Agroecology in Action: Empowering Tribal Communities in Mandla, India through Trainings on Bio-fertilizer and Bio-pesticides

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1. Summary

This report outlines the training sessions and exposure visits conducted by CGIAR's Agroecology team in partnership with PRADAN for local communities in Mandla district, Madhya Pradesh, India. Training sessions introduced agroecological practices such as Agroecological Homestead Model (AHM) *and Krishi Kund* (Microsite) and covered essential topics such as preparation techniques for bio-fertilizer and bio-pesticide preparation, pest identification, and sustainable crop management techniques to 119 farmers (105 females, and 14 males). Additionally, the report outlines the preparation techniques of bio-fertilizers and bio-pesticides such as *Neemastra, Kanda Khaad, Jivamrit, Brahmastra, Agniastra,* and *Mathastra*.

The knowledge gained through these trainings is expected to support long-term adoption of agroecological practices, promoting resilience and sustainability for tribal farmers. Future plans include additional training sessions and continuous support, ensuring the successful adoption and scaling of agroecological practices for improving livelihood and ecosystem services.

2. Background

Tribal communities in Madhya Pradesh, India, often have limited interaction with outside world and minimal exposure to development initiatives. Their reliance on self-production of monocrops and Non-Timber Forest Products (NTFPs) frequently results in imbalanced nutrition, inconsistent income, dietary monotony, and soil degradation, all of which negatively impact ecosystem services.

To address these challenges, CGIAR's Agroecology Initiative has established Agroecological Living Landscapes (ALLs) in the Narayanganj block of Mandla district. These ALLs are multi-stakeholder, territorial spaces where agroecological innovations are co-designed, tested, and implemented by a diverse range of actors, including small-scale farmers, local communities, researchers, NGOs, and government bodies.

In collaboration with local tribal farmers and stakeholders, the initiative has co-designed a cost-effective Agroecological Homestead Model (AHM) for homestead management, and *Krishi Kund* (Micro-site) for restoring degraded farmland. Both AHM and *Krishi Kund* (Micro-site) aims to improve and stabilize income while enhancing dietary diversity, ensuring balanced self-consumption, and promoting environmental sustainability.

3. Introduction to the Agroecological practices

Homestead management: Homesteads are an integral part of most rural households, serving as hubs for production and consumption of diverse foods required by the household. Although integration of animals into these homesteads is common in farming communities, rapid urbanization, rising land costs, distress migration, and the increasing reliance on chemical-intensive farming practices have led to abandonment of some of these traditional homestead activities. This shift has contributed to reduced dietary diversity, imbalanced nutrition, malnourishment, and compromised human health. To address these challenges, CGIAR's Agroecology Initiative facilitated the promotion of Agroecological Homestead Models (AHM) in few households with the support of PRADAN.

AHM is an integrated and holistic model of land management focused on optimal utilization of homestead land (Figure 1). The model includes **water harvesting and storage systems** for irrigation; **multi-layer vegetable cultivation** (including roots, leafy greens, shrubs such as brinjal, climbers such as gourds), **crop rotation**, use of **natural amendments**, **composting** and **backyard poultry** rearing while also exploring the potential of **beekeeping** primarily for pollination services.

Figure 1: Agroecology Homestead Model (Photograph: Sudharsan Malaiappan/IWMI)

Restoring degraded land:

Decades of land degradation in Madhya Pradesh, India, have led to poor land productivity, scarce natural resources, and reduced ecosystem services, leaving large areas unsuitable for cultivation. Additionally, long fallowing has left soil surface exposed to erosion, further exacerbating degradation of these farmlands. This has resulted in cultivation of fewer crops (in terms of diversity) and likely leading to imbalanced nutrition, unstable incomes, and increased migration. To address these challenges, CGIAR's Agroecology initiative, in partnership with local farmers and stakeholders, has developed an intervention that improves productivity of these degraded farmlands through a resource-efficient practice called *Krishi-Kund* (microsite), to restore degraded lands and enhance productivity. This intervention allows restoration of degraded land by focusing on improving micro-sites rather than entire parcels of land using organic amendments.

