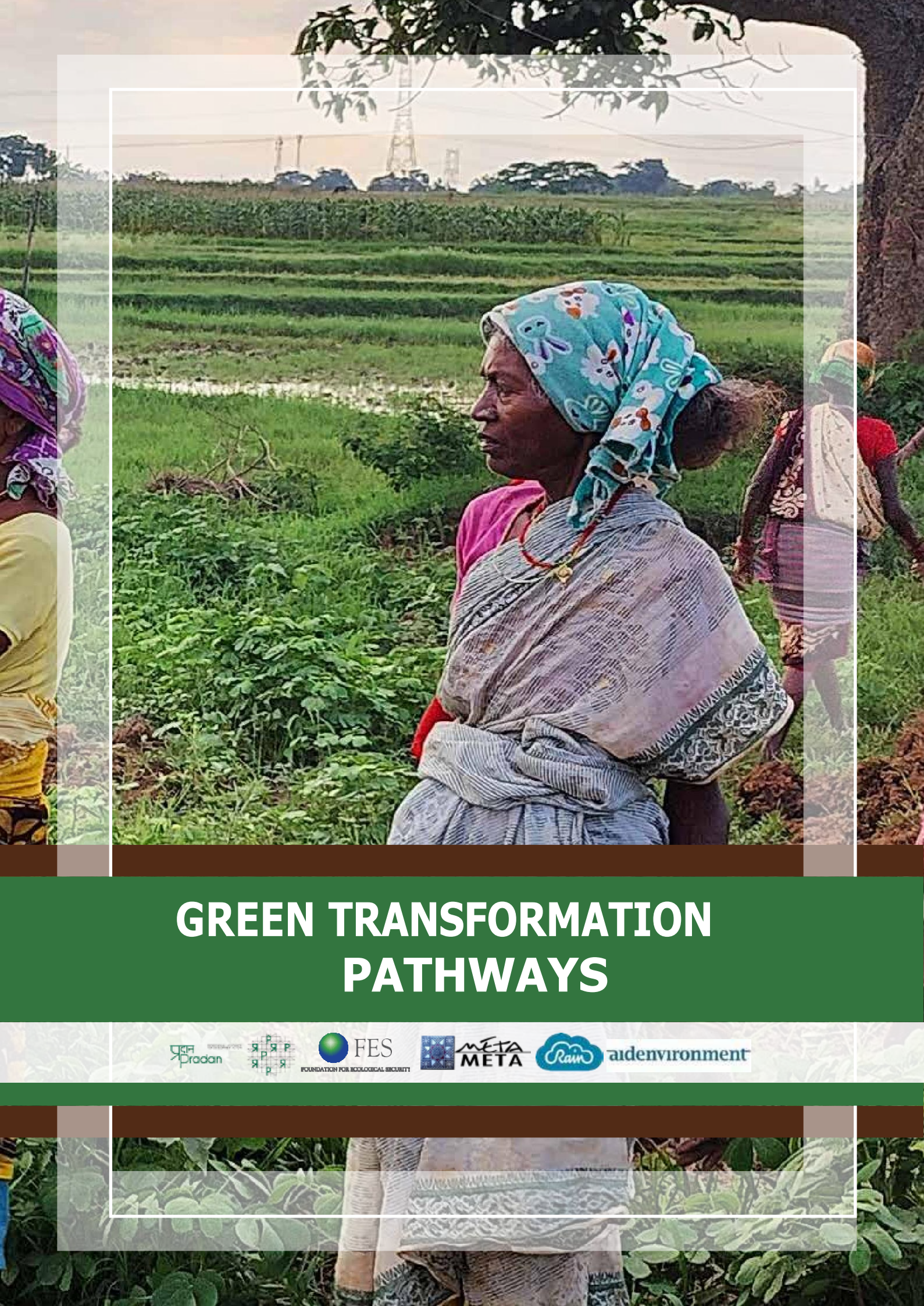


# GREEN TRANSFORMATION PATHWAYS

Pradan

FES
FOUNDATION FOR ECOLOGICAL SECURITY

META META

Rain

aidenvironment

# PREFACE

The Green Transformation Pathways (GTP) aims to create a vibrant circular rural economy based on an extensive exchange of valuable products and services, supported by strong institutions and value chains. This is done through fostering sustainable management of natural resources and regenerative agriculture practices that add to the quality of life. GTP wants to achieve this in the feminized rural settings of the states of Madhya Pradesh and Jharkhand in India, both part of the extensive dry-land Agro-Ecological Zone 7.

