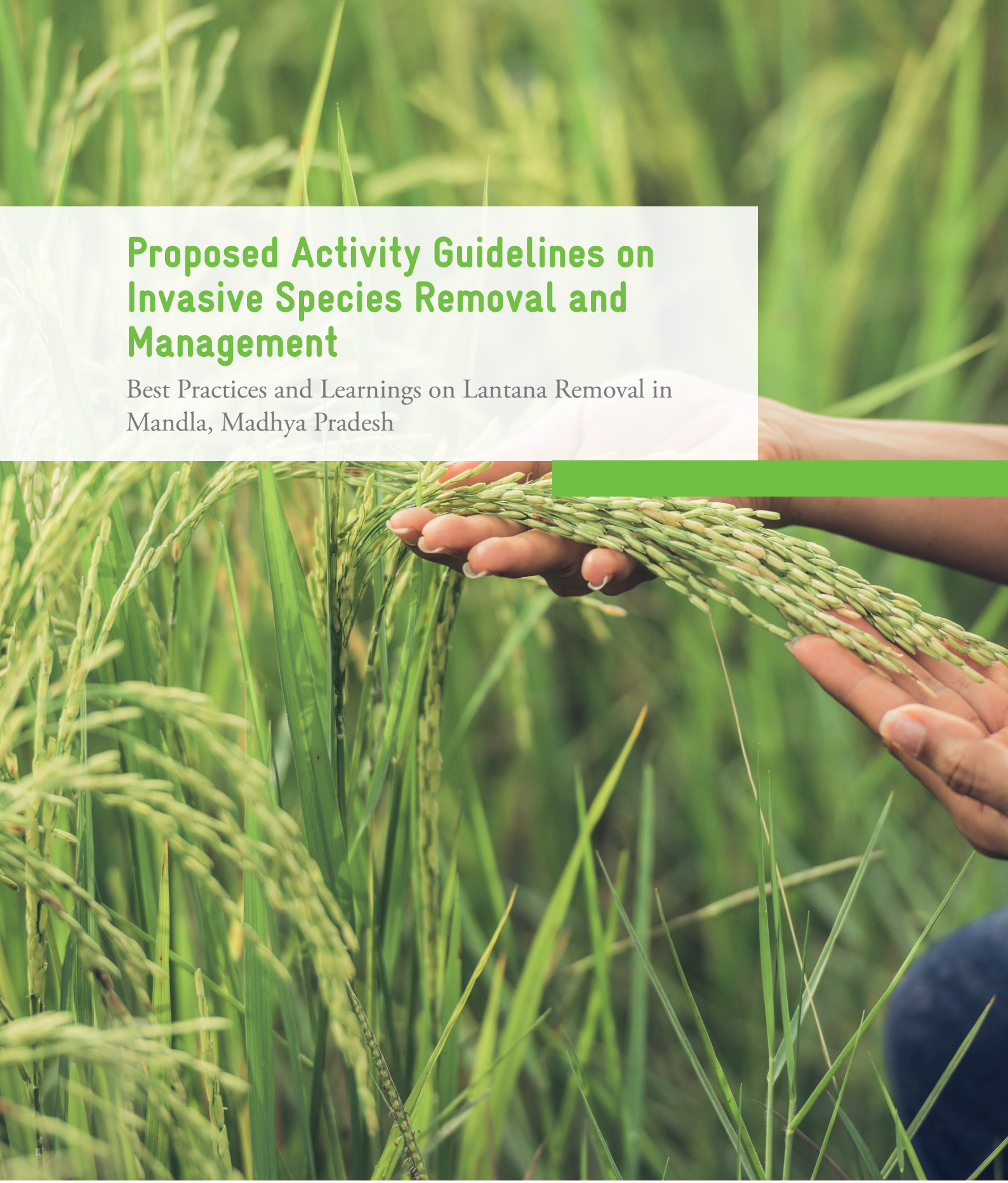

Proposed Activity Guidelines on Invasive Species Removal and Management

Best Practices and Learnings on Lantana Removal in Mandla, Madhya Pradesh

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Lantana has escaped from gardens and has invaded more than

40%

of India's tiger habitat Regions of Shivalik hills, central India, and southern western Ghats are the worst affected

Image: Alvesgaspar/wikimedia commmons

Background

More than 200 invasive species are estimated to occur in India (Hiremath, Ankila, 2018). Some of India's most widespread invasive species include Lantana, Parthenium, Siam weed, Mexican Devil, and Mesquite or Prosopis Juliflora.

