The experience of Forest Landscape Restoration in Madhya Pradesh, India

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HIGHLIGHTS

- Under FLR, 150 ha of degraded forest landscape has been subject to active community participation.
- In the process of restoration of degraded forests, 1350 person-days were involved which helped the participating communities during lean months of the year.
- Regeneration of NTFP species such as *Asparagus racemosus*, *Chlorophytum borivilianum, Emblica officinalis* showed the effectiveness of restoration measures in promoting biodiversity conservation.
- Sowing fodder grass has been found to be a useful intervention offering nearby communities green fodder on cut and carry basis.
- FLR can be part of climate change adaptation and mitigation strategies.

SUMMARY

The concept of Forest Landscape Restoration (FLR) is highly relevant to the Indian context as it is a cost-effective option to cover large degraded forests rapidly. It envisages adopting a holistic view of greening that goes beyond tree planting in order to attain the goal of carbon sequestration and biodiversity enhancement through ecosystem restoration while at the same time developing the socio economic security of tribal communities.

This paper details the implementation of an FLR initiative in three demonstration plots in Sheopur and Dindori, Madhya Pradesh which are the homes of the Sahariyas and Baigas tribes, with a focus on restoration and effective community engagement.

Preliminary observations have produced promising results in terms of social engagement and financial income generated from the harvest. In addition soil and moisture conservation through the adoption of 400–500 saplings/ha indicate a rapid greening and significant carbon sequestration.

Keywords: degradation, Forest Landscape Restoration, livelihood, PVTGs, community engagement

Expérience de la restauration du paysage forestier au Madhya Pradesh, en Inde

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Le concept de restauration du paysage forestier (FLR) est très pertinent dans le contexte indien, étant à même d'être une option financièrement favorable pour couvrir les forêts dégradées rapidement. Il envisage d'adopter une vue holistique du verdissement, allant bien au-delà de la seule plantation d'arbres pour atteindre le but de la séquestration du carbone et le soutien de la biodiversité à l'aide d'une restauration de l'écosystème, tout en développant la sécurité socio-économique des communautés tribales.

Ce papier détaille la mise en œuvre d'une initiative de FLR dans trois sites de démonstration au Sheopur et au Dindori, au Madhya Pradesh, foyer des tribus Sahariyas et Baigas, avec une attention particulière accordée à la restauration et à un engagement efficace avec la communauté.

Des observations préliminaires on produit des résultats prometteurs en termes d'engagement social et de revenus financiers générés par la récolte. De plus, la conservation du sol et de l'humidité grâce à l'adoption de 400 à 500 jeunes arbres/ha indiquent un verdissement rapide et une séquestration de carbone importante.

La experiencia de la restauración del paisaje forestal de Madhya Pradesh en la India

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El concepto de Restauración del Paisaje Forestal (RPF) es muy pertinente en el contexto indio, ya que es una opción rentable para cubrir rápidamente grandes bosques degradados. Propone adoptar una visión holística de la ecologización que vaya más allá de la plantación de

árboles para alcanzar el objetivo de secuestro de carbono y mejora de la biodiversidad mediante la restauración del ecosistema, al tiempo que se desarrolla la seguridad socioeconómica de las comunidades tribales. Este artículo detalla la implementación de una iniciativa de RPF en tres parcelas de demostración en Sheopur y Dindori (Madhya Pradesh), que son los hogares de las tribus Sahariyas y Baigas, con un enfoque en la restauración y la participación efectiva de la comunidad. Las observaciones preliminares han arrojado resultados prometedores en términos de participación social e ingresos financieros generados por los aprovechamientos. Además, la conservación del suelo y la humedad mediante la adopción de 400-500 brinzales/ha indica un rápido reverdecimiento y una captura de carbono importante.

INTRODUCTION

Forest Landscape Restoration (FLR) offers a sustainable solution to reduce emissions, sequester carbon and enhance human and environmental resilience in order to cope with the expected impacts of climate change (UNCCD 2017).

The impacts of climate change are visible on forest landscapes both directly and indirectly. Drying of landscapes due to erratic rainfall, heat waves and recurring forest fires are limiting the benefits from ecosystem services. Indirectly, crop failure is forcing local populations to resort to unsustainable harvesting and use practices of NTFPs. This is particularly true of the most primitive tribal communities having no other safety net to ward off climate driven disasters. This trend of unsustainable extraction and use has resulted in biodiversity decline of important NTFP species. Cumulatively these and many others factors are contributing to forest land degradation.

Forest Landscape Restoration is a well thought-out strategy for regaining ecological functionality and enhancing human wellbeing, and issue that is particularly important given the high current rate of deforestation.