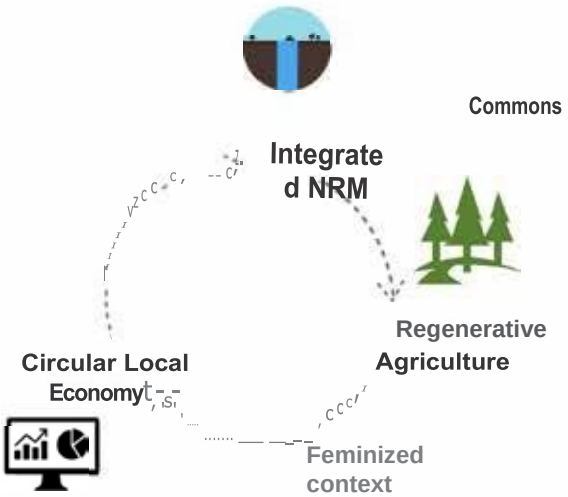
Behind this is the thinking that natural resource management is the starting point of any economic development. It is hard to imagine a thriving population in a totally degraded environment. A well-managed resource base creates the base for healthy agriculture, including livestock keeping and fishery. This requires the adequate management of the commons. There are many linkages: in the management of the microclimate, in creating water security, in controlling soil loss, in producing the biomass for livestock and bio-fertilizer but even in the mindset of people by giving attention to the common good. Integrated natural resource management particularly creates the base for regenerative agriculture, the type of farming that sustains and even improves the resource base.

As such regenerative agriculture is the opposite of the degenerative agriculture practice that we now often see (crop losses, pollution, loss of biodiversity, soil degradation, water wastage). There is a gamut of better regenerative practices: better land preparation, better seeds, better tools, soil improvement, safe control of pests including rodents, better storage, better transport, more value addition to the product, better knowledge, many of these regenerative practices are rooted in local services and inputs. As such regenerative agriculture can give a boost to the local economy. We strongly believe in this in Green Transformation Pathways. Circular local economies where this a large circulation of useful services is the way out of shortage and the key to buoyancy. All this has to happen in a feminized context. As more men moved out of the rural areas, more women were left behind in agriculture, this can also be a strength, if the support systems are aligned around this.

The ultimate aim of Green Transformation Pathways is system change – not to excel in one place, but to create the pathways and even the GT road to change the system towards vibrant economies based on sustainable resource management, rewarding regenerative agriculture and the support activities. For this Green Transformation Pathways tries to explore and address system barriers, build coalitions, and finetune the core model of circular growth.

