PROJECT COMPLETION REPORT
(2010-2012)

Population dynamics of selected threatened medicinal plant species and conservation management through community participation in buffer and transition zone of Achanakmar-Amarkantak BR (M.P.)

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Submitted
by
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WOS-B (SSD/SS/003/2009)

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SCIENCE & SOCIETY PROGRAMME

A. SUMMARY SHEET

1. TITLE OF THE PROJECT:

Population dynamics of selected threatened medicinal plant species and conservation management through community participation in buffer and transition zone of Achanakmar-Amarkantak BR (M.P.)

2. PI & ORGANISATION:

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3. DATE OF START: 18th March, 2010

4. TOTAL COST OF THE PROJECT: Rs. 8.22 lakh (at the time of sanction)
Rs. 8.77 lakh (Revised budget)
Rs. 7.65 lakh (Recieved)
(Refunded Rs. 9051.00)

5. STAFF SANCTIONED: Nil

6. TOTAL EXPENDITURE: Rs. 7,56,580.

7. EQUIPMENTS ACQUIRED, IF ANY: Annexure I
1. Global Positioning System (GPS)
2. Distometer

8. SUMMARY OF PROGRESS MADE: (UPTO 300 WORDS):

- A pilot survey of the East Karanjiya range comprising of 105 compartments and Amarkantak range with 47 compartments was undertaken to locate populations of the target species viz. *Celastrus paniculatus, Embelia tsjeriam- cottam, Peucedanum nagpurens, Rubia cordifolia* and *Thalictrum foliolosum*. The selected threatened medicinal plant species were then studied by laying quadrat and transects and their density determined.
- Not a single population of *P. nagpurense* was found so far in both the ranges, although there are many sites which constitute the characters of its habitat.
- Seven beats in Amarkantak range and seven beats in East Karanjiya were sampled for the population density of four target species, the rest did not harbour the target species as large to be termed as population. The localities were mapped. Almost all beats in Amarkantak and nearly 12 beats in East Karanjiya range had some compartments infested with invasive *Lantana* cover.
- The populations of *C. paniculatus E. tsjeriam- cottam,* and *R. cordifolia* shared almost same habitat. In terms of density, *C. paniculatus* was the most populous species, which faces a crisis of different magnitude. Its young plants are sourced from old population which had been cleared off, by harvesters or forestry operations (?) by clearing climbers The present population with density as high as 2781plants/ ha. (Beat Lapti) needs protection from grazing cattle and degradation of canopy trees.
- Rampant grazing and browsing was observed for *E. tsjeriam- cottam* as well. Although it has sizeable population at least in closed forest canopy of 30-45%, browsing by cattle has affected its flowering and fruiting, which has resulted in low yield as well as poor / near negligible regeneration.
- Few populations of *T. foliolosum* were found in both the ranges of Amarkantak and East Karanjiya and the area of occurrence was not very large. However, there are areas identified which can prove to be good habitat, if species are introduced or are protected from human intervention, could help in species area expansion.
- *R. cordifolia* showed regeneration and occupied area in accordance with its habitat requirement of closed canopy and slopes. The populations of *R. cordifolia* were recorded from Bhundakona, Bijauri, Damgarh, and Umargohan beats in Amarkantak along with few unsampled localities in Shambhudhara, Kapildhara and Sonmuda. In East Karanjiya range, it was observed in Chauradadar, Dakshin Chauradadar, Kabir, Kharidih, Jagatpur and Hazaridadar (Narigwara) beats.
- Although both ranges showed signs of biotic pressure and human interference throughout, the area still has potential factors favourable for rehabilitation and enhancing population of target species.
- The permanent plots for monitoring population dynamics were laid and marked with target plants, 41 plants of *T. foliolosum* in 6 plots and 145 plants of *R. cordifolia* in 9 plots were tagged after recording of initial observations, in least disturbed areas of Shambhudhara, Damgarh and Kabir to study the dynamics of population of the two species. However, the subsequent observations could not be taken as the end of project period before season did not allow second observation and proposed extension of another year (without additional budget for work) was not granted.

- Soil samples have been collected and analyzed from each site to assess its role in providing substrate to established population. The determined soil characterstics reveal that it may provide compatible conditions in sampled beats for the establishment of all the four target species.
- Four interface programmes were conducted in selected villages with forest protection committees to encourage and promote the techniques of sustainable harvesting of medicinal plants and importance of conservation. The knowledge dissemination tools involved posters, demonstration with live plant material and photographs of threatened species. Nine species medicinal plants *viz*. pudina, kali tulsi, bach, lemon grass, gwarpatha, adusa, giloy, aonla, harra and bel of direct use to villagers were distributed to encourage herbal homestead garden and promote use of herbals among them.
- Socio-economic profile of participants was assessed through questionnaire. It suggested that 90% of participants had not harvested medicinal herbs and other NTFP's other than sal leaves, aonla, harra and mahul whenever available in last 2-5 years commercially. It was mainly due to unavailability of the produce.
- Publications done during the project period are given in Annexure II.

B. DETAILED REPORT

1. **INTRODUCTION** (NEED IDENTIFICTAION * S&T NEEDS IN PROPOSED AREA OF INTERVNETION) : 200 WORDS

Medicinal plants are the threatened resources globally, particularly, the plants harvested from the wild. The majority of these occur mainly in tropical and subtropical regions of the world. World Health Organization in 2002, estimated that revealed that a large part of the population in developing country rely on traditional healthcare that in India is based on 7500 plant species, which are used by tribal, ethnic and even sub rural communities. Further, of these at least 10% are actively traded within the country. Ninety five percent of these traded species are harvested from the wild (FRLHT, 2003), which as Leaman (1998) observed was uncontrolled and unmonitored that too in government owned land like forests.

Madhya Pradesh significantly contributes to the medicinal plant extraction done from the natural areas, in the country. The Conservation/Threat Assessment and Management Prioritization workshops (CAMP & TAMP) carried out in July 2003 and later in January 2006 identified the threatened plant flora of the states of Chhattisgarh and Madhya Pradesh according to IUCN guidelines. Forty four and 41 plants were assessed as threatened species under various categories, viz. critically endangered, endangered, vulnerable and data deficient, respectively in the two workshops, in 2003 (Ved *et al*., 2003) and 2006 (Ved *et al*., 2006).

Being a state with large tribal population with as many as 18 tribal districts (FSI, 2005) a substantial part of peoples livelihood comes from forest based enterprises like collection and processing of NTFP, working for forestry works, etc. Some frequently harvested species on demand are *Acorus calamus, Andrographis paniculata, Celastrus paniculatus, Curcuma angustifolia, Costus speciosus, Embelia tsjeriam cottam, Chlorophytum tuberosum, Gloriosa superba, Rubia cordifolia, Thalictrum foliolosum, Dioscorea bulbifera, Phyllanthus emblica, Aegle marmelos, Terminalia chebula, T. bellirica,* etc. The increasing demand of medicinal plants has led to indiscriminate harvesting of economically important plants including medicinal plants. Globally, the use of plant based drugs has enhanced manifold and India continues to be one of the largest exporters of raw material for these products. The source of these materials largely being the wild has resulted in over-exploitation of many of these species, which has threatened their survival in the natural forests.

A set of conservation recommendations were given in CAMP workshop for each of these species, so that further knowledge regarding their dispersal, regeneration, favourable conditions for their regeneration, biotic and abiotic requirements, distribution pattern, etc. is gained for their better management. The study on population dynamics of these threatened species is the first step towards *in-situ* conservation efforts and involves study of structure of population, growth, regeneration, mortality, etc. In a given area, a self sustaining population is one which regenerates at the rate, enough to balance the extraction of regenerating units like roots, fruits, seeds, etc. in natural conditions. There are long term

studies that have been carried out in other parts of the world in natural areas for shrubs, herbs, grasses, plants like *Sanicula europaea* L. (Apiaceae) and *Dentaria bulbifera* L. (Brassicaceae) (Gustafson, 2003), *Kosteletzkya pentocarpus* (Malvaceae) (Pino *et al.*, 2007), *Harpagophytum procumbens* (Burch.) DC. ex Meisn. (Strohbach and Cole, 2007), *Linnaea borealis* (Erriksson, 1991), impact of harvesting and changes affected by it on population dynamics in *Garcinia lucida* (Guedje *et al*., 2002), genet and ramet affecting population dynamics in *Solidago canadensis* (Hartnett and Bazzaz, 1985), *Euryodendron excelsum* (Shen *et al*., 2008), among others. The studies showed the patterns of recruitment and factors responsible for regeneration and sustaining population are specific for each species in given climatic and edaphic conditions.

The present study was taken up to map the population of species selected for the study viz. *Peucedanum nagpurens, Thalictrum foliolosum*, *Embelia tsjeriam- cottam, Celastrus paniculatus* and *Rubia cordifolia* in the two ranges and study dynamics of two species in the selected sites. As per recommendations the populations, its structure, regeneration and habitat requirements of these species need to be studied and therefore, the present study was taken up in the area known to inhabit these species.

The need to promote awareness among villagers of forest villages is also felt more than ever as the destructive practices of resource use has had tremendous impact on natural forest resources and habitat on the whole. Therefore, promoting awareness on sustainable harvesting practices and conservation was taken up as well in this study.

