbed preparation	60.00	-	-	-	60.00
2. Cost of Seed	60.00	-	-	-	60.00
3. Seed Sowing	50.00	-	-	-	50.00
4. Seed bed maintenance	90.00	-	-	-	90.00
5. Land preparation	450.00	-	-	-	450.00
6. Fertilizer application	2300.00	500.00	500.00	500.00	3800.00
7. Transplanting, weeding and interculture	500.00	500.00	500.00	500.00	2000.00
8. Irrigation	1200.00	1200.00	1200.00	1200.00	4800.00
9. Harvesting & transport to distillation site	700.00	1000.00	1000.00	1000.00	3700.00
10. Distillation Cost	1750.00	3000.00	3000.00	3000.00	10750.00
Total	**7160.00**	**6200.00**	**6200.00**	**6200.00**	**25760.00**
Oil yield in kg/ha	**35.00**	**60.00**	**60.00**	**60.00**	**215.00**
Gross return in Rs/ha	**10,500**	**18,000**	**18,000**	**18,000**	**64,500**
Net Profit	**3,340**	**11,800**	**11,800**	**11,800**	**38,740**

fans and other articles. The khus oil is used in medicine, soap, perfumery and cosmetic industries.

This grass is a densily tuffed perennial grass, about 0.9-1.8 m high. It occurs in the plains and lower hills, upto an altitude of 1,200 m. It is particularly abundant on the banks of rivers and rich marshy soils (Anon., 1972). There are two varieties of this grass, one flowering and the other non-flowering. The north-Indian grass is the flowering variety, while both varities are found in South India.

4.3 Flower Oil

4.3.1 Keora (Pandanus tectorius) : Among essential oils extracted from flowers of forestry origin, 'Keora' is very popular aromatic perfume. It is referred to as screw pine. This popular perfume is derived from the flowers of P. tectornius (Keora) a small evergreen shrub or a tree. This species is found in many parts of Madhya Pradesh, coastal Orissa, Rajasthan, South India, West Bengal and Uttar Pradesh. In the tidal forests it is found as dense impenetarable thickets (Anon., 1972). The plant starts flowering in July and continues till mid-December. Flowers are abundant from August to September. A single flower may weigh as much as 150 g (Anon., 1972).

The Otto of Kewda is prepared by macerating the flowers with sesame oil. This is used in the preparation of fragrant hair oils. The flowers can be distilled with water into sandal wood oil kept in the reciever of the still. The distillate, which is called sandali 'attar' 'Keoda' is used in perfumery. The Keora essence can also be absorbed in odourless, white, light or heavy mineral oil in lieu of Sandal wood oil. The flowers can be distilled, without the addition of water or other essential oils and with no diluent oil in the reciever, to prepare pure keora oil. But this is not usually done as the yield is only 0.1 to 0.3 per cent by weight of fresh flowers and there is bound to be excessive loss of perfumes during preparation.

4.4 Wood Oil

Oil yielding woods include sandal, agar, deodar and pines. However, excepting sandal which has spread in many parts of the State, others are not found in Madhya Pradesh.

There are records of first plantation of Sandal in early years of Nineteenth Century (1880) in (Chandan Bagh or Sandal Garden) Ari Range of South Seoni Forest Division by Narayan Prasad, E.A.C.E. over an area of one hectare. However, due to favourable

conditions for its growth Sandal trees are now found in several, Forest Divisions in Central and Western parts of the State. This tree is found widely scattered in patches in forest areas as well as in private lands of Seoni, Sagar, Rewa, Raisen, Guna, Bhopal, Sehore, Indore, Dewas, Ujjain, Rajgarh and Mandsaur Districts of Madhya Pradesh. It has been cultivated in gardens and compounds of bungalows in cities and towns. In Ujjain, Indore and Sehore Divisions, Sandal is not found in very small patches. A large number of trees are found in private compounds in towns of Ashta, Sehore, Indore, Ujjain and owners are aware of the value of this tree. It is very common to see natural Sandal trees as an associate of teak in comparatively drier localities in Central and Western Madhya Pradesh. According to a survey in Seoni area as against only 35 sandal trees in 1905 there were as many as 21,594 in 1980 (Chaturvedi and Date, 1981).

While Sandal trees in South India are infected by a viral disease called spike disease of Sandal no such problems have been witnessed in this State.

The oil yield from its roots is highest and that from chips is the lowest. The yield from billats varies from 4.5 to 6.25 per cent. The heartwood yields on an average, around 4 to 6 per cent oil. Sample analysis of sandal wood from Seoni areas gave 5.6% oil and 90.8% santalol content. This oil content is comparable to the trees from some of the best localities of Karnataka and Tamil Nadu. Since there the commercial exploitation of Sandal trees is not practised in this State, it is difficult to give figures on annual outturn of this wood oil. However, the way this species is invading low density teak forests infested by Lantana, someday it may become an important source of rural employment.

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CHAPTER V

MEDICINAL AND AROMATIC PLANTS

Introduction

Madhya Pradesh forests are richly endowed with natural genetic resources of tropical broad leaves species. Medicinal and aromatic plants are found as understorey in the natural forests. Although on account of past misuse, over utilization and biotic pressures in certain areas many plant species of medicinal importance have disappeared, there are still a large number of areas in the State which could be said to be a store house of such plants.

By composition, the forests of Madhya Pradesh are classified as Teak forests occupying an area of 27,783 sq km (17.88%); Sal (Shorea robusta) occupying an area of 25.704 sq km (16.54%) and mixed miscellaneous species constituting about 65.58 per cent (101,927 sq km). Although one or the other plant species recorded to be of medicinal importance is found in these forests, surveys carried out (Prasad and Pandey, 1987; Prasad et al. 1988; Pandey and Shrivastava, 1989; Prasad et al. 1989; Prasad and Pandey, 1989; Oommachan et al. 1989) indicate that generally speaking the natural Sal (Shorea robusta) forests are rich in medicinal plant wealth and among these forests also, the moister valley sal forests are considered to be 'gene sanctuaries' (Anon, 1988). Teak and Mixed miscellaneous forests are also rich although, the floristic composition varies to a great extent. Distribution pattern of important medicinal and other useful plants in the natural Sal forests are summarised in Table 5.1 Similarly the distribution pattern of medicinal plants in teak and miscellaneous forests are given in Table 5.2.

Extent of occurrence of medicinal plant species in Sal, Teak and mixed miscellaneous forests are well demonstrated by the figures given in Table 5.1 & 5.2. From these Tables it would be seen that although Sal forests provide most hospitable site conditions for the growth of many medicinal and aromatic plants, in the absence of protection plant density tends to deplete fast. As a result some of the protected teak forests support far more plants per hectare than sal forest ecosystem.

Table 5.1: Distribution Pattern of Important Medicinal Plants in Some Natural Sal Forests of Madhya Pradesh

	S	I	T	E	S							
	Shahdol District Amarkantak Plateau		Bilaspur District						Mandla District			
			Amadoh		Lamni		Achanakmar		Motinala		Chada Baigachak	
	No. of Species	Density per ha.	No. of Species	Density per ha.	No. of Species	Density per ha.	No. of Species	Density per ha.	No. of Species	Density per ha.	No. of Species	Density per ha.
Medicinally useful plants	27	40940	15	143425	31	208250	31	184250	26	151250	12	84250
Plant species important as food source (plant or plant parts)	4	2070	4	20000	5	38000	2	36500	2	29600	1	14750
Plant species having not much importance in respect to medicine or food	2	410	2	14500	6	38750	2	22750	4	45000	4	52250
Total	**33**	**43420**	**21**	**177925**	**42**	**285000**	**17**	**243500**	**32**	**225850**	**17**	**284050**

Although for the present all of these plants may not be of economic importance they could prove to be useful in future. Further, high plant density in the protected forests clearly brings out that in the absence of protection, a number of plants are fast disappearing.

5.1 Species Distribution

Central Indian Deciduous forests have common associates in top canopy as well as in understorey and ground flora. However, some variation in the occurrence of medicinal and aromatic plants differ to a great extent depending upon the type of tree forests viz., Sal, Teak and mixed miscellaneous (non-teak, non-sal species). Broadly speaking the important plant species occurring in different forest types are given in Table 5.3.

Table 5.3: Occurrence of important species in Sal, Teak and Mixed Forests

A. SAL FORESTS

(Bastar, Bilaspur, Raipur, Ambikapur, Shahdol, Sidhi, Mandla, Jabalpur, Balaghat & Durg):

Medicinal Species :

Andrographis paniculata, Abrus precatorius, Cassia fistula, Curcuma amada, Cannabis sativa, Curcuma longa, Celastris paniculata, Dioscoria bulbifera, Emblica officinalis, Gardenia gumifera, Gloriosa superba, Helicteris isora, Holarrhena antidysenterica, Hemidesmus indicus, Mallotus phillippinesis, Nyctanthes arbortristis, Pueraria tuberosa, Sida cordifolia, Swertia angustifolia, Vetiveria zizinoides, Dioscorea hispida, Curcuma angustifolia, Anacylus pyrethrum, Urginea indica, Rauvolfia serpentina, Costus speciosus, Curcuma caesia, Allium laptaphyllum, Acorus calamus etc.

B. TEAK FORESTS

(Bastar, Raipur, Durg, Mandla, Seoni, Jabalpur, Damoh, Sagar, Panna, Tikamgarh, Chhattarpur, Betul, Hoshangabad, Balaghat, Khandwa, Dhar, Jhabua, Raisen) :

Medicinal Species :

Andrographis paniculata, Abrus precatorius, Adhatoda vasika, Asparagus racemosus, Achyranthes aspera, Cassia fistula, Calotropis gigantia, Chlo-

rophytum tuberosum, Curcuma longa, Curculigo orchioides, Celastrus paniculata, Dioscorea hispida, Emblica officinalis, Gardenia lucida, Helicteris isora, Holarrhena antidsenterica, Mallotus phillippinensis, Nyctanthes arbortristis, Terminalia belerica, Terminalia chebula, Elepharispermum subsessile, Tinospora cordifolia.

C. MIXED MISCELLANEOUS FORESTS

(Bastar, Raipur, Shahdol, Sidhi, Rewa, Jabalpur, Seoni, Betul, Khandwa, Damoh, Chhattarpur, Tikamgarh, Sagar, Khargone, Jhabua, Ratlam, Mandsaur, Bhopal, Vidisha, Indore, Guna, Gwallor, Morena, Bhind & Datia):

Medicinal Species :

Aegle marmelos, Asparagus racemosus, Abrus precatorius, Achyranthes aspera, Andrographis paniculata, Adianthum lunalatum, Allium cepa, Allium sativum, Aloe barbandensis, Cassia fistula, Curcuma amada, Curcuma angustifolia, Chlorophytum tuberosum, Curculigo orchioides, Curcuma aromatica, Curcuma longa, Urginea indica, Cyperus scariosus, Costus speciosus, Dioscorea bulbifera, Dioscorea hispida, Celastrus paniculata, Emblica officinalis, Gloriora superba, Helicteris isora, Hemedesmus indicus, Mentha arvensis, Nyctanthes arbortristis, Ocimum bacillicum, Piper longum, Plubago zeylanica, Psoralea carylifolia, Rauvolfia serpentina, Strychnos nuxvomica, Sida cordifolia, Swertia angustifolia, Terminalia belerica, Terminalia chebula, Vetivera zizinoides, Withania somnifera etc.

Although, floristically, teak forests of Seoni are quite comparable to the natural Sal forests of Mandla, Bilaspur and Shahdol districts (Table 5.1 & 5.2), in terms of useful medicinal plants the latter areas are more hospitable. Plant species which are being extensively used by tribals such as Dioscoreas, Curcuma angustifolia, C. aromatica, Urgenia indica, Zingiber purpureum, Allium spp., Curcuma caesia, Acorus calamus, Xantholyum alatum, Hibiscus cancellatus, Costus speciosus etc. are found abundantly in Sal forests of above localities than in teak or mixed miscellaneous forests.

Natural Sal forests of Bastar district are floristically more rich than other Sal bearing forests of Madhya Pradesh. One reason for this vegetational diversity in Bastar Sal forests is comparatively

less biotic pressure and favourable climatic conditions. Other areas having identical floristic diversity are Sal forests of Surguja, Raigarh (Jashpur Nagar), Raipur district & other important localities such as Amarkantak, Supkhar, Achanakmar, Lamni, Pachmarhi, Motinala etc. Teak forests and forests of mixed miscellaneous species are also rich in medicinal wealth. Some most prominent areas known for vegetational wealth in terms of medicinally useful plants are being given as under.

5.2 Important Localities Rich in Medicinal and Aromatic Plants:

5.2.1 Amarkantak Plateau : Amarkantak is the source of the river Narmada. It lies on a plateau at an altitude of approximately 1000 m. The hills are capped with bauxite and lateritic products. The plateau carries sub-tropical (sub-montane) vegetation. The forest type is classified as Central Indian Sub-tropical hill forests. The flora of the area is interesting as it presents few types that are characteristic to the North-west and Central Himalaya. It is also interesting to note the proportion of genera to species. The percentage of species of dicotyledons and monocotyledons in the flora of this area is 68.3 and 26.5, respectively while in the flora of the world it is 81.30 and 18.70, respectively. Thus the percentage of monocotyledons in the flora of Amarkantak is very high as compared to the percentage of monocotyledons in the flora of the world. A large number of rare and endangered species of medicinal values are still found localised in moist and sheltered pockets on Amarkantak Plateau. However, considerable mining activity is continuing in the area which has disturbed the rich ecology of the place. In order to preserve the genetic resources of this area it is essential to suspend any form of working which is inimical to the ecological balance of the plateau. Any disturbance to the site would destroy some of the rare and endangered plant species such as 'Gulbakaoli' (Hydychium coronarium), Jangli Pyaj (Urgenia indica), Kali Haldi (Curcuma caesia), Bach (Acorus calamus), Tejraj (Xanthoxylum alatum) and a number of commonly occurring medicinal plants of mass consumption by tribals and other forest dwellers.

Table 5.2: Distribution Pattern of Important Medicinal Plants in Some Teak Forests of Seoni District in Madhya Pradesh

Plant Categories	S I T E									
	Pench National Park Protected Forest		Rukhad Wildlife Sanctuary (Semi-protected		Reserved Forests		Mandla District Mixed Forests Nainpur Project Area (Partially Protected		Narsinghpur Teak Forest Jhoteswar unprotected	
	No. of Species	Density per ha.	No. of Species	Density per ha.	No. of Species	Density per ha.	No. of Species	Density per ha.	No. of Species	Density per ha.
Medicinally important plants	12	249920	7	105200	2	27150	17	42856	4	12000
Plant species important as food source	16	234500	8	70500	6	59500	5	2500	3	22000
Plant species having not much importance in respect to medicine or food	51	824280	25	657000	18	120750	51	259977	30	106000
Total	**79**	**1308700**	**40**	**832700**	**26**	**207400**	**73**	**305333**	**37**	**140000**

5.2.2 Pachmarhi Plateau (Hoshangabad) : Pachmarhi a popular hill station of Madhya Pradesh, having in it the higher hill top (Dhupgarh) of Central India, presents very interesting features in its flora. Nearly 304 species of flowering plants and ferns are reported from Pachmarhi Sixteen species are new records for Madhya Pradesh (Oomachan et al. 1989). Out of the total area of 60 sq km covered by the plateau, five-sixth is dominated by sub-tropical evergreen forests. The flora consists of a mixture of the temperate and tropical elements. Pachmarhi region is remarkable as it forms a meeting ground for Himalyan and South Indian species. Rare orchids, Pteridophyte and medicinal plants are found in abundance in this region. On account of micro-climatic variation due to altitude, soil and forest types (Teak, Sal and Mixed forests are represented) a large number of plants having medicinal and aromatic properties are found in this area.

5.2.3 Patalkot Valley (Tamia Escarpment) : Patalkot in Chhindwara district is unparallel for beauty and enchantment of natural landform on the northern edge of Satpura; is an area of geographical isolation inhabited by the 'Bharia' and 'Gond' tribes living 300-400 m down the escarpment. The deep valley gives birth to river Dudhi. The forests are of mixed type although teak and Sal are also represented in this area. According to a survey carried out some 20 years ago (Saxena and Shukla, 1974), 275 plant species, mostly having some medicinal value or the other were enumerated in this valley. However, as discussed in the foregoing paras, despite its inaccessibility and isolation from general population this area has not remained unaffected. Biotic pressures have depleted the plant resources from the area. As a result in less than 20 years, more than 50 species have disappeared (Anon, 1990).

5.3.4 Bailadilla Hills : Bailadilla Reserved Forests falls in the Dantewara Range of Bastar district. The forests in hill range abound with unusual flora and fauna. There are three main inner valleys in the hill range; they are Bailadilla, Taki and Galil. The vegetation in the upper reaches consists of dense forest, whereas

along **nala** banks and lower slopes very luxuriant tree growth consisting of semi-evergreen tree species, shrubs, herbs, ferns and palm are available. The valleys and inner slopes of the hills in the crest of Bailadilla hills develop tropical semi-evergreen to evergreen forests. On account of varied physiographic features and consequent varying micro-climatic elements and vegetational associations the area is quite rich in medicinal plants which are found associated with teak, sal and mixed miscellaneous forests of tropical moist deciduous forests of Central India and semi-evergreen to evergreen forests of Southern India. However, the rich flora of great economic importance has been gradually depleted on account of intense biotic activity resulting from large scale iron-ore mining in Bailadilla hills. In view of the floristic importance of this area it has become very essential to take drastic measures for in situ and ex situ conservation of plant resources and associated fauna still surviving in the area.

5.2.5 Khurchel Valley Nature Reserve : It is spread over in 10 compartments of the Matia Reserve Forest of Narayanpur Forest Division in Bastar. This valley represents one of the healthiest teak areas in the country. The forest is multistoreyed consisting of varied flora and fauna. It also has large components of medicinal plants. Although no systematic survey has been done, floristically it is said to be comparable to the vegetational multiplicity of Silent Valley in Kerala. On an average, each hectare supports 1500000 to 2200000 plants represented by herbs, shrubs, grasses and trees. This area is very ideal to be included in the Protected Area Network.