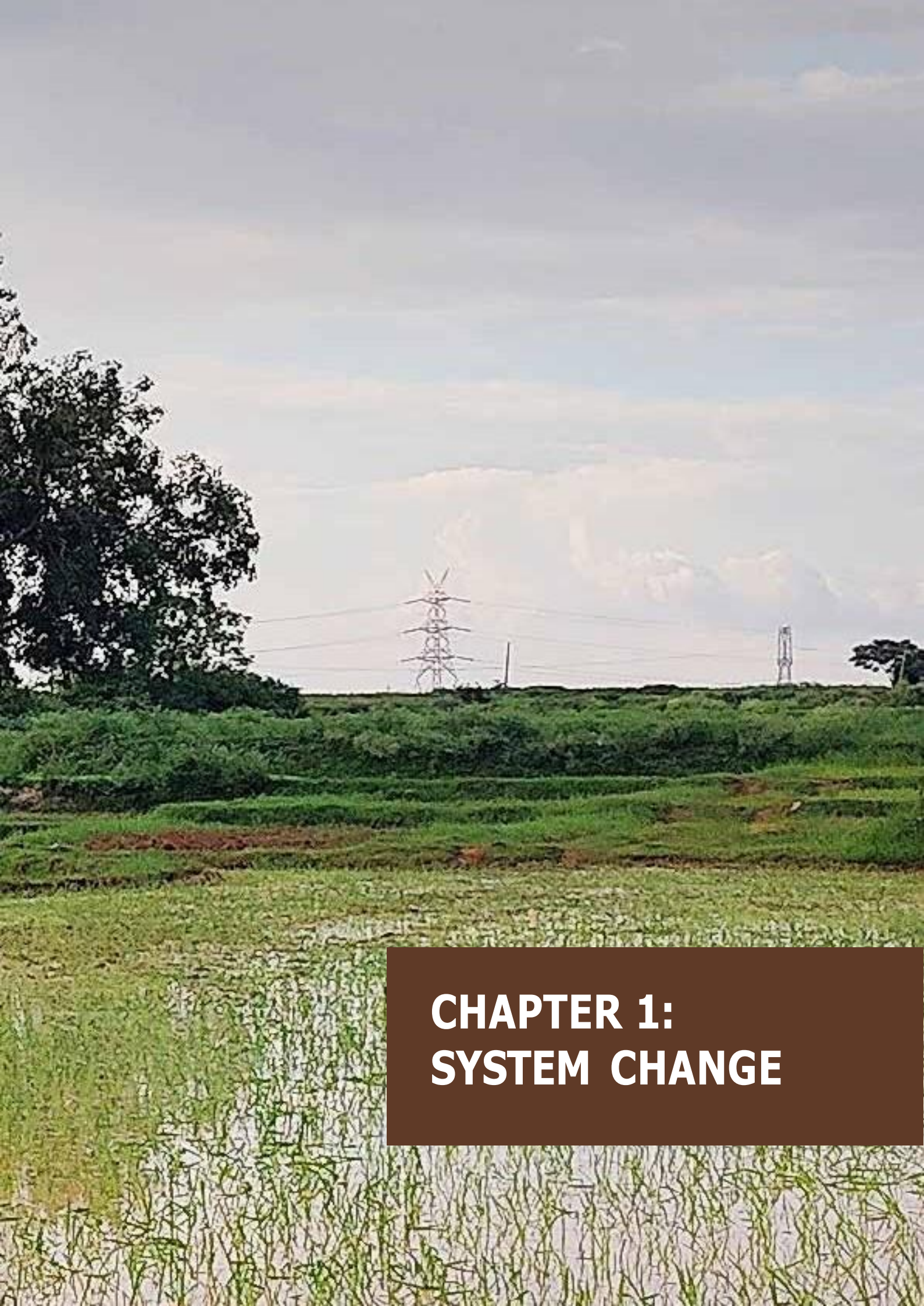
Learning is central in Green Transformation Pathways. GTP develops tries to explore what is possible in different domains of action, all of them intertwined to address systemic changes. These domains of action are circular local economy, natural resource management, regenerative agriculture, commons management, the centrality of women in agriculture and the interlinkages. This bundle is part of the

discovery. It is a collection of blogs on findings, lessons learned, examples, analysis, and recommendations generated in the past months of the Green Transformation Pathways program. They are based on trying to do things and seeing how things get done. The blogs are made by the different people working throughout the GTP program. We hope this bundle and the other learnings helps us build a better approach and strategy for system change.




- Avijit Choudhury, Frank van Steenbergen, Ishan Agrawal, Saheb Bhattacharya & Niels Lenderink (steering committee)

Green Transformation Pathways (GTP) is a program supported by the IKEA Foundation and implemented through a consortium led by PRADAN, FES, MetaMeta, Rain/Aidenvironment.