Madhya Pradesh, in India, has recorded forest cover of 7.8 M ha of which 3.6 M ha is reported to be under different stages of degradation (Forest Survey of India Report 2019) with open and degraded forests in the state having increased over the last 10 years. The State Forest Department Govt. of Madhya Pradesh undertakes FLR over an area of 60,000 ha of degraded forest for restoration each year but the status of open and degraded forest is still increasing indicating that labor and technology alone may not cope-up with the increasing pace of forest degradation.

The task of restoration is huge and may require significantly more resources and efforts to restock the entire degraded forestlands. In order to cover such a large tract of degraded forests, the state Government has issued notification eliciting the involvement of NGOs and other civil society organizations who may have access to corporate funding in order to join the major task of FLR. Such organizations are expected to be effective social mobilizers and thus could bridge the gap between community and forest department for speedy restoration of degraded forest areas. The willing voluntary organizations are required to have tri-partite arrangements with the local forest department and communities in order to prepare a micro-management plan for the area in order that the priorities of the forest department and communities are addressed through ecological, social and economic improvement. Such a strategy also needs to focus on strengthening of community institutions such as women self-help groups (WSHGs) and JFMCs through capacity building for inclusion in planning, implementation, equitable sharing of benefits, participatory monitoring and evaluation.

Forest degradation is often associated with decline of NTFP resources and subsequent reduction in household income of forest dependent communities. Until the 1990s, NTFP resources supported about 30% of household requirements of tribal populations, which was almost equal to agriculture income. Climate change coupled with other anthropogenic pressure led to reduction in household income by 10–92%. (Prasad and Sharma 2014).

The FLR approach received renewed attention at the beginning of the 21st century in terms of regaining the ecological functionality of deforested and degraded areas (Cesar *et al*. 2021). The FLR approach included interventions that addressed enhancement of local livelihoods, ecosystem services (ES), and biodiversity conservation at the landscape scale and is currently viewed as an element of "Nature-based Solutions", designed to address complex socio-environmental problems.

According to GLF (2014), landscape based restoration recognizes the interactions between stakeholders and multiple land users by integrating them into a joint management process. The landscape approach brings together actors who identify and implement practices to achieve an optimal balance of ecological, social, and economic benefits from forests and agricultural landscapes (GPFLR 2014).

FLR has been hailed as the solution to various intertwined crises, including climate change, biodiversity collapse, land degradation, water crises, food insecurity and rural poverty (Pörtner *et al*. 2021, Weigent *et al*. 2022). FLR entails the restoration of multifunctional landscapes that, depending on local circumstances, may include large natural forest, grassland, peat land and coastal ecosystems, as well as smaller forest patches, riparian zones, agro-forestry and remnant trees in non-natural landscapes (Chazdon *et al*. 2016, Temperton *et al*. 2019). In recent decades, FLR has evolved from a process that focused mainly on biophysical aspects to one that deals with social and livelihood dimensions as well (Ota *et al*. 2020). The focus of many restoration efforts is on simultaneous improvement of ecological integrity and connectivity and, the strengthening of nature's contributions to people (Díaz *et al*. 2018) at the landscape level (Holl 2017). Restoration at the landscape level, where a mix of land uses and competing claims exists, is arguably more challenging than conservation alone, and requires active interaction between actors across governance levels to identify and implement restoration pathways (Wilson and Cagalanan 2016, Mansourian *et al*. 2019).

The State Forest Department and the Govt of Madhya Pradesh are undertaking various FLR initiatives through two major schemes, the Green India Mission (GIM) and the National Afforestation Program (NAP). While NAP is implemented for afforestation of degraded forestlands, GIM aims at improving the quality of forests and increasing forest cover as well as cross-sectoral activities on a landscape basis.

Assisted Natural Regeneration (ANR) is a blend of active community participation and restoration, and passive planting and sowing in order to hasten the process of restoration. Local communities participate to help native vegetation particularly NTFPs, which they traditionally collect and which have declined due to their own unsustainable practices.

This FLR project was initiated in primitive tribal dominated areas and therefore the success of restoration was determined by an approach which included the communities from planning stage itself.

METHODOLOGY

Location Details

Sheopur (25.7309° N, 76.9182° E) lies in northern part of Madhya Pradesh (*Figure no.1 map of Madhya Pradesh*) with the major river of Chambal passing on its northern most boundary. The area is dotted with ravines which are known for their infertile terrain, water scarcity and frequent droughts making farming almost impossible. The forest area of Sheopur forms the extended catchment of the Chambal ravines.

The area is dry with an average rainfall of 940 mm. Summer temperatures vary from 42°C–45°C and in winter the range is 14–16°C. In the climate vulnerability index it is rated as a highly vulnerable district.