Both AHM and Krishi Kund (Microsite), grounded in agroecological principles, aims to ensure dietary diversity, nutritional and food security, improve soil health and various ecosystem services. These models offer pathways to enhance productivity and income from unutilised land.

The farmers were also trained with the required knowledge and skills to implement these approaches effectively, including the preparation and use of bio-fertilizers, bio-pesticides, and sustainable land management practices through trainings and exposure visits. Details of these trainings are presented in the subsequent sections.

4. Objective of the trainings

Key objectives of the trainings and exposure visits are to promote sustainable agriculture practices and agroecological principle-based farming practices such as homestead management and restoring degraded land. 119 farmers (105 females, 14 males) participated in village level and district level training.

The trainings aimed at imparting knowledge/ and hands on experience on:

- Methods to utilize locally available resources as inputs and thus reduce the dependency on chemical fertilizers and pesticides to lower input costs.
- Awareness about bio-fertilizers, bio-pesticides, improving soil health to make them self-reliant.
- Preparation and application of bio-inoculants.

5. District level training on AHM

The discontinuation of some of the farming practices has resulted in the loss of traditional knowledge related to productive and sustainable land management. Revamping of home steads, including the modification and optimization of practices through Integrated Farming System (IFS) principles, has created a need for knowledge sharing within the community. This shift has highlighted the necessity of a well-structured capacity-building program to facilitate the adoption and scaling of these updated practices.

IWMI in partnership with PRADAN is setting up experimental pilots with small holder farmers within the ALL. The exposure visits and training (Figure 2) sessions helped these new adopters to understand the implementation and management of the model. The training sessions included hands-on experience with land preparation, compost application, setting up multi-layers, seed treatment, nursery beds and transplanting at the start of the crop season.

A field exposure visit was organized in *Kumhara* village in Mandla district, where 48 farmers from the ALL were introduced to agroecological practices that can be integrated into AHM. This was followed by a practical session on the implementation and management techniques of AHM.

Figure 2: Exposure visits and Training of farmers at district level (Photographs: PRADAN)

Each participants received a booklet on the AHM, outlining its components, processes, and implementation techniques. Following the training, 20 farmers from the ALL adopted the AHM, by applying the knowledge gained from the exposure visits and training sessions with support and guidance from the agroecology initiative team.

6. Village level training

Subsequent village level trainings (*Figure 3*) were conducted to introduce agroecological practices, nutrient and pest management using natural amendments, instead of chemical fertilizers and pesticides. Farmers were educated on preparation of bio-fertilizers and bio-pesticides such as *Neemastra, Kanda khaad, Jivamrit, Brahmastra, Agniastra, and Mathastra*.

Village level training was conducted at five villages: *Boriya, Dargarh, Jhujhari, Kunda and Kondra*. All the villages are located in Narayanganj block of Mandla district in Madhya Pradesh, India.

Figure 3: Training of farmers at village level (Photographs: PRADAN)

7. Bio-input preparation process

Table 1 provides a list of the bio-inoculants on which farmers received training, including their type and application method (foliar or soil).

Table 1: List of bio-inoculants

S.No.	Name	Type	Application (Foliar or soil)
1	*Neemastra*	Bio-pesticide	Foliar
2	*Kanda Khaad*	Bio-fertilizer	Soil
3	*Jivamrit*	Bio-fertilizer	Both
4	*Brahmastra*	Bio-pesticide	Foliar
5	*Agniastra*	Bio-pesticide	Foliar
6	*Mathastra*	Bio-pesticide	Foliar

Preparation process of the bio-inoculants is mentioned in the subsequent sections.

Neemastra

Neemastra is a Sanskrit name (Neem referring to *Azadirachta indica* and Astra means weapon) of the concoction prepared from neem leaves/seeds, which is a bio-insecticide used to protect crops from pests and diseases. It is known to help in controlling the reproduction of harmful insects. Ingredients required for preparation of *Neemastra* is listed in Table 2.