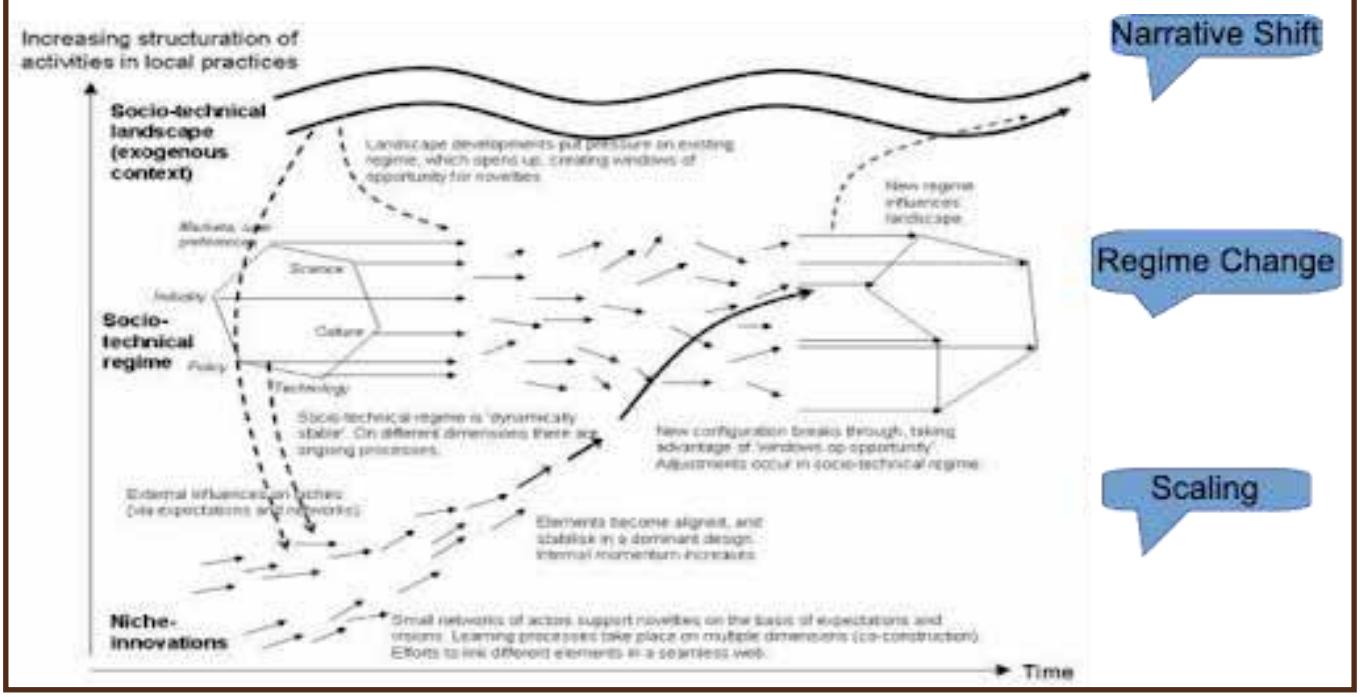
# CHAPTER 1: SYSTEM CHANGE

# INTRODUCTION TO SYSTEM CHANGE & SCALING WITHIN GTP

Using the core model explained in the preface GTP aims to create vibrant rural economies in Jharkhand and Madhya Pradesh. For this there needs to system change.

A system is defined as a regularly interacting or interdependent group of items forming a unified whole[1]. A fundamental principle of a system is that it is something more than a collection of its parts[2]. Systems thinking in practice encourages us to explore inter-relationships (context and connections), perspectives (each actor has their unique perception of the situation) and boundaries (agreeing on scope, scale and what might constitute an improvement). Systems thinking is beneficial in addressing complex or wicked problem situations. A change in the actors, institutions, functions, norms, practices, behaviours, narrative, policies, programs, money flows), and niche innovations/initiatives at the local or government level is system change. System change can be used to shift the conditions that are holding a problem in place.

Figure 1 Three layers of system change



For this, it is essential to develop a deeper understanding of the various systems that impact the existing livelihood challenges. These multiple systems in GTP have been identified as the natural resources, agriculture, non-land based activities, institutions and local economy. These systems consist of various elements, like technology, policy, markets, infrastructure, science, industries, and cultures which are produced and maintained by firms and industries, policy makers, and politicians, consumers, civil society, engineers and researchers. Systems are thus influenced by multiple types of actors. Therefore, working with the mentioned systems and different actors is vital to bring a system change to address these livelihood challenges.

The transition depends on the following three layers and their interactions (Figure 1):

1. Socio-technical landscape: This is a broader context like demographic trends, political ideologies, societal values, and macroeconomic patterns.
2. Socio-technical regime: It accounts for the deep structure that brings stability to the elements like technology, policy, markets, infrastructure, science, industries and cultures.
3. Niches: These are protected spaces like R&D laboratories, subsidised demonstration projects, or small market niches where users have unique demands and are willing to support emerging innovations.