5.2.6 Kanger Reserve : The Kanger Reserve is about 48 km long and 29 km broad forming the southern portion of Jagdalpur plateau in Bastar district, spread over 1020 sq km.The forests mainly belong to the moist peninsular Sal wherein two sub-types (a) moist peninsular plateau type and (b) moist peninsular Kanger Valley type are distinguished. Apart from the above, the mixed forest

occurring in this region belong to South Indian tropical moist deciduous forests. Kanger reserve is the place of origin for Kanger, Jaimer and Kolab rivers.

In greater part of the Kanger reserve, sand stone and shales are met with, while near the Kanger Valley deposits of limestones are fairly common. While blind fishes, cave pearls, a chamber of musical stones were for the first time discovered in Indian caravan. A new species of cave cricket Kempiola shankari named after the explorer Prof. Shankar Tiwari, was brought to light in the world of Zoology. This natural heritage is very rich in flora and fauna and is a store house of medicinal plants and needs conservation as a biosphere reserve. Although Rauvolfia serpentina has disappeared from many parts of Bastar Forests, the species is still found in this area. Infact more than one variety of this medicinal herb is reported in this area.

5.3.7 Kurundi Reserve Forest : Kurundi is situated at a distance of 25 km from Jagdalpur. Here Sal and teak occur side by side which is considered as ecological wonder. A large number of medicinal herbs, climbers and trees are found as an understorey to the tree forests. Since the area is very compact and relatively free from biotic pressure, it may be declared as protected area for in situ conservation of rare plants.

5.2.8 Abujhmarh : Abujhmarh constitutes a distinct division of Bastar district. It is spread over 4000 sq km in Narayanpur, Bijapur and Dantewara Tehsils of Bastar district. There are in all 14 peaks which exceed 909 m in height and are clad with virgin subtropical evergreen forests. Abujhmarh means 'the unknown plateau' and is inhabited by Abujhmarh tribals. The flora of this place is fabulously rich. Sal forests occur in the north upto Irkbbatti and in the south eastern portion of Abujhmarh. Mixed plants are common in the middle part with plenty of bamboo, representing a number of genera and species. Special steps are needed to conserve the natural habitat of this tribal belt.

5.2.9 Garhakota-Ramna Reserve of Sagar : Garhakota-Ramna Reserve is situated about 5 km to the north of Garhakota, on the western bank of river Sonar in Dhana Range of Sagar Forest Division. This reserve is an epitome of nearly all the forest types of Sagar district. The reserve occupies an area of 5 sq km but the geological formation and soil types have normally influenced the distribution of vegetation in this area as climate and other factors of environment can not be expected to produce such marked variations in such a small area. It is very common sight that inspite of apparent climatic uniformity in this area many direct soil types and forests exist side by side. The micro-climatic differences, produced due to variation in slope, aspect, relief, proximity to water courses, soil and geological formation and rocks appear to have caused perceptible variation in the vegetation. These micro-climatic variations have resulted in segregation of species to form distinct stands. The marked variation from towering teak trees on alluvial deposits along Sonar river to pure patches of dwarf tree (Anogeissus pendula) forests on rocky and dry patches. Only within less than a kilometer distance there is a great floristic variation ranging from Anogeissus pendula as pure patch on one end to luxuriant teak forests on the river banks and on alluvial deposits. In between are patches of mixed miscellaneous forests which are normally found in periodically undated areas. Medicinal and aromatic plants are quite abundant in this areas.

Mention of above areas does not mean there are no other potential areas requiring special protection measures. Many natural forests under teak, sal and mixed miscellaneous stands could be delineated for providing intensive protection measures. In order to have a detailed account of areas rich in medicinal and aromatic plants the Madhya Pradesh Council of Science and Technology has sanctioned a research project to State Forest Research Institute, Jabalpur on status survey of medicinal plants in the natural forests of Madhya Pradesh. This project is intended to cover natural forests of 8 districts of the State. For another 20 districts such survey is being planned by the State Forest Research Institute with its own resources. On the basis of this survey more and more areas would be known which may be in the need of strict protection and other conservation measures.

Certain areas like natural forests of Kanha, Bandhavgarh, Madhav, Indravati, Sanjay, Satpura and Kanger Wildlife National Parks are already well protected. These areas support many useful plants. Although, these areas may not be available for commercial exploitation they would certainly act as gene-pool resources for the posterity.

5.3 Strategy for Ex-situ Conservation

Forest degradation and deforestation is closely linked with the socio-economic compulsions of the tribals and other forest dwellers who have been co-existing with the forest from time immemorial. In the absence of any viable alternatives to grazing and fuelwood the rural population would continue to depend upon forest resources for their daily requirements. Flowers, fruits, seeds, roots, rhizomes, leaves etc., or one of the other plant species are being utilized as food, spices, medicines, fibre, building materials etc. In the present context there are hardly any substitute to these items of daily requirements and this situation is likely to continue. These biotic pressures would thus have adverse ecological impact on the area and worst of all many important plants in time to come, may disappear altogether. As already discussed, many areas which once supported variety of materia medica now need to be conserved and propagated for posterity.

5.3.1 Preservation and Propagation : Ethnobotanical herbarium and museum of plants could be one strategy for conservation of threatened plant species. However, the most useful method would be to preserve and multiply the plants in botanical gardens, nurseries and through large scale cultivation. The latter one could be a strategy for those species which are commercially important and which could be adopted by farmers and landless labourers. Many medicinal and aromatic plants of commercial importance may not require big agricultural fields but could also be grown in the backyards.However, before the medicinal plants could be adopted by farmers, research-cum-demonstration centres shall have to be established in different agro-climatic zones. Package of practices

shall have to be evolved for being recommended to the prospective farmers. Similarly, processing techniques would also have to be imparted before the produce could be accepted by Aurvedic industries and traders.

Further, extensive survey to collect marketing intelligence shall also be required to ascertain the prospective markets, consumption at home and abroad, marketing channels, rates, profitability etc. Based on these informations the projects could be drawn on economic viability of cultivation of each plant species.

Available informations on cultivation of medicinal and aromatic plants indicate that on account of short gestation period, say 4-10 months it has a great potential for being takenup by farmers. This could thus become an important item under poverty alleviation programme.

5.4 Research-cum-Demonstration Centres

A comprehensive study of the locality factors and their correlation with those of the original habitat of a particular plant provides the most sound approach towards evolving a set of suitable species for any locality. On the basis of such study the State should be divided into a number of zones, and a set of species evolved for each of them. However, such a clearcut division is not possible owing to a multitude of complex variable factors. Madhya Pradesh is wholely situated in the tropical region, but for a few pockets like Pachmarhi, Amarkantak etc. which enjoy cooler climate on account of their altitude. Once these sub-montane pockets are isolated, temperature ceases to be a factor of consequence and zones could be formed on the basis of soil and rainfall.

For many reasons prominent being growing period (4-10 months for many), requirements of inputs, processing and perishability, market fluctuations, cutivation of medicinal plants is, in general, more akin to agriculture than to forestry, and necessitates concentrated operations (Pawar, 1966; Prasad and Pandey, 1990). Based on these considerations representative places in each agricultural zone could be selected. Taking this into view the following centres appear to be ideal for establishing Research-cum-Demonstration Centres. These centres are postulated to be the nuclei around which the whole enterprise of extensive cultivation shall gradually be continued to perfection.

Some infrastructure already exists at these centres and experiments are also continuing on various silvicultural inputs.

5.4.1 **Locations** :

a. **Shivpuri** : For northern region, with hot climate and moderate rainfall, and calcarious clay and loamy soils. Dry scrub and stunted tree forests and medicinal flora prevalent in dry localities.

b. **Indore** : For western region, being a representative of Malwa region with black cotton soil, moderate rainfall and not very hot summer; mixed miscellaneous forest flora.

c. **Jabalpur** : For central region having rich clayey loam soils, and fairly good rainfall; representing the flora of teak and mixed miscellaneous forests.

d. **Motinala/Chilpi** : As a representative of good clayey loam soil and fairly high rainfall; representing the flora of Sal areas.

e. **Raipur** : Representative of Chhatisgarh region having red sandy soils and good rainfall; flora of moist teak, mixed and Sal forests.

f. **Sonhat (Surguja district)** : Representative of central-eastern part of the State representative of most of the sal forests types.

g. **Khairkatta (Bastar district - Bhanupratappur division)** : Most suitable for cultivating plants of paddy area; flora associated with moist sal forests; Old East Bengal rehabilitation camps.

h. **Jagdalpur** : Cultivation of medicinal plants found naturally occurring in sal, mixed and teak forests.

i. **Amarkantak** : Flora of sal areas; to cover paddy and wheat tract of Mandla, Bilaspur and Shahdol districts.

j. **Pachmarhi** : Cold place with heavy rainfall.

k. **Delakhari in Chhindwara district** : To cover the flora of teak and sal areas.

Some more centres could be located depending upon the agro-climatic representation needed and ofcourse on the basis of local acceptance and expectations of the people from such a scheme.

5.4.2 Criteria for Success : The primary criteria that govern the success in medicinal plant cultivation would be :

a. Correct choice of species (governing success of plantation).
b. Satisfactory growth of plants (governing quantity of yield).
c. Conditions conducive to enhanced production of active principles (governing quality).
d. Correct time and method of collecting, curing and drying (to minimise loss of active principles and impart good external characteristics).

5.4.3 Type of Works to be Done at Different Centres : There are no set rules for medicinal plant culture and experience in field is the most reliable guide for arriving at the requisites of each species. In order to achieve this, therefore, the above centres should aim at achieving the following objectives :

a. To evolve a suitable set of locality factors for a particular plant by trying its cultivation at different stations.
b. To evolve the best techniques of propagation under which maximum success in plantation is obtained.
c. To evolve an optimum range of cultivation wherein the intensity, incidence and type of weeding, irrigation etc. should be decided upon for each plant.
d. To study the effect of manures and fertilizers in various proportions in order to devise the most favourable combination of higher yield.
e. To workout the best time, method and organisation for harvesting the various parts like root, leaf, inflorescence etc. of each plant.
f. To workout the best techniques of curing, drying and preparation of crude drugs for the markets.

g. To study the diseases and other damage caused by various viral, fungal and insect pests during cultivation and storage for arriving at an appropriate formulations for prevention and control.

5.4.4 Extension Works to be Done by Research-cum-Demonstration Centres : The Research-cum-Demonstration Centres should be responsible for extension works also. Apart from imparting technical know-how on cultivation and economic viability, these centres should also be able to supply quality seeds and other reproductive material at competitive rates. In brief the objectives would be as follows :

i) They should function as ideal exhibition centres of well planned nurseries and plantations.

ii) They should also be appended with a herbarium of plants grown at the station and also those growing in the region. A museum should also be maintained, incorporating the best samples of crude drugs and in some cases even the finished products for ready reference, comparison and exhibition to people.

iii) They should also be able to provide good quality seed and other planting material to private enterprisers, besides catering for the departmental extension needs.

iv) They should help prospective growers (with data) to prepare viable projects for institutional finances.

Research-cum-demonstration centres have already been established at Amarkantak, Jabalpur, Bilaspur and Jagdalpur by State Forest Research Institute, Jabalpur. Medicinal plant nurseries have also been established at Delakhari (Chhindwara), Lamta (Balaghat), Khairkatta (Bhanupratappur in Bastar) and Sonhat (Baikunthpur Division in Surguja district). These nurseries have been established by Forest Divisions and have excellent collection of plants which are Ethnobotanically important in the region of their location. Some more nurseries have been established by various Forest Divisions but the works therein are not of any significance.

Four centres (Amarkantak, Bilaspur, Jabalpur and Jagdalpur)

established by this Institute are intended for collection and storage of (i) commercially important plants and (ii) threatened plants. Other main activities at these centres are experimental trials for determining optimum inputs for maximum yield and for carrying-out research on time of harvesting and post-harvest processing.

5.4.5 Species under Experimental Trial : The species which are being experimented at these centres are as follows :

1. Rauvolfia serpentina (Sarpgandha)
2. Withania somnifera (Aswagandha)
3. Mentha arvensis (Pipermint)
4. Urgenea indica (Jangli Pyaj)
5. Allium purpureum (Jangli Lahsoon)
6. Curcuma caesia (Kali Haldi)
7. Acorus calamus (Bach)
8. Xanthium alatum (Tej Raj)
9. Hibiscus cancellatus (Kamraj)
10. Curcuma aromatica (Jangli Haldi)
11. Curcuma amada (Amahaldi)
12. Cymbopogon martinii (Roshangrass)
13. Curcuma angustifolia (Tikhur)
14. Anacylus pyrethrum
15. Swertia chirata (Chirayata)
16. Glycerrhiza glabra (Mulethi)
17. Chlorophytum tuberosum (Safed Musli)
18. Asparagus racemosus (Satawar)
19. Spilanthes acmella (Akarkar)
20. Gloriosa superba (Kalihari)
21. Adhatoda vasica (Adusa)
22. Hydychium coronarium (Gulbakaoli)
23. Costus speciosus (Keokand)
24. Zingiber purpureum (Jangli Adarakh)
25. Dioscorea bulbifera
26. Pimpinella anisum

5.5 Economic Returns :

Cultivation of medicinal plants promises good returns. Based on 2-years data on cultivation of 4 important medicinal plants taken up at Amarkantak, and Jagdalpur Centres (Table 4), annual net return from Rs.13,030 per hectare from Chlorophtum tuberosum, (Safed musli) to Rs.54,270/ha from Rauvolfia serpentina and Rs.48,040/ha from Curcuma angustifolia. Acorus calamus gave annual net return of Rs.27,040/ha. Other important species like Curcuma aromatica, Dioscoreas, Zingiber sp., Allium sp., Hibiscus cancellatus etc. are also being experimented for determining the optimum inputs required and likely yield from their cultivation.

5.6 Production Potential From Natural Forests

Although no systematic survey has so far been carried out to assess the availability of different medicinal plants in the natural forests of Madhya Pradesh there are some guestimates brought out by some field foresters. Estimates were workedout for Kanker and Bastar districts by Foresters which have been given in Table 5. Similarly, for 10 species abundantly occurring in Bilaspur, Shahdol and Mandla districts, this Institute has carried out survey. Random plots of size 2mX2m were laid in natural forests of these districts during September-October. Their underground biomass was assessed by digging out the roots and rhizomes and by drying-out other plant parts. The results of these assessments are given in Table 5.6. Table 5.6(A) gives the figures of recorded collection from natural forests of Madhya Pradesh. However, these estimates are only indicative of the richness of the area and should not be taken as a source of commercial raw material. Any attempt to harness these resources for commercial purpose would destroy the plant resources in much less time than could be anticipated.

Marketing Problems

5.6.1 Market : Presently the medicinal and aromatic plants are being exploited by petty contractors through tribals and other forest dwellers. The collected material is then passed on

Table 5.4: Return from Cultivation of some Medicinal Plants at Amarkantak

S.No.	Species	Yield Kg/ha	Market Rate (Rs./kg)	Market Value (Rs.)	Total Expenditure (Rs.)	Net Return
1.	Curcuma angustifolia	9800	6.00	58800	10760	48040
2.	Rauvolfia serpentina	850	75.00	63750	9480	54270
3.	Acorus calamus	3500	10.00	35000	7960	27040
4.	Chlorophytum tuberosum	150	150.00	22500	9480	13020

to the traders located in towns and cities throughout the States. According to the preliminary surveys carried out in Katni, Jabalpur, Dhamtari and Jagdalpur it was revealed that most of the medicinal plants are marketed outside Madhya Pradesh. The most important market outlets are understood to be in Lucknow and Kanpur in Uttar Pradesh. Markets for export of certain plant products are Bombay and Delhi. Most of the traders who were contacted during market surveys have been very evasive about the rates they pay to the petty contractors and actual rates at which they export to major markets like Delhi, Bombay, Kanpur, Lucknow etc.

5.6.2 Profit : In the absence of proper records of collection, transport and sales it is not possible to assess the wages a tribal and other collector gets and how much of the total profits are being aportioned between middlemen (petty contractors), traders and exporters. However, preliminary surveys, interviews and market bulletins of medicinal and aromatic plants incidate that the wages or renumeration a tribal gets is less than one per cent of the total profit of the produce. Again about 10-25 per cent of the total profit goes to the petty contractors; traders and exporters sharing the remaining profit (75-90 per cent) equally (Bhatnagar, 1990).

5.6.3 Requirements within State : There is no precise statistics about the total requirements and consumption of medicinal and aromatic plants. Tribals and forests dwellers depend on these plant resources for use as medicine, spices and food.