Table 2: Inputs required for Neemastra preparation

S.No.	Inputs	Unit	Quantity
1	Water	Litre	3
2	Fresh cow dung	Kilogram	1.5
3	Cow urine	litre	3
4	Neem leaves	Kilogram	3
5	Garlic	grams	250
6	Red chillies	grams	250

Steps involved in preparation of *Neemastra* are as follows

1. Neem leaves and red chilies are ground and set aside.
2. Fresh cow dung is mixed with water to create a cow dung slurry.
3. In a separate container, ground neem leaves, red chili paste, garlic, cow urine, and the prepared cow dung slurry are mixed.
4. This mixture must be stirred twice a day – once each in the morning and evening – for the next 48 hours.
5. The container should be kept in shade to prevent the loss of micronutrients due to sunlight and heat.
6. After 48 hours, the mixture is strained twice. First, it is filtered with a strainer or mosquito net to remove large particles, and then through a cloth to remove finer components.

For field application, 20 litres of *Neemastra* are diluted with 200 litres of water, which can cover an area of 4000 m^2 (1 acre). It can be applied at intervals of 7-10 days if insect and pest infestation is observed, otherwise it can be applied on a need basis.

Figure 4 shows the preparation process of Neemastra.

Figure 4: Preparation process of Neemastra (Photographs: PRADAN)

Kanda khaad

Kanda khaad (manure prepared from Cow dung) is a nutrient-rich bio-manure, known for improving soil fertility and promotes plant growth due to its nitrogen, phosphorus, and potassium content. *Kanda Khad* is considered as a sustainable and eco-friendly alternative to chemical fertilizers, promoting healthy soil and crop growth while reducing dependency on synthetic inputs. It is widely used in traditional and natural farming systems, particularly in areas where livestock and cow dung are readily available.

Ingredients required for preparing Kanda Khaad: Water (3 liters), 6-month-old cow dung cakes (3-4 cakes) and a container for preparing the inoculant.

Preparation method: The preparation process involved soaking 3-4 cow dung cakes in a 5-liter container filled with water for 48 hours. If the cakes don't fully submerge, bricks can be placed on top to help. After soaking for 48 hours, the liquid is strained three times and stored in a bottle in the shade for future use.

For field application, 20 litres of *Kanda khaad* is diluted with 200 litres of water, which can cover an area of 4000 m^2 (1 acre). This mixture is typically applied once in every 7 to 10 days. *Figure **5*** shows the preparation process of *Kanda Khaad*.

Figure 5: Preparation process of Kanda Khaad (Photographs: PRADAN)

Jivamrit

Jivamrit, derived from two Hindi words – "*Jeevan*" (means life) and "*Amrit*" (means nectar of immortality). *Jivamrit* is an organic fertilizer that improves the activity of beneficial microorganisms in the soil, provides essential nutrients to plants, and helps in maintaining soil fertility. It also prevents fungal infestation in the crops. Ingredients required for preparation of Jivamrit are listed in *Table 3*.

Table 3: Inputs required for Jivamrit preparation

S.No.	Inputs	Unit	Quantity
1	Cow urine	Litre	10
2	Gram Flour	Kilogram	2
3	Jaggery	Kilogram	2
4	Termite Soil	Handful	
5	Cow dung (fresh)	Kilogram	10
6	Normal water	Litre	180
7	Plastic container (drum) capacity -	Litre	200

Steps involved in preparation of *Jivamrit* are as follows

1. Add 10 litres of fresh cow urine (filtered to remove solid particles) in the plastic container.
2. In separate pan, prepare a slurry by mixing 2 kg of gram flour with water, and then add it in the container.
3. Prepare a slurry with 10 kg of fresh cow dung with water, sieve out solid particles, and then add it in the container.
4. Add 2 kgs of jaggery and a handful of termite soil into the container.
5. After adding all the ingredients, add 180 litres of water.
6. Stir the solution with a long stick in a clockwise direction, ensuring the beneficial microbes are preserved.
7. Cover the plastic drum with a cloth and place it in a shaded, cooler place.
8. Stir the solution three times a day in a clockwise direction for 7 days.
9. After 7 days, strain the solution using a cloth to sieve out solid particles, and solution is ready for use.