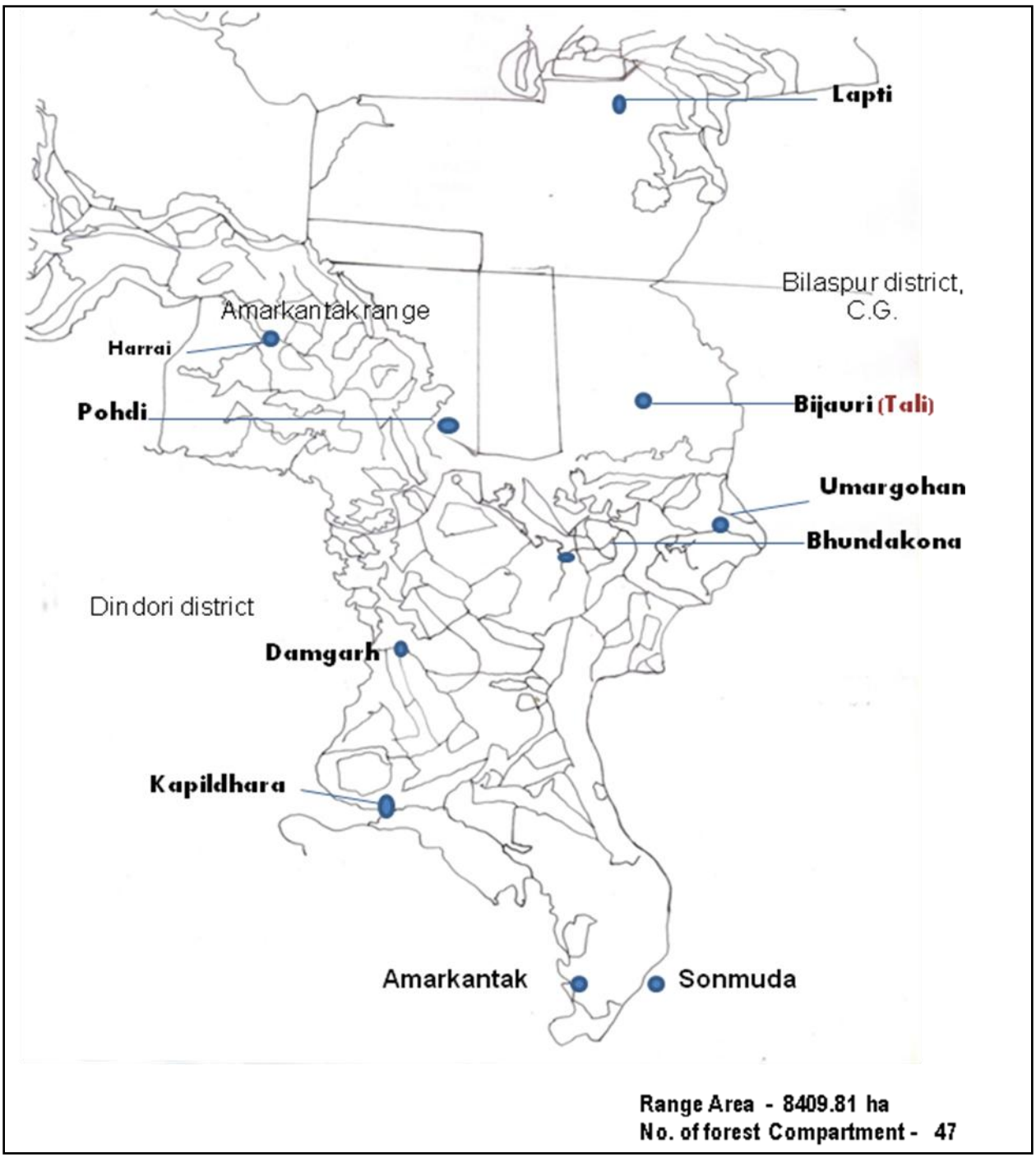
2. OBJECTIVES (AS APPROVED IN THE PROEJCT):

1. Mapping distribution of populations and study of population dynamics of selected threatened species in the selected site.
2. Promoting participation of forest dwelling communities in conservation of medicinal plants and traditional knowledge of their use through awareness programmes and interface workshops.

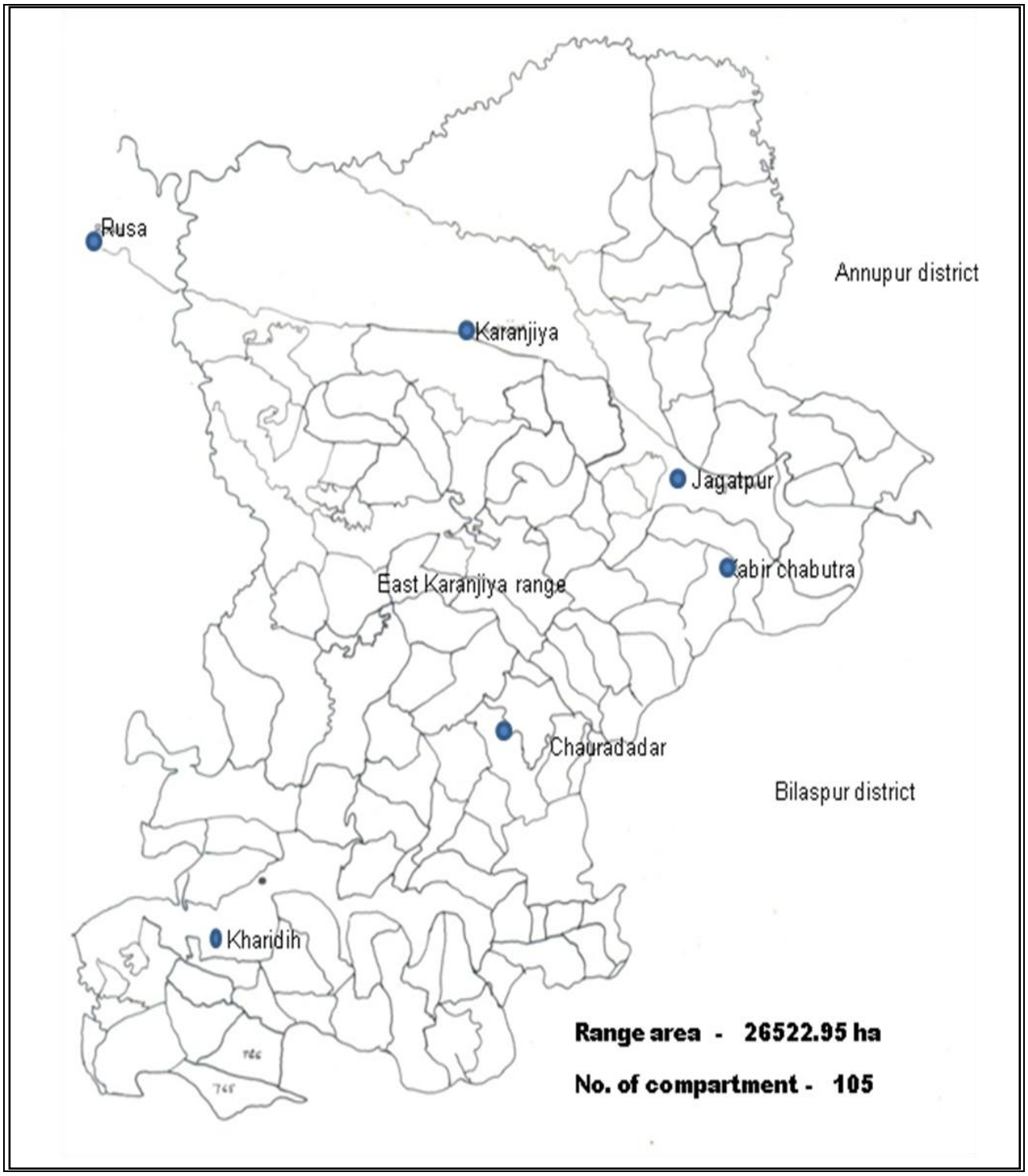
3. PROJECT AREA (VILLAGE, BLOCK, TOTAL AREA COVERED etc.)

The project was implemented in two forest ranges in buffer and transition zone of Achanakmar-Amarkantak Biosphere, Madhya Pradesh; one on the plateau of Amarkantak Forest Range (Map 1) of Anuppur Forest Division with 47 compartments having a total area of 8409.81 ha. and its neighbouring East Karanjiya Forest Range (Map 2) of Dindori Forest Division comprising of 105 compartments with a total area of 262522.95 ha. which forms part of Satpuda mountain range. Both the forest ranges constitute moist deciduous sal forest and its sub types.

The members of forest protection committee of five villages (Table 1) of buffer zone of Achanakmar-Amarkantak Biosphere Reserve were selected to participate in the interface workshop on sustainable harvesting of medicinal plants and their conservation.



Map 1. Amarkantak Range, Anuppur Forest Division



Map 2. East Karanjiya Range, Dindori Forest Division

Table 1. The details of village area and its population

S.No.	Village	District	Area (ha.)	Population
1	Kharidih	Dindori	729	1499
2	Damgarh	Anuppur	1341.077	251
3	Bhundakona	Anuppur	226.144	281
4	Umargohan	Anuppur	871.09	336
5	Barsot	Anuppur	409.95	453

4. COMMUNITY BACKGROUND (CASTE, OCCUPATION): 200 words

The villages in the two range constitute tribal population mostly belonging to *gonds, baigas* and *yadavs*, besides few other communities like *oraons, kols, panka* etc. The major occupation of these communities has now become farming. However, the contribution of other activities like gathering / collection of Non-timber forest produce such as mahua, mahul leaves, harra, bahera, aonla, medicinal plants, edible fruits and leaves, fuel wood, etc. working as labourers in forestry operations, making items from bamboo and other materials, etc. in livelihood have lessened over the years due to declining resources. Barring small township of Amarkantak and East Karanjiya, the region comprises of rural population with few facilities and awareness. The area still shows impacts of traditional farming *bewar* practiced in the past, however, presently rainfed farming is being done by the population.

5. METHODOLOGY FOLLOWED (SURVEY; MOBILIZATION; TECHNOLOGY IDENTIFICATION; TRANNSFER & ADOPTION; DEMONSTRATION & TRAINING COMPONENT, ETC.): 500 words

Target species:

The following five medicinal plant species assessed as vulnerable in central India were selected for the population study and of these, two species viz. *Rubia cordifolia* and *Thalictrum foliolosum* for population dynamics. Of these, *Celastrus paniculatus, Embelia tsjeriam- cottam, Rubia cordifolia* (Fig. 1a-d) are on high consumption trade list of the industries which amounts to >100 MT, which for these species is 453, 725 and 536 MT and totally sourced from wild (Ved and Goraya, 2007). The details of species are under:

a. *Celastrus paniculatus* Willd. (Malkangni) Family: Celastraceae

It is an unarmed woody climber, with variable glabrous, rounded leaves having acuminate apex and crenate margins. The inflorescences are terminal pubescent panicles with green male and female flowers. Capsule subglobose bright yellow trivalved 3-6 seeded fruit enclosed in red fleshy aril. The flowering occurs between March-May and fruits between May- August.

It is globally distributed in tropical to sub-tropical regions of India, Myanmar, China, malesia, Srilanka and Phillipines and also in North America. Within India, it is found in

Fig. 1a *Thalictrum foliolosum* (flowering), Mamira

Fig. 1b *Celsatrus paniculatus,* Malkangni

Fig. 1c *Embelia tsjeriam-cottam* (fruiting) Baibirang

Fig. 1d *Rubia cordifolia,* Manjeeth

deciduous forest in sub- Himalayan upto 1800-2000m in central India, Western Ghats extending to Rajmahal hills in Bihar and Orissa upto 1500m (Anon, 1992).

Seeds, fruits coat, arils yield fatty oils. Leaf sap is used as antidote for opium poisoning (Kirtikar and Basu,1987), seeds are laxative, emetic and tonic, seed oil used has therapeutic properties used in nerve stimulant, asthama, leprosy, paralysis, leucoderma, brain tonic (Nadkarni, 1976) & rheumatic pains. Bark is used as abortifacient (Vaidyaratnam, 1994). Celastrin an alkaloid has been isolated from seed which has stimulant action on depression (Barnwal and Singh, 2000).

b. *Embelia tsjeriam cottam* (Roem. & Schult.) A.DC (Baibirang, Birangi)
Family: Menispermaceae

It is a woody climbing deciduous shrub of nearly 2m. height. The leaves are obovate-oblong, with rusty pubescence beneath. The flowers are persistent arranged in axillary raceme, bearing greenish white corolla and fruits are drupes turning red with persistent style. It is found in Dry to moist deciduous forests in open as well as shady slopes and plains alike. The flowering and fruiting occurs between July and January.