Table 5.5: Potential of some economically important indigenous medicinal plants of Bastar District

No.	Species	Habit of the Plant	Local Name	Plant Part & Used	Used for	Locality where found	Approx. available Qty.
1	2	3	4	5	6	7	8
1.	Adathoda vasica (A. zeylanica)	Shrub	Adusa	Leaves and Roots	Bronchitis	Whole district	1000 t
2.	Curcuma angustifolia	Shrub	Tikur	Tuber	Dysentry, Stomach pain, Heart diseases	-do-	100 t
3.	Terminalia arjuna	Tree	Arjun	Bark	Heart diseases	-do-	10000 t
4.	Withania somnifera	Shrub	Ashwagandha	Root	For women after delivery	Jagdalpur, Kondagaon	10 t
5.	Curcuma aromatica	Shrub	Van Haldi	Root	Skin diseases	Whole district	1/4 t
6.	Solanum xanthocarpum	Shrub	Kateri Chhoti	Fruit root and leaves	Uterus disorder eye diseases, urinary disorder	-do-	10 t
7.	Dioscorea pentaphilla	Climber	Kantala	Tuber	Oil for reuhmatism	-do-	10 t
8.	Gloriosa superba	Climber	Kalihari	Bulb	Uterus pain, abortion, easy delivery	-do	1 t
9.	Abutilon indicum	Shrub	Kanghi	Bark	Tonic for pregnant lady	-do-	100 t
10.	Tinospara cordifolia	Climber	Giloy	Bark & Root	fever, madness, blood purifier	Kanger N. Park & other parts of Bastar	50 t
11.	Abrus precatorius	Climber	Gunj	Seed & Root	Asthama, Bronchitis	Whole district	1 t
12.	Smilax macrophylla	Climber	Rani-datoon	Root	Blood dysentry Urinery trouble	-do-	100 t
13.	Asparagus recemosus	Shrub	Satavar	Tubers	Blood pressure	Whole district	1000 t
14.	Luffa achinata	Climber	Bandal	Root, leaves & fruits	Tonic joinder and for Bone problems	-do	100 t
15.	Curcuma caesia	Shrub	Naraka-choor	Root	Leprosy & Asthama	Bijapur, Dantewara	100 t

According to a preliminary information (Bhatnagar, 1990), only a fraction of the total collection is locally used, the bulk finds its way out to major markets. However, some quantities are purchased by Govt. Ayurvedic Pharmacies in Madhya Pradesh. Ayurvedic Colleges in Madhya Pradesh also require some medicinal plants. A list of medicinal plants and their requirements by Government Ayurvedic Pharmacy of Gwalior, Raipur and Unani Pharmacy, Bhopal have been given in Table 5.7. Although, this list could not be said to be exhaustive and the requirements may also be an under-

Table 5.6: Potential of Some Economical and Indigenous Medicinal Plants of Sal Areas of Mandla, Shahdol and Bilaspur

S.No.	Species	Habit of Plant	Local Name	Plant Parts Used	Used For	Locality where found	Approx. available Qty.(T)
1.	Adhatoda vasika	Shrub	Adusa	Leaves and Roots	Cough, Germs killer, scorpion bite	Spread in moist deciduous forests	20000
2.	Curcuma aromatica	Herb	Ama Haldi	Root	Spices, Fracture, skin diseases, blood purifier	Whole District	25000
3.	Zingiber purpureum	-"-	Adarakh	-"-	-"-	-"-	10000
4.	Curcuma caesia	-"-	Kalihaldi	Root	Cold-cough, Fracture, Blood purifier	Around Amarkantak	10
5.	Acorus calamus	-"-	Bach	Root	Vitality, blood purifier, cold.	-"-	500
6.	Urgenia indica	-"-	Jangli Pyaj	Root	Blood purifier	-"-	50
7.	Dioscorea hispida	Climber	Baichandi	Bulbs	Food	All parts of the districts	100
8.	Curcuma angustifolia	Herb	Tikhur	Root-bulbs	-"-	-"-	10000
9.	Chlorophytum tuberosum	-"-	Safed Musli	Root	Vigour	-"-	5000
10.	Asparagus racemosus	Climber	Satawar	Whole Plant	Vitality, food & medicine	-"-	2000

5.1 Rauvolfia serpentina - Formerly abundant now endangered.

assessment this gives an idea of requirements within the State. For a broad picture the requirements listed in Table 5.7 could be inflated 4-5 times taking into consideration the requirements of dispensaries of Government Ayurvedic Colleges

Table 5.6(A): Average collection of Medicinal Plant in Madhya Pradesh

S.No.	Species	Botanical Names	Collection
1.	Behara	Terminalia belerica	67.25
2.	Safed Musli	Chlorophytum tuberosum	847.30
3.	Neem	Azadirachta indica	214.25
4.	Baibairang	Embelia tsjeriam-cottam	7,935.20
5.	Aonla	Emblica officinalis	206.35
6.	Tikhur	Curcuma angustifolia	405.60
7.	Baichande	Dioscorea hispida	508.90
8.	Bael phal	Aegle marmalose	814.00
9.	Kusum Seed	Schleichera oleosa	48,083.00
10.	Kapoor Kachri	Kaempferia galanga	1,000.00
11.	Tamarind	Tanarindus indica	1,006.86

and some pharmaceutical industries located in the State. It will be observed that this inflated quantity may be only 1-2 per cent of the total collection potential of the produce. Once the cultivation of some species becomes popular, new market outlets will have to be investigated.

5.6.4 Market Rates : Market Rates in Katni, Jabalpur (Madhya Pradesh) have been collected and compared with those prevailing in Delhi. Table 5.8 gives the market rates of some important medicinal and aromatic plants in these three markets.

Medicinal Plants with their parts used :

Plants and their parts used for medicinal purposes are summarised in Table 5.9.

5.7 Research and Development Works

An extremely rich flora accompanied with a wide spectrum of agri-climatic conditions and traditional expertise of local people in handling medicinal and aromatic plants indicate bright prospects for gainful utilization of locally available resources in Madhya Pradesh. However, presently very little is known about the market structure and profitability and therefore the farmers are hesitant in taking up the commercial cultivation of medicinal and aromatic plants. Another important aspect is lack of knowledge on optimum input and other agri-technology required for growing economically important plants.

Many natural forests also support very rich flora having important medicinal properties. However, on account of past misuse and overuse of resources a number of plants have already disappeared. There are a number of plants which are threatened and need immediate attention.

In order to conserve the existing plant resources and proliferate the most important onces, intensive and extensive research on various aspects of medicinal and aromatic plants will be needed. Looking to the economic importance of many plants found in the natural forests and in view of the bright prospects of these being adopted by marginal and sub-marginal farmers for commercial cultivation and full-fledged Research and Documentation (R & D) Centre need to be established at Jabalpur.

Table 5.7: Important Medicinal Plants with their Parts used

S.No.	Name of Medicinal Plants	Family	Local Name	Parts Used
1	2	3	4	5
1.	Aconitum heterophyllum	Ranunculaceae	Atil	Tuberous, roots
2.	Clerodendron phlomoides	Verbenaceae	Agnimanth	Bark, Roots
3.	Trachyspermum ammi	Apocynaeae	Ajwain	Seeds
4.	Adhatoda vasica	Acanthaceae	Adusa	Leaves, Roots
5.	Emblica officinalis	Euphor-biaceae	Aonla	Whole Plant
6.	Hollarrhena antidysentrica	Apocynaceae	Indrajo	Leaves, Bark, Seeds
7.	Ricinus communis	Euphorbiaceae	Erandmul	Leaves, Roots, Seeds & oil.
8.	Solanum Indicum	Solanaceae	Hantakari	Whole Plant
9.	Picrorhiza kurrooa	Scrophula-riaceae	Kutki	Rhizome, Seeds
10.	Piper nigrum	Piperaceae	Kalimirch	Seeds & Fruits
11.	Vetivera zizinoides	Graminae	Khus	Roots, Oil
12.	Tribulus terrestris	Zygophyllaceae	Gokhru	Fruit, Root, Whole plant
13.	Tinospora cordifolia	Menispermaceae	Giloy	Stem, Roots
14.	Commiphora mukul	Burceraceae	Gugal	Gum
15.	Swertia chirata	Gentianaceae	Chirayata	Whole Plant
16.	Plumbago zeylanica	Plumbaginaceae	Chitrak	Roots
17.	Carum carvi	Umbelliferae	Kalajeera	Fruit, Seeds and Oil
18.	Woodfordia floribunda	Lythraceae	Dhawai	Flowers
19.	Operculina tarpenthum	-	Nagarmotha	Root, Stem
20.	Nelumbium speciosum	Nymphaeaceae	Neelkamal	Whole Plant
21.	Trichosanthes dioca	Cucurbitaceae	Patolpatri	Fruits
22.	Boerhavia diffuse	Nyctaginaceae	Punarnava	Leaves, Roots
23.	Acorus calamus	Aroidae	Bach	Rhizome
24.	Glycirrhiza glabra	Papilionaceae	Mulethi	Pelled Roots
25.	Asperagus racemosus	Liliaceae	Satawar	Whole Plant
26.	Rauvolfia serpentina	Apocynaceae	Sarpagandha	Roots
27.	Hemidesmus indicus	Asclepiadaceae	Anantmul	Root, Rootbark, Juice

28.	Terminalia arjuna	Combretaceae	Arjun	Pods, Leaves, Roots, Bark
29.	Vitis quadrangularis	Vitaceae	Harjuri	Leaves, Roots Bark
30.	Oroxylum indicum	Bignoniaceae	Arloo	Root bark,Bark
31.	Saraca indica	Caesalpiniaceae	Ashok	Bark, Flowers
32.	Withania somnifera	Solanaceae	Ashwa-gandha	Leaves, Roots
33.	Carum roxburghianum	Umbelliferae	Amjoda	Seeds
34.	Abutilon indicum	Malvaceae	Kanghi, Atibala	Leaves, Roots, Bark, Fruit,Seeds
35.	Spilanthes acmella	Compositae	Akarkara	Flowers
36.	Citrullus colocynthis	Cucurbitaceae	Indrayan	Root, Fruit,Seeds
37.	Calotropis gigentia	Asclepiadaceae	Ak,Madar	Root bark, Root Leaves, Flowers
38.	Cuminum cyminum	Umbelliferae	Safed jeera	Fruits,Seeds
39.	Piper cubeba	Piperaceae	Kabab-chini	Fruits
40.	Mucuna pruriens	Papilionaceae	Kiwadi	Seeds, Roots,Pods
41.	Gloriosa superba	Liliaceae	Kalihari	Tuberous roots
42.	Piper chaba	Piperaceae	Chavy	Fruits
43.	Santalum album	Santalaceae	Chandan	Wood,Seeds,Oil
44.	Nardostachys jatamansi	Valerianaceae	Jatamasi	Rhizome, Oil
45.	Myristica fragerns	Myrtaceae	Jaiphal	Leaves, Fruits
46.	Ballospermum montanum	Euphorbiaceae	Dantimul	Leaves,Seeds, Roots

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Some of the important aspects requiring indepth studies are as follows:

1. Survey and compilation of data on commercially important medicinal and aromatic plants occurring in each agro-climatic zone and their association with different forest communities. This information will help in recommending suitable species for economic cultivation by farmers and for underplanting in forest plantations.
2. A status survey highlighting the present distribution and extent of occurrence of these species. This would help delineate the habitat of important plant species requiring immediate steps for protection, the ultimate aim should be to conserve germ plasm.

Table 5.7: Medicinal Species and their requirement in Govt. Ayurvedic Pharmacy Gwalior and Raipur and Unani Pharmacy, Bhopal Madhya Pradesh

S.No.	Name of Species	Latin Name	Approx. Quantity (kg.)
1	2	3	4
1.	Anant mool	Hemideamus indicus Br.	145.000
2.	Amaltas	Cassia fistula Linn.	500.000
3.	Arjun twaku	Terminalia arjuna Bedd.	210.000
4.	Atil (Ativasa)	Aconitum heterophyllum wall	3997.500
5.	Angimanth (Arni)	Clerodendron phlomidis Linn	1058.500
6.	Aml Bent	Garcinia pedunculata Roxb.	558.000
7.	Asthi Samhali	Vitis guadrangularis Well.	65.000
8.	Arloo	Oroxylum indicum vent.	312.500
9.	Ashok Chhal	Saraca indica Linn.	400.000
10.	Ajwaine	Trachyspermium ammi Linn.	1590.000
11.	Adusa (Vasaca)	Adhatoda vasica	1014.000
12.	Anardana	Punica granatum Linn.	669.000
13.	Arhar ki jad	Root of Cajanus indicus spreng	39.000
14.	Agar (Agru)	Aquilaria agallocha Roxb.	1.200
15.	Ashwagandha	Withania somnifera Dunal.	742.500
16.	Ajmod	Carum roxburghianum Benta.	471.750
17.	Agast ke pushpa	Sesbania grandiflora Linn.	30.000
18.	Atibala	Abutilon indicum Linn.	332.000
19.	Akarkara	Spilanthes acmella Murr.	17.000
20.	Aphim	Papaver somniferum Linn.	185.000
21.	Anwla	Emblica officinalis Gaertn.	7044.000
22.	Aam ki guthli	Mangifera indica Linn.	149.000
23.	Imli	Tamarindus indica Linn	342.000
24.	Ilayachi chhoti	Elettaria cardamomum Maton	124.000
25.	Ilayachi badi	Amonum subulatum Roxb.	510.000

1	2	3	4
26.	Inbrayab	Hiogrrhena antidysenterica Wall.	3870.000
27.	Indrayan ki jad	Citrullus colocynthis schrad	56.000
28.	Irimend ki chhal	Acacia farnesiana Willd.	240.000
29.	Ootgun	Blepharis edulis Pers.	17.000
30.	Aak	Calotropis gigentia (Linn.) R.Br.	54.000
31.	Ajaji	Cuminum cyminum Linn.	60.000
32.	Erand mool & tal	Ricinus communis Linn.	1240.000
33.	Elua	Aloe barbadensis mill	1380.000
34.	Kateri chhoti	Solanum surattense	1363.500
35.	Kateri badi	Solanum indicum Linn.	1407.500
36.	Kutki	Picrorhiza kwrrooa Linn.	4080.000
37.	Kamal Keshar	Nelumbium speciosum Willd.	145.000
38.	Kayphal	Myrica nagi Thunb.	1790.000
39.	Kali Mirch	Piper nigrum Linn.	5247.000
40.	Kababchini	Piper cubeba Linn.	40.000
41.	Kakdasinghi	Rhus succedanea Linn.	1575.000
42.	Karanj	Pongamia glabra Vent.	515.000
43.	Kachur	Curcuma zedoaria Rose	485.000
44.	Kapikachhu	Mucuna pruriens De Prod.	17.000
45.	Keekhari	Gloriosa superba Linn.	136.000
46.	Ketki	Pandanus fascicularis Lamk	22.000
47.	Kachnar chhal	Bauhinia variegata Linn.	120.000
48.	Prishnparni	Ureria picta Desv.	868.000
49.	Kooth	Saussurea lappa clarke	590.000
50.	Khus	Vetiveria zizanioides Linn.	2205.000
51.	Khajoor	Phoenix dactylifera Linn.	190.000
52.	Kharenti	Sida cordifolia Linn.	800.000
53.	Gokhru	Tribulus terrestris Linn.	3316.000

1	2	3	4
54.	Giloya	Tinospora corditolia Miers	7000.000
55.	Gambhari	Gmelina arborea Linn.	851.000
56.	Gondani	Cordia rotnii Roem.	4.000
57.	Gugal	Commiphora mukul Engl.	2662.000
58.	Chirayta	Swertia chirata Buch. Ham.	3312.000
59.	Chavya	Piper chaba Hunter	808.000
60.	Chitrak	Plumbago zeylanica Linn.	1145.000
61.	Chandan (Rakta)	Pterocarpus santalinus Linn.	2612.000
62.	Chandan (Shwet)	Santalum album Linn.	132.000
63.	Chameli pay	Jasminum arborescens Roxb.	15.000
64.	Chakbad beej	Cassia tora Linn.	41.000
65.	Jayphal	Croton tiglicum Linn.	25.000
66.	Jatamansi	Nordostachys jatamansi Do.	657.000
67.	Jeera shwet	Cuminum cyminum Linn.	540.000
68.	Jeera siyah	Carum carvi Linn.	1080.000
69.	Jayphal	Myristica tragerns Houtt.	228.000
70.	Jaypatri	Myristica tragrens Houtt.	96.500
71.	Jamun Guthli	Syzygium cumini skeels	145.000
72.	Tejpatra	Cinnamomum tamala Nees	459.000
73.	Tagar	Valeriasa wallichii Dc.	482.000
74.	Trin kantrmarn	Pinus succinifera cornw	250.000
75.	Tumbru ke beej	Zanthoxylum alatum Roxb.	4.000
76.	Til tail	Oil of Sesamum indicum Linn.	5620.000
77.	Dal chini	Cinnamomum zeylanicum Nees	625.000
78.	Devdaru	Cedrus deodara (Rxob.) Loud.	1470.000
79.	Daru haridra	Barboris aristata Dc.	775.000
80.	Draksha	Vitis vinifera Linn.	960.000
81.	Danti mool	Ballospermum montanum Juell.	118.000
82.	Dhawai ke phool	Woodforia floribunda Salisb.	1160.000
83.	Dhamasa	Fagonia arabica Linn.	349.000
84.	Dhania	Coriandrum sativum Linn.	837.000

1	2	3	4
85.	Dhantur	Datura alba nees	66.000
86.	Neem ki chhal	Azadirachta indica a. Juss.	4037.000
87.	Netrawala	Pavonia odorata Willd.	1881.000
88.	Nishoth	Operculina turpethum Manso	3155.000
89.	Nag keshar	Mesua ferea Linn.	472.000
90.	Nag bala	Sida veronicaefolia Laud.	80.000
91.	Nagarmotha	Cyperus scariosus R. Br.	7574.000
92.	Nag valli	Piper bettle Linn.	21.000
93.	Nilotpal	Nelumbium speciosum willd.	1024.000
94.	Pippali	Piper longum Linn.	9250.000
95.	Patla	Stereospermum suaveloens Dc.	2044.500
96.	Palash beej	Butea frondosa Roxb.	90.000
97.	Pathani lodhra	Symploeos crataegoides Buch Ham.	355.000
98.	Piparment	Mentha piperata Linn.	50.000
99.	Pushkar mool	Imula recemosa Hook	196.000
100.	Patel patra	Trichosemthus diocia Roxb.	1639.000
101.	Prasarni	Paederia toetida Linn.	367.000
102.	Pit pada	Fumaria parviflora Lamk	1280.000
103.	Punarnava mool	Boerhaevie diffusa Linn.	1516.000
104.	Priyangu	Callicarpa macrophylla vahl.	1.200
105.	Patmaran	Prunus puddum Roxb.	76.200
106.	Piperamool	Roots of piper longum Linn.	921.200
107.	Bel girih mool	Aegle marmelos correa	3500.000
108.	Bahera (Baheda)	Terminalia belerica Roxb.	8150.000
109.	Bach	Acorus calamus Linn.	1846.000
110.	Vay vidag	Embelia ribes Burm.	443.000
111.	Bansh lochan	Bambusa arundinacea Willd.	2928.000
112.	Bhilava	Semecarpus anacardium Linn.	65.000
113.	Bharangi	Clerodendron serratum spreng.	155.000
114.	Bhang	Cannabis indica Lamk	200.000
115.	Ghoohar	Euphorbia nerilfolia Linn.	41.000