For field application, 20 litres of *Jivamrit* are diluted with 200 litres of water, which can cover an area of 4000 m^2 (1 acre). This mixture is typically applied once in every 7 to 15 days. Figure 6 shows the preparation process of *Jivamrit*.

Figure 6: Preparation process of Jivamrit (Photographs: PRADAN)

Brahmastra

Brahmastra is an organic insecticide used to protect crops from insects (fruit borer, pod borers, stem borers etc.), and increases the resistance of the plant to pest attacks. It is made from various types of leaves containing specific alkaloids and has a shelf life of approximately six months. Ingredients required for preparation of Brahmastra is listed in *Table 4*.

Table 4: Inputs required for Brahmastra preparation

S.No.	Inputs	Unit	Quantity
1	Cow urine	Litre	10
2	Neem leaves	Kilogram	3
3	Custard apple leaves	Kilogram	2
4	Papaya leaves	Kilogram	2
5	Datura leaves	Kilogram	2
6	Guava leaves	Kilogram	2
7	Plastic container (drum) capacity -	Litre	50

Steps involved in preparation of *Brahmastra* are as follows

1. Finely crush the neem, custard apple, papaya, and datura leaves.
2. Take a 50-liter container and add the crushed leaves.
3. Add 10 Liters of filtered cow urine into the drum.
4. Cover the plastic drum with a cloth.

For field application, 20 litres of *Brahmastra* is diluted with 200 litres of water, which can cover an area of 4000 m^2 (1 acre). *Brahmastra and Neemastra* can be applied alternatively at interval of 7 to 10 days depending on infestation. Neemastra has more insecticidal effect, whereas Brahmastra is supposed to be helpful in controlling diseases. Application should commence just after crop emergence/transplantation. Figure 7 shows the preparation process of *Brahmastra*.

Figure 7: Preparation process of Brahmastra (Photographs: PRADAN)

Agniastra

Agniastra is an organic pesticide used to protect and control pest infestation on crops. It is effective on aphids, stem borers, fruit borer, pod borer, and leaf roller. Its shell life is about six months. Ingredients required for preparation of *Agniastra* is listed in Table 5.

Table 5: Inputs required for Agniastra preparation

S.No.	Inputs	Unit	Quantity
1	Cow urine	Litre	10
2	Neem leaves	Kilogram	5
3	Tobacco	Kilogram	1
4	Turmeric	gram	250
5	Green chilies	Kilogram	1
6	Garlic	Kilogram	1
7	Ginger	Kilogram	1
8	Container - capacity	Litre	10

Steps involved in preparation of *Agniastra* are as follows

1. Take a 10-liter capacity container and fill it with 5 liters of water.
2. Finely chop the neem leaves, chilies, garlic, and ginger.
3. Add 5 kgs of neem leaves, 1 kg of tobacco powder, 1 kg of chilies, 1 kg of garlic, 1 kg of ginger, and 250 grams of turmeric powder into the container.
4. Boil the mixture for about 45-50 minutes until the leaves and other ingredients are thoroughly infused into the water.
5. Then store the mixture in a shaded area to cool for 24 hours.
6. After 24 hours, ad 10 liters of cow urine in the prepared mixture. Strain the solution with sieve to remove solid particles.
7. Store the prepared solution in a container under a shed or in a cool area to protect the micronutrients from heat and sunlight.

For field application, 20 litres of *Agniastra* is diluted with 200 litres of water, which can cover an area of 4000 m^2 (1 acre). This mixture is known to have both insecticidal and antifungal antibacterial properties. Though not scientifically substantiated but some farmers believe it having controlling effect on viral infection and spread which is likely to have controlling effect on disseminator insects. Figure 8 shows the preparation process of *Agniastra*.