It is native to Eastern India and deccan peninsula, distributed throughout India, Myanmar, Srilanka, in India Maharashtra, Goa, Karnataka, Kerala, Tamilnadu, Andhra Pradesh, Madhya Pradesh in deciduous to semi-evergreen forests (Anon, 1952; Bhattacharya, 2000).

The leaves and fruits are of medicinal importance. The leaves are applied on itches. The fruits are used for blood purification and as condiments. The fruits are carminative, antispasmodic, taenifuge properties, paste of seed is beneficial for cutaneous properties (Sivarajan and Indira, 1994). The medicinal properties are due to the presence of embelin (Khare, 2004).

c. *Peucedanum nagpurens* (C.B.Cl.) Prain (Tejraj) Family: Apiaceae

It is an erect perennial herb. Leaves 1-3 pinnate, ultimate segments, lanceolate or ovate. Umbels compound with 12-16 rays, bracteoles 4-7. Fruits truncate, emarginate at narrow base.

It is found in Moist Deciduous Mixed forests and is known to be endemic to Eastern Ghats. The global distribution is restricted to Bihar, Orissa, West Bengal, Madhya Pradesh and Chhattisgarh in India and Nepal at an elevation 900-1500mt. It is occasionally found in partly shady areas. The flowering occurs between September- November and fruiting between November to December.

The roots and seeds of this plant are traded for use in stomach ailments and tonic.

d. *Rubia cordifolia* Linn. Sensu Hook.f. syn. *Rubia manjith* Roxb. ex Fleming (Pilia, Indian Madder**)** Family: Rutaceae

It is a stiff climbing herb, prickly or hispid, angular stem growing upto 10m. long. The leaves simple, ovate - cordate rounded at base arranged in a whorl. Stipules modified into leaves or absent. Flowers are white or greenish, axillary or terminal cyme, fruits globose and deep purple in colour. The rootstock is perennial.

It is found in sunny slopes in Moist deciduous or Mixed forests. It flowers during February to December and fruiting occurs from March to January.

It is a distributed throughout the lower hills of Indian Himalayas in the North and Western Ghats in the South and Japan, Indonesia, Ceylon, Malay, Peninsula, Java and tropical Africa in moist temperate and tropical forests, upto an altitude of 3500m (Anon, 1972; Khare, 2004)

The roots of *Rubia cordifolia* are of high commercial importance for dye, besides its leaves and stem are also used for their medicinal properties. The roots work as tonic, antidysentric, antiseptic, deobstruent. The leaves and stem is used as vermifuge. Extract froms a constituent of dry septilin used for rhinosinal infections. Roots are also used for colouring medicinal oil. It is an efficient blood purifier and extensively used against blood, skin and urinary diseases. It is useful in eye and ear ailments, ulcers, inflammation, leprosy, and urino-genital disorders. It is found to be active against *Staphylococcus aureus*, and contain hepatoprotective (Mohana *et al*., 2006), anticer and antioxidant (Son *et al*., 2008), antimicrobial and antidysentric and astringent properties (Radha *et al.*, 2011).

e. *Thalictrum foliolosum* DC. (*Mamiri, Piljari*) Family: Ranunculaceae

It is a perennial fern-like erect herb upto 1-1.2m in height. Stems flexuous. Leaves tri-pinnate with truncate roundish lobulate lesflets. Flowers small in large branched panicles, pedicels capillary. Stamens exerted, on filiform, white or pink filaments.

It is also a high altitude plant found on slopes of ravines and streams in sunny and shady edges of rocks in rather cool places. It is globally distributed in the Himalayan ranges across India, Nepal, Bhutan, South-East Tibet & Burma between altitude of 900-3400mt. It has been recorded from Jammu& Kashmir, Himachal Pradesh, Uttar Pradesh, Madhya Pradesh, Sikkim, Meghalaya, Bihar, Orissa, Andhra Pradesh and Tamilnadu. The flowering occurs between July and September. It is pollinated by insects or wind.

The root of this plant is anti- periodic, diuretic, febrifuge, ophthalmic, purgative, stomachic and tonic. It is very effective crude remedy for jaundice.

The following methodology has been adopted for achieving the objectives of the project:

1. Pilot survey: Pilot survey of the area to collect initial information regarding approach roads, potential habitat areas of selected species, village forest committees, etc. was done. Habitat localities of target species were surveyed.

2. Recording of population size and structure of target species: To map the populations of target species, study was done by laying random strip transects 1x20m for species *Embelia tsjeriam-cottam, Celastrus paniculatus* and *Rubia cordifolia* and 1x1m square quadrat plots for small populations of *Thalictrum foliolosum* in areas of uniform population.

To monitor population for studying dynamics of recruitments, permanent plots of size 5x5 m were laid for plant species *T. foliolosum* and *R. cordifolia.* Plants were tagged with plant and plot numbers on aluminium tag. Initial observations were recorded viz. number of ramets, plant size, branching, flowering and fruiting status, etc.

Sample plots for assessing population of *T. foliolosum* were laid in all locations encountered. Transects were laid for *E. tsjeriam-cottam, R.a cordifolia* and *C. paniculatus* in large occurrence areas in both the ranges. Ninety transects in Amarkantak and thirty five plots in East Karanjiya were laid for later three species. The difference in number of plots is due to the area of occurence. While in Amarkantak, the species were present in almost all compartments, in East Karanjiya, the presence of species was restricted to one or two

compartments in the beat and because the distance between the plots was required not to be too close, therefore the number was kept five.

3. Collection of soil samples from each site and its analysis: Soil samples were collected from sites from 0-15cm depth. The analysis for parameters namely pH, EC, organic carbon, available nitrogen, available phosphorus and available potassium was done following standard methods as described by Jackson (1965), Black (1965) and Piper (1950).

4. Preparation of extension material: Posters were prepared for display (Annexure III) to disseminate knowledge regarding conservation of species and habitat and sustainable harvesting of NTFP's among the participants. Photographs of threatened species were used for identification of threatened species and questionnaire for gathering information of socio-economic background was prepared.

5. Organization of awareness programme and conduction of interface with villagers: Interface workshops to promote sustainable harvesting methods of NTFP's and conservation of medicinal plants were conducted involving members of forest protection committee members of selected villages. Exchange of knowledge through their medicinemen was also done on rarity of plants and causes of threats, etc. Participation of all stakeholders including local forest staff, medicine men, women community members, etc. was ensured.

6. Analysis of data, identification of associate species: The data were analysed for population density for both the ranges as per standard phyto-sociological methods. Associate species were identified and listed using state floras (Mudgal *et al*., 1997; Verma *et al*., 2001).

6. TECHNICAL BACK-UP SUPPORT AND LINKAGES ESTABLSIHED WITH S&T INSTITUTIONS: 200 WORDS

1. Dr. N. Roychoudhury
Sc F and Head
Forest Entomology Division,
Tropical Forest Research Institute,
Jabalpur (M.P.)

2. Field staff of state forest department of all beats provided support during field work of the study and identified gap areas during the visits.

3. Mr. V. Diwan, World wide fund WWF field unit at Kharidih. His self help groups made sure that plants distributed at workshop were planted and maintained during summers.

7. SCIENCE & TECHNOLOGY COMPONENT: 300-400 words

The mapping of population of selected plants was done beat-wise in both the ranges. Sampling was conducted in beats earmarked during pilot survey. Population of *Peucedanum nagpurens* was not observed in both the ranges. Although, some medicine-

men claim to have collected roots of the species recently, but it could not be verified and their cooperation with regard to locating the species was not received. Therefore, only four species have been dealt with during the study. The area showed signs of various habitat degrading factors such as invasion by *Lantana camara*, grazing and browsing by cattle, ground fire in areas of Amarkantak range, frost impact in extreme winters experienced in sal dominated areas and above all empty forest syndrome which suggests good canopy cover yet depleted ground and middle canopy; all these factors were observed in most of the areas of both the ranges (Figs. 2a-f)**.** A large part of Amarkantak range had been under mining for long time which has disturbed the ecological compatability and fragile niches of many high altitude species of the region. The beat-wise density of target species in both the ranges are shown in Figs. 3a-d and 4a-d. Status of target species is detailed in the following paragraphs:

a. *Celastrus paniculatus* Willd.: *C. paniculatus* locally known as Amjun and Malkagni in trade, is a liana found in open and moderate canopy, plains as well as slopes of sal and miscellaneous forests in the area. It was also observed uniformly throughout the range of Amarkantak and East Karanjiya. However, the population was not mature. The present populations of plants, which may not be termed as seedlings, are presumably sourced from suckers of roots of mature plants which earlier may have been removed or cut during forestry operations. The fact that suggests this is the presence of plantlets in clusters and the source was traced to old roots (Fig. 6c).

It was the most hardy species which recorded maximum density at Lapti in Amarkantak range 2781 plants ha^{-1} and 1400 plants ha^{-1}in Kharidih and Hazaridadar (Narigwara) beat in East Karanjiya. In open canopy area of Bijauri in Amarkantak also, it recorded a comparable density of 2594 plants ha^{-1}. IVI was highest in Bijauri beat (46.92) in Amarkantak range and Hajaridadar beat (61.32) of E. Karanjiya range.