1	2	3	4
116.	Moosli kand	Cureuligo orchioides Gaertn.	71.000
117.	Mal kanghi	Celastrus paniculata Willd.	41.000
118.	Madhvi	Hiptage madaulota Gaertn.	18.000
119.	Mansparni	Terramnus labialis spreng.	125.000
120.	Mugdaparni	Phasiolus trilobus Aid	62.5000
121.	Mahua ke phool	Madhuca indica J.F. Gmel.	50.000
122.	Manjith	Rubia cordifolia Linn.	1532.000
123.	Mochras	Bombax malabaricum Dc.	633.000
124.	Mulaithi	Glycyrrhiza glabra Linn.	1016.000
125.	Manyee	Galls of Tamarix gallica Linn.	215.500
126.	Murva	Bauhinia vahlii W & A	151.500
127.	Irwa	Cynodon dactylon Linn.	22.000
128.	Yavasa	Alhagi camelorum Fisch	286.000
129.	Renuka	Vitex agnus-castus Linn.	48.000
130.	Lanka	Caryophyllus aromaticus Linn.	737.000
131.	Laudhra	Symplocos racemosa Roxb.	178.000
132.	Lajjalu	Biophytum sensitivum Linn.	1.2000
133.	Lahsun	Allium sativum Linn.	185.000
134.	Vidhara	Argeria speciasa sweet	300.000
135.	Vatsnam	Aconitum ferox wall.	609.000
136.	Vidarikand	Pueraria tuberosa Dc.	15.000
137.	Vantakur	Picus bengalensis Linn.	68.000
138.	Varun chanal	Cetaeva religiosa	1300.000
139.	Shalparni	Desmodium sp.	200.000
140.	Shyonak	Oroxylum indicus	2070.000
141.	Shatawari	Asparagus racemosus	150.000
142.	Shital chini	Piper cubaba	100.000
143.	Shwet kamal	Welumbium speciosum	100.000
144.	Soa (Shatpushpa)	Peucedanum graveolens Linn.	17.000
145.	Sanay	Cassia angustifolia vahl.	369.000

1	2	3	4
146.	Rai	Brassica juncea Linn.	3.000
147.	Salone ki chhal	Alstonia scholeris R.Br.	41.000
148.	Sahjan	Miringa pterygosperma Gaertn.	115.000
149.	Sarson pili	Brassica campestris Prain.	9.000
150.	Sagindha	Rauvalfia serpentina Benth	1750.000
151.	Sambhal	Vitex negundo Linn.	55.000
152.	Safed raal	Resin of Shores robusta Gaertn.	67.000
153.	Sarson ka tail	Oil of Brassica campestris Prain.	2928.000
154.	Siras ki chhal	Albizzia odoratissima Benth.	401.000
155.	Sugandhavala	Pavonia odorata willd.	2120.000
156.	Saunph	Roeniculum vulgare mill.	95.000
157.	Saunth	Zingiber officinale Rose.	10263.000
158.	Harsinghar	Nyetanthus arbor-tristis Linn.	55.000
159.	Sahdevi	Vernonia cinerea Less.	22.000
160.	Harad Vakkal	Terminalia chefaie Retz.	10480.000
161.	Haldi	Curcuma longa Linn.	627.000
162.	Harenuka	Vitex agnuscastus Linn.	20.000
163.	Heera bol	Commiphora myrrha Holmes.	65.000
164.	Hingupatri	Gardenia gummifera Linn.	17.000
165.	Hau ber	Juniperus communis Linn.	55.000
166.	Hijjal beej	Barringtonia acutangula Linn.	15.000
167.	Kuchla	Strychnos nuxvomica Linn.	24.000
168.	Vakuchi beej	Psoralia corylifolia Linn.	12.000
169.	Kanermool (Rakta)	Nerium odoratum)	54.000
170.	Kanermool	Thevatia neriifolia Juss.)	
171.	Ustkhuddal (Charu)	Lavandula stoeches Linn.	120.000
172.	Amarvel vilayati	Cuscuta europea Linn.	32.000
173.	Mastagi roomi	Resin of Pistacia lentiscus Linn.	55.000
174.	Mooli	Raphanus sativus Linn.	10.000
175.	Gule Banphasa	Viola odorata Linn.	65.000

1	2	3	4
176.	Gule Gulab	Rosa damascena Miller	28.500
177.	Kateera	Astragalus heratensis Bung	39.500
178.	Unnav Hirayati	Zizyphus sativa Gaertn.	165.000
179.	Revand chini	Rheum oficinala Baill	44.000
180.	Adrak	Zingiber officinale Rosce	493.500
181.	Aasarol (Tagar)	Asarum curopaeum Linn.	16.000
182.	Kulanjan	Alpinia chinensis Roscoe	5.000
183.	Billi Lotan	Melissa officinalis Linn.	8.000
184.	Keshar	Crocus sativus Linn.	3.800
185.	Ark Gulab	Rosa damascena miller	72.000
186.	Gond Babul	Gum arabic	92.000
187.	Karanjava	Caesalpinia bonducella Flem	100.000
188.	Ajvayan Khragsahni	Hyoscyamus albus Linn.	10.000
189.	Rasout Jard	Extractum berberis	50.000
190.	Maju sabj	Quercurs infectoria olivier	89.000
191.	Chilgoja	Pinus gerardians Wall.	25.000
192.	Bihdana	Pyrus cydonia Linn.	26.000
193.	Magja Pista	Pistacia vera Linn.	25.000
194.	Magja Badam	Prunus amygdalus schneid	46.000
195.	Sibbe Muktari	Aloe perryi Baker	50.000
196.	Suranjan Shiri	Merendera persica	51.700
197.	Varg Babul	Acacia arabica	25.000
198.	Hallo	Lepidium sativum Linn.	25.000
199.	Magja Tikhm Neem	Azadirachta indica A. Juss.	50.000
200.	Gule Gavjawan	Coecinia glauca Savi	250.000
201.	Behman Surkh	Salvia haemotodes	26.000
202.	Behman Safed	Centaurea behen Linn.	28.200
203.	Salab Mishri	Orchis mascula Linn.	28.000
204.	Tal Makhana	Asteracantha longifolia Nees.	25.000
205.	Moosli Safed	Asparagus adscendens Roxb.	31.000

1	2	3	4
206.	Tudri	Lebidium iberis Linn.	50.000
207.	Salab Panja	Orchis sp.	25.000
208.	Jalafa Musallam	Convolvulus jalapa Linn.	50.000
209.	Tukhya Tulsi	Ocimum basilicum Linn.	25.000
210.	Tukhya Kanoncha	Salvia spinosa Linn.	25.000
211.	Bartang	Plantago major Linn.	25.000
212.	Gond Chinia	Batea Gum	225.000
213.	Aama Haldi	Curcuma aromatica Salisp.	275.000
214.	Podina	Mentha sativa Linn.	110.000
215.	Kundur	Boswellia floribunda	50.000
216.	Makckhutak	Solanum dulcamara Linn.	100.000
217.	Post Badam	Prunus anygdalus schneid	50.000
218.	Babuna	Matricaria chamomilla Linn.	29.500
219.	Gulmundi	Sphaeranthes indicus Linn.	40.000
220.	Rogne mool	Rose damascena miller	250.000
221.	Anjir Jard	Ficus carica Linn.	45.000
222.	Khubbaji	Malva sylvestris Linn.	45.000
223.	Tukhma Kahu	Lactuca sativa Linn.	25.000
224.	Tukhma Khatmi	Althoca officinalis Linn.	30.000
225.	Tukhma Kakdi	Cucumis momordica Linn.	22.000
226.	Rogne Kanta	Linum usitatissimum Linn.	60.000
227.	Singhara	Trapa natans Linn.	20.000
228.	Tukhm Kasni	Cichorium Antybus Linn.	20.000
229.	Jaravand	Aristolochia longa Linn.	25.000
230.	Varga Hina	Lawsonia inermis Linn.	25.000
231.	Bojidana	Tanacetum umbelliferum	27.000
232.	Supari	Areca catechu Linn.	26.000

3. Study of market structure, marketing channels and pricing of various medicinal plants. This would facilitate and bring efficiency in marketing of medicinal plants which have so far been a bottleneck in popularising their cultivation.

Table 5.8: Market Rates of Some Important Medicinal Species

(In Rs/per quintal)

S.No.	Species	Local Name	Katni	Jabalpur	Delhi
1.	Emblica officinalis	Aonla	800.00	140.00	500.00
2.	Terminalia bellerica	Bahera	90.00	200.00	250.00
3.	Chlorophytum tuberosum	Safed Musli	1400.00	25000.00	14000.00
4.	Curcuma angustifolia	Tikhur	2000.00	-	-
5.	Embelia tsjeriam-cottam	Baibai-rang	800.00	-	1800.00
6.	Acorus calamus	Bach	1200.00	900.00	-
7.	Dioscorea daemona	Baichandi	1100.00	-	-
8.	Semecarpus anacardium	Bhilwa	100.00	100.00	500.00
9.	Cyperus rotundus	Nagar-motha	200.00	900.00	-
10.	Swertia chirata	Chirayta	400.00	500.00	-
11	Woodfordia floribunda	Dhawai-phool	200.00	-	700.00
12.	Aegle marmelos	Bel Guda	225.00	-	500.00
13.	Rauwolfia serpentina	Sarpgandha	-	12500.00	6000.00
14.	Withania somnifera	Ashwagandha	-	4000.00	5500.00
15.	Randia dumatorum	Mainphal	185.00	400.00	-
16.	Curcuma caesia	Kali Haldi	-	2000.00	-

4. Local agro-technology for plants to be propagated in different agro-climatic zones willhave to be developed and demonstrated.
5. Agro-forestry strategy may also have to be taken into account in order to optimise benefits to the marginal farmers and tribals living in forest areas. Such strategy will help in improving, specially tribal area.
6. Highly degraded soils and wastelands can be restored by planting some medicinal plants and grasses like palmarosa, lemon grass etc., which grow in extremely degraded soil and are regarded good soil binders and are soil builders also.

7. Analysis of profitability trends in pharmaceutical industry vis-a-vis their present requirements and future needs.
8. Investment pattern and raw-material requirements of pharmaceutical industries.
9. Extension work to making the cultivation of medicinal and aromatic plants more acceptable by poor farmers.

Conservation and propagation of medicinal and aromatic plants should be a National concern as these plants are vital for our survival. Their cultivation by rural poor fits-in all poverty alleviation programme. Indian system of medicine has stood the test of time and this would continue to be so in future as well.

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CHAPTER VI

TANS AND DYES

Introduction

Tannins are widely distributed throughout the forest vegetation and are found in the bark, leaves, fruit and wood of forest plants. Tannins and dyes are in the form of secretion found almost universally in plant tissues in small or large amounts. Very few plants, however, contain these products in concentrations adequate enough to make them commercially important as sources of tannins and dyes.

The term **"tannin"** was introduced by Segvin to denote substances of vegetable origin capable of converting animal skin into leather. It is estimated that the country's demand for vegetable tanning extracts in the organised sector of tanning industry is about 47,000 tonnes whereas, unorganised and cottage sector require 70,000 tonnes of the extracts per annum (Tiwari, 1981).

India has the largest livestock population (about 415 million) in the world (Anon, 1982). The prospects for leather industry are therefore very good. Tanning of hides and skins of animals improves their flexibility and offers resistance to decomposition. Tanning is being done since times immemorial. The bulk of the tannins are used in leather industry. Table 6.1 lists out the most suitable species containing tanning material.

A. TANS

6.1 Fruit Tans

6.1.1 Myrobalans (Harra)

(a) General : Myrobalans are among the most important of tanning material of fruit origin. Fruit of the tree of Terminalia chebula commercially known as chebulic myrobalan is one important tanning material. The two other commercially known myrobalans are Terminalia belerica and Emblica officinalis. However, neither of

Table 6.1: Tannin content of vegetable taking materials occurring in Central India

Species	Part used	Tannin (per cent)	Classification
Acacia catechu	Cutch	57.59	Catechol
A. leucopuloea	Bark	17	"
A. mollissima	Bark	35	"
A. nilotica	Bark	12-18	"
Anogeissus latifolia	Mature leaves Young leaves	16-18 30-32	Pyrogellol
Anacardium occidentale	Leaves	23	"
Cassia auriculta	Bark	18	Catechol
C. fistula	Bark	9-12	"
Casuarina equisetifolia	Bark	7.18	"
Cleistanthus collinus	Bark	25	"
Emblica officinalis	Twig bark	21-24	"
Hopea parviflora	Bark	21.0	"
Peltophorum ferrugineum	Mature bark	20.3	"
Shorea robusta	Bark	7-9	"
Terminalia arjuna	Bark	23	Mixed catechol & Pryogellol
T. belerica	Nut	12	"
T. chebula	Nut	33	"
T. tomentosa	Bark	15	"
Ziziphus xylocarpa	Fruit	16-23	Catechol

these two species compares favourably with the first one. This species is found throughout the mixed deciduous forests and even in drier forests and on revenue wastelands, field bunds, village commons etc.

Madhya Pradesh is the most important producer of myrobalans accounting for 75 per cent of the total production of the country (Gupta and Guleria, 1982).

(b) Time of Collection : Research has indicated that the best time for collection of fruits for the optimum tannin content is the month of January in the country. The collection after this yield slightly inferior quality. Collection done too early also show similar quality. A good sample contains tannin to the amount of 32 per cent. The tannin content varies from 12 to 49 per cent.

(c) Grading : In the trade practise grading is done by picking out the inferior fruits to constitute a lower grade, the remainder being the first grade. The following grades are generally recognised (Anon., 1972). Bimlies (B's) exported from Bimlipatam (Andhra Pradesh). Jabalpur (J's) exported from Jabalpur (Madhya Pradesh), Rajpores (R's) exported from Kolhapur (Maharastra). Vingloras (V's) exported from Maharastra.

Coast Madras, or Madras, exported from Tamil Nadu forests.

(d) Markets : The important markets for Myrobalans in India are (Tiwari, 1982) :

1) Madhya Pradesh - Rajpur, Durg, Mandla, Chhindwara, Jabalpur, Shahdol, Katni, Raigarh, Bastar, etc.

2) Maharastra - Satara, Poona, Kolaba, Chandrapur etc.

3) Orissa - Mayurbhanj, Kalahandi, Ganjam, Koraput, Keonjhar, Belangir, etc.

4) Andhra Pradesh - Adilabad and Nalgonda.

5) Bihar - South Bihar areas

6) Karnataka - Belgaum, Kanara, Mysore, Bangalore.

7) Tamil Nadu - Salem, Madurai, Coimbatore.

Myrobalans are one of the most important tanning materials of the pyrogellol class. These tans produce a brownish coloured deposit on leather called bloom, as opposed to the catechol class of tans which do not produce this bloom. Myrobalan tan is not very astringent, and penetrates the hide very slowly. When used alone it produces a soft, mellow and rather spongy leather which lacks good wearing properties. Myrobalans in India are largely used in conjuction with babul, avaram and mangrove barks. They are not, as a class, considered a good weight giving tan-stuff, and the proportion of tannin combining with the hide substance is small compared with other tanning materials (Anon., 1972).

(e) Production Potential : Production of myrobalan in Madhya Pradesh during past two decades have been given in Table 6.2.

The production figures would show there has been a lot of fluctuation in the production of Harra. The peak production of 525 thousand quintal was reported in 1971-72. After this period the production ranged between 21 to 220 thousand quintals. In the past 5-6 years, the production figures has more or less stabilised around 100 thousand quintals. One reason for declining production has been the felling of Myrobalan (T. belerica) tree standing on revenue wastelands which were gradually brought under plough. In the past trees have also been felled during silvicultural fellings. General site degradation, hacking, aridity due to lack of adequate rainfall etc. have also added to the poor health of trees and consequently low production. In view of the importance of this tree in particular and almost all fruit bearing trees in general, a few years ago, the State Government restricted the felling of such trees. This administrative

Table 6.2: Production of Myrobalans in Madhya Pradesh

Year	Production in '000 qt.
1970-71	235.392
1971-72	525.003
1972-73	21.179
1973-74	66.370
1974-75	53.497
1975-76	90.000
1976-77	220.827
1977-78	126.827
1978-79	121.927
1979-80	175.783
1980-81	49.000
1981-82	91.600
1982-83	203.867
1983-84	167.634
1984-85	90.432
1985-86	98.832
1986-87	127.882
1987-88	117.479
1988-89	98.637
1989-90	114.055

measure must have helped in conserving myrobalan trees but yet another positive step is needed in propagating such trees by including them in plantation programmes.

(f) Employment Potential : Although, work-study on daily collection by an adult are not available some guestimates have been made (Pant, 1979). According to these estimates about 20 mandays are required to gather 10 quintals myrobalan. However, this appears to be unrealistic as each days collection of 50 kg myrobalan may be a difficult task as the trees are scattered and fruiting of trees is not uniform. Observations in the tribal areas indicate that each person on an average

collects 8-10 kg myrobalan each day. Taking a figure of 10 kg collected by a person each day would mean 10 persondays to collect one quintal 'harra' (fruits of Terminalia belerica). Taking an average annual collection figure of 100,000 quintals, this minor forest produce is capable of generating 100,000 persondays every year. However, it has to be remembered that this is not a full time job. The labourers collect during morning hourse and dry in their backyards before taking it to week-end markets.

6.1.2 Pods of Babul : Another tan-fruit of purely local importance is the pod of babul. These pods are sought after by tanners not only for their tannin content but also because of the good colour they give to, and the softening effect they have on leather. Babul pods are used for tanning locally in Uttar Pradesh and Maharastra but not in Madhya Pradesh. The tannin content is 12-19 per cent in the pods and 18-27 per cent after the removal of seeds. It is said that a babul tree yields about 18 kg of pod cases in a year. Though large quantities are available, they do not seem to be utilised fully in tanning on account of the drawbacks given as above.

6.1.3 Emblica officinalis : Fruits of E. officinalis are also rich in tannin. Fruit contains 28 per cent tannin (Twig bark 21 per cent, stem bark, 8-9 per cent and leaves contain 22 per cent tannin). Abundance of trees of E officinalis in the natural forests shows it could become source of tannin and generate rural employment. Immature fruits are usually employed in tanning in combination with other tan stuffs such as myrobalans.

6.1.4 Katber (Ghont-Ber) : The only other tan-fruit of any importance is that of Zizyphus xylocarpa. It is a small tree found in almost all parts of the State. Its fruits impart a black colour to the leather.

6.2 Wood Tans

There is no tree species containing tannin in its wood in

Madhya Pradesh. The most important wood tan is obtained from Quebracho colorado which does not occur in this State.

6.3 Bark Tans

The main tree species known to have bark tannin are Acacia nilotica (babul), Cassia auriculata (avaram), A. mollisima (wattle) and Shorea robusta.

However, in the context of Madhya Pradesh, barks of A. nilotica, Cassia auriculta and Shorea robusta are important.