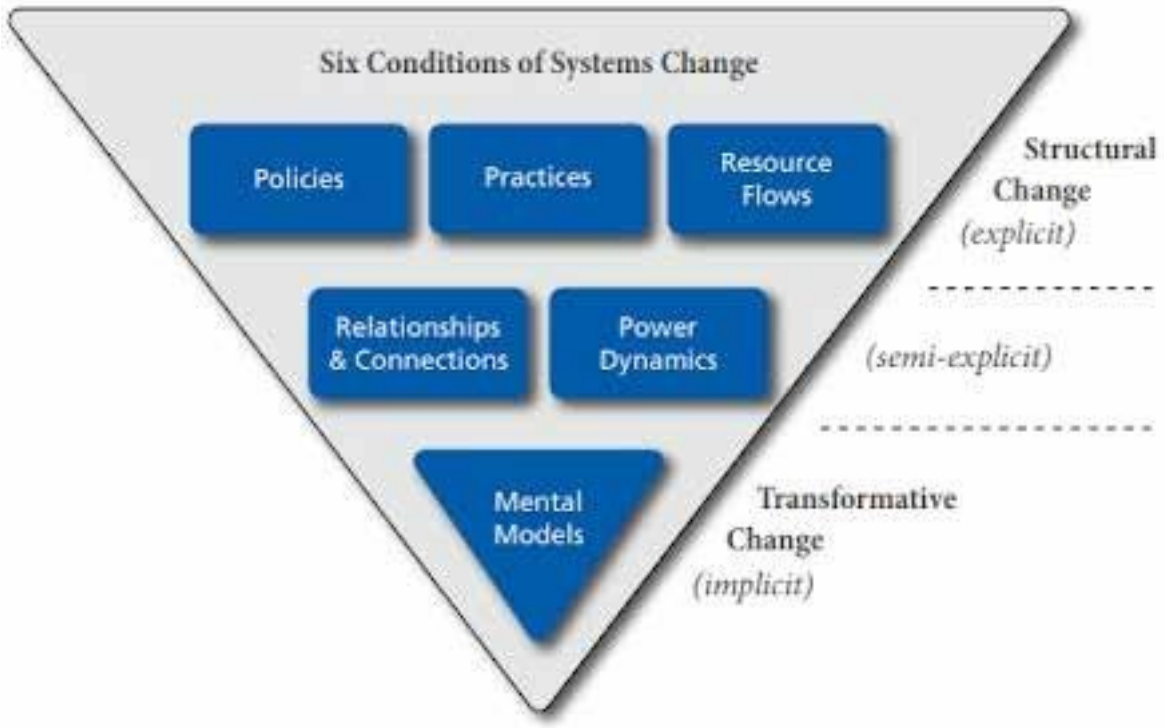



Figure 2 Six conditions of systems change

As seen in Figure 1, these layers interact to make a system change. The innovations at the niche level

[1] https://www.merriam-webster.com/
[2] Meadows, D. H. (2008). Thinking in systems: A primer. chelsea green publishing.

cause internal momentum. Similarly, changes at the landscape level cause destabilisation of the regimes resulting in windows of opportunities for the innovations at the niche level, which shifts the overall narrative of the systems.

Additionally, there are six conditions to system change (Figure 2) that play an essential role in holding an environmental and social problem in place. These six conditions are:

1. **Policies:** Government, institutional and organisational rules, regulations, and priorities that guide the entity's own and others' actions.
2. **Practices:** Espoused activities of institutions, coalitions, networks, and other entities targeted to improving social and environmental progress. Also, within the entity, the procedures, guidelines, or informally shared habits comprise their work.
3. **Resource Flows:** How money, people, knowledge, information, and other assets such as infrastructure are allocated and distributed.
4. **Relationships & Connections:** Quality of connections and communication occurring among actors in the system, especially those with differing histories and viewpoints.
5. **Power Dynamics:** The distribution of decision-making power, authority, and formal and informal influence among individuals and organisations.
6. **Mental Models:** Habits of thought—deeply held beliefs and assumptions and taken-for-granted ways of operating that influence how we think, what we do, and how we talk.

Figure 2 puts the condition on three levels concerning how visible they are and their ability to change a system. The explicit systems are earlier to address; however, the less explicit conditions are the most challenging to clarify but can have huge impacts on shifting the system. Changemakers must ensure that they pay sufficient attention to the relationships, power dynamics, and especially the underlying mental models.