Only few individuals near habitation and villages have been found to be mature and flowering. The state is such that even villagers of present generation in many areas do not have the knowledge of its commercial use and traditional medicinal use. Only the medicine-men and older persons in the village Damgarh, Bhundakona and Umargohan revealed that it was collected in large scale and oil was extracted for their own subsistence besides taking to the market trader for sale. The species associated with it in natural habitat were recorded along with regenerating trees (Table 2).

b. *Embelia tsjeriam cottam* (Roem. & Schult.) A. DC.: *This* is a shrub locally known as Birangi found uniformly throughout the sampled areas in both ranges with 25-45% canopy cover on slopes and plains alike. The present population is in a degraded state and few localities constitute full grown individuals in both the ranges. It is heavily grazed species (Fig. 6d) and this has lessened the flowering and subsequently the fruiting. As a result, the production of fruits as well as regeneration through seeds, of this major NTFP in the region has declined. The per day collection of *birangi* does not yield enough revenue for the efforts equaling a days' wages, which has discouraged the harvests even further. This species is hardy with regard to open gaps in canopy and therefore was recorded in all the sampled beats. However, complete open canopy also is not favourable to this species,

Figs. 2a-b *Lantana camara* now represents the lower and middle canopy in many areas of biotic pressure

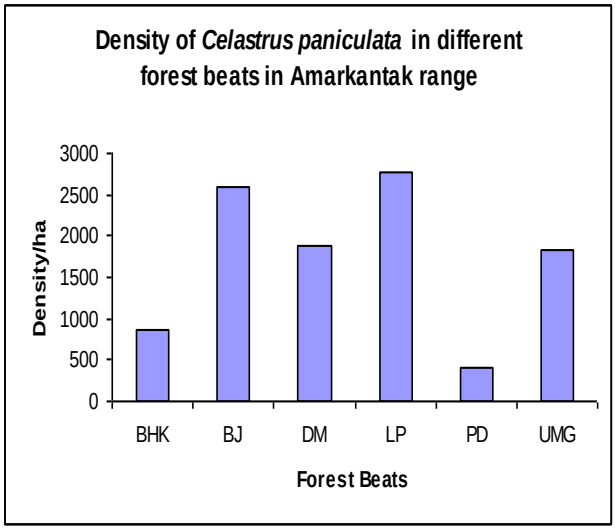
Fig. 2c Grazing in Amarkantak range

Fig. 2d Ground fire impacts the herb and

Fig. 2e The winter experienced the worst frost in many years affecting sal in Harrai and Damgarh beat severely

Fig. 2f The degradation of mining and biotic pressure has left forests empty without middle canopy and ground flora in parts of Amarkantak range

a.



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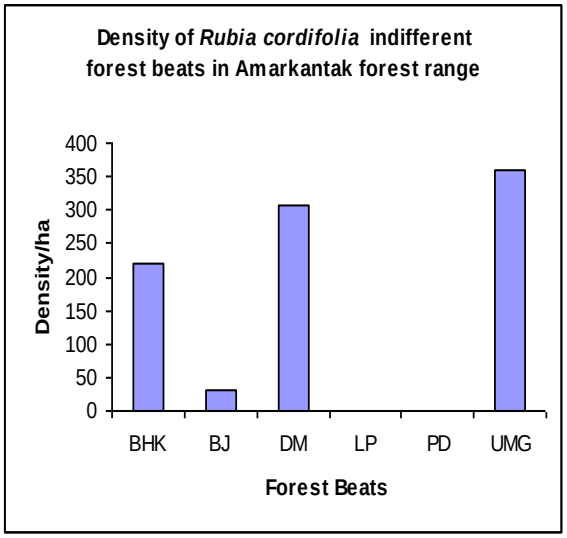

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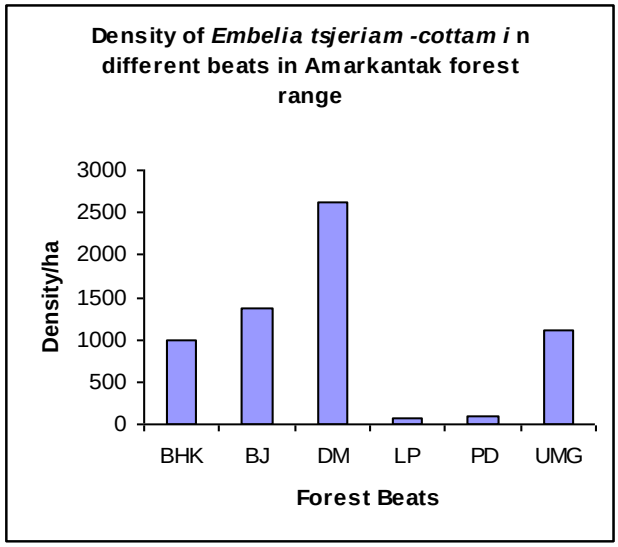
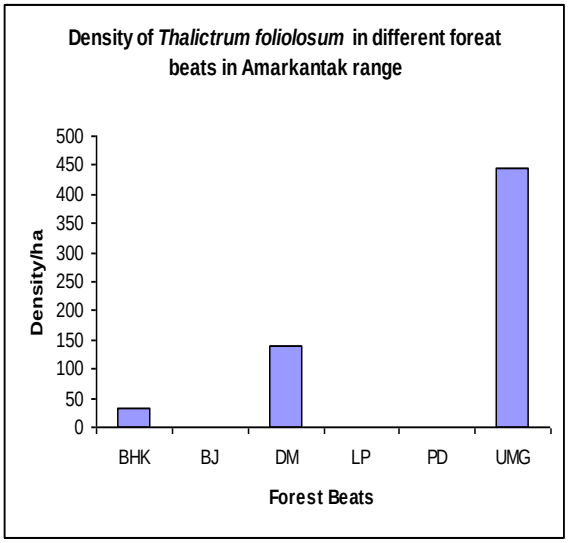


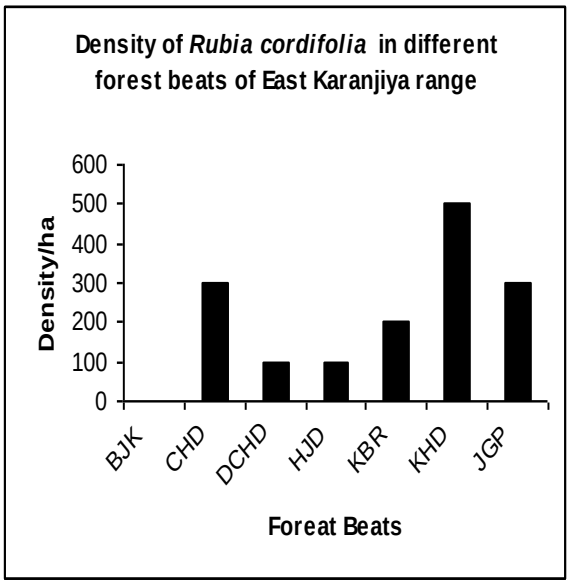
d.



BHK- Bhundakona; BJK- Bijauri; DM- Damgarh; LP-Lapti; PD- Pohdi; UMG- Umargohan

Figs. 3a-d. Density/ha of target species in different beats of Amarkantak Forest Range

a.



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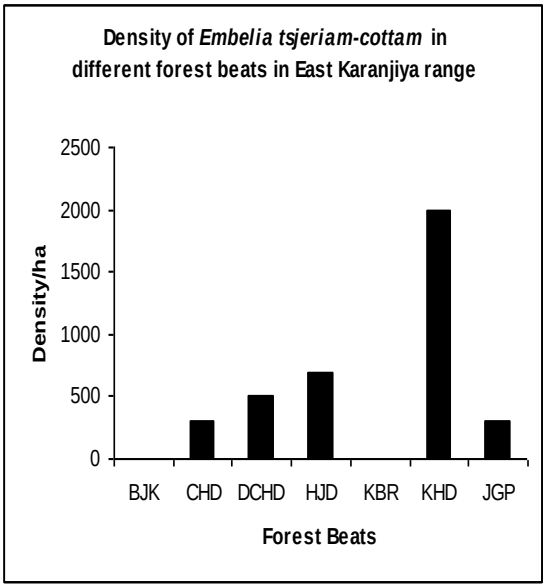
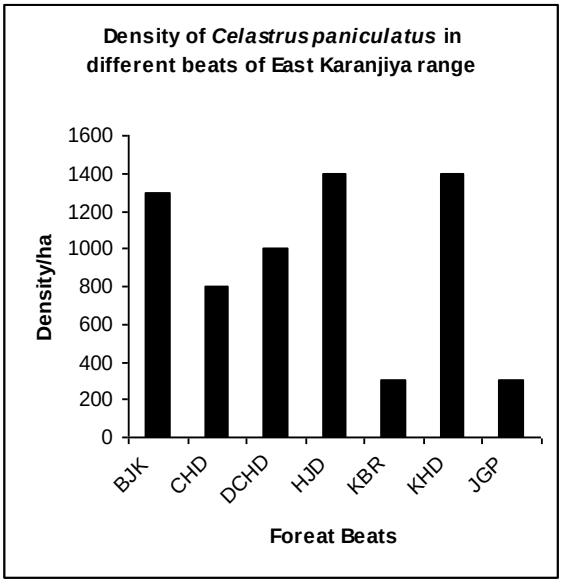


c.



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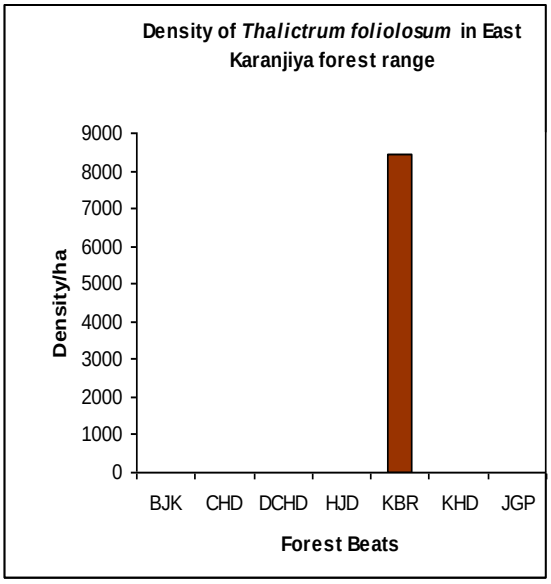

BJK- Bijauri;CHD-Chauradadar; DCHD-Dakshin Chauradadar; HJD- Hajaridadar; KBR-Kabir; KHD-Kharidih; JGP- Jagatpur

Figs. 4a-d. Density/ha of target species in different beats of Amarkantak Forest range

which was evident from its remnant density of 62.5 plants ha^{-1}. In Amarkantak range, the maximum density was recorded in Bijauri beat (1375 plants ha^{-1}) followed by Damgarh and Umargohan. Pohdi with IVI of 3.2 had a heavy infestation of *Lantana camara.* The mat formed by the invasive species was found not suitable for any forest activity like wild animal movements and plant regeneration where seed dispersal modes are barred.

In East Karanjiya range, *E. tsjeriam-cottam* recorded maximum density at Kharidih with 2000 plants ha^{-1}, however, Hajaridadar with only 700 plants ha^{-1} recorded maximum IVI 38.28. Bijauri and Kabir did not record this species for diffrent assumed reason. while Bijauri has mixed forests and very steep slopes and gorge, species in Kabir may have undergone destructive harvesting, where twigs with unripe fruits were broken to ease collection, in the process although some fruits are left fallen , do not transform into new plants because of unripe state. Nursery techniques and regeneration protocol for this species has been developed which may help propagate this species foe replantation in such areas.

c. *Rubia cordifolia* Linn. sensu. Hook.f.: The herbaceous perennial climber locally known as pilia or charmuhi is found on rocky, open or shady areas especially on slopes. This species was not found on plains, but on mild to steep slopes. Almost all hilly tracts in beats Kapildhara, Damgarh, Bhundakona, Sonmuda Bijauri, Umargohan and Pohdi in Amarkantak range and Chauradadar, Dakshin Chauradadar, Jagatpur, Kharidih, Kabir and Hajaridadar beats in East Karanjiya Range, harboured this species. It was not observed in Lapti, Harrai and Amarkantak in Amarkantak range and nearly 11 beats in East Karanjiya range due to disturbance created, open habitat, heavy infestation of *Lantana camara,* areas with grazing and browsing (Fig.6e).