6.3.1 Babul (A. nilotica) : Babul tree (A. nilotica) is a moderate sized evergreen tree found practically in all parts of the State. However, it is more prominent in black cotton soil, along roadsides, on field bunds, and other community wastelands. The trees of babul is a rare site. Tannin yields from barks vary from 12 to 20 per cent. The barks are cheapest source of tannin suitabie for heavy leathers. Better results could be obtained when this material is used in combination with myrobalans. Babul tree being an important tree yielding, fuel charcoal, fodder, small timber for agricultural implements in rural areas, it may not be feasible to harvest the trees purely for bark. However, during normal felling of tree its bark could add to the return. According to an estimate (Anon., 1972) the yield of bark per hectare with about 625 trees aged 15 years is about 12.5 tonnes. Taking a price of Rs.45 per tonne (Sharmuganathan, 1971) the output per hectare from bark could be valued at a minimum of Rs.5,600.

6.3.2 Sal bark (Shorea robusta) ; The Sal forests occupy an area of 25,740 sq km (16.54%) on an average 265,000 cu m of timber and 200,000 cu m of fuelwood is obtained from the annual Sal coupes. Presently, its barks are not being used on large scale probably because it does not give desired softness and colour to the leather. However, possibilities exist for using this bark in conjuc-

tion with myrobalan. Wattle bark has replaced avaram and Sal barks to a great extent.

6.4 Leaf Tans

6.4.1 Anogeissus latifolia : The tree is found in the sub-Himalayan tract from the Ravi eastwards and in Central and Southern India. In Madhya Pradesh, this species is universally distributed in all forest types viz., teak, Sal and mixed miscellaneous stands. Its leaves have been used for many years under the name of dhawa sumac. The dry mature leaves contain about 32.5 per cent of tannin and 10.5 per cent of non-tan, whereas the dry reddish tips of young leaves have been found to contain upto 55 per cent. A mixture of green leaves, red leaves and petioles, when dried and ground to a coarse powder, yields a product containing about 38.5 per cent of tannin and 13.8 per cent soluble non-tans. The tannin penetrates rapidly and produces a satisfactory pale-coloured leather with a greenish tinge, the leather, however, is sensitive to light.

Although, the leaves are of great importance its collection poses great practical difficulties. The young reddish coloured leaves with high tannin content can be collected only in a short period before the break of monsoon rains in order to avoid the great risk damage from damp. The leaves have to be dried speedily if fermentation and consequent depletion of tannin content are to be avoided. However, with the monsoon setting in this step becomes difficult. This has always come in the way of commercial exploitation of this source.

6.4.2 Carissa spinarum (Karaunda) : This is a thorny evergreen shrub found in most parts of the State. The tannin content in the leaves is low (9-15%) but it is less variable than in the case of dhawa sumac. The leaves are difficult to collect, but there is the advantage that the leaves can be collected throughout the year. The tannage is slow, causing extreme swelling of the

hide. Very satisfactory results are however, obtained with admixtures with other tan-stuffs. The twig-bark of Emblica officinalis, for instance, is eminently suited for admixture with Karaunda leaves, as the red effect of the former neutralises the greenish colouration produced by the latter.

Table 6.3: Collection of Dhawai Phool (Woodfordia floribanda)

(in quintals)

Circle	1981-82	1982-83	1984-85	1985-86
Durg	17	22	250	119
Jagdalpur	50	70	106	55
Kanker	225	159	260	161
Raipur	162	96	190	933
Shahdol	350	21	25	-
Surguja	800	725	773	790
	2194	**1093**	**1704**	**2058**

B. DYES

Dyes have been chiefly used in the textile industry. Dyes are also used for colouring points, varnishes, leather, ink, paper and medicines. Only a few of over 2,000 known tree species providing these materials are currently exploited on a small scale. Based on their origin, dyes have also been grouped into wood, bark, flower and fruit, root and leaf dyes (Anon., 1972).

Although no systematic survey have been done to assess the production potential of plant origin dyes, some informations have been compiled from the records of Divisional Forest Officers.

6.5. Wood Dyes

Among wood dyes of any commercial importance, cutch dye deserves mention especially in the context of this State. The cutch extract from Acacia catechu (Khair) is by far the most valuable of all the wood dyes. It has the valuable property of being a tan extract as well as a dye agent, but it derives

its unique importance from its preservative qualities when used for tanning and dyeing canvas, leather or cloth for marine purposes. It is used for dyeing fishing nets, awnings, sail cloth, mail bags etc. It is also used in dyeing wool and silk and for weighting the leather.

6.6 Bark Dyes

Many bark yield brown and black dyes, but as the barks are often used for tanning purposes the dye contained in them is, more often than not, considered a defect rather than an asset.

Bark dyes not very important, but few need to be mentioned which have some relevance to this State.

6.6.1 Acacia species : The barks of A. farnesiana and A. leucopholea yield a black dye.

6.6.2 Terminalia tomentosa : The bark of this species is also used for dyeing to a black colour.

6.7 Root Dyes

There are numerous forest trees and plants whose roots yield dyes of varying quality but the majority are unimportant as they are only used locally by villages. However, most of the

tree having roots-yielding dyes are not found in this part of the country. The most important species found elsewhere are Berberis aristata, Datisca cannabina, Morinda coreia (M. tinctoria), Punica granatum, Rubia cordifolia etc.

6.8 Leaf Dyes

Indigo (Indigofera tinctoria), once the "King of the dyestuffs" was formerly cultivated in India on an extensive scale. Due to the introduction of synthetic dyes, the cultivation has ceased altogether. The leaves of several species of Indigofera contain a soluble colourless glucoside, known as 'Indican' which oxidises in water to form the soluble indigo. This dye is remarkable for the permanancy and strength of its deep blue colour.

Another wild plant Lawsonia inermis, the henna tree is of local importance. This yields the orange dye known as henna dye. This plant is grown as garden hedge. The leaves which contain the colouring matter, are dried and ground into a puste. Henna is a fast dye and is used for fabrics and leather. It is also used for dying the hair, eye-brows and finger nails and for other forms of personal adornment.

Chlorophyll responsible for green colour of plants can also be extracted with the help of various solvents. It can also be used as a colouring matter for foods, soaps, denitrifices and the like. Its importance lies in its being a harmless substance.

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CHAPTER VII

LAC

Introduction

Lac generally known as shellac, in its refined form is a secretion from an insect. Lac has been known in India since times immemorial. A description of lac insect is given in the Atharvaveda where it is termed 'Laksha'. Its mention is found in Mahabharat the great Indian Epic where 'Kauravas' in the nefarious plot to do away their cousins, the 'Pandavas' built the highly inflamable and cleverly camouflaged 'Lakhagriha' (lac house). In the middle ages, lac was used in several countries in Europe and Asia for impressing seals on documents. In the modern times lac is used for a variety of purposes in plastics, electrical goods, as adhesives, leather, wood finish, printing, polish and varnish, ink and a number of other industries. It is also the principal ingredient of sealing wax. Its main use at one time was in the manufacture of gramaphone records which declined recently due to the introduction of synthetic materials. Till the early 1950's India had virtual monopoly in the production of lac, accounting for nearly 85 per cent of the total production. Later on Thailand increased its production to share about 25-30 per cent of the world's requirement.

Shellac is the improved form of lac. When synthetic resin was developed having properties of shellac, the demand for it went down. The change in technology of sound recording, the use of gramaphones was discarded. A substantial portion of shellac was used in the production of gramaphones. Nevertheless, with the increase of consumption of electricity the demand for shellac as insulator again recorded upward trend. At present India's total production of lac, commercially known as stick lac is 20,000 M.T. After processing, about 8,000 M.T. shellac is available. Domestic consumption is about 3,000 M.T. and the remaining 5,000 M.T. is exported to the world market (Bhoumik and Pandya, 1990) for being used in the industries.

The reasons identified for dwindling demand for lac are a) competition with synthetic resins b) change in technology c) lack of aggressive sales promotion in overseas and Indian market d) disappearance of small manufacturers due to uncertain market conditions.

7.2 Host Plants

Lac is the resinous substance secreted by the tiny lac insect, Laccifer Lacca Kerr., as a protective covering it is found as a parasite on a number of plants, both wild and cultivated.

Two important strains of the lac insect are commonly recognised in India, the 'Rangeeni' and the 'Kusumi', depending on the host plant on which the insect feeds. The Rangeeni crop is raised on several host plants, the most important are palas (Butea monosperma) and ber (Ziziphus mauritiana). The Kusumi strain of lac is raised on Kusum (Schleichera oleosa) tree.

About a hundred species of plants have been recorded as hosts for the lac inject in India, but only a dozen of these are usually used species for lac cultivation in Madhya Pradesh. Butea monosperma, Zizyphus mauritiana, Schleichera oleosa together account for over 85 per cent of the production. Schleichera oleosa (Kusum) accounts for 10 per cent. Lac on ghont (Zizyphus mauritiana) is mainly cultivated in Jabalpur, Bhopal and Sagar areas. Other hosts for lac cultivation in Madhya Pradesh are given in Table 7.1

Table 7.1: Other hosts for lac cultivation in Madhya Pradesh

Botanical name	Locality and characteristics
1. A. leucophloea	good encrustations observed in Bhind district
2. A. pinnata	in various parts of Madhya Pradesh
3. Albizzia amara	reported host in Bundelkhand
4. A. lebbeck	in Chhatisgarh region
5. A. odorarissina	a host in several parts of Madhya Pradesh
6. Dalbergia paniculata	good infections in Sagar district
7. Dichnostachys cinera	reported host in Northern Madhya Pradesh
8. Samanea saman	good encrustations noticed in some parts

There are four major lac hosts in Central India which are mostly utilised for lac cultivation. These are (a) two Kusumi hosts, (b) two Rangeeni hosts. The **Kusumi** hosts are i) Schleichera oleosa and ii) Acacia catechu. Lac crops raised are named after the months in which they are harvested. Kusumi produces 'aghani' in January-February from plants infected in June-July, and another crop Jethi obtained in June-July from January-February infection.

Rangeeni strain produces Katki (after Hindi month Kartik) crop harvested in October-November from innoculation made in June-July and Baisakhi (after Hindi month Baisakh) obtained in June-July from innoculations in October-November. Butea monosperma and Zizyphus jujuba are the Rangeeni crops of this region. More than 85 per cent of the total production comes from Rangeeni crop (Chhabra, 1943, NCA, 1976).

Kusum lac is especially light and clear in colour, and is more valued than that from any other tree. Moreover, it is generally accepted that brood from the Kusum tree will thrive on any other lac bearing tree to which it may be transferred; but that the reverse is not the case, as insects from other trees will not live on transfer to the Kusum tree (Lindsay and Harlow, 1921).

Besides the traditional hosts some other hosts for cultivation of lac in Madhya Pradesh have been listed in Table 7.3. The yield of lac is directly dependent on the selection of host tree with proper type of feeding ground. The insect needs to have succullent shoots as it cannot drive its sleder probasics through thick bark. Pruning becomes as essential part of activity in cultivation of lac. On the basis of experimental trials at the Indian Lac Research Institute, Ranchi, it has been found that the best results are obtained by pruning in February for raising the 'katki' crop and in April for raising the 'Baisaki' crop (mauritiana) in the case of the major Rangeeni hosts, ber (Zizyphus) and palas (B. monosperma). For kusum, pruning in the months of June-July and January-February are reported to be beneficial. In respect of the Baisaki

crop partial defoliation of Butea monosperma and partial pruning of Zizyphus mauritiana are said to improve the yield. However, for better results the operations have to be carried out in early October on Butea monosperma and in early January on Zizyphus mauritiana.

Lac sticks having mature female insects ready to give rise to the next generation are called brood lac. A female is capable of giving rise to a large number of larvae and, to get the maximum benefit, it is essential that the brood should be cut at the proper time so as to secure the emergence of the maximum possible number of larvae from it (Anon., 1972).

7.3 Lac Cultivation

Lac cultivation should be done in a planned way. It has to be rotational so that the host plants get sufficient rest. Excessive lopping and pruning may ultimately result into the death of trees. Proper methods of producing and infecting the trees have to be adopted so that apart from yield in sustained basis there is no damage to the trees. The operations for systematic cultivation of the two crop viz., Rangeeni and Kusmi are given in the subsequent paras.

7.4 Collection and Storage of Sticklac

Lac is collected in two forms, Ari and Phunki. In the former case it is cut from the host plant and in the latter case it is generally collected from the brood lac after it has been used for infection. The lac may then be sold as it is, or freed from the sticks and then sold in that form. In the case of Kusumi lac, the usual practice in some parts of the State is to sell the lac with the sticks before it is taken to the market. Once the lac has been removed from the sticks while in other the lac is removed from the sticks before it is taken to the market. Once the lac has been removed from the sticks, it is commercially known as sticklac.

After collection the next process is the drying of the sticklac. The sticklac is spread in the shade in layers about 15 cm thick and turned over about once or twice a week till it becomes dry. The sticklac contains the lac encrustations as well as the bodies of the lac insects and some of the predators. If left in a heap or in bags, fermentation takes place and heat is generated. This, with the pressure from the top layers, causes the sticklac to form into lumps. In order to avoid lump formation, frequent turning is very essential.

After drying sticklac is carefully winnowed to free it from foreign matter like bits of wood, sand etc. It can then be stored for sometime before it is further processed. Too long a storage, particularly in a hot climate, affects its physical and chemical properties adversely, rapidly becomes polymerised and deteriorates after 3-4 years of storage it is almost ruined for industrial uses. It is usually the practice to keep sticklac from different species of host plants separately.

7.3.1 Rangeeni Crop : The host trees should be enumerated and the area divided into three coupes a, b, c, their sizes in the proportion 3:1:3 on the basis of their lac yield. This is done to ensure that an adequate supply of brood lac is maintained within the area for the coupes. A and C are rested is alternate years. Coupes is cultivated for one crop only each year and lies fallow during the rest of the year. The lac larvae get six month old shoots for feeding in the coupes A and C and four month old shoots in coupe B. Schematic description of operations to be carried out for cultivation of Rangeeni crop are given in Table 7.4.

7.5 Production Potential

Although, scientific assessment of production potential of lac in Madhya Pradesh has not been done actual figures on collection in earlier times and conservancy wise are given in Table 7.2 and 7.3.

Table 7.4: Suggested schedule for seasonal operations for cultivation of Rangeeni Crop

Nature of Operation	Coupe No.		
	A	B	C
Pruning	April, 1990	February, 90	-
Infection	October-November 1990	June-July, 90	-
Harvesting	June-July 1990	Oct.-Nov. 90	-
Pruning	-	February, 90	April 91
Infection	-	June-July, 90	Oct.-Nov.,90
Harvesting	-	Oct.-Nov., 91	June-July, 92

From these tabulated statements it would be seen that the production has been more or less stable. One reason for this state of affair appears to be uncertainity about export. Demand of lac in overseas markets have been fluctuating to a great extent. Another factor may be that the current production is the outcome of natural availability of lac on host plants. Scientific and planned inoculation by any agency has seldom been done probably again due to uncertain markets. However, in view of its importance to the small farmer and landless labourers it could become good source of income provided the inoculation is properly done.

Table 7.2: Average annual production of stick lac in Madhya Pradesh

Year	Average Production in quintal	Per cent to total country's production
1951-60	13,019	31.4
1961-66	6,818	22.7
1966-71	6,099	20.6

Among various places in the State, Durg and Kanker Forest Conservancies accounted for maximum output of lac. Once this activity is recognised as an important ingredient of rural development and after the market intelligence have been properly collected production could be increased manifold.

Table 7.3: Production of lac in Madhya Pradesh

Forest Conservancy	1981-82	1982-83	1983-84	Average Annual Production
Balaghat	36.00	387.00	411.00	278
Chhindwara	127.00	156.00	-	142
Raipur	1780.00	-	-	1780
Kanker	2914.16	4800.00	-	3857
Seoni	-	86.00	251.00	169
Surguja	-	30.00	-	30
Durg	7141.50	10067.00	10325.55	9178
Sagar	48.00	26.00	32.00	35

7.3.2 Kusumi Crop : In the kusum crop eighteen month old shoots provide the most suitable feeding material for the lac larvae and that harvesting serves the purpose of pruning too. The best procedure is to cultivate one crop in two years, thus giving the host tree eighteen months rest in between successive crops. To get yield in a systematic way the area is divided into four equi-productive coupes. For the cultivation of this crop also the suggested schedule of operations is given in Table 7.5.

Table 7.5: Suggested schedule for seasonal operation for cultivation of kusum crop

Nature of Operation	Coupe No.			
	A	B	C	D
Pruning	Jan.-Feb.,90	June-July 90	Jan-Feb 91	June-July 91
Infection	June-July 91	Jan-Feb 92	June-July 92	Jan-Feb 93
Harvesting	Jan-Feb 92	June-July 92	Jan-Feb 93	June-July 93

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CHAPTER VIII

TASAR

Introduction

India produces all the four known kinds of silk, viz., mulberry, tasar, eri and muga. The demand for silk fabrics is on the increase. Sericulture is a very labour intensive operation. Silk is obtained from the cocoons of Silkworms. Its production has four components a) cultivation of host plants of silkworms, b) rearing silkworm upto cocoon stage, c) reeling of cocoons into continuous filaments called raw silk and d) silk throwing and weaving by which filaments are twisted and woven into fabrics (NCA, 1976).

The earlier important silk producing countries were France and Italy. But now China and India occupy an enviable position in the production of natural silk. Ten per cent of the world's tassar production is produced by India and the rest from China (NCA, 1976). Mulberry and tasar are the most important silk accounting for 78.4 and 11.9 per cent of the total production of natural silk. Of the total production of Tasar, Bihar and Madhya Pradesh account for 43.8 and 49.2 per cent, respectively. Silkworms feed on a wide variety of trees. Tasar worm Antheraca sp. unlike other silkworms is not domesticated. The species on which it feeds are arjun (Terminalia arjuna), Sal (Shorea robusta), Saj (Terminalia tomentosa, Lendia (Lagerstroemia parviflora), Jamun (Eugenia jambolana) and many other species.

Tasar rearing is practised in eastern and south-eastern Tribal part of the State. Bastar, Bilaspur, Raigarh, Surguja, Balaghat and Mandla are the prominent areas. Raisen, Sidhi, Narsinghpur, Seoni, Chhindwara districts too have made a beginning in this cottage industry as Directorate of Sericulture has established mulberry farms and other infrastructure in this districts.