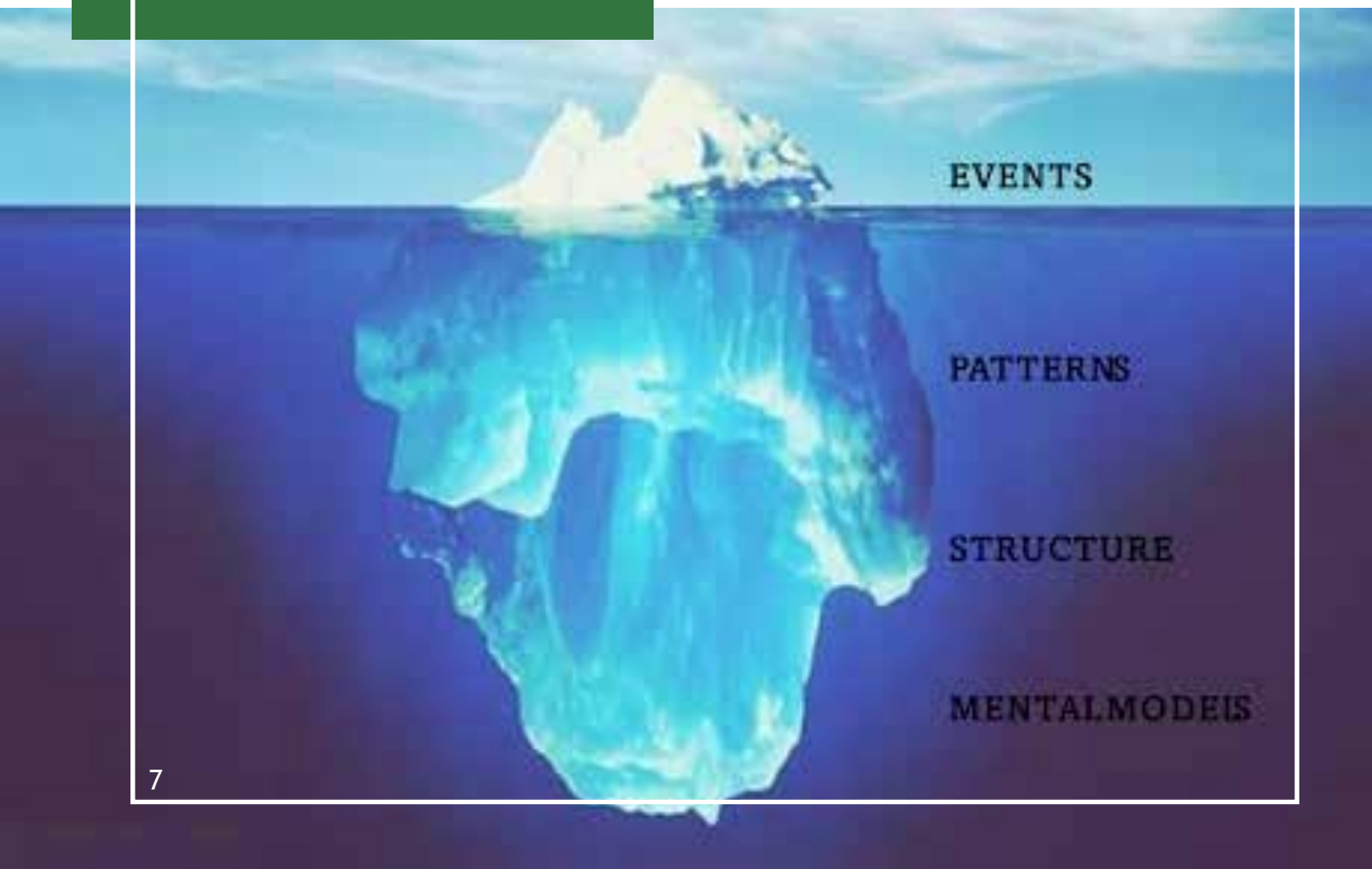
The blogs bundled in this chapter result from GTP's system change activities and explorations thus far. The topics included are an explanation on the iceberg model, local governance, mental models and horizontal learning. The chapter also discuss two examples of system change towards regenerative agriculture, i.e. the abrupt setback in Sri Lanka and the encouraging trajectory followed in Sikkim.