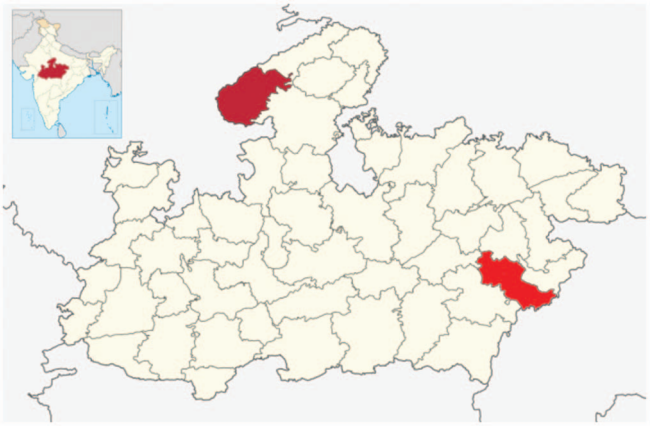
Away from the river, the sand and silt deposit provide very good growing condition for dry deciduous forests, with valuable timber and non-timber resources. Amongst the important medicinal plants and NTFPs in the area are Mahua (*Madhuca longifolia*), Salai *(Boswellia serrata*), Guggal (*Commiphora wightii*), Kullu (*Sterculia urens*), Aonla (*Emblica officinalis*), Satavar (*Asparagus racemosus*), and Achar (*Buchanania lanzan*) Bael (Aegle marmelos) Safed mushli (Chlorophytum borivilianum) Gudmar (Gymnema sylvestre).

Sahariyas are the major tribal community of the district and they are part of the Particularly Vulnerable Tribal Groups (PVTGs), a groups that depends on forests for half of their household needs throughout the year. Sahariyas collect a variety of NTFPs, which account for 50–60% of their household needs.

The Sahariyas have enjoyed the privilege of informal tree tenure in respect of Salai (*Boswellia serrata*), a gum-yielding tree and Mahua flowers for brewing the heritage drink (wine).

Dindori district lies between 22.8457° N, 81.0755° E and is one of the most remot districts in eastern Madhya Pradesh (*Figure 1*). It forms part of the major catchment of the Narmada River arising from Amarkantak and draining into the Bay of Bengal. The district has very fertile black cotton soil with lateritic patches on the higher hills and plateaus. Sal

FIGURE 1 *Map of Madhya Pradesh highlighting Sheopur and Dindori*



trees (*Shorea robusta*) and moist and dry deciduous species dominate the forests. The average rainfall of the district is 1450 mm. The ruling summer's temperature is 35°C and in winters 12–15°C.

The districts harbour a number of important medicinal plants and NTFPs including Harra, Baheda (*Terminalia chebula and T bellirica*), Aonla (*Emblica officinalis*), Satavar (*Asparagus racemosus*), and Achar (*Buchanania lanzan*).

The Baiga tribe of Dindori, who were hunting and gathering communities until the 1970s, are the major tribal community and also belong to the PVTGs. They collected a variety of NTFPs which account for 50–60% of their household income.

RESTORATION PLAN

While the State Forest Department emphasizes conservation and meeting environmental commitments, local people's interest lie mostly in the direct benefits through collection and use of NTFPs for their sustained livelihoods. Therefore, interventions are deemed necessary to incentivize community participation, as they are key to the success of attaining the goal of faster greening of the degraded and dry forest patches. The planting of palatable grasses and other NTFP species, which can be available for harvest in first year, have been provided at the planning stage in order to assure the communities that a micro-management plan has taken into consideration their immediate livelihood needs vis-à-vis the regaining of ecosystem services.

Preparation of the micro-management plan

The micro-management plan was prepared in consultation with local Joint Forest Management Committees (JFMC) for Sheopur Forest Division (*Panwara* and *Goras villages)*. Similarly, the micro-management plan for Dindori (Dhurkuta and Kandawani forest villages) was also prepared and was approved by the local divisional forest officer. The deliberations of the JFMC committees had the representation of front line foresters who guided the communities. The women members

had a say in the plantations of the relevant NTFP species and their harvesting schedule. The most important NTFP species were given due priority in supplementary planting and sowing activities to enrich the degraded areas and assist in regeneration of deficient areas.

Sowing of palatable grasses for cattle took place in the first year along with planting of some other NTFPs and medicinal plant species such as Giloy (*Tinospora cordifolia*), Kewanch (*Mucuna pruriens),* Satavar (*Asparagus racemosus*), Safed musli (*Cholrophytum borivilianum)* and Aonla (*Emblica officinalis*), Drumstick (*Moringa olifera*). The willing cooperation of the groups began yielding benefits such as fodder grass and some early yielding NTFPs and, with increased partnership in planning and benefit sharing, appeared to enthuse the communities.