Tasar rearing has been practised by tribals for a long time. The season for tasar rearing activity is between August and December. A crop beyond this period is not taken, because after this there is deterioration in the size of cocoon and quality of the fibre, but such cocoons, if collected at all, are collected wild during leaf-fall (i.e. towards March).

8.2 Production Estimates

Central Silk board has estimated the Tassar to raw silk production in the country (Table 8.1). According to the estimates, production was likely to increase manifold between 1979-80 to 1999-2000 A.D. Efforts in this direction have already been initiated. Sericulture Directorates have been opened in most of the States for raising the production through their networks being established in each districts.

Table 8.1: Estimated Tassar to raw silk production

	Tassar	Other Silks
1979-80	650 (13.5)	4,825 (86.5)
1984-85	975 (13.7)	7,130 (86.3)
1989-90	1300 (12.6)	10,335 (87.4)
1994-95	1625 (12.0)	13,570 (88.0)
1999-2000	1930 (11.5)	16,920 (88.5)

Madhya Pradesh is essentially a consumer of cocoons as important weaving centres are located in the districts of Bilaspur, Raigarh and Bastar. The weavers in the State purchase cocoons and convert these into raw silk.

The State has opened 12 Tassar Seed Centres to help tribals collect healthy seeds. The rising demand for these has made the Central Silk Board Tassar Demonstration Project. The schemes started in 1977-78. Under every 8 units opened by the State, one unit is of Central Silk board which produces healthy seed for meeting the requirements of these units. In the State there are 69 Tassar Demonstration Project Centres and each supplies to around 1000 tribals for sericulture free of charge.

8.3 Research Work

Research work on tassar is done at the Central Tassar Research Station, Ranchi. There are heavy losses of Tassar worm in the open from mortality due to unfavourable weather, diseases, parasites and predetors. A rearer, therefore, hardly gets an effective yield of 10-20 per cent. Investigations at Ranchi showed that about 30 per cent loss occurs only during the first larval instar. The loss goes on decreasing subsequently with the advance of age when larval develop capacity of self protection and proper grip. As the tassar worm likes natural conditions for growth, it was considered that it would in itself be a significant achievement if protective rearing could be done in the initial stage. Persistent efforts of the Tassar Research Station have established the possibility of controlled rearing of newly hatched worms during the first 10 days or so and this results in an increase of about 40 per cent of cocoon yield over the traditional methods of complete outdoor rearing (NCA, 1976).

8.4 Arjun Plantations for Rearing Silkworms

Terminalia arjuna trees can also be grown on alkaline wastelands. The trees are planted fairly close together at a distance of 1mX1m or 2mX2m so that in the 3rd or 4th year of their planting the branches of one tree meets the branch of another. The tassar producing larval are introduced on the young shoots sometime

at the end of September and after about 45 days tassar cocoons are ready. It is also possible to harvest 2 crops of cocoons in a year. During this period, labour is required to deive away the various predators which damage the caterpillars. The cocoons are produced on the trees themselves and have to be collected manually. All this requires employment of manual labour. It has been calculated roughly one family can sustain itself on about a hectare of Arjun plantation (Tiwari, 1983).

8.4.1 Employment Potential : Govil (1985) estimated the potential production and employment on an annual basis on one hectare of Arjun plantation (Table 8.2).

Table 8.2: Annual Production and Employment Potential (per ha)

S.No.	Item	Unit	Age of plantations			
			3	5	7	10
1.	Cocoon	Kahan	31	39	47	59
2.	Yarn	Kg	47	59	71	89
3.	Cloth	Metre	345	433	521	653
4.	Labour		1	1	2	2
	a) rearing	man year	1	1	2	2
	b) reeling	- " -	2	2.2	2.8	3.6
	c) weaving	- " -	0.4	0.5	0.6	0.7
	Total labour		**3.4**	**3.7**	**5.4**	**6.3**

8.5 Extension Activities in Madhya Pradesh

Directorate of Sericulture has established a number of centres in 12 districts of the State (Table 8.3). More such centres are being planned in different parts of the State.

Table 8.3: Prominent Silk rearing centres in Madhya Pradesh

S.No.	District	Centre Names	Production Centre
1.	Bastar	Minakpali, Kotapali, Modakpal, Barsur, Sukma, Chaparbhanpur Chapka, Narainpur, Biragaon, Charai, Parsanda, Awapali	Bhopalpatnam, Nemak
2.	Bilaspur	Pali, Bijna, Tuman, Tiwarta, Korbi, Kartala, Kudmura, Parsai	Katghora, Korba, Barpali
3.	Rajgarh	Katankiiya, Nati, Bari, Kudamkela, Sidhibahar, Kunkuri, Kasavel, Kanak-vira, Dongripali	Chal, Barghora, Lalunga, Baramkela
4.	Sarguja	Argani, Basen, Tatapani, Premangagar, Kelhari, Kalaspuri	Ambikapur, Udaipur
5.	Mandla	Arari, Madhpuri, Sijora, Tendai, Bahara	-
6.	Balaghat	Paraswara, Damua	-
7.	Raisen	Neemkhera	-
8.	Narsinghpur	Tendukhera, Jhoteshwar	-
9.	Seoni	Khewalari	-
10.	Sidhi	Siriki	-
11.	Chhindwara	Sirpa	-
12.	Jhabua	Kodli	-

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CHAPTER IX

GUMS AND RESINS

Introduction

It is not easy to draw distinction between gums, gum-resins, resins and oleo resins, as the products designated by these names commercially do not react chemically in the same manner (Trotter, 1925). Gums are translucent amorphous substances which are degradation products of the cell walls of woody species and which exude spontaneously from the trees. Exudation is accelerated by injuries made in the bark, and this is made use by gum collectors.

Gum, is generally a substance of more or less sticky nature or one which was at one time of a sticky or plastic consistency. Gums are soluble in water and resins are soluble in alcohol but not in water (Anon., 1972).

Gum-resins are essentially a mixture of gum and resin, formed naturally in the woodcells, by the degradation of the cell wall and the drying up of the plant juices.

Resins often occur mixed in essential oil and are known as oleo-resins. When oleo-resins include some gum also, as in the case of the exudation from Boswellia serrata (Salai) they are called gum oleo-resins (Anon., 1972).

Some plants yield only gum, some others only resins, and yet other both gum and resin. Thus gums are a group of plant products related to sugars and carbohydrates, and consist of polysaccharides or their derivatives. True gums are formed as a result of disintegration of internal plant tissue through a process known as gummosis.

Many forest trees yield gums of commercial importance, gum karaya (Sterculia urens), gum ghatti (Anogeisus latifolia), gum arabic (Acacia senegal or A. arabica). Other gums of local importance are semla gums (Bauhinia retusa), siris gum (Albizzia lebbek), Bengal Kino (Butea monosperma), Malabak Kino (Pterocarpus marsupium) and katera gum (Cochlospermum relegiosum).

Gums find use in a variety of industries like food, pharmaceutical, textile, paper, dyeing and adhesives. In pharmaceutical industry the gums find use due to their emulsifying and stabilising properties and also as suspending agents. Paper industry uses the gums as beater additives. Gums are also used in cosmetics, paints, ceramic and ink making industries (Tiwari, 1981).

So far there is no definite or uniform method of tapping. The method used is such that the regular supply of gum is assured without causing serious damage to the trees. The gums ooze out from the stem in liquid form and dry up into translucent and amorphous tear shaped bodies or flakes on exposure to the atmosphere. The method of tapping followed is quite crude and large scale damage to trees of Sterculia urens have been reported on account of general forest degradation brought about by fire, grazing, cutting etc. The natural regeneration of this important species is also not coming. The trees which have been subjected to irregular tapping have been deformed and need complete rest. Concerned by the drying and disappearance of this majestic tree, the State Government imposed complete ban on tapping of Kullu tree.

The commercial gums enter the market in the form of dry exudations. They are used in a variety of ways in the industry. The varieties having the least colour and highest adhesive power and viscosity are the most valuable. The finer grades are utilised in clarification of liquors, 'finishings' of silk and preparation of quality water colours. Intermediate grades are used in confectionary, pharmaceuticals and printing inks, in sizing and finishing textile fabrics, and in dyeing. The cheaper grades are put to many uses such as adhesives, calico printing, and sizing of paper, and also find use in the paint industry.

The gum collected from the forests contain 15 to 20 per cent moisture. The big lamps are broken into small pieces of 1 to 2 cms size.

9.2 Commercially Important Gums

9.2.1 Gum Karaya (Sterculia urens): This is a common tree found in the tropical deciduous forests, mostly in dry and rocky areas. The gum derived is known as gum karaya, kullu

or katira gum. It is abundantly found in the state contributing to about 50 per cent of the gum production. Regular tapping for obtaining gum has been reported to have started in 1930.

The gums exudes from the tree all the year round the flow is more in hot weather. Tapping is done between October to June. Trees of and above 0.9 m or 90 cm in girth at breast height are tapped. Trees of lower girth are not tapped. Middle aged trees yield more gum. The yield per tree per season varies considerably depending upon many factors. Yield of one kg per tree per season has been reported. The Indian Standard Institution has graded gum and has specified gums into three grades, Grade I (White to amber), Grade II (Reddish pale yellow) and Grade III (Brown to black). The average annual collection in the State was around 11,000 quintals till 1977-78. The state has potential of producing 2,000 tonnes annually. Table 9.1 gives the figure of collection of different types of gums in the State in the past 5 years (Maithani, 1990).

Table 9.1: Collection of gums in Madhya Pradesh

	Collection in '000 q
Year	**Collection**
1985-86	12.688
1986-87	14.017
1987-88	15.820
1988-89	17.451
1989-90	10.334

Source : Maithani, G.P. (1990)

Irregular and unscientific tapping in the past has damaged the trees. If further tapping was allowed the tree might have been destroyed. Trees were drying and it was suspected that if the tapping is continued further this tree may disappear

altogether. Although, officially the collection of Kullu gum is banned there are stray reports of surreptitious tapping in some part of the State. Apart from economic importance of gum, Sterculia urens is a magnificant tree of dry deciduous forests, mostly occurring on drier slopes, hills and other denuded sites where other species do not comeup. Very few plantation of this species are known to have been raised in the State. These plantations are on very small scale, done mostly on experimental basis. The efforts to plant this tree species need to be takenup on large scale.

A number of natural spots in dry teak forests have good concentration of Sterculia urens trees. One such spot is in Raisen Division on all slopes of Raisen Fort. This area has good natural regeneration which needs to be protected. Another spot in Narsinghpur Division in Tendukhera Range has also been seen. Natural teak forests of Sidhi (Chhuiya ghat) has also a large number of this tree of all age classes. This tree species is also found gregarious in some parts of Sagar, Chhatarpur, Seoni etc. where strict protection measures can ensure good stand of this species.

9.2.2 Ghatti Gum (Anogeissus latifolia): This is a large tree found occurring widely throughout the State. It is the source of 'ghatti' gum. The tree is conspicious by the colour of the leaves which turn red in the autumn season.

The tears are round, opaque externally and transparent internally, and almost free from cracks. The colour varies from whitish yellow to amber. It is sometimes brown due to impurities. This gum is said to be superior to babul gum in colour (Anon., 1972).

So far no systematic method of tapping is done. The present method of tapping consists of making incision on the trees. The gum oozes out of the tree in round or vermicular tears. It is picked up when they dry up. The average

annual production was around 5,000 quintals. The state has a large potential. This gum is widely used in pharmaceutical, paint industries and calico printing etc.

9.2.3 Acacia nilotica (Babul): The tree is widely distributed throughout the State. The babul gum is of commercial importance in the internal trade.

The gum exudes spontaneously, mostly during the months of March to May, and hardens into rounded or ovoid tears about a centimetre long and varying from a pale straw colour to a dark reddish-brown or almost black. It is believed that tapping accelerates the flow, but this is not often practised. The average yield per tree is only about a hundred grams, though some trees yield upto a maximum of a kilogram per annum (Anon., 1972).

9.2.4 Pterocarpus marsupium (Bija Sal): This is a large tree widely distributed in the State. It is the source of an important red coloured astringent gum which exudes from the bark. It is an important medicine in cases of diarrhoea and dysentry (Anon., 1972).

Trees over 1.8 m girth are usually tapped. A single tree may yield as much as 1.4 kilogram of liquid gum or 0.45 kg of dry gum. The tree may be tapped on alternate sides once in five years without damage.

9.3 Resins

Resins occur in the pure and mixed states with oils, gums, etc. They can be classified into : (a) hard, (b) oily and (c) gum types. The first category includes 'dammer' resins obtained from trees belonging to Dipterocarpaceae and Buseracea families, and are commercially important. Within this group, sal resin is considered to be the most important (Gupta and Guleria, 1982). Due to the damages tapping can give to the health of Sal tree tapping is not allowed. However, looking to the vast area the sal forests occupy in the State, naturally oozing resins if allowed to be

collected, it may generate employment for rural poor and at the same time provide good revenue to the State.

9.3.1 Boswellia serrata (Salai): This tree is found in dry deciduous forests, being common in dry hills throughout the State. On tapping this tree exudes a gum-oleo-resin known commercially as 'salai gum', gugul or Indian olibanum. It is an important associate of Teak and Sterculia ureas (Anon., 1972).

The fresh exudation from the punctured resin ducts comes in 5-8 cm long tears. It hardens slowly in about 4 days, retaining its golden colour and transparency. Tapping period extends from November to June or July. The average annual yield of gum for some trees is about I kg per tree, while some others do not yield any gum. Tapping does no injury to the tree and the method of tapping influences the yield. It must however be remembered that general degradation of the natural forests has considerably influenced the natural regeneration of this tree. Salai being localised to hillsides, dry slopes and other refractory sites is considered as an outcome of 'ecological residue' and as such it is difficult to regenerate the species artificially. Excessive exploitation of this species thus may not be desirable.

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CHAPTER X

EDIBLE PRODUCTS

Introduction

Natural Forests supplement the food supplies for human beings, particularly the tribals. Several forest fruits and seeds, flowers, rhizome, tubers or roots and barks, honey and wax etc. are consumed by people not only during periods of food scarcity and famines but also in normal times. A number of tree species provide such edible products. A number of forestry species have been listed (Anon., 1972) but no details regarding the quantitive availability of these products is documented. Some estimates were made in respect of annual yield of Mahuwa flower (Madhuca latifolia) for the entire country. However, in the absence of any acceptable basis, this could also be treated as a guestimate. For other species yielding nutritious products like Annona squamosa, Buchnania lanzan, honey and wax, various tubers and roots, very little information is available.

These products are very important in context of Madhya Pradesh where every fifth person is tribal. These edible products come handy to the tribals and other forest dwellers as they sustain them during the period of food scarcity. Some of these products, apart from being a source of food also provide good nourishment as they are rich in protein, sugar, starch, vitamins, minerals etc. Some edible products are highly priced for their delicacies, medicinal values and industrial uses. As such these are in great demand in the urban centres also. Increase in demand in the urban areas have had retrogressive effects on the very survival of tree species yielding the edible products. In order to get maximum yield and to avoid hard labour in gathering these products from forests, these trees are being mercilessly felled.

In the present section an attempt has been made to assess the potential of these edible products from available records. The collection and revenue figures from these products are gross underestimates as unrecorded removal of these products for bonafide consumption is not

reflected in these figures. However, these figures provide indicative trends and open the possibilities of organising collection and marketing of these products for the benefit of local people. This may also help in arresting the process of forest degradation being brought about by unthoughtful cutting of tree species yielding these products.

10.1 Chironji (Buchanania lanzan)

Buchanania lanzan commonly known as Chironji, Achaar or Chaar is an important tree species, frequently found in mixed dry deciduous forests of Madhya Pradesh. A medium sized tree, attaining a height of over 15 m and a girth of 120 cm almost evergreen and leafless only for a short time (CSIR, 1948). The tree is a moderate light demander.

Buchanania lanzan flowers from January to March and the fruits ripen from April to June. The fruit is an ovoid drupe about 0.5 inch long, black when ripe, with a hard two valved stone 0.35 to 0.4 inch in diameter enclosing an oilseed. (Troup, 1986). The seeds fall before or at the commencement of rainy season (June-July).

The tree has economic importance for the edible fruits it yields. The fruit is eaten by the local people and kernels are extracted and dried for sale in the market. It is the Kernel which is rated as delicacy and is therefore highly priced. The Kernels have a flavour something between that of pistachio and almond, and are eaten raw or roasted. They are commonly used in sweet preparations.

In the State it is principally reported from two different types of forest zones of the State. The first comprise of the Sal region represented by districts of Jagdalpur, Raipur, Kanker, Shahdol and Surguja. The other tracts are comparatively drier represented by Forest Divisions in the districts of Sagar, Chhindwara and Seoni with predominantly Teak and mixed miscellaneous forests in patches. In the latter category, Sagar district shows maximum collection followed

by Seoni and Chhindwara, the other two adjoining districts. In the first category Shahdol, district showed maximum collection of Chironji, followed by Bilaspur and Kanker Forest Divisions.

The production figures based on the available records in various Forest Offices have been presented in Table 10.1 The revenue figures given in column (4) and (5) per quintal rate in Col. (6) reveal great variation. A lowest rate of Rs.19.00 per quintal in Sagar to unbelieveable and unrealistic figure of Rs.1,830 per quintal in Jabalpur confirm that the removal shown in Forest Office records are either gross underestimates of productive potential or the upset price fixed for sale of this important produce is faulty. It is a general practice to auction the entire Forest Division or Range in respect of a certain minor forest produce. There are no sincere efforts made in assessing the production potential of the produce and as a result economic importance of these minor forest produce is ignored. The Govt. price fixed for sale is determined by the rate obtained in the preceeding years. The sale price for minor forest produce also does not take into account the prevailing market of the produce. Although it is universally accepted that many non-wood forest products are inappropriately called minor forest produce. In fact, these are of major economic and social importance. Foresters, however, give weightage only to timber and fuel and tend to ignore minor forest produce. As a result the correct assessment of the production potential and market value of minor forest produce is not available. These facts are well examplified by very wide variation in the rate of chironji (Table 10.1) obtained by sale in different Forest Circles of the State.