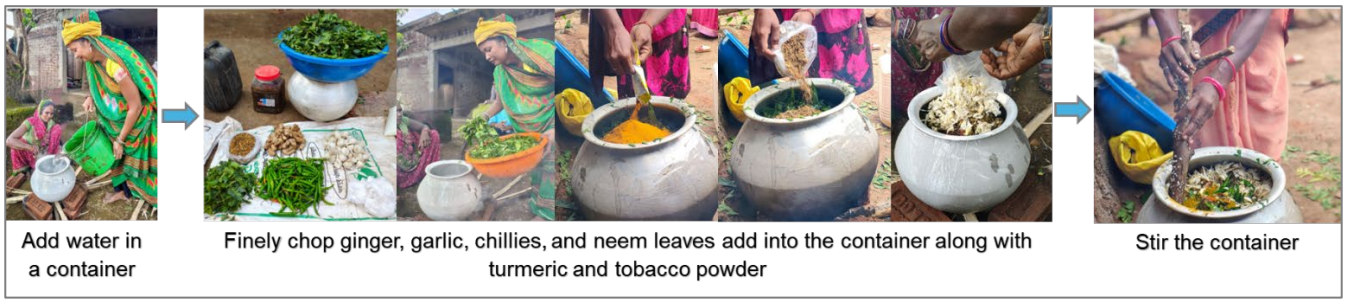

Figure 8: Preparation process of Agniastra (Photographs: PRADAN)

Mathastra

Mathastra is an organic concoction which is acidic nature used to prevent crops from fungal infections and various pest attacks. As aphids produce honeydew, it attracts other pests and helps in escalating the pest infestation, hence the acidic nature of this concoction does not allow aphids to replicate. Ingredients required for

preparation of *Mathastra* are listed in Table 6.

Table 6: Inputs required for Mathastra preparation

S.No.	Inputs	Unit	Quantity
1	Buttermilk	Litre	2
2	Cow urine	Litre	0.5
3	Turmeric powder	gram	10
4	Asafoetida	gram	5
5	Container – capacity	Litre	3

Steps involved in preparation of *Mathastra* are as follows

1. In 3-litre capacity container add 2 litres of butter milk and 0.5 litres of cow urine.
2. In separate pan, prepare a slurry by mixing 10 grams of turmeric powder with water, and then add it in the container.
3. Take 5 grams of asafoetida in a bowl and mix with warm water and then add it in the container.
4. Keep the solution undisturbed for 24 hours in a shade or in a cool place.

For field application, 20 litres of *Agniastra* is diluted with 200 litres of water, which can cover an area of 4000 m^2 (1 acre). Preparation should be commensurate with application schedule and long-term storage is not advised. The lactic acid bacteria present in *Mathastra* is known for their antifungal and antibacterial properties, which can help manage pests and diseases. Figure 9 shows the preparation process of *Mathastra*.

Figure 9: Preparation process of Mathastra (Photographs: PRADAN)

8. Conclusions and Way forward

In the preparation of bioformulations, it is recommended to use the dung and urine of indigenous cows, specifically local breeds. While there is no concrete scientific study supporting this, the rationale is based on the richness and diversity of the microbial population found in these breeds, as well as their compatibility with local soil and climatic conditions.

During exposure visits, farmers were introduced to effective plant and soil management practices, particularly composting methods that utilize cow dung, crop residue, and local biomass. Through village-level training, they gained insights into disease and pest management, including recognizing visible symptoms and understanding the advantages of using natural bio-inoculants. Farmers also learned how to prepare cost-effective pest control solutions using locally available materials.

This capacity-building exercise ensured equal participation of interested women and thus served as a tool for women's empowerment and advancing gender equity within the community. Further trainings will be provided on other bioformulations, nursery management, pollination, and effective water management, ensuring the

continued adoption and success of the model. The farmers trained in these methods will also play a key role in transferring knowledge to their neighbours and communities. Moving forward, CGIAR, in collaboration with PRADAN, ICAR, and other key stakeholders, plans to organize additional training sessions for farmers, integrating feedback from current adopters. These efforts aim to strengthen the management of homestead models, fostering the long-term success and sustainability of these agroecological practices. The concentrations of nutrients, insecticidal, and pesticidal components in bioformulations have yet to be determined, with plans for future analysis. However, capturing and standardizing these concentrations presents challenges due to the sensitive nature of the living organisms in the formulations, which can be affected by environmental changes, the geographical origins and abundance of the inputs used, storage conditions, water quality, and preparation methods.

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