SITE SELECTION

A total of 150 ha area was selected at three different sites. One forest patch of 50 ha in the dry deciduous forests of Sheopur (Goras and Panwara villages), and two patches each of 50 ha in Dindori forest division (village Dhukutta and Kandawani), were taken up for restoration in consultation with the respective Divisional Forest Officers of Sheopur and Dindori and local JFMCs.

The selection of sites was guided by the richness of biodiversity in the area, the existence of watering throughout the year (for the purpose of year round monitoring), the existing biotic pressure as a possible factor responsible for site degradation, soil conditions and willingness of the local community. Soil testing to collect data on soil fertility was also carried out in order to highlight nutrient cycling through strict fire control measures.

Field implementation

With active community participation, the following interventions were planned for field implementation of the FLR:

Soil and water conservation – Construction of soil and water conservation structures are necessary to arrest soil erosion and facilitate percolation of rainwater. Run-off from forests also partly helps to fertilize agricultural land in the catchment and aids in the establishment of emerging seedlings and saplings, thus assisting in the establishment of natural regeneration. Earth and loose boulders structures (3m x 0.5m x 0.6m) were constructed to arrest soil erosion – 20 structures in Sheopur and 40 in Dindori. The construction of check dams reduced the velocity of runoff water and helped to trap silt and soi, thus promoting vegetation growth upstream. The structures are shown in Figure 2.

Site preparation for planting – A pit size $1m^3$ was employed, with added soil from nearby nala (rich in compost) and organic manure added before planting.

Grass seed sowing – Sowing of palatable grass took place between planted rows as well as on the periphery to be used as cattle fodder.

FIGURE 2 *Bolder check-dam construction*

Assisted Natural Regeneration – Adoption of promising seedlings and saplings was undertaken with a focus on regeneration of NTFP species through ANR. This process involved practices such as cutting back of malformed growth and adoption of promising seedling/sapling as a future crop, soil and water conservation, protection from grazing and fire, and frequent cleaning and weeding.

Setting up of in-situ nurseries for replacement due to mortality

Seed collection and seed bank of NTFP species for future multiplication. Plantation were established of *Mucuna pruriens*, *Tinospora cordifolia*, *Chlorophytum borivilianum, Asparagus racemosus, Moringa oleifera, Emblica officinalis*, *Sterculia urens* and *Terminalia bellirica*. The list of species includes those promising early harvest (1–2 years) as well as those tree species which have high NTFP values.

Protection and Maintenance through grass cutting for fodder, soil improvement and moisture conservation around adopted plants. Frequent monitoring of survival and growth of the plants also took place.

A draft restoration plan was prepared for discussion with community's front line foresters and other stakeholders. After four visits to the proposed sites and three general bodies, meeting of JFMCs and local forest officers, the final restoration plan was prepared. In order to reflect the aspirations of women members, a sub- women group was constituted by the JFMC, with female members of the implementing agency (SRPDR) assisting them.

ECOLOGICAL ASSESSMENT

Three Conservation, Assessment, Management and Planning workshops (CAMP) took place, two in Sheopur Forest Division (district) and one in Dindori Forest Division (district) organized jointly with TERI SAS University, New Delhi under the technical guidance of IUCN India. The CAMP workshops highlighted the current ecological status of the most

collected and traded NTFP species. Communities, traders, foresters, academics and voluntary organizations deliberated the status of the species. During the workshop, 22 species in Sheopur and 10 species in Dindori were prioritized based on the extent of use, commercial importance and demand in the market. Observations on aspects such as habitat of occurrence, collection intensity, market value were drawn. It was discovered that some species such as *Asparagus racemosus*, *Emblica officinalis*, *Buchanania lanzan*, *Chlorophytum borivilianum* and *Commiphora wightii* have declined by 80–90% in the wild since 2010. *Sterculia urens* and *Aegle marmelos* and *Anogeissus latifolia* were reported to have declined by 50% in the past two decades. The major causes of decline of these species are high biotic pressure, ignorance of sustainable harvesting practices, destruction of habitat, decreased natural regeneration and destructive harvesting. Some species such as *Boswellia serrata*, *Terminalia chebula* and *Terminalia bellarica* are also declining in the natural forest due to top-drying, absence of natural regeneration and excessive tapping/over exploitation. During the ecological assessment, it was evident that the major economically important species such as Salai (*Boswellia serrata*), Harra (*Terminalia chebula*), Baheda (*Terminalia bellirica*), Safed Musli (*Chlorophytum borivilianum*) and Anola (*Emblica officinalis*) are also becoming more scarce. With declining NTFP and unsustainable agriculture practices, the village community is often compelled to migrate to the towns and nearby states in the search a means of sustaining their livelihoods.