Plantations of this species have not been tried on large scale. The only plantation of this species has been raised

Table 10.1: Collection and Revenue from Buchanania lanzan in Madhya Pradesh

Circles	Collection Average	Per cent of State's Collection	Net Annual Revenue (in thousand Rs.)	Per cent Share	Revenue (Rs. per quintal)
1	2	3	4	5	6
Bilaspur	472.00	3.07	51.0	5.00	108.05
Chhindwara	922.00	6.00	402.7	59.50	436.00
Narsinghpur	150.00	0.97	76.7	7.45	506.66
Raipur	60.00	0.53	8.8	0.86	110.00
Sagar	8651.00	56.27	165.7	16.25	19.00
Jabalpur	65.00	0.43	119.8	11.75	1830.76
Shahdol	3252.00	21.15	117.1	11.48	35.00
Surguja	128.00	0.83	15.0	1.57	117.18
Seoni	1653.00	10.75	62.5	6.14	37.50
Total	15373.00	100.00	1019.3	100.00	-

by State Forest Research Institute, Jabalpur at Bilaspur on hard lateritic soil locally known as Bhata soil. This species is a slow growing. Flowering and fruiting starts after 8-10 years of planting. Application of phosphatic fertilizers and trace elements (Tracel-I) at the rate of 500 g and 100 g per tree (10-years old plantation) gave an average yield of 3 kg per tree. More plantations of this species need to be raised. Collection of fruit and edible seeds provide jobs to rural poor during June-July when the tribals are in search of work and food.

10.2 Aonla (Emblica officinalis)

A small or medium sized deciduous tree with smooth greenish grey, exfoliating bark. Emblica officinalis is found wild or cultivated throughout the greater part of the State. Leaves are feathery with small narrowly oblong, pinnately arranged leaflets. The tree is common to the mixed deciduous forests.

The fruit is green when tender changing to light yellow or brick red colour when mature. It is sour and has medicinal value. However the fruit is better known for pickles, preserves and jellies.

Table 10.2: Average yearly collection and Revenue from Emblica officinalis in M.P. (1981-86)

(in quintals)

Circle	Average Yearly collection (q)	Per cent of Collection	Revenue (in yearly average)	Per cent share	Revenue (per quintal Rs.)
Shahdol	2992	14.5	20.6	10.7	6.90
Raipur	1463	7.1	21.4	11.42	14.70
Rewa	2382	11.6	11.4	5.9	4.80
Kanker	2652	13.0	12.6	6.5	4.75
Jagdalpur	1075	5.2	2.4	21.2	2.25
Surguja	4366	21.1	65.0	34.8	8.00
Gwalior	4415	22.0	51.7	26.7	6.00
Jabalpur	576	2.7	1.2	0.6	2.10
Durg	580	2.8	2.4	1.2	4.15
Total/Av.	**20501**	**100.00**	**188.7**	**100.00**	**9.20**

The average annual collection in the State is assessed at 20,500 quintals. Surguja and Gwalior Forest Conservancies account for about 43 per cent of the total collection and 60 per cent of the revenue realised. The revenue earned varies from a low Rs.2/- to Rs.14/- per quintal of Aonla fruit. It has to be seen that the prevailing collection rate varies from Rs.30-50 per quintal in different collection centres. It is as much as Rs.75/- per quintal in Panna where Aonla of very good quality (big sized fruits) are found. Selling rate of fresh Aonla fruit also varies to a great extent. While selling rate in the market places in Madhya Pradesh varies from Rs.3-5 per kg (Rs.300-500 per quintal), in Delhi and Kanpur where bulk of the Aonla produced in Northern Madhya Pradesh is taken fetches upto Rs.1,000/- quintal. On account of various preparations made from fresh Aonla, it is a valued fruit. It is also being collected for being used in the preparation of Ayurvedic tonics and medicines. According to the interviews conducted in Aonla producing area about half of the total collection is sent for 'Ayurvedic' preparation. However, despite the fact that Aonla is a very valuable fruit, the State Forest Department is not getting the full royality.

A survey carried out in Damoh Division (Tendukhera Range) (Bhatnagar and Bhausar, 1988) revealed that average collection of Aonla per labour day is 50 kg. Taking the current collection of 20,500 quintals, the annual employment generated in collection activity alone is 41 thousand person days.

There is no information available on yearly production of Aonla per tree from natural forests and in the plantation. The yield would depend upon factors such as health and size of tree, size of fruit, periodicity and several other factors.

In order to assess the fruit production from 'Aonla' seed orchard raised in the campus of State Forest Research Institute, Jabalpur in 1978 gave following production figure (Table 10.3.).

Table 10.3: Aonla Production per Tree

Year	No. of Trees fruitful	No. of fruit	Total weight	Weight Kg per tree
1987	30	1540	16.625	0.554
1988	28	1390	14.500	0.518
1989	24	252	3.095	0.141
1990	34	6812	115.957	3.4105

These plantations are comparatively young (10-12 years old). In the natural forests of Panna which is famous for better quality (bigger in size) fruits, well grown trees of 20-25 years age yield an average 22.68 kg per tree. In plantations and seed orchards the yield can be increased by the application of irrigation, fertilizer and trace-elements.

10.3 Mahua Flowers

There are two species of Mahua i.e. Madhuca indica or latifolia and M. longifolia. These two species are closely related and though they are botanically distinct, the trade does not make any distinction between them. Both are valued for their flowers and fruits. Mahua grows wild in forests

as well as in cultivated areas. It is also planted on roadside in a certain parts of the country and nowadays it is preferred for social forestry plantations. Mahua trees are found throughout the State. However, Mahua trees are less common in drier parts of northern Madhya Pradesh.

It is a large deciduous and evergreen or semi-evergreen tree and bears fruit from end of February to April. The fruit ripens during June to August and falls to the ground by itself. It starts giving flowers and fruits between 10th to 15th year after their planting. Mahua raised by seed dibbling in 1948 over an area of about 1.5 hectare near Amla forest village in south Chhindwara was observed to commence flowering after 20 years (Chitwadgi, 1968; Prasad 1986). The fleshy, cream coloured corollas of its flowers are eaten raw or cooked, by the poor people. When fresh, the flowers are extremely sweet with a peculiar pungent flavour and a characteristic odour. When fermented and distilled flowers yield a spirituous liquor which is also known as 'country beer'.

Mahua flowers are a rich source of sugar, vitamins and calcium and thus, offer wholesome nourishment when boiled with rice. Most of the tribals near the forest areas also distill the Mahua flower for liquor. It makes a very patent drink and efforts are being made to refine it in modern distilleries.

Efforts are also being made to encourage the consumption of the Mahua flower in its processed form in urban areas. The Foodcraft Institute, Ahmedabad is reported to have tried preparation of jams and jellies from Mahua flowers. These products are currently reported to be lacking in transparency and, thus, call for further research. There are many institutions engaged in developing processes to encourage the increased consumption of Mahua flowers. These efforts are desirable particularly because the Mahua tree can grow on the most barren ground frequented by long and severe droughts. The tree with its useful flowers and multipurpose

fruits can be a great relief to the poor people when an unusual dry spell can destroy most other crops. In rural areas of the State, tribals and other forest dwellers depend so much on Mahua flower in the days of scarcity that they purchase it from local traders selling out a substantial part of their hard earned wages. Bartering wheat for Mahua salt and kerosene oil are very common in some tribal areas of the State. It should, therefore, be ensured that the efforts towards the commercial exploitation of Mahua do not lead to a situation where the residents in and near forests find themselves deprived of a relatively cheap, nutritious and natural food source.

According to an estimate made by FRI, DehraDun a Mahua tree yields about one quintal of flowers annually. According to this estimate about 25,000 tonnes of the flowers are gathered in India every year. However, in an experimental trial conducted by State Forest Research Institute average yield per tree varies from 11.433 kg to 76.799 kg/tree depending upon the size of the tree. The data on actual collection of flowers from Mahua trees of different dimensions have been summarised in Table 10.4.

Table 10.4: Yearly average Mahua collection from trees of different size

Year	Tree Size - No. of Trees	Quantity of flowers collected from different sized tree in Kilogram				
		61-90 (3)	91-120 (5)	121-150 (6)	151-180 (6)	Over 180 (5)
1987		9.666	24.300	23.666	48.666	59.50
1988		15.283	54.990	33.766	96.980	107.150
1989		14.300	30.125	33.733	52.858	58.530
1990		6.875	33.102	11.630	21.095	75.948
Mean		**11.433**	**35.480**	**26.311**	**53.070**	**76.799**

The present campus of State Forest Research Institute, Jabalpur occupies an area of about 95 hectare. It was acquired in 1970. It had a status of revenue wastelands. The area has been given good protection in the past about 20 years. There are in all about 257 trees in 95 ha area. In other words it comes to 270 per sq km. There are varying estimates of total number of Mahua trees per sq km. According to the report of pre-investment survey of Forest Resources a total of 6,724,057 trees were calculated over an area of 19,425 sq km. This gives a figure of 346 trees per sq km.

Assessment of tree population by Awasthy (1971) was made for Dandkarnya Project as 212 trees per sq km. Thus, the asessment varies from 212 trees in southern Madhya Pradesh to 346 in central zone and 270 in small area of SFRI, Jabalpur which was originally of revenue wastelands.

10.5 Other Edible Products

Although there are innumerable edible products available from forests the most important areas have already been described. However, there are a few more products which deserve mention. Tamarind (Tamarindus indica), Sitaphal (Annona squamosa) and Bael Phal (Fruits of Aegle marmalos) are also important products which are collected from natural forests. These products are localised. For example Tamarind is extensively found in southern and eastern parts, Sitaphal in central and eastern parts and Bael phal in dry deciduous forests every where in the State. Annual average collection of these produce have been summarised in Table 10.5. These figures have been compiled from the extraction figures shown by petty contractors. These are not based on any scientific study and therefore the figures given in Table 10.5 could at the best be taken as rough estimates.

A number of other forest produce extracted from forests (Anon., 1972) are tabulated in Table 10.6. By scientific survey their collection could be streamlined. Apart from revenue to the Forest Department, by organising cooperative marketing or support price system, these produce can generate rural employment to substantial population.

Table 10.5: Other edible products

(in quintals)

Species	1981-82	1982-83	1983-84	1984-85	Average
Tamarind	18700	191560	100680	122560	108375
Sitaphal	8296	8257	4000	9300	7463
Baelphal	195	137	24	39	99

Presuming that Mahua trees are uniformly distributed in the natural forests of Madhya Pradesh, taking a conservative figure of 200 trees per sq km there may be about 3.11 million trees in 155,414 sq km natural forests of the State. There are over, 71,000 established villages in the State. This may be multiplied by a modest figure of 24 trees in each village presuming that in past about two and a half decades due to degradation, hacking, lopping, about 270 trees as are available in SFRI, Jabalpur, the number might have disappeared at the rate of 10 per cent of trees each year. Thus a figure of 24 trees per village as in 1990 may be taken. The total tree population thus works out to about 1700,000 trees. This way the total tree population in natural forests, roadside and revenue areas (villages) comes to 48 lakhs or so. On the basis of the collection figures compiled by State Forest Research Institute an average tree (middle-aged) should yield about 30 kg per tree. Thus, 48 lakh trees are capable of yielding 144,000 tonnes of fresh mahua flower. In terms of air-dried flowers the State has a production potential of 43,200 tonnes of Mahua flower taking a driage figure of about 70 per cent. Taking the prevailing current price of Rs.2,000 per tonne, the market value of produce is Rs.86 million. However, the entire produce is not sold as a substantial portion is utilized by tribals to supplement their food requirements. Taking an average collection of 3 kg of air-dried mahua flower per day, the employment generated would be 14.40 million person days.

Table 10.6: Edible species occurring in Madhya Pradesh

S.No.	Species	Local Name	Uses
1.	Aegle marmelos	Beal	Medicinal value
2.	Artocarpus lakoocha	Lakooch	Edible fruit
3.	Coix lachryma-jobi	Adlay (grass)	Edible seeds
4.	Dioscorea oppositifolia	Baichandi	Edible; Protein rich; Medicinal
5.	Diospyros melanoxylon	Tendu	Fruits edible
6.	Ficus glomerata	Gular	Fruits edible
7.	Mangifera indica	Mango	Edible fruits
8.	Phoenix acaulis	Khajur	Edible fruits
9.	Semecarpus anacardium	Marking nut	Marking nut, Medicinal & edible fruits
10.	Syzygium cuminii	Jamun	Edible fruits
11.	Ziziphus mauritiana	Ber	Edible fruits

There is need to encourage plantation of Mahua tree on wastelands and as a component of farm forestry. In view of the fact that the tree is fast disappearing from natural forests, the Government has banned all fellings of Mahua tree in the normal silvicultural operations. Efforts need to be made to conserve existing Mahua trees as they are very important in the tribal economy of the State.

10.6 Honey and Wax

Honey is a sweet, viscid liquid elaborated by honey bees (Apis sp.) from the nectar collected by them from flowers. The honey is stored in the cells of the honey-comb and later used by bees as food (Anon., 1957). It is a nutritious food and natural sugar.

Honey is composed of moisture (20-25%), dextrose (30-35%), sucrose (35-50%) and minerals (0.1 to 2.5%) (Peerzade, 1979). Besides honey forms a natural nutritious food for the rural people. It is also used for medicinal purposes.

There are two types of honey. The first type is known as natural or rock bee honey. It occurs naturally in forests

Table 10.7: Production of Honey in Madhya Pradesh

(in quintals)

Circles	Average Yearly Production	Per cent to Total
Balaghat	3.5	0.65
Chhindwara	2.0	0.37
Indore	270.0	50.05
Jagdalpur	31.0	5.75
Kanker	16.0	2.96
Rewa	100.00	18.54
Raipur	82.00	15.20
Sagar	5.00	1.92
Shahdol	30.00	5.56
Total	**539.5**	**100.00**

and a single hive can yield upto 35 kg of honey, and 1 kg of wax. Although this category of honey is considered inferior in quality and medicinal value but for tribals it is an important food item. The second type of honey is cultured in apiaries by breeding of the Indian bee.

The average yearly production of honey in natural forests is given in Table 10.7. Average yearly production of 539.5 quintals has been recorded in different circles. Indore, Rewa and Raipur alone account for 73 per cent of the total production. In the case of honey and wax also there is no precise estimate as the collection is done by petty contractors who take a Range or Division in the auction. Not realising the importance of such precious commodities, Foresters auction the produce based on the previous amount of bids. Since there is no scientific method for assessment of this forest produce and that only local purchasers/ contractors come forward to bid in the auction, there is little competition. As a result true price or royality is rarely realised.

Forest Department should sponsor such a study to assess the productivity by sampling method in different regions/forest types.

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CHAPTER XI

GRASSES

Introduction

Grasses are used for a variety of purposes other than grazing. There are several grass fibres used for matting, rope making, paper-pulp, etc. The most important is the Sabai grass also known as bhabar (Eulaliopsis binata). This is a perenial grass found extensively in the State.

In the State, Shahdol, Betul, Hoshangabad and Chhindwara reported collection of this grass from natural forests. Although the production figure from Balaghat is not available, forests of this district are known to possess natually growing Sabai grass. A different variety of this grass which is locally known as 'Mawa' grass is extensively found in Mandla district of Jabalpur Conservator's circle. 'Mawa' grass is also used for rope-making. Annual average production is about 2,000 quintals. Earlier Sabai grass formed an important raw material for the paper and pulp industry, but bamboo has now become an important raw material.

The extraction of this grass has been reported to be difficult and time consuming particularly because the grass grows in widely scattered patches (Gupta and Guleria, 1982). However, tribals and forest dwellers who go for collection of other MFP in the forests do collect some grasses for rope making during their leisure.

11.1 Vetiveria zizanioides

This grass yields long fibrous roots which are used throughout the State for making the Khus-Khus 'tatties' or aromatic scented mats which are hung during the hot season to keep cool. This grass is found in many areas of the State, mostly confined to water-logged patches. Although, no systematic survey has not been done about its occurrence and production potential it provides seasonal employment to artisans in Chhatisgarh, Bundelkhand and some other areas of Central Madhya Pradesh.

11.2 Sabai Grass (Eulaliopsis binata)

This is a perennial species found on the bare slopes and in forest blanks of the sub-Himalayan tracts, and in Bihar, Orissa, West Bengal, Madhya Pradesh and the Punjab. In recent years attempts have been made cultivate this species on a commercial scale in Uttar Pradesh, Bihar, Orissa and Madhya Pradesh. In Orissa, the economics of Sabai grass cultivation has been found superior to paddy. As a result many fields which were previously used for growing paddy are now being put under this grass.

In Madhya Pradesh, the bulk of the requirements of Sabai rope is for tying of cut bamboos (commercial and industrial) used to be imported from Orissa. Existing grass available in the natural forests have also been used for rope making used for the same purpose. The efforts are now on to propagate this grass on cattle proof trenches, in forest blanks and as underplanting in the afforested areas. According to a study carried out by M.P. Forest Development Corporation (Jesani, 1979) it was shown that the activities relating to the cultivation, harvesting and rope making generates an employment of 1,000 person days per year (Table 11.1). For a project envisaging planting over an area of 1625 hectares, an estimated 16,25,000 person days employment could be generated annually.

In order to get the maximum return from entire products, and to supplement the raw-material requirements by pulp and paper industry the following points need consideration:

(a) Achieve economy in transportation;

(b) Enable uniformity in packing the digesters, and

(c) Avoid rotting.

There is also the problem of fire hazards. There are genuine problems, but similar or other such problems could also be observed in the case of other raw materials. It is

therefore, important to study whether Sabai grass has a comparative cost disadvantage in relation to other raw materials.

Table 11.1: Employment Potential through Cultivation, Harvesting and Rope-making from Sabai Grass

S.No.	Name of Activities		Person days
A.	**Plantation (per hectare)**		
	(i)	Demarcation and marking	06
	(ii)	Clearance	03
	(iii)	Site Preparation, Soil Working etc.	200
	(iv)	Planting up	75
	(v)	Weedings (3) and Soil Working	150
	(vi)	Fire Protection	02
	(vii)	Building and Inspection Path	54
		Sub Total	**490**
		Or	**500**
B.	**Harvesting (per hectare) : Total Expected Yield 41 q/ha**		
	(i)	For 1 q	6 person days
	(ii)	For 41 q	246 person days
		Sub Total	**250**
C.	**Rope Making and Marketing**		
	(i)	On three shift basis 180 q a year by one machine	
		i.e. for 180 q	3 X 360 person days
		So far 1 q	6 person days
		For 41 q	246 or 250 days
		Sub Total	**250**

Total (A) + (B) + (C) = 1000

Cultivation, harvesting and rope making activities are labour intensive creating large number of skilled and semi-skilled jobs for the rural poor. This grass when planted on cattle proof trench, results into effective land utilization when planted in the forest blanks it provides soil cover against soil erosion. This is an important minor forest product being a short duration grass can be grown like agricultural crops.