It can also be assumed that due to indiscriminate harvesting by medicine-men/ traders of Amarkantak due to its accessible position nearer to habitation its population has declined tremendously. The species associated with it in natural habitat were recorded along with regenerating trees (Table. 2). In Amarkantak range the maximum density of *R. cordifolia* was recorded in Umargohan as 361 plants ha^{-1} with IVI of 7.57. In East Karanjiya range, this was maximum in Kharidih with 500 plants ha^{-1}, however, IVI was a little higher at Jagatpur with 14.77 (Figs. 5a- d; Fig. 6b).

d. *Thalictrum foliolosum* DC.: The perennial herb species locally known as Mamira or Munga patti inhabits a shady yet rocky steep slopes, emerging out from among the rocks. Very few locations were encountered in the ranges and biotic pressure in the form of grazing was observed even at high altitudes. In East Karanjiya range four populations were recorded in three compartments in Kabir and Chauradadar beat. Although, the compartments had good forest cover, *T. foliolosum* was present only in areas of non- disturbance on steep slopes. The location of populations is encountered away from habitation. The villagers, however, use the roots in times of personal need. In Amarkantak range, six populations of *T. foliolosum* were encountered in Bhundakona, Damgarh, Kapildhara, Sonmuda and Umargohan beat again on steep rocky slopes where damage by grazing animals was observed as well. The species associated with it are given in Table-3. However, the population in Kapildhara and Sonmuda

were not sizeable enough for sampling and scarcely distributed over a patch of area. This however could be a potential site of regenerating a sizeable population. (Figs. 5e and f)

Fig. 5a-b. Potential habitats; c-d. marked plots for population dynamics study; e-f. marking of plots on steep slopes

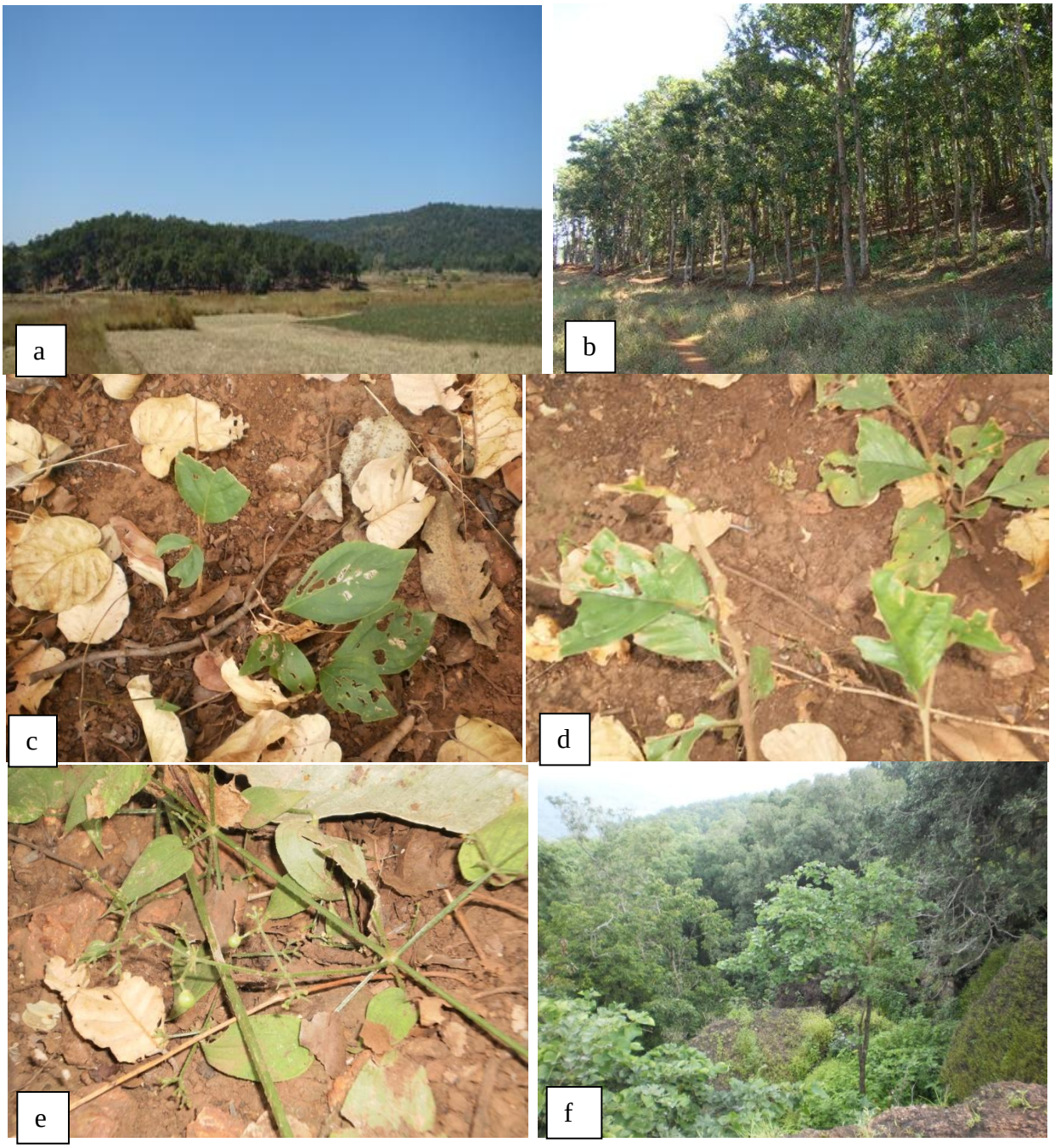

Fig.6a-b Good forest cover from distance is actually empty forest within;c-e. browsing of Amjun, Baibidang and Pilia; f. sites like these could not be visited due to poor accessibility

Associate species of the target plants:

The habitat occupied by *Embelia tsjeriam-cottam* and *Rubia cordifolia* was also very much alike and thus in many beats and therefore were uniformly found. *Celastrus paniculatus* was however more hardy species, was found in shade and open areas like Lapti and Hajaridadar alike. Nearly 63 species of herbs, shrubs, climbers and trees were observed in association with those species, which included pure *Shorea robusta* patch, *Shorea robusta- Mallotus philipensis*, *Shorea robusta- Syzygium cumini* community (Table 2).

The threatened herb species was found in association with 23 plants (Table 3). Herbs like *Adiantum lunulatum, A. incisum, Triumfetta rhomboidea, Sida cordifolia, Curculigo orchioides, Emilia sonchifolia*, climbers like species of *Dioscorea* sp., *Asparagus racemosus* and *R. cordifolia* were also observed along with *Thalictrum foliolosum* on steep slopes (Fig. 6f.), semi shaded to no shade and well drained areas. *R. cordifolia* was found with this species in moderate shade areas only.

Table. 2. List of associate species of *Celastrus paniculatus, Embelia tsjeriam- cottam* and *Rubia cordifolia*

S.No.	Plant species	Local Name		Family
1.	*Asparagus racemosus* Willd.	Satavar	C	Liliaceae
2.	*Cissempelos pareira* L.	Padhin	C	Menispermaceae
3.	*Hemidesmus indicus* (L.) R. Br.	Anantmool	C	Periplocaceae
4.	*Peuraria tuberosa* (Roxb. ex Willd.) DC	Patalkumbhara	C	Fabaceae
5.	*Rubia cordifolia* Linn. Sensu Hook.f.	Manjishtha	C	Rubiaceae
6.	*Corchorus aestuans* L.		H	Tiliaceae
7.	*Curculigo orchioides* Gaertn.	Kalimusli	H	Hypoxidaceae
8.	*Desmodium gangeticum* (L.) DC.	-	H	Fabaceae
9.	*Indigofera* sp.	Birhul	H	Fabaceae
10.	*Thalictrum foliolosum* DC.	Mamira	H	Ranunculaceae
11.	*Triumfetta rhomboidea* Jacq.		H	Tiliaceae
12.	*Bauhinia vahlii* Wight & Arn.	Mahul	L	Caesalpiniaceae
13.	*Celastrus paniculatus* Willd.	Amjun	L	Celastraceae
14.	*Pavetta crassicaulis* Bremek.	Narisaya	L	Rubiaceae
15.	*Ventilago denticulata* Willd.	Keonti	L	Tiliaceae
16.	*Smilax zeylanica* Linn.	Potar	L	Smilacaceae
17.	*Colebrookia oppositifolia* Smith	Amera	S	Lamiaceae
18.	*Embelia tsjeriam-cottam* auct.non (R. &S.) A.DC.	Baibirang	S	Myrsinaceae
19.	*Lantana camara* L.	Barmasiya	S	Verbenaceae
20.	*Phoenix sylvestris* (L.) Roxb.	Chhind	S	Arecaceae
21.	*Solanum violaceum* Ortega	Janglibhata	S	Solanaceae
22.	*Vernonia cinerea* (L.) Cinerea		S	Verbenaceae
23.	*Vernonia divergens* Buch.-Ham.	Mogti	S	Verbenaceae