RESTORATION PROCESS AND IMPACTS

In Demo plot 1 (Sheopur), in order to assess the floristic composition of important NTFP species, 10 sample plots of different sizes were established and a detailed enumeration of vegetation was carried out. This was done through transect walks on transect lines 200 m apart. Species were enumerated on both the left and right side of the Transect. The findings are summarized in Table 1.

Table 1 indicates that there were seven species with established saplings in the degraded but protected patches. However, with the exception of two economically important NTFP

TABLE 1 *Plant Bio-Diversity status before and after FLR intervention*
Demo Plot – 1, Sheopur (Goras village)

S. no	Local/Common name of Plant	ScientificName	before intervention (Plants/ha)	No. of Plants/ha post intervention		
				Planted (Number/ha)	Adoptedthrough ANR (Number/ha)	Total
1	Kureta	*Holarrhena flribunda*	350	-	-	350
2	Baheda	*Terminalia bellirica*	50	-	4	54
3	Salai	*Boswellia serrata*	50	2	7	59
4	Siris	*Albizia procera*	400	-	-	400
5	Sisham	*Dalbergia sissoo*	200	-	-	200
6	Chirol	*Holoptelea integrifolia*	100	-	-	100
7	Palas	*Butea monosperma*	150	-	6	156
*8	Asparagus	*Asparagus racemosus*	-	5	15	20
*9	Safed Mushli	*Chlorophytum borivilianum*	-	4	18	22
*10	Kullu	*Sterculia urens*	-	8	4	12
*11	Chironji/Achar	*Buchanania lanzan*	-	2	4	6
*12	Mahua	*Madhuca longipolia*	-	2	6	8
*13	Guggal	*Commiphora wightii*	-	10	2	12
*14	Gudmaar	*Gymnema sylvestre*	-	4	-	4
*15	Giloy	*Tinospora cordifolia*	-	4	-	4
*16	Aonla	*Emblica officinalis*	-	10	8	18
*17	Khair	*Acacia catechu*	-	10	5	15
*18	Karanj	*Pongamiapinnata*		2	-	2
*19	Seetafal	*Annona squamosa*		2	-	2
Total			**1300**	**65**	**79**	**1444**

Available Plants per ha **1300+144 = 1,444 (9.97% increase)**

B - Demo plot 2 (Kandawani in Dindori)

Plant Bio-Diversity status before and after FLR intervention is summarized in Table – 2 for Kandawani and in Table – 3 for Dhurkuta demo plots (2 & 3 respectively)

species, namely Salai (*Boswellia serrata)* and Baheda (*Terminalia bellerica*), the other five species could be considered in either the timber or fuel wood categories. The plants of these 7 species were sparsely distributed in about 25 ha area. The total number of natural saplings were 1300/ha. For such a tropical dry forests, these numbers are not sufficient to provide uniform site protection. Furthermore, many species grow as shrubs and as under story plants. Only four species, Chirol, Siris, Sisoo and Salai, are tree species, which account for a total tree population of about 50% (750/ha) and are concentrated in a few well protected and moist places.

In the blank areas measuring about 20 ha, 3660 plants (183/ha) from 12 NTFP species were planted with a view to harvesting in the next 2–10 years. The selection of these species was carried out on the basis of their economic importance decided by consultation with communities and frontline foresters.

In addition to naturally established plants and planted saplings, 79 plants were adopted through selection of robust growing saplings/coppice shoots from a cut tree trunk through the process of ANR. These plants adopted from the malformed growing stock were scattered throughout the landscape spread over of about 40–50 ha. Thus, the area of 50 ha had a final population of 3660 plants. At the end of the rainy season there was a mortality of 42 plants (2 plants/ha), which were replaced in August 2022. Further mortality of 2–3% is likely during the extreme summer which may be replaced during following rainy season.

Seeds of palatable grasses were procured from the Indian Grassland and Fodder Research Institute, Jhansi, Uttar Pradesh.

In demo plot 2 of 50 ha, in Kandawani village, Dindori forest division (Table 2), the existing plant diversity was represented by 15 species, with a well-established plant population of 931/ha. In order to ensure community participation, 75 plants/ha were additionally planted. Within the individual that struggled, 322 plants/ha were adopted through ANR, which were mostly those with high NTFP values. Currently, this area now has 1328 plants/ha, which represents an increase of 29.89% in terms of plant density/ha. These are observations at the end of first rainy season where work included activities such as soil and water conservation, cutting back of malformed coppice growth, assisting natural regeneration are improving plant vigour. The conservation activities are being maintained and in the next rainy season soil and water conservation and protection activities will continue.