11.2.1 Production Potential : Although no systematic survey about its availability in the natural forests is available there are varying estimates of its production potential in this State. According to a report of M.P. Forest Development Corporation (Jesani, 1979) about 15,000 quintals are estimated to be annually available in the forests of the State (Table 11.2).

Table 11.2: Occurrence of Sabai grass in the Natural Forests of Madhya Pradesh

S.No.	Districts	Approximate Potential (q)
1.	Balaghat	600
2.	Bastar	1600
3.	Bilaspur	1000
4.	Chhindwara	500
5.	Hoshangabad	200
6.	Khandwa	500
7.	Narsinghpur	5000-
8.	Raigarh	500
9.	Surguja	600
10.	Satna	500
11.	Other Districts	4000
	Total	**15000**

As against the anticipated annual production potential of about 15,000 quintals, the extraction of this gress has been less than 10 per cent (1213.864 q) of total potential. The annual extraction between 1980-81 to 1986-87 and the revenue realised therefrom is given in Table 11.3. An average annual collection of 1213.864 quintals and revenue of 20,719.40 realised. However, the figures from Balaghat are available for past 4 years (1987-88 to 1990-91). The production from this district has been showing gradual increase from 800 quintals in 1987-88 to 1500 quintals in 1990-91. This makes the recorded removal of about 3,000 q which is about 25 per cent of the estimated production in the State. This figure of production is very much on lower side. It appears that substantial quantity of grass extracted from the natural forests remained unrecorded.

11.3 Other Grasses used by Pulp and Paper Industries

Although, Sabai grass is well accepted by pulp and paper industry there are a number of other grass species which are suitable for paper making. The most important ones in this category are Arundo donax (nal), Cymbopogan citratus (West Indian lemon), C. flexuousus (lemon), C. winterliantus (Java citronella), Desmostachya bipanata (dab), Heteropogan contortus (Kusal), Imperata cydinadtica (Siru), Pennisetum hopesackeri (Mawai), Saccharum munja, Saccharum spontaneum (Kans), Themeda arundinacea (Ulla), T. cymbaria (Elephant grass), T. quadrivalvis (Gunera), Tripsacum loxum (Gantamala) and Vetiveria zizaniodies (Khus-Khus). The Forest Research Institute, DehraDun has reported that a number of grasses can be efficiently pulped, but the efficiency of the process can be enhanced when mixed with bamboo to the extent of 50 per cent (Podder, 1979).

Sharma (1977) reported that about 300,000 to 400,000 tonnes of various grasses could be annually harvested from

forests in India. The natural and man-made forests in Madhya Pradesh alone are capable of producing about 200,000 to 300,000 tonnes of useful grasses annually (Prasad and Jalil, 1987). Assuming that harvesting one tonne of grasses, on an average, will require 10 person-days, the employment potential in harvesting grasses can be estimated at a minimum of 3 to 4 million person-days or 1 to 1.4 million person years. In respect of Madhya Pradesh where forested areas are inhabited predominantly by tribals and other weaker sections, the grass cutting alone can generate a lot of employment. The only thing is to organise the work of grass collection and streamline marketing. Some important grasses and their yields from forest areas have been reported (Table 11.4 by Gupta and Guleria (1982). The production will vary from locality to locality and may be dependant on a number of soil, climatic and vegetational (tree cover) parameters. However, these figures provide an indication to prepare viable projects.

11.4 Phool Bahari (Thysanolaena maxima) Roxb.

A tall, reed-like, perennial grass, found on shady slopes in forests, especially on damp, steep banks along ravines and water-courses almost throughout the country and in the Nicobar Islands also, ascending upto an altitude of 2,000 m. Culms solid, smooth and rounded, upto 4.0 m high as thick as the little finger, leaves large, broad, somewhat resembling those of bamboos, tapering to a fine point, panicles terminal, dense, bushy foxtail-like, 30-90 cm long.

This grass is of common occurrence in moist forests of Bastar, Raipur, Bilaspur, Balaghat, Mandla, Seoni, Chhindwara, Betul districts. However, it is rarely seen in drier forests of northern and north-western parts of the State.

This is a very elegant grass, suitable for cultivation in gardens for the foliage and as a screen. The stem-tips

and tender leaves are used as fodder. The grass is available in large quantities during June-December, and is used as a cattle-feed, both in summer and in the period of scarcity during winter. Trials have shown that it is in no way inferior to many other cultivated fodders.

Table 11.4: Important Fodder Grasses and their Yields on Forest Lands in India

S.No.	Grass Species	Approx. yield per ha (tonnes air dry matter)	Distribution
1.	Andropogon annunnulobus (belia grass)	6.0	Throughout India
2.	Apluda mutica (Kundha)	4.0	- " -
3.	Bothriochloa species	20.0	Most part of Central India
4.	B. intermedia (Sandhar)	5.0	Throughout India
5.	Bromus species (Brome grass)	8.25	Greater parts of Central high lands
6.	Cenchrua ciliaris (Anjan, Dhaman)	15.21	Maharashtra, M.P. Rajasthan & drier parts of South India
7.	C. setigerus	13.0	North-west India
8.	Chloris gyana	16.5	Hot-moist regions
9.	Cynodon dactylon	2.2-3.0	Throughout India
10.	Dicanthium annulatum	10.00	Excepting hilly north west and north east
11.	Eragrostris species	5.0-6.0	Plains of Central and northern and southern India
12.	Heteropogon contortus	50.0	Himalayan forests
13.	Iseilema laxum (Mushan, Mushal)	10-12.0	Central India
14.	Panicum maximum (Guinea grass)	58.0	Most areas
15.	Paspalum dilatatum	15.4	Hill forests
16.	Pennisetum purpureum (Elephant)	150.0	Central India

Table 11.3: Annual reported production of Sabai grass from forests of Madhya Pradesh

Production : in Quintals
Revenue : in Rupees

Circle	1980-81		1981-82		1982-83		1983-84		1984-85		1985-86	
	Production	Revenue	Production	Revenue	Production	Revenue	Production	Revenue	Production	Revenue	Production	Revenue
Shahdol	1979-80 250/-	460/-	-	-	-	-	-	-	-	-	-	-
	1980-81 250/-	400/-	250/-	375/-	233/-	2880/-	225.50	2700/-	-	-	-	-
Balaghat	1987-88	600 q	-	-	-	-	-	-	-	-	-	-
	1988-89	700 q	-	-	-	-	-	-	-	-	1.00	251/-
Raipur	1989-90	1200 q	-	-	9.82	5700/-	-	-	-	-	-	-
	1990-91	1500 q	-	-	-	-	-	-	-	-	-	-
Hoshangabad	-	-	900/-	13465/-	900/-	12120/-	900/-	9999/-	-	-	200/-	17077/-
Kanker	-	-	-	1100/-	-	1175/-	-	-	-	-	-	-
Chhindwara	-	-	425/-	5050/-	40.00	4100/-	1288/-	16750/-	-	-	777/-	10100/-

Table 11.5: Production of Phool Bahari from forests of Madhya Pradesh

Production in Numbers

Circle	1980-81		1981-82		1982-83		1983-84		1984-85		1985-86	
	Production	Revenue	Production	Revenue	Production	Revenue	Production	Revenue	Production	Revenue	Production	Revenue
Jagdalpur	-	-	-	-	256530/-	16300/-	98300/-	17700/-	54300/-	21610/-	56030/-	27725/-
Kanker	179862	36550/-	175162/-	5000/-	217825/-	44350/-	235840/-	34000/-	35700/-	46001/-	-	-
Shahdol	-	-	-	-	-	400/-	-	450/-	-	-	-	-

The panicles are made into soft brooms, used for sweeping the highly polished, hardwood floors, and are more durable than those made from Phragmites sp. The stems are used as reed-pens for writing.

A decoction of the roots is used as a mouth wash during fever.

11.4.1 Production Potential : There is no record of its assessment in the natural forests of the State. It is considered a very unimportant forest produce and therefore it is sold in auction. Normally, the entire Division or Range is sold for a few hundred rupees. There is no scientific basis for the fixation of upset price. The value is fixed on the basis of past year's prices obtained. Removals are also not correctly known as the purchaser and petty contractors tend to give under estimates of the material removed by them. Bulk of the total production is also removed by the tribal's and others who bring it to the local week-day markets where the broom grass is bartered for kerosene oil, salt and similar things.

Recorded removal of this grass has been summarised in Table 11.5. This data could not be made available by other Conservancies and therefore the figures in respect of Jagdalpur, Kanker and Shahdol Conservancies only have been compiled. On an average about 411,300 broom-sticks are shown to have been removed giving an annual revenue of Rs.60,000 to 70,000. Since the figures from other Forest Conservancies are not available the production and revenue figures could be multiplied six times (20 Forest Conservancies, to get the rough estimates of annual removals. Presuming that one personday is required for making 10 broom-sticks, for estimated about 250,000 to 3,000,000 broom sticks on a most conservative estimate 250,000 to 300,000 persondays worth employment can be generated by this alone. Since the removal of this produce does not have any deleterious effect on forest regeneration, it could be extracted without disturbing its growth and abundance.

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CHAPTER XII

RESEARCH NEEDS IN MINOR FOREST PRODUCE

Introduction

Madhya Pradesh possesses vast wealth of Minor Forest Produce. The estimated value of these minor forest produce would run into hundreds of crores. The produce give numerous of benefits, a) in the form of revenue to State Government, b) subsistence needs to the rural particularly tribal population, c) employment generation often seasonal in areas where it is most needed and d) meeting important raw material requirements of the industry. Minor Forest Produce include bamboo, oilseeds, fruits, resins, barks, leaves, medicinal plants, tans, dyes animal products, etc.

Emphasis to Minor Forest Products in State was given when the Report of the Industrial Survey Committee appointed by the govt. of the Central Provinces and Berar (1939) was published. The importance of Minor Forest Products was realised as a source of forest revenue as well as for creation of employment potential, particularly in rural areas. As a consequence of this realisation trade in some Minor Forest Produce was Nationalised. However, majority of these produce remained in the unorganised sector. Further, the quantitative assessment in respect of most of the non-wood forest products is not available. Neither is information available as to the amount consumed by the local population and the amount sold at markets. Efforts on scientific management of these minor forest produce has been hampered due to many reasons, chief being the increase of biotic pressures on forests leading to deforestation and degradation.

Some of these forest products can hardly be labelled as minor in terms of their revenue earning capacity and utility to the rural population. For instance bamboo which is equally important to the poor as well as to the industr generates considerable employment.

One significant point is that there are many deficiencies such as lack of data on production potential, income and employment generation where minor forest produce are concerned. Inventoring of various important Minor Forest Produce is therefore essential.

Due to various biotic factors many important Minor Forest Produce are becoming scarce. Enhancing the production of these products from forests and other lands is essential to carryout studies on ecological and socio-economic aspects.

12.1 Employment Potential

Most of the unemployment in India is in rural areas. Rural unemployment has two features viz., seasonal and perennial. Agriculture which is the main occupation in rural areas is by nature seasonal occupation. Some estimates show that for at least five to seven months in a year, a substantial part of the population engaged in agriculture is idle. This is the seasonal unemployment. The second aspect of rural unemployment is the perennial under-employment or disguised unemployment. Over the years there has been a sharp increase in the working population engaged in agriculture without a corresponding increase in the area of cultivation. This has led to surplus population engaged in agriculture. In other words the marginal productivity of surplus labour may be very low.

It has been found that in collection of Minor Forest Produce employment is generated in rural and backward areas, this shows the strong backward linkages of forestry in creating rural employment. However, estimates on potential employment generated through collection of all minor forest produce have so far not been estimated. Studies have indicated that most of the rural population engaged in collection of minor forest produce are predominantly tribal (Bhatnagar, 1988 and 1989). Employment is generated mostly during the non-agricultural season when unemployment and underemployment problems are acute.

12.2 Research Needs

With rapidly increasing population and growing demands of the industry, many minor forest produce are depleting.

Bamboo holds multiple significance for commercial and rural household needs. This important species is gradually disappearing from forests on account to gregarious flowering. Research efforts are required for its propagation and development. These include standardisation of planting techniques, increasing yields per hectare, rhizome/vegetative propagation, soil working and irrigation requirements, methodologies for rehabilitation of flowered areas, etc.

Tendu leaf (Leaf of Diospyros melanoxylon) is of great commercial importance. It has great relevance in the tribal economy of the State as it generates employment mainly to rural poor. Naturally growing bushes of D. melanoxylon in the natural forests, on culturable wastelands, village common, on road side etc. provide good quality leaves for beedi making. As against this, the leaves obtained from tall trees are very thick and tough and not suitable for beedi making. However, to get more collection in a shortest possible time, there is a growing tendency among rural population to lop and pollard trees. Felling of trees is also very common. These destructive methods of collection are thus depleting this important MFP. In the absence of research to get best quality leaf from lesser number of trees, there is a growing trend to collect more or more leaves irrespective whether the leaf is utilizeable or not. Although before plucking some pruning especially of tendu bushes is carried out. However, the time method and intensity of pruning and need for other cultural operations are some of the areas requiring research. The other parameters which need intensive research are in areas of grading, curing (drying), packing and storage. Artificial regeneration of tendu has not been attempted anywhere. In view of the vast potential of the trede in this product, many village commons and other wastelands could be brought under tendu plantations. Areas beneath high tension lines could be planted with this species. The plants should be trained to grow in bushy form, not exceeding a metre or two in height.

Some experiments were taken up by the State Forest Research Institute to study the effect of time of collection (winter and summer) on the quantity and quality of Tendu leaves. Effect of pruning and burning the area on yield/quantity of leaves. Plucking of leaves during post monsoon/winter period does not have any adverse impact on production during summer. However, such experiments need to be taken up on other areas and on a larger scale.

Tree based minor oilseeds have assumed significance during recent years due to shortage of vegetable oil. Some of the tree based oilseeds have established market for their oils and butter, but some need yet to gain commercial importance due to various hindrances in their composition, collection, etc. A few tree species which are commercially exploited are Neem (Azadirachta indica), Mahua (M. latifolia), Kusum (S. oleosa), Karanj etc. Sal (Shorea robusta) is the most important tapped source. In almost all oilseeds there is lack of information on actual and potential production. In Sal seed the seeding cycle varies from year to year. A study assuming the total collection data of Sal seed in Madhya Pradesh revealed every alternate year as a bad seed year. This periodical fluctuation of seed production did not show significant correlation to weather factors such as onset of monsoon and total rainfall (Bhatnagar and Kawadia, 1989). Sal seed generates an estimated employment of 41 lakh person days per annum in collection activity in Madhya Pradesh besides being a source of revenue to the government. Studies are however required on the variation in seed cycle, correct methodoloy for collection, effect of Sal seed collection on natural regeneration of Sal forest etc.

There is a widespread concern for the continuing depletion of Sal forests in the State. Large scale mortality in sal trees and lack of natural regeneration are being attributed to the fall out of intensive Sal seed collection. Views are

being expressed that if no timely action to regulate, (some suggest to stop it) are taken the Sal forests may vanish soon. The Sal forest ecosystems are so well connected with the well beings of the tribals that large scale drying of Sal trees is being said to be a forecast for ecological devastation. Tribals and forest dwellers, during the period of scarcity collect food, fibres, fruits, thatching material, medicinal herbs and spices and a number of useful products which cannot be obtained from any other forest types. In ecological paralence, the Sal forests are considered to be near climax formation, whose destruction will not only deprive the tribals from their bare requirements but would, it is feared, bring down water table and cause many hardships. Research on these aspects need to be undertaken.

Mahua (Madhuca latifolia) is an important tree both to tribal population and industry. The season for collecting the seed is short and in the absence of organised harvesting a considerable portion of the crop is lost during monsoon. Recent observations show that Mahua is rapidly declining from forests. It is often lopped. Research is required to propagate this tree species through Tree Improvement Programme, also to reduce the long time span in flowering. Neem, Karanj, Kusum and other minor oilseeds also require research on production potential and oil content. Survey of natural potential of these trees and conservation and propagation of different provenances also need intensive research.

Medicinal plants occur in a wide range of forests. However, no systematic survey has been done to indentify the rare and endangered medicinal species and their occurrence in various forest types. Many medicinal plants like Rauvolfia serpentina are known to have been over exploited. These plants possess important medicinal properties and need in situ as well as ex situ cultivation and propagation. Cultivation trials

are necessary in different edapho-climatic zones. Assessments of yields of important medicinal plants due to various silvicultural and material inputs also needs to be worked out. Lack of market information and research is a constraint. Studies are required to study the market structure for medicinal and aromatic plants, variations in price levels, marketing margins and various channels for marketing.

In Madhya Pradesh, a project on survey of medicinal wealth in the State is in progress. Market surveys are also being undertaken. These studies need to be strengthened by providing necessary finance and personnel.

Many edible products are found in the forests, Chironji (Buchanania lanzan) is an important produce of the State. Average yearly collection of this seed is eleven thousand quintals per annum. The market value of this produce was Rs.958 lakhs in 1988 at the rate of Rs.80/- per kilogram. Potential employment generated in collection of this seed is 59.99 lakh person days per annum (Bhatnagar and Bhausar, 1988). Unfortunately this tree is being lopped frequently.

The growing biotic pressure and consequent site degradations are not allowing its regenerations in the natural forests. Research is needed to propagate this species. Studies have also revealed that the local population engaged in collection of this produce earn about Rs.25/- per kg and a large portion of the remaining goes to the middlemen.

Whether Chironji (seed of B. lanzan) collection can be organised through cooperatives needs to be looked into. Mahul (Bauhinia vahlii) whose leaves are used as cups and leaf plates is another produce, where market being in the unorganised sector has resulted in a large margin going to the middlemen (Bhatnagar, 1989). The collection and marketing of these produce therefore needselaborate planning and infrastructure.

Aonla (Emblica officinalis) is another common edible product occurring in forests. Estimates reveal that about a half of the total produce in the State is sent for preparation of medicines. Often this fruit is bartered in tribal areas for salt. This tree species is also becoming scarce due to various biotic pressure.

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