24.	*Woodfordia fruticosa* (L.) Kurz.	Dhawai	S	Lythraceae
25.	*Moghania strobilifera* Roxb.	-	S	Papilionaceae
26.	*Moghania semialata* Roxb.	Rahratti	S	Papilionaceae
27.	*Carissa spinarum* L.	Karonda	ST	Apocynaceae
28.	*Casearia elliptica* Willd.	Chilhi	ST	Flacourtiaceae
29.	*Casearia graveolens* Dalz.	Bhedi	ST	Flacourtiaceae
30.	*Cassia fistula* L.	Amaltas	ST	Caesalpiniaceae
31.	*Catunaregum spinosa* (Thunb.) Tirven.	Mainhar	ST	Rubiaceae
32.	*Helicteres isora* L.	Ainthi	ST	Sterculiaceae
33.	*Ixora arborea* Roxb.	Padpadi	ST	Rubiaceae
34.	*Albizia lebbek* (L.) Benth.	Basa	T	Caesalpiniaceae
35.	*Anogeissus latifolia* (Roxb.ex DC.) Wall.	Dhawa	T	Combretaceae
36.	*Bauhinia malabarica* Roxb.	Amti	T	Caesalpiniaceae
37.	*Bridelia retusa* Sprengel.	Kasai	T	Euphorbiaceae
38.	*Buchnania lanzan* Spreng.	Char	T	Anacardiaceae
39.	*Cassine glauca* (Rottb.) O.Kuntze	Jamrasi	T	Celastraceae
40.	*Diospyros melanoxylon* Roxb.	Tendu	T	Ebenaceae
41.	*Diospyros montana* Roxb.	Patwan	T	Ebenaceae
42.	*Dolichandron falcatum* (Wall. ex DC.) Seem.	Pandri	T	Bignoniaceae
43.	*Ficus benghalensis* L.	Bargad	T	Moraceae
44.	*Flacourtia indica* (Burm.f.) Merr.	Kakai	T	Flacourtiaceae
45.	*Glochidion velutinum* Wight	Kodha	T	Euphorbiaceae
46.	*Lagerstoemia parviflora* Roxb.	Lendia (Sejha)	T	Lythraceae
47.	*Lannea coromandelica* (Houtt.) Merr.	Gunja	T	Anacardiaceae
48.	*Mallotus philippensis* (Lamk.) Muell.	Rori	T	Euphorbiaceae
49.	*Miliusa tomentosa* (Roxb.) Sinclair	Kari	T	Combrataceae
50.	*Phyllanthus emblica* L.	Aonla	T	Euphorbiaceae
51.	*Pterocarpus marsupium* Roxb.	Beeja	T	Fabaceae
52.	*Schleichera oleosa* (Lour.) Oken.	Kusum	T	Sapindaceae
53.	*Shorea robusta* Gaertn.	Sal	T	Dipterocarpaceae
54.	*Stereospermum suaveolens* DC.	Garudphal	T	Bignoniaceae
55.	*Syzygium cumini* (L.) Skeels	Jamun	T	Myrtaceae
56.	*Terminalia alata* Heyne ex Roth	Saja	T	Combretaceae
57.	*Terminalia chebula* Retz.	Harra	T	Combretaceae
58.	*Xylia xylopyra* Willd.	Sure	T	Mimosoideae
59.	*Zizyphus mauritiana* Lamk.	Ber	T	Rhamnaceae
60.	*Zizyphus* sp.	-	T	Rhamnaceae
61.	*Radermachara xylocarpa* (Roxb.) K.Schum.	Katori	T	Bignoniaceae
62.	*Mangifera indica* Linn.	Aam	T	Anacardiaceae
63.	*Tamarindus indicus* Linn.	Imli	T	Caesalpiniaceae

C-climber; H-herb; L-liana; S-shrub; ST- small tree; T-tree.

Table 3. List of species found in association with *Thalictrum foliolosum* DC.

S. No.	Plant species	Habit	Family
1.	*Asparagus racemosus* Willd.	C	Liliaceae
2.	*Dioscorea bulbifera* L.	C	Dioscoreaceae
3.	*Dioscorea hispida* Dennst.	C	Dioscoreaceae
4.	*Dioscorea pentaphylla* L.	C	Dioscoreaceae
5.	*Rubia cordifolia* Linn. Sensu Hook.f.	C	Rubiaceae
6.	*Arthraxon* sp.	G	Poaceae
7.	*Bidens pilosa* L.	H	Asteraceae
8.	*Emilia sonchifolia* (L.) DC.	H	Asteraceae
9.	*Vernonia cinerea* (L.) Less.	H	Asteraceae
10.	*Ophioglossum* sp.	H	Ophioglossaceae
11.	*Adiantum philippense* L.	H	Adiantaceae
12.	*Adiantum incisum* Forsk.	H	Adiantaceae
13.	*Leucas aspera* (Willd.) Link.	H	Amaranthaceae
14.	*Commelina* sp.	H	Commelinaceae
15.	*Curculigo orchioides* Gaertn.	H	Hypoxidaceae
16.	*Corchorus aestuans* L.	H	Tiliaceae
17.	*Triumfetta rhomboidea* Jacq.	H	Tiliaceae
18.	*Sida cordifolia* L.	H	Malvaceae
19.	*Bauhinia vahlii* Wight & Arn.	L	Caesalpiniaceae
20.	*Embelia tsjeriam-cottam* (Roem. & Schult.) A. DC.	S	Myrsinaceae
21.	*Vernonia divergens* Buch.-Ham.	S	Asteraceae
22.	*Cyperus* sp.	Sedge	Cyperaceae
23.	*Catunaregum spinosa* (Thunb.) Tirvengadum	S or ST	Rubiaceae

C-climber; H-herb; L-liana; S-shrub; ST- small tree; T-tree.

Characterstics of soil in habitats of target species:

The chemical properties of the soil in sampled areas of Amarkantak and East Karanjiya ranges are shown in Table- 4 and 5 respectively. The results showed narrow difference in certain parameters like pH and organic carbon% while higher in electrical conductivity and nitrogen. The pH in Amarkantak ranged between 5.8-6.3, while it was 5.4-6.0 in East Karanjiya Range. Determination of EC showed results ranging between 7.74-15.51 mS/cm and 3.3 -5.81 mS/cm in Amarkantak and east Karanjiya Range respectively. The organic carbon% was analysed between 1.45-3.2% and 0.96-2.25% in Amarkantak and East Karanjiya range respectively. Available nitrogen was comparatively higher in Amarkantak with 463.4-693.24 kg/ha than in East Karanjiya where it was analysed between 336-555.7kg/ha and following the trend available phosphorus and potassium was also on higher level in Amarkantak Range having 36.03-59.4 and 728.8-1452.5 kg/ha. and East Karanjiya having 11.4-33.4 and 240-462.3 kg/ha. respectively. All the three available nutrients were found to be in high level of concentration in sampled areas in both the ranges except with potassium

touching the higher side of moderate level. The results thus exhibit the potential of all the sampled beats (with non-occurrence of one or other species) for supporting the populations of target species in both the ranges.

Table- 4 . Chemical properties of soil of sites with *Celastrus paniculatus, Embelia tsjeriam-cottam, Rubia cordifolia* and *Thalictrum foliolosum populations* in Amarkantak Range.

S. No.	Sites	EC	pH	Organic Carbon %	N/ha (Available)	P/ha (Available)	K/ha (Available)
1	Bhundakona	15.54±5.47	6.28± 0.49	2.32± 0.72	653± 67.25	59.44±75.62	1452.50±374.57
2	Bijauri	10.98±4.17	5.81± 0.23	1.89± 0.54	583.2±101.35	44.71±28.34	797.50±176.92
3	Damgarh	7.74±1.78	5.89± 0.22	1.61±0.66	463.4±112.04	48.39±36.27	937.5±353.41
4	Lapti	13.16±5.06	6.04± 0.37	1.45± 0.70	606.4±119.6	50.23±25.42	925.00±305.64
5	Pohdi	12.02±3.82	6.05± 0.22	3.20± 3.77	587.4±59.5	36.03±14.54	728.75±234.30
6	Umargohan	14.84±4.15	6.17± 0.38	2.10± 0.56	693.24±46.8	40.50±30.83	776.25±113.31

Values are mean with SD

Table- 5. Chemical properties of soil of sites with *C. paniculatus, E. tsjeriam-cottam, R.cordifolia* and *T. foliolosum populations* in East Karanjiya Range.

S. No.	Sample	EC (mS/ cm)	pH	Carbon %	Available N kg/ha	Available P kg/ha	Available K kg/ha
1	Kabir	5.81±0.43	6.0±0.68	2.16±0.53	555.7±52.8	28.7±7.82	729.17±109.21
2	Kharidih	3.33±0.22	5.5± 0.2	1.67±0.01	459.33±3.77	13.23±5.14	308.53±140.5
3	Hajaridadar	4.08±0.34	5.4±0.2	1.31±0.18	385.67±31.48	11.37±0.66	405.63±93.99
4	Bijauri	4.15±0.27	5.9±0.2	2.25±0.67	511.67±106.38	26.83±11.68	454.2±17.2
5	Chauradadar	4.675±0.05	5.9±0.2	1.74±0.12	492.5±46.5	26.6±2.05	462.3*
6	Dakshin Chauradadar	4.7±0.2	5.7±0.36	1.33±0.26	418.5±82.5	14.35±6.15	411.4*
7	Jagatpur	4.770.33	5.9±0.2	1.8±0.05	523.67±11.9	25.93±1.1	-*

Values are mean with SD; - = Very high; *high values could'nt be detected in replicates

4. People's participation from planning to implementation stage (with emphasis on their involvement in technology generation/ modulation/ transfer/ adoption; co-operative formations/ self help groups: gender perspective**):**

During the pilot survey the selected villages (based on the information of the local staff of forest department) a general meeting with inhabitants was done. Their dependence on the NTFP's was assessed and the availability was confirmed. The date of interface programmes were decided taking into consideration the agricultural works and maximum participation of villagers in the programme.

Four interface workshops to promote sustainable harvesting methods of NTFP's was conducted involving five villages Bhundakona, Umargohan (Figs. 7 a-f), Damgarh (Figs. 8a-f). and Barsot (Harratola) (Figs. 9a-f). in Amarkantak range in January 2011 and May, 2012 and in village Kharidih (Figs. 10a-f). in East Karanjiya range in January, 2011. The total number of beneficiaries at the programmes were 113 and 59 in Amarkantak and East Karanjiya range respectively (Annexure IV). The women participation was as much as 31%. Majority of the participants were members of Forest Protection Committees (FPCs). Participants' interest and understanding regarding conservation and role of NTFP's in livelihood was assessed by collecting information in questionnaire which had been analysed (a sample is enclosed as Annexure V).

Nearly 450 plants of nine medicinal plants viz. pudina, kali tulsi, bach, lemon grass, gwarpatha, adusa, giloy, aonla, harra and bel were distributed to the beneficiaries to encourage the homestead medicinal garden and plantation (of tree species like Harra and Bel) in village areas. The species distributed could be directly used by villagers in need.

The socio-economic details of the participants revealed that their major occupation is farming but the produce if enough for their subsistence only. They work as labourers in government schemes to supplement income for cash and from other sources like collection of tendu leaves, mahul leaves, aonla, harra, bahera, ratanjot, sal seeds, sal leaves, char, etc.

The agricultural practices have changed according to the villagers. The traditional crops of maize, millets like, kodo, kutki, dhan, arhar, jowar, urad, bajra, madiya, etc. has been sidelined by crops like wheat, soybean, masoor, chana, matar, peanut, ramtil, til, tiwra, sarson, etc. Few villagers grow their traditional crops. The shift has been cited by villagers as one of the longterm change that had occurred in last 2-3 decades. The longterm changes cited by the participants give insight to their understanding of nature and observant eye. The other changes cited are decline in rainfall period as well as volume, depleting water bodies, low germination in paddy, decrease in bamboo, beeja, saja, mahul, moya grass, etc. as local resource , increase in invasives like *Parthenium* and *Lantana camara*, *Ipomaea* sp. and trees like *Cassia fistula*, also development indicators like road, school, dam, tubewells, wells, ponds, metalled road, panchayat, population increase and forest degradation, etc. An important issue raised by a participant states that giving land inside forests as patta (piece of land) has increased accessibility and has shrinked demarcation of forests.