Data on the distribution of natural plant diversity and resulting plant population through supplementary plantation and ANR operations are given in Table 3, which indicates that 1169 plants/ha were present, represented by 18 main species of timber and non-timber values. There were also 35 plants/ha that were additionally planted and 288 plants/ha were adopted through ANR. Through this approach the existing plant number

TABLE 2 *Plant Bio-Diversity status before and after FLR intervention*
Demo Plot – 2, Dindori (Kandawani village)

S. no	Local/Commonname of Plant	ScientificName	before intervention (Plants/ha)	No. of Plants/ha post intervention		
				Planted (Number/ha)	Adopted throughANR (Number/ha)	Total
1	Harra	*Terminalia chebula*	15	5	12	32
2	Tendu	*Diospyrus*	20	-	5	25
3	Achar	*Buchanania lanzan*	25	10	30	65
4	Aonla	*Emblica officinalis*	10	12	14	36
5	Kullu	*Sterculia urens*	2	-	2	4
6	Bael	*Aegle marmelos*	3	2	2	7
7	Safed Musli	*Chlrophytum*	76	6	105	187
8	Malkangni	*Celastrus paniculatus*	10	6	25	41
9	Bhilwa	*Semecarpus anacardium Linn.*	12	-	15	27
10	Dhawai Phool	*Woodfordia fruticosa*	150	12	42	204
11	Bach	*Acorus calamus*	11	10	16	37
12	Menhar	*(Randia dumetorum)*	259	-	14	273
13	Amaltas	*(Cassia fistula)*	168	-	10	178
14	Dhawai	*(Woodfordia fruiticosa)*	49	4	12	65
15	Vai-vidang	*(Embeliatsjeriam cottam)*	121	8	18	147
Total			**931**	**75**	**322**	**1328**

Available Plants per ha **931+397 = 1328 (29.89% increase)**

C - Demo plot 3 (Dhurkuta in Dindori)

TABLE 3 *Plant Bio-Diversity status before and after FLR intervention*

S. no	Local/Common name of Plant	ScientificName	before intervention (Plants/ha)	No. of Plants/ha post intervention		
				Planted (Number/ha)	Adoptedthrough ANR (Number/ha)	Total
1	Harra	*Terminalia chebula*	20	05	5	30
2	Tendu	*Diospyrus*	17	-	8	25
3	Achar	*Buchanania lanzan*	37	8	14	59
4	Aonla	*Emblica officinalis*	15	10	9	34
5	Kullu	*Sterculia urens*	1	-	5	6
6	Bael	*Aegle marmelos*	2	-	2	4
7	Safed Musli	*Chlorophytumborivilianum*	84	04	16	104
8	Malkangni	*Celastrus paniculatus*	14	-	74	88
9	Bhilwa	*Semecarpus anacardium linn*	8	-	19	27
10	Dhawai Phool	*Woodfordia fruticosa*	110	-	35	145
11	Bach	*Acorus calamus*	13	-	21	34
12	Menhar	*(Randia dumetorum)*	241	-	30	271
13	Amaltas	*(Cassia fistula)*	146	-	17	163
14	Dhawai	*(Woodfordia fruiticosa)*	41	-	10	51
15	Vai-vidang	*(Embelia tsjeriam cottam)*	151	-	9	160
16	Baheda	*Terminaliabellirica*	122	04	02	128
17	Mahua	*Madhucalongifolia*	15	02	05	22
18	Jamun	*(Syzygium cumini)*	132	02	07	141
Total			**1169**	**35**	**288**	**1492**
Available Plants per ha					**1169+323 = 1492 (21.64 % increase)**	

of 1169 was increased to 1492 plants/ha (an increase of 21.64%) most of which are now a source of NTFP collection by local communities. Soil and water conservation measures resulted in creating a hospitable habitat condition for better plant growth, and existing biodiversity was strengthened and community participation ensured by incorporating NTFP yielding species in the restoration plan.

ENHANCEMENT OF CARBON SEQUESTRATION POOL

Through the increase in the plant population it is likely that the ability of the area to increase its carbon sequestration has improved. Measurements will take place in the future.

ECOLOGICAL FUNCTIONALITY

There has been a clear improvement in habitat conditions through the prevention of soil erosion and also water conservation measures undertaken via check dams (Figure 2). The arrestment of soil was assessed at 1.3–1.6 tonnes/ha in demo plots in Dindori (Kandawani) and 0.6 tonnes/ha in Sheopur. The sprouting of dormant seeds and seedlings of *Asparagus recemosus* are also emerging (Figure 3) and other rhizome plants such as Safed musli (*Chlorophytum borivilianum*).