Lantana Camara, a woody shrub of American origin, was introduced in India as an ornamental plant in the early 1800s. Over the last 200 years, Lantana invaded more than 40% of India's tiger habitat regions, including the areas of Shivalik Hills in (can specify?), Central India (can specify?) and southern Western Ghats.[1]

Lantana is among the top ten worst invasive species in the world.[2] In India, it occupies an estimated three lakh square km forest area, in addition to thousands of hectares of private and common lands. Studies indicate that Lantana has invaded over 13.2 million hectares of pasture lands in the country.

Given the growing concern in India on Lantana invasive species, the Forest Department as well as Non-Government Organisations (NGOs) in the country are making concerted efforts for its removal. Lantana eradication has been an integral part of working plans prepared by the Forest Department in which budget allocations are made for Lantana eradication in affected areas. In the Indian state like Himachal Pradesh have even drafted a policy for Lantana eradication, which invites collaboration with village panchayats, NGOs and Community-based Organisations (CBOs) at the village level. Currently, NGOs are also working for Lantana removal through grants from donor agencies.

In recent years, the funds from the Mahatma Gandhi National Rural Employment Guarantee Scheme (MNREGS) are also being utilised for Lantana removal in several regions of the country. Moreover, in 2022, the Madras High Court directed the state and central governments to use the funds available under MNREGS for the removal of invasive plant species in forest areas, by engaging tribals and local communities.

However, considering the magnitude of area infested by Lantana species and the costs involved in the Lantana removal there is need for exploring innovative models that are cost effective and self-sustaining.

Need for Removal

The infestation of invasive species has a wide range of adverse effects on the local ecology, biodiversity, and livelihoods of village communities.

- It inhibits the germination and growth of any other plant under its cover. As a result, there is no vegetation to check the resultant soil erosion once the rainwater begins running off during the monsoon.
- It prevents natural regeneration of trees, herbs and shrubs, affecting the local biodiversity.
- Certain invasive species like Lantana provide cover to wild animals, like wild boars, to hide, endangering the safety of the communities who frequent forest fringes. These wild animals also damage farmlands in proximity to the infested areas.
- Invasive species inhibit access of the communities to several natural resources, compelling them to traverse longer distances to collect fuel wood, firewood and Non-Timber Forest Products (NTFPs). This exponentially increases the possibility of human-wildlife conflictS.

Objectives

The core objective of the activity is two-fold: removal of invasive species from the land, and using it to manufacture biochar for agricultural purposes. Biochar is a substance that is produced through pyrolysis of organic matter, such as Lantana shrubs, in the case of Mandla in Madhya Pradesh. Biochar is a nutrient-rich substance that can be applied to agricultural soils. Biochar helps in carbon sequestration. Studies suggest biochar could help India reduce 41.41–63.26% of emissions from agricultural and its allied activities.[1]

Since the land reclaimed from invasive species can be used for growing crops, this exercise would reduce dependence on external inputs by circulating the removed species within the same land.

This activity comes with environmental and economic benefits in the short-term and long-term.

Environmental:

- Increase in biodiversity.
- Improved soil fertility and carbon sequestration through application of invasive species-derived biochar.

Economic:

- Additional employment for people involved in Lantana removal in the short-term.
- Increased cultivable land for farmers, thereby increasing their incomes in the long-term.
- Reduced cost of cultivation for farmers by providing them biochar at reasonable prices.

1 Padma, T.V. (2022) Exploring biochar as a nature-based solution to reduce greenhouse gas emissions. https://india.mongabay.com/2022/06/exploring-biochar-as-a-nature-based-solution-to-reduce- greenhouse-gas-emissions/

In meeting these direct objectives, the activity also has several indirect positive impacts:

- Significant reduction in the probability of human-wildlife conflicts.
- Lantana eradication will ensure an increase in the availability of fuelwood, grasses and NTFPs on commons. This will reduce the time and labour expended by women in gathering the same.
- If the removed Lantana is pyrolysed into biochar for use on the same land, it can help improve soil quality and carbon sequestration.

Activity Implementation

The activity envisages the involvement of local communities, farmers, and village collectives in the entire cycle of removal of invasive species, preparing biochar from removed vegetation, and in employing the cleared land in cultivation of crops and/or trees.

The formulation of the activity, selection of participants and implementation partners, and setting down rules for its self-sustaining replication must take into account its holistic nature and long-term impact.