Contribution by women was almost 50 % in all five villages. The NTFP collected from the forests in both ranges include mahul leaves, tendu, sal twigs and sal seeds, aonla, harra, bahera has declined over the years and therefore does not yield enough produce. Chakora seeds have however, increased. Subsistence produce like Imli, koilar, char, mahua, bans, kachri, jamun and medicinal plants are collected for personal use. Wood of gunja, ghari, dumar for cultural use and fuelwood are sourced from forests. Among medicinal species baibirang, charmuhi (pilia), keokand, bach, jogilat, tikhur, kalimusli, kamraj, bhograj, mamiri, vanpyaz and baheda were collected by medicinemen and old knowledgeable villagers.

9. IMPACT ANALYSIS WITH INDICATORS (QUALITATIVE & QUANTITATIVE DETAILS; TECHNO ECONOMIC VIABILITY; IMPROVEMENT IN PRODUCTIVITY:

Figs. 7a-f Interface workshop on conservation and sustainable at workshop conducted at Bhundakona MPCA Amarkantak Range

Figs. 8a-f. Interface workshop conducted at Village Damgarh (Range Amarkantak) where women participation was significant and distribution of plants conducted

Figs. 9a-f. Interface workshop conducted at Barsot (Harratola) in Amarkantak range, where medicine men and women equally participated.

Figs. 10a-f. Interface workshop conducted at Kharidih, Karanjiya range, where medicine men and women equally participated.

QUALITY & QUANTITY/INCOME GENERATION/LIVING STANDARD/SKILL UPGRADATION & MANAGERIAL CAPABILITY/ENVIRONMENTAL CONDITIONS/PERSONNEL TRAINED AS THE CASE MAY BE): 500 words

NA

10. SPECIAL FEATURES (NEW TECHNOLOGY GENERATION/ INNOVATIVENESS IN TERMS OF LOW COST/DESIGN/ENVIRONMENTAL FRIENDLY ETC; REPLICABILITY POTENTIAL & MULTIPLIER EFFECT IN NEARBY AREAS): 300 words

Mapping of threatened and valuable useful plant species needs to be carried out in potential areas to presume their productivity and population. It also enables to assess the status of plants on regular intervals. The threats to their existence are determined during the process which will lead to timely mitigation measures.

The awareness programmes for village dwellers is necessary in forest fringe and forest villages to promote conservation and sustainable usage of natural resources which was earlier followed by them as part of their living. However, nowadays, the concept needs to be promoted among them so as to bring them back to their natural resource based living and adding supplement to their livelihood.

11. APPLYING FOR PATENT, IF ANY: No

12. INDICATORS APPLIED FOR MONITORING:

- Number of individuals, new seedlings/plantlets, flowering and fruiting.
- Interest of villagers in growing and conserving threatened medicinal plants and its use for personal purpose. (through PRA exercise)

13. FOLLOW UP ACTION (POST PROJECT): 300 words

1. A follow up visit to the villages where the sustainable harvesting techniques were demonstrated and medicinal plants distributed, will be done as and when funds are available to assess the impact and interest of participants.

2. The two ranges were surveyed and the assessment of the target species revealed their depleting state in forest beats where the population is still surviving. Also, there were sites that had comparable soil charactersitcs as well vegetation association, which encourages the possibility of rehabilitation of these species or enhancing their population further to strengthen and their soil was also tested for basic parameters. Thus, a proposal with an objective of restoring such sites and carrying out enrichment planting of these vulnerable species has been proposed under same scheme. The multiplication protocols for *Thalictrum foliolosum*, *Embelia tsjeriam-cottam* and *Rubia cordifolia* have been standardized by researchers. Under the Biosphere Reserve programme, state forest department has fenced certain areas in Amarkantak range, which fall in the potential sites as well. The planting stock will be prepared by the villagers and enrichment planting will also be done by the

participant villagers to get their involvement in conservation activity. It has been observed that villagers feel responsible for the activities that have been carried out by them or with their consent in and around their areas of habitation, thus confirming their stakeholders' rights on resources.

14. CONSTRAINTS & SUGGESTIONS: 300 words

- As the equipment purchase was finalized in March 2011, the coordinates of the localities were not taken during the Ist year sampling.
- The 2nd year grant was released late by nine months and the revalidation of previous year's balance was also not communicated which held up the work. As the work was field based the time of work is crucial and any delay leads to seasonal unavailability of target species and thus affects observations.
- At the first year review it was directed that 2nd year **delayed** funds (which were released after 7 months) may be used in the extended period. The extension was proposed to record observations for population dynamics study for the 2nd year at the marked plots. As the field based studies are seasonal and as extension were not granted the effort and initial observations will not be sufficient to infer the dynamics of the selected species.

15. CONCLUSION: 300 words

The outcome of the project has raised an important issue of declining population of medicinal plants and which has been corroborated by the socio-economic profile of the participants suggesting that the dependence on collection of NTFP's which was a source of income generation because the availability has declined and the search and collection efforts does not yield minimum a day's wages. This is particular to resource to medicinal plants raises an alarm as the area was an imported wild source of medicinal plants that includes the target species of this project.

Browsing has emerged as a major factor of low fruit yield despite of sufficient population of *Embelia tsjeriam- cottam* and hampers plant growth of *Celastrus paniculatus* and damages *Rubia cordifolia* regeneration as well. The study revealed the sites which has declining population and potential sites for restoration of these and like species for checking further depletion of these native threatened species which provided supplement source of income and medicine to villages around forests. More such to assess the status of populations of economically forest resources will allow timely intervention to protect remaining populations and initiate steps to enhance their area of occurrence to further areas.

Anthropogenic disturbances alter vegetation composition in a magnitude that changes association of species and even leading to local extinction of many species. Species that are pollinated by animals or insects are more vulnerable such changes than the species that are dispersed and pollinated by wind (Shankaar *et al.,* 2004. Among the target species of this study, *Thalictrum foliolosum* recorded few populations of still very small extant. It is pollinated by both insects and wind, and several locations in both the ranges can prove to be potential sites that can be rehabilitated.

Local ground forest staff has been involved in both the ranges and they have also been monitoring the villagers' dependence on forests as well as encouraging the villagers to

ensure protection of forests from fire and indiscriminate harvesting of NTFP's through FPC's. Thus, attention is needed from the government and local bodies towards enriching the empty forests with plantations and protecting from biotic pressure especially grazing and browsing.

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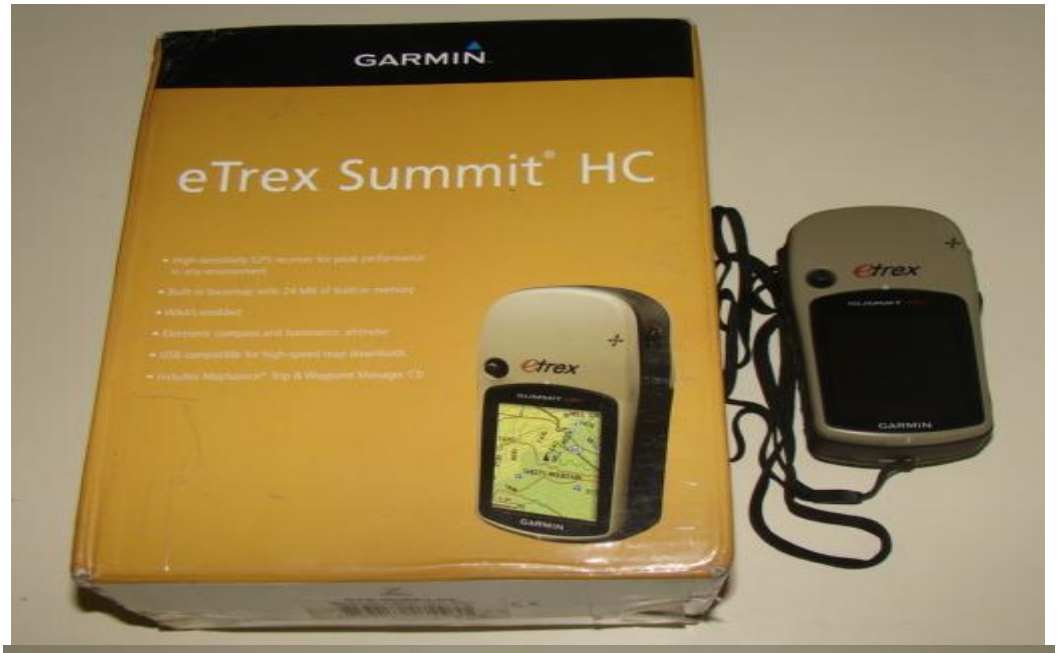
Annexure I



Instruments purchased under the project

Annexure II

Publications and abstracts published during the project period:

Sharma Ruby and Joshi, K.C. 2010. Status of medicinal plants in natural forests of Amarkantak and East Karanjiya Forest Range of Eastern Madhya Pradesh. National conference on Biodiversity Resources Management and Sustainable development, November 2010, Government M.S.Golwalkar College, Rewa (abstract).

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Sharma, R. and Roychoudhury, N. (2012). Mapping populations of threatened medicinal plant species in Amarkantak forest range in Madhya Pradesh. National Conference on Biodiversity Assessment, Conservation and Utilization, 9-11 February, 2012, Abasaheb Garware College, Pune, pp. 45-46 (abstract).

Roychoudhury, N., Sharma, R., Yadav, D. K. and Kushwaha, D.K. (2012). Achanakmar-Amarkantak biosphere reserve: a potential source of flora and fauna. National Conference on Forest, Environment and Climate Change: Issues and Challenges, January 30-31, 2012, Department of Forestry, Wildlife & Environmental Sciences, Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.), p. 56 (abstract).

Sharma, R. and Roychoudhury, N. (2012). Achanakmar-Amarkantak biosphere reserve. National Conference on Biodiversity & Biotechnology : Biological Resources Conservation Management and Sustainable Uses, March 13-14, 2012, Govt. M. S. Golwalker College, Rewa (M.P.), p. 23 (abstract of invited paper).

Yadav, D. K., Sharma, R.,., Kushwaha, D.K. and Roychoudhury, N. (2012). Diversity of grasses in Achanakmar-Amarkantak biosphere reserve. National Conference on Forest, Environment and Climate Change: Issues and Challenges, January 30-31, 2012, Department of Forestry, Wildlife & Environmental Sciences, Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.), p. 52 (abstract).