FIGURE 3 *Regeneration of Asparagus racemosus in Sheopur*

LIVELIHOOD IMPROVEMENTS

The highlighted restoration interventions have brought positive results as reflected in all three demo plots in Sheopur and Dindori. The interventions of the project were planned in such a way that the community, who were involved through participatory planning and implementation, benefitted in the first year of intervention itself. The observations on greenery, survival and growth after one rainy season (three months after planting) showed over 95% survival and signs of establishment regeneration.

Three months after the implementation of final restoration plan, the roots and rhizomes of medicinal plants such as *Chlorophytum borivilianum, Randia dumetorum, Curcuma*

longa, Curculigo orchioides and *Curcuma angustifolia Roxb* appeared to be carpeting the forest floor thereby improving its biodiversity value. These plants are valuable medicinal plants, which contribute INR. 20-25,000 to each household.

Grass seeding in the blank patches contributed green fodder for cattle – the dry and derelict surface of degraded patches of Goras and Panwada in Sheopur forest division was a boon for milch cattle owners. The Sheopur site was highly degraded, dry with many natural grasses, which are not useful as cattle fodder. The palatable grass sowing and access to villagers for sustainable grass removal contributed INR. 20-25000/household because of higher milk yield sampled from 60 villagers who owned milch cattle.

In Dindori the overall habitat conditions are more hospitable with good soil and moderately high rains of 1450 mm. Against this, Sheopur annually receives about 750 mm rains. As such, the grasses in Dindori forests are not harvested as the grass production outside forest is adequate as compared to forest areas. However, the natural growth of roots and rhizomes production in Dindori are better than Sheopur.

The Safed musli (*Chlorophytum borilivanum*) which was planted in the vacant spaces was ready to harvest in December 2022 and has been retained to be used as seed for sowing in the next rainy season of 2023 in both areas of Sheopur and Dindori. Following this it will be allowed to be sustainably harvested. More such species will be planted which will further incentivize the communities for more active participation.

A total of 1350 person days of wage labour were generated through these demo plots of which the employment of women ranged from 60 to 70%. It was also observed that migration from the two villages of Panwara and Goras was greatly reduced (only 5 families sent one of their persons to adjoining Sawai Madhopur District of Rajasthan) in search of better employment opportunities.

INCENTIVIZING COMMUNITY PARTICIPATION

Forest degradation is often attributed to climate change and resulting anthropogenic pressure. The tribal communities of Sahariyas of Sheopur and Baigas of Dindori have large dependence on NTFPs and, due to frequent crop failure, the only safety net available to them is to extract as much as possible to compensate for the loss of agriculture production. Consequently, they tend to resort to unsustainable harvesting of NTFPs. Thus, they are both the cause of the problem of lack of resources as well as being those who suffer from those actions. With this in mind, the restoration plan included 8–10 species which are harvestable at the end of the first year. These elements were included in the restoration plan in order to provide an insurance for active participation in protection, sustainable management and use practices.

CAPACITY BUILDING OF COMMUNITIES TO PLAN AND IMPLEMENT FLR

The significant involvement of communities from planning to field implementation, particulalry in respect of formulating equitable access and benefit sharing, provided adequate opportunities for learning. In this regard, the concept of FLR echoes the experience of Joint Forest Management (JFM) when launched in 1990. The current efforts of FLR now reinforces the concept of community participation through capacity building of community carried out through community mobilization, FGD, Red-listing workshop and during planting and ANR works.

More than 200 villagers in Sheopur and Dindori villages were involved in planning, implementation and monitoring. All the participants benefitted from the capacity-building program and can utilize the insights from the program to effectively conserve biodiversity in the surrounding villages.

IMPACTS OF FLR

Ecological Impact – Habitat loss is a major threat to loss of biodiversity in all types of forests. The ecological imbalance caused due to deforestation and forest degradation also leads to other effects such as floods, drought, desertification and disruptions in transportation and tourism. In addition, deforestation is very important with regard to climate changes as it releases carbon from trees, which accounts for 20% of the human caused carbon emissions (FAO 2000).

Deforestation also impacts negatively on investment in the forestry sector, which has been very low as compared to other sectors. As the government does not encourage private sector investment in forest restoration the areas under open and degraded forests continue to increase. There is an urgent need to restore these forests as soon as possible and, as such, the private sector needed to be brought in to current thinking through a mechanism acceptable to government policy. Carbon financing could be used as an incentive for the private sector to participate in forest restoration. Although the areas available for high output plantation may not be available, restoration activities are essential in order to provide livelihood support to forest dependent populations, particularly the primitive tribes who have a high dependence on forest biodiversity.