Identifying Potential Activity Areas

The activity formulation starts with the identification of areas of intervention. This is possible through remote sensing and Geographic Information System (GIS) technologies technologies. This involves analysis of various factors such as spatial resolution, spectral band and time of observation during the growth cycle. These sites can also be identified on the basis of spectral signature differences between the crops and through digital image processing techniques.

In the specific case of Lantana, for example, identification of its growth is based on the spectral response variation of the land cover in a multi-dimensional feature space produced by different spectral bands. Generally, per pixel classification is used based on the training samples obtained from the ground truth data. Usually, non-agricultural areas and forest areas are taken up first. These are identified using open-source Land Use Land Classification (LULC) maps available on the Bhuvan portal. A supervised classification procedure is applied using high resolution Resources at LISS III (23 m spatial resolution satellite imagery available in Bhuvan) or other satellite data of high resolution (e.g., Landsat 8 and sentinel 2)

Ground truth (GT) data is a critical component for Lantana identification. The accuracy and confidence level improves with the availability of better quality and high number of GT sites. Typical ground truth information includes latitude, longitude, location, land cover, stage and condition along with two photographs of the field. Currently GT data is collected using mobile-based applications and uploaded to the Bhuvan geo-platform of Indian Space Research Organisation (ISRO).

Identifying Potential Activity Partners

To mobilise local communities and involve them in Lantana eradication work, it is crucial to work with local NGOs as potential activity partners. These NGOs help to achieve the following objectives:

- Mobilising farmers into Producer Groups and sensitisation about the need to eradicate invasive species from their private lands and village commons.
- Capacity building of farmers on good practices practices for removal of invasive species.

- Capacity development of farmers in production and application of biochar/ terra preta.
- Encouraging farmers to take up cultivation of millets in private lands from which invasive species have been eradicated.
- Facilitating access to quality seeds.
- Developing farmer linkages with FPOs for sale of millets grown on reclaimed land.
- At a later stage, supporting farmers in obtaining organic certification if required.

Steps of Implementation

A. Invasive species eradication – the Lantana example

The Cut Root-Stock method, developed by the Ce for Environmental Management of Degraded Ecosystem (CEMDE), is the method applied to clear Lantana. The Cut Root-Stock method involves 50-60% less manual effort compared to cutting or slashing. The method prescribes the following:

- The root must be cut exactly below the transition zone to eliminate the reproductive ability of the plant.
- After uprooting, the bush must be kept upside down, else the contact of root with soil may rejuvenate the uprooted stock.
- The hole left at the point of removal must be nine to twelve inches in diameter to ensure little disturbance of dormant Lantana seeds lying in the soil.

The seed of Lantana remains in the soil for three years. So, the area needs to be mopped up for the following two years.

B. Restoration of reclaimed land

Land reclamation and restoration models may be based on prevalent land use systems in the selected area.

- Multiple cropping through mixed cover crop species for private crop land.
- Diversified millet cultivation for upland fallow land.
- Grassland for grazing for non culturable wasteland.
- Natural regenerative practices (multiple tree species) for degraded forest.

Reclaimed land must be mapped and monitored for two years to catch reinfestation before it spreads. The seeds of Lantana which have fallen on the ground regerminate in the next two years. The geotagging of reclaimed land on the Bhuvan mobile application, and further viewing and updating the data on the Bhuvan NABARD geo-portal helps in creating evidence around the productive use of land after reclamation. These tools can be used to detect changes in soil organic carbon, canopy growth, crop acreage and crop yield in the reclaimed area. Tools like e-Prakriti use high-resolution images to train a machine-learning algorithm to generate maps of areas degraded by Lantana infestation.

Ground Rules

While it is easier to take up the activity on private lands, it is equally important to take up the activity in the common lands as well in the villages for maximum benefit to accrue to the society. Both require a different set of ground rules.

Rules for management on Common Lands:

It is decided by the community based on the type and need of the site and therefore this differs from one village to another. However, some basic common rules include :

1. Prohibition of open grazing on some patches of land or for a set time to allow regeneration of saplings.
2. Illicit felling of trees is prohibited.

3. Only dry twigs, branches can be collected as fuelwood.
4. All the villagers have equal rights to collect NTFPs. However, this must be done through plucking or collecting, not through cutting trees or branches.
5. Sanctions and fines instituted for offenders.