Annexure III

महत्वपूर्ण वृक्ष प्रजातियों के प्रर्वधन की जानकारी

क्र.	प्रजाति का नाम	स्थानीय नाम	पुनर्उत्पादन	फल लगने का समय	अंकुरण प्रतिशत (%)
1.	अजाडिरेक्टा इंडिका	नीम	बीज द्वारा गूटी, जड़ चूसक	जून–अग.	75–90
2.	आर्नोजिया ग्रेसीस	नगोड़ सिरस	बीज द्वारा	फर.–मार्च	80–90
3.	अल्बीजिया लेबेक	काला सिरस	बीज द्वारा	मार्च–अप्रै.	75–90
4.	अकेसिया कटेचु	खैर	बीज द्वारा	मि.–अक्टू.	75–80
5.	अकेसिया निलोटिका	बबूल	बीज द्वारा	अक्टूबर	90
6.	एमब्लीफैंजस एमला	आंवला	बीज द्वारा	सित.–अक्टू.	70
7.	एल्स्टोनिया स्केलारिस	खरोरा	बीज द्वारा	दिस.–मार्च	70
8.	एलेक्स रेक्सेन्स	मलाबार	बीज द्वारा, गूटी, जड़ चूसक	अप्रैल–मई	70–80
9.	इंगा डल्सिस	बो	बीज द्वारा	दिस.–अप्रै.	75–80
10.	मूटिया सोनरेपा	पलाश	बीज द्वारा, गूटी, जड़ चूसक	अप्रै.–जू.	70–75
11.	डैल्बेरजा सलाटारिकम	शीशम	बीज द्वारा	मार्च–मई	60–65
12.	बौहुनिया वेरेगेटा	कचनार	बीज द्वारा	मई–जून	70–80
13.	बॉसवेलिया सिरेटा	सलई	बीज द्वारा	मई–जून	80
14.	अडीनेंथिरा पि. पवुल्ल	करई	बीज द्वारा	फर.–मार्च	70
15.	युकलीप्टिस ग्लाब्लस	अधार	बीज द्वारा, गूटी, जड़ चूसक	अप्रैल–जून	80–90
16.	डीक्लीरोस्पर्मम सिलिंड्रिकम	गजगल	बीज द्वारा	मई–जून	80
17.	डलबेरिया सिस्टुला	अमलतास	बीज द्वारा	जून–गई	80
18.	ग्लाइरीडाइसीपियम सीपीयम	मिलं	बीज द्वारा	मई–जून	80
19.	ग्मेलाइना इंडिका	सेमरा	बीज द्वारा	जून–अग.	80–90
20.	मार्इकेलिया चम्पाका	चम्पा	बीज द्वारा	अग.–सित.	80–100
21	गेलाईना ऑरबोरिया	खमेर	बीज द्वारा, गूटी	मई–जून	70–80
22	जिमनोस्पोरिया मोंटिग्लेना	मकाई, वर्मी	बीज द्वारा	मार्च–जून	60
23	मिलाडीना पाटीकलोरा	डीन	बीज द्वारा	अक्टू.–अप्रैल	60–80
24	मिलिया अजाडिरेक	बकाईन	बीज द्वारा	दिस.–जू	80–90
25	हार्मोनिया बाइनेटा	अंजन	बीज द्वारा	अप्रैल–जून	70–100
26	होलोप्टेलिया इंटेग्रिफोलिया	चिरोंज	बीज द्वारा	मार्च–जून	80–90
27	हार्मेडिनिया बोडीकोलिया	हल्दू	बीज द्वारा	फर.–अप्रैल	80–90
28	पोन्गामिया पिन्नाटा	करंज	बीज द्वारा, गूटी	मार्च–जून	80–90
29	बोरिया रोक्सटा	साज	बीज द्वारा, गूटी	जून	70–80
30	माइरिस्टिका स्वुविनी	जायफल	बीज द्वारा, गूटी	अप्रैल–जून	70–80
31	रांसमिडा फेब्रीफ्यूजा	रोहन	बीज द्वारा	जून–अग.	70–80
32	सेटोनन ऑक्सम	धंगन	बीज द्वारा	अप्रैल–जुलाई	80–90
33	सेलीबारया एलाइटीरियम	सिलारा	बीज द्वारा	दिस.–मार्च	60–70
34	स्टरकुलिया यूरेन्स	कुलू	बीज द्वारा, जड़ चूसक	अप्रैल–जून	70–100
35	डायस्पायरोस मेलेनोक्साइलान	तेन्दू	बीज द्वारा	अप्रैल–जून	80
36	डलबर्जिया सिस्सु	सिस्सु	बीज द्वारा	दिस.–मार्च	60–80
37	टेक्टोनीलेस ग्रेंडाडस	सीसू	बीज द्वारा, ग्राफ्ट	अप्रैल–मई	70
38	डालबर्जिया लेटीफोलिया	शीशम	बीज द्वारा	जन.–अप्रैल	80–90
39	फाईलेन्थस एम्बिलिका	आंवला	बीज द्वारा	अक्टू.–दि	80–90
40	लानिया कोरोमंडेलिका	मोयन	बीज द्वारा	मई–जून	80–90
41	लेजरस्ट्रोमिया पार्वीफ्लोरा	लेंगिया	बीज द्वारा	दिस.–जन	80
42	टर्मिनेलिया एलेटा	साजा, साज	बीज द्वारा, गूटी	मई–मार्च	60–70
43	टर्मिनेलिया बेलिरिका	बहेरा	बीज द्वारा, गूटी	मार्च–अप्रैल	80
44	टर्मिनेलिया चेबुला	हर्रा	बीज द्वारा, गूटी	मई–मार्च	80–90

उष्ण कटिबंधीय वन अनुसंधान संस्थान, जबलपुर

संरक्षण के जरूरी उपाय

- नियंत्रित व उचित विधि से कटाई अथवा क्रमिक रूप से चयनित वृक्षों की कटाई जिससे वन वृक्ष विहीन न हो।
- वनों के आग हानिकारक उन सभी कारणों का जिनकी उपज मनुष्य की गतिविधियों से हो।
- कृषि व आवासीय निर्माण हेतु वनों के विनाश पर रोक। वन भूमि का अन्य किसी भी प्रकार के उपयोग हेतु विनाश मनुष्य जाति के लिए आत्मघाती है।
- वन रक्षण – पर्यावरणीय कारकों के द्वारा वनों को नुकसान से बचाया जा सकता है। इनमें पादप रोग, नए invasive species, प्राकृतिक मूल पादपों को नुकसान, खरपतवार की तरह पनपने वाले, पशु चरण से वन संरक्षित है।
- कुछ प्राकृतिक सुंदरता वाले वन क्षेत्रों का पर्यटन स्थल के रूप में विकास, राजस्व अर्जित करने का अच्छा साधन है जिसे वन संरक्षण के उद्देश्यों में उपयोग किया जा सकता है।
- वृक्षारोपण – इसे नियमित व आवश्यक प्रक्रिया के रूप में किया जाना चाहिए। काटे गये वृक्षों के अनुपात से व प्रजाति वार वृक्षारोपण वनों की दशा में सुधार का प्रभावशील माध्यम हो सकता है। बहुउपयोगी वृक्षों को बढ़ावा दिया जाना चाहिए व मिश्रित प्रजातियों का प्रयोग किया जाना चाहिए।
- जैविक घटकों का सतत उपयोग व प्रबंधन।

उपयोगी पौधों का संरक्षण

संग्रहण विधि के सिद्धांत –

संग्रहण का मान व दर इस तरह निर्धारित होने चाहिए कि–

- उसकी दीर्घ कालीन उपलब्धता, जीवन क्षमता व गुणवत्ता प्रभावित न हो।
- संग्रहण उसके प्रवर्धन क्षमता से कम न हो जिससे भविष्य में इसकी संख्या प्रभावित न हो।
- संग्रहित की जाने वाली प्रजाति के बारे में निम्नलिखित जानकारी होना आवश्यक है।

मात्रा/विकास/दर/क्षमता/प्रवर्धन	आयु
समय सारणी	आवृत्ति
घनत्व	अच्छी संग्रहण पद्धति

उष्ण कटिबंधीय वन अनुसंधान संस्थान, जबलपुर

Sample of posters prepared for interface programmes

Annexure IV

कार्यशाला दमगढ़ 6 जनवरी 2011

क्र.	नाम व पिता का नाम	गाँव	हस्ताक्षर
1.	विजयसिंह / श्यामलाल	दमगढ़	[illegible]
2	पंचमसिंह / गोपाल सिंह	"	पंचमसिंह [illegible]
3	रामदीनसिंह / प्रतापसिंह	"	रामदीन
4	रेवासिंह / लक्ष्मणसिंह	"	रेवासिंह
5	विस्सू / मंगल [illegible]	"	[illegible]
6	अमीरसिंह / सुखरामसिंह	"	
7	राम कृपालसिंह / भीमसिंह	"	रामकृपालसिंह
8	बेसाहूसिंह / घासपालसिंह	"	बिसाहूसिंह
9	बिरेन्द्रसिंह / जगदासिंह	"	बिरेन्द्र सिंह
10	अजासिंह / मोहनसिंह	"	अजयसिंह
11	धीरसिंह / सुखरामसिंह	"	[illegible]
12	नरबदासिंह / भारतसिंह	"	फूलवतीबाई
13	गीताबाई / टीकमसिंह	"	[illegible]
14	गुलाबवती / सेजराज	"	[illegible]
15	सुधरतबाई / छोटेलाल	"	
16	विदयाबाई / रघुवीरसिंह	"	
17	राम कलीबाई / सोमनाथ	"	
18	फूलवतीबाई / उदमसिंह	"	फूलवतीबाई
19	सुरीबाई / सहदेवसिंह	"	
20	पंकजिमाबाई / श्यामलाल	"	तुलसीबाई
21	तुलसीबाई / रामप्रकाश	"	
22	मोहिनबाई / जितनसिंह	"	
23	बसन्तबाई / मंगल यादव	"	
24	अनितादेवी / कीर्तनसिंह	"	अनीता
25	सानतीबाई / ओरशसिंह	"	शान्ती बाई
26	मीराबाई / लक्ष्मण यादव	"	
27	गोपीनबाई / संचरिह यादव	"	
28	इमरतीबाई / कीर्तनसिंह	"	
29	सरतियाबाई / रामदीनसिंह	"	

Delivered lecture on Sustainable harvesting of medicinal plants of Biosphere Reserve at one day workshop conducted at Kanan Pendari, Bilaspur on 26th October 2010 for forest field staff of Achanakmar-Amarkantak Biosphere Reserve by the Institute

Delivered lecture on Medicinal plants of Biosphere Reserve, their uses and their conservation at one day workshop conducted at Bilaspur on 3rd March 2012 for forest field staff of Achanakmar-Amarkantak Biosphere Reserve by the Institute