***Biodiversity consideration*:** In Sheopur demo plot, 2455 saplings of species, namely, *Emblica officinalis, Madhuca longifolia, Commiphora wightii, Sterculia urens, Asparagus racemosus, Boswellia serrata, Millettia pinnata, Annona squamosa, and Tectona grandis,* were planted. Species such as *Asparagus racemosus, Mucuna pruriens*, *Tinospora cordifolia* that are smaller plants having very high NTFP value were planted on the periphery so that the growth of planted tree and ANR saplings was not disturbed. In addition, naturally growing plants were also adopted (12 500 plants) under ANR. Six locally grown NTFP species, namely *Boswellia Serata, Lagerstroemia parviflora, Emblica Officinalis, Terminalia bellirica, Aegle marmelos, Azadirachta indica,* were also reserved for nurturing.

In Dindori district, a total of 4805 saplings of a range of species, *Emblica officinalis, Madhuca longifolia, Sterculia urens, Terminalia chebula, Terminalia bellirica, Buchanania lanzan, Aegle marmelos* and *Syzygium cumini,* were planted**.** In addition to planted species a number of important NTFP

species which were regionally rare and endangered such as *Terminalia bellarica, Terminalia chebula, Buchananania lanzan, Sterculia urens, Aegle marmelos, Celastrus paniculatus, Emblica officinalis, Chlorophytum borivillanum, Woodfordia fruticosa, Gloriosa superb* and *Embelia ribes,* were also adopted and protected (Figure 4) for future harvesting. *Mucuna pruriens*, *Tinospora cordifolia* and *Moringa oleifera* saplings were planted along boundaries to provide biological fencing and provide early income (within 1–2 years).

The assisted natural regeneration interventions resulted in growing stock improvement and it is anticipated that the area will in the future provide a good green canopy. With the silvi-cultural treatment in the area, natural regeneration of species such as *Asparagus racemosus* and *Emblica officinalis* have been recorded (Table 3). It is expected that some of the established saplings of *Buchanaia lanzan* and *Emblica officinalis* as result of ANR practices in Dindori will soon start flowering and fruiting thereby providing the communities of Kandawani forest village in Dindori forest region with the result of their hard work.

Similarly, the Sahariyas of Sheopur, who had exhausted their *Asparagus racemosus* stock in the nearby villages and were travelling far away to other districts of Sawai Madhopur, were happy to see the re-emergence of the species so valuable to their household income.

Social Impact – The most primitive tribal groups, such as the Sahariyas of Sheopur and Baigas of Dindori, derived more than 50% of their household income from the collection- use and sale of NTFPs. Forest degradation deprive these communities of their source of livelihoods and, often due to forest degradation, agricultural land down-stream, also get impoverished. Thus, their life support system is being depleted affecting their social standing and forcing them to migrate to other areas with their family including the young ones while leaving the aged behind. This is a very serious example of social displacement and the restoration project has demonstrated the potential of reversing this situation due to better agriculture and through engagement and emerging local leadership.

Economic Impact – The FLR intervention made a sisgnificant contribution to the income of local population with household income showing an improvement of between 5% and 10% in the first year through grass cut and carry. These forest patches were previously very dry and therefore, neither NTFP nor green grass was available. However, following the programme, grass removal was valued at INR 10–15,000 per day for about 120 days with about 50–60 villagers owning cattle using the facility and benefiting economically as milk yields increased.

FIGURE 4 *Thalla preparation for tree adoption activity*

THE WAY AHEAD

Land degradation has many dimensions. Weed infestation, loss of NTFP biodiversity, absence of natural regeneration and enhanced periods of plant dying, all are contributing to forest degradation. During the project implementation it was found that the loss of NTFP biodiversity in the two districts of Madhya Pradesh and its place gradually being occupied by the menacing growth of *Lantana camara* appear to be the main indicators of forest land degradation in the area. It is also felt that climate change events are adversely affecting the livelihoods of forest dependent communities. Frequent agriculture crop failure is compelling the dependent communities to make good their loss of agriculture-based livelihood through unsustainable and destructive extraction of NTFPs.

The Government Forest Department has opened the FLR to voluntary organizations seeking CER funds in an effort to assist rapid restoration of degraded ecosystems in order to address the livelihood issues of communities and ensure functionality of ecosystem services.

After this successful demonstration of a restoration project over an area of 150 ha of degraded forest, it is now planned to replicate and scale-up the FLR work in about 1500 ha in the next couple of years. However, implementation of the identified FLR strategies in other districts of the Central Indian State will require financial resources. The key to identifying the suitability of specific mechanisms for the financing of FLR projects is a clear understanding of the restoration needs, socio-economic context, institutional capacity, political landscape and biophysical dimensions of the restoration sites (FAO 2021). Through the implementation of the demonstration restoration project it is now possible to understand both the restoration needs in Central Indian region and an approach towards addressing those needs.

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