Rules for Management on Private Land:

Following rules can apply for invasive species management on privately held land:

1. Land cleared of lantana must not be left fallow.
2. Benefits received by individual farmers through the village institution will have to be shared with the community in some form. It may be through selling yield (such as fruits in the case of plantation) at a lesser price in the village.
3. Everyone in the village will have access to NTFPs such as tendu leaves and fodder obtained from the lands where Lantana has been cleared
4. In cases where individual farmers are unable to cultivate land cleared of invasive species, rules may be prescribed for the land to be given to a landless family for cultivation, under a yield-sharing agreement between landowner(s) and the beneficiary family.

Implementation Challenges: Lantana

In the specific case of Lantana removal, the following challenges are foreseen:

- **Cost of removal:** The total person-days required for removal of Lantana is given in the table below. In the second year it is expected to cost 40% and in the third year the expected cost is less than 10% of the initial cost. Cost of Lantana removal through uprooting is estimated to be between INR 10,000 and INR 20,000 per ha (depending on the density of infestation) when eradication operations are taken up for up to three years. The villagers find it difficult to take interest in the process due to these cost implications.
- **More effort needed in areas with high rainfall**: Areas with high rainfall typically have greater starting invasion of Lantana, which requires considerably greater initial eradication effort. Such areas also witness greater Lantana re-invasion.
- **Soil erosion:** The removal of Lantana from an area exposes the soil to rain and may make the area vulnerable to soil erosion. Proper follow up in the form of establishment of pastures or cultivation of crops on the cleared lands can help reduce soil erosion.

Cost norms for reclamation of Lantana infested land (example from Mandla, Madhya Pradesh)

Cost of lantana removal

S.No	Density of Lantana	Cost of removing Lantana per acre (Rs)*	Person-days required per Acre	INR		
				Year 1	Year 2*	Year 3*
1.	Densely infested	3088	38	3088	1235	247
2.	Moderately infested	1754	22	1754	701	140
3.	Sparsely infested	1123	14	1123	449	90

(*In case millet cultivation is taken on cleared land there is no cost incurred as it comes from community contribution)

Income flow for individual farmers from cultivation of millet (one acre landholding)

S.No	Particulars	Unit	Organic Cultivation		Total Cost (INR)				
			Quantity	Cost (Rs.)	Year 1	Year 2	Year 3	Year 4	Year 5
A.1	Recurring cost								
A.1.1	Land preparation and sowing								
1.1.1	Land preparation	L/s			2000	2100	2205	2315	2431
1.1.2	Seed	Kg	5	50	250	263	276	289	304
1.1.3	Seed sowing	Person days	2	250	500	525	551	579	608
	Total A.1.1				**2750**	**2888**	**3032**	**3183**	**3343**
A.1.2	Main Field cultivation								
1.2.1	Manuring	Tonnes	1	1000	1000	1050	1103	1158	1216
1.2.2	Weeding	Person days	5	250	1250	1313	1378	1447	1519
1.2.3	Harvesting cost	Person days	5	250	1250	1313	1378	1447	1519
	Total A.1.2				**3500**	**3675**	**3859**	**4052**	**4254**
A.1.3	Post harvest expenses								
1.3.1	Drying and grading	Person days	3	250	750	788	827	868	912
1.3.2	Packaging and transportation cost	Qtl	400	3	1200	1260	1323	1389	1459
	Total A.1.3				1950	2048	2150	2257	2370
	Cost of Cultivation (A1.1 +A1.2+A1.3)				8200	8610	9041	9493	9967
B.1	Yield per Acre								
1.1	Kutki	Qtl	4	4000	16000	16800	19404	20374	21393
	Total (B)				16000	16800	19404	20374	21393
C	Net Returns (B-A)				7800	8190	10364	10882	11426

Income flow in Commons after reclamation of degraded areas infested with lantana (per acre returns)

Activity	Production/ acre	Price	Revenue (Rs/acre)
Fodder production (qtl)	6	Re 1/kg*	600
NTFP (Tendu leaf) (bag**)	1	3000/Bag	3000
NTFP (Chakoda) (kg)	40	Rs 25/kg***	1000

#Chakoda or Sickle senna (Senna tora) is an ayurvedic plant useful in migraine, asthma, worm infection, insect bite and skin diseases. Seeds are used as the substitute of Coffee.

* Rs 1/Kg for fodder is taken as minimum imputed value as there is no payment mechanism in villages for grass

** 1 standard bag of Tendu Leaves contains 1000 bundles of 50 leaves each

*** Rs 25/kg is the prevalent rate for Chakoda in the local market

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