# IT'S JUST THE TIP OF THE ICEBERG!!

Authors: Meghna Mukherjee, Ishan Agarwal, Saheb Bhattacharya

One of the most common approaches to address challenges is to react based on what is visible. For example, if there is less water available in any structure: the solution is more often than not to build more water harvesting structures. However, when we dig deeper and understand the layers, we know the trends and the reasons which influence those trends. Digging deeper allows us to peel additional layers to understand the beliefs, customs, and norms of why events happen in a particular manner.

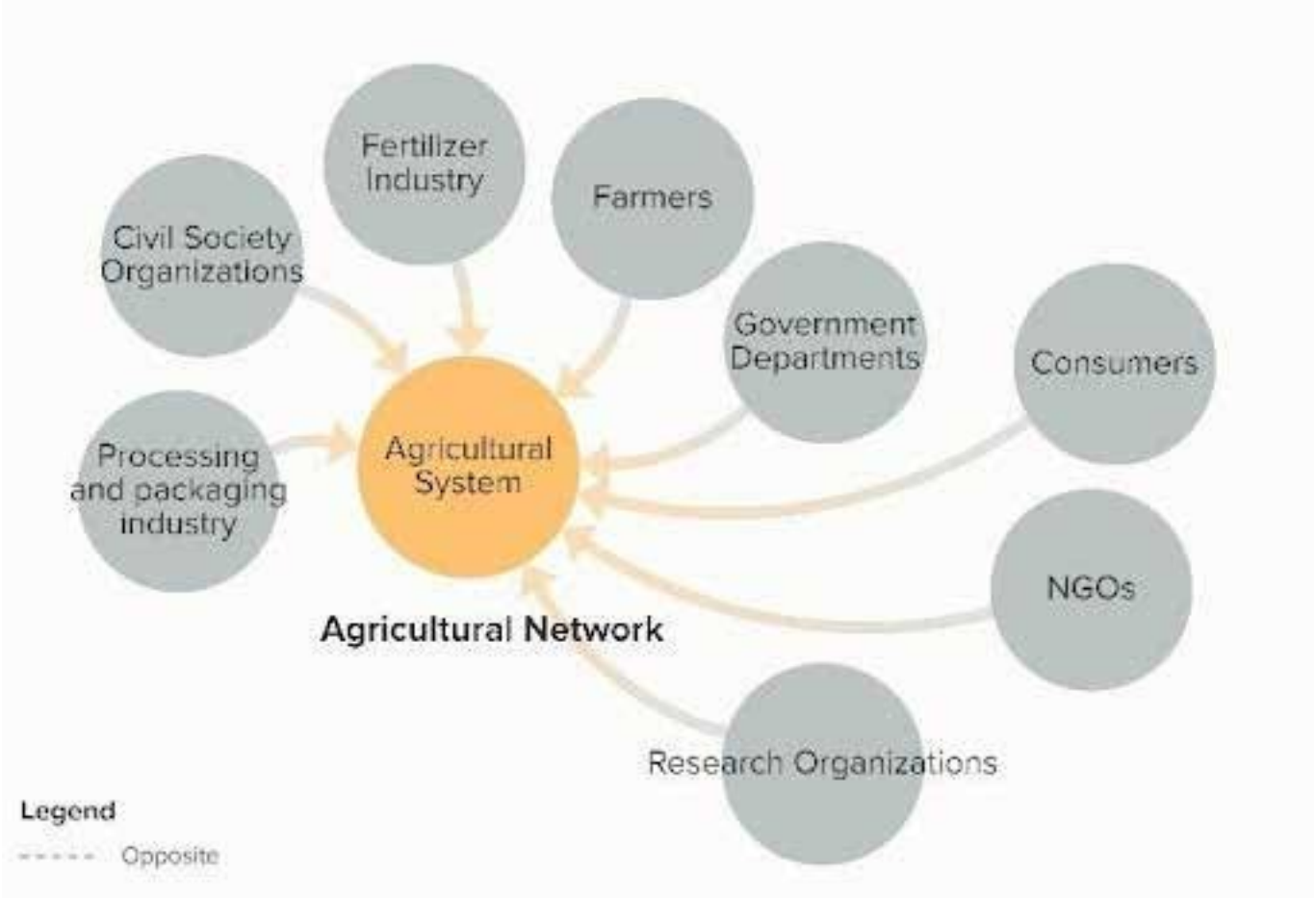
To facilitate the understanding of what is beneath the pile of layers, researchers/practitioners, and policymakers rely on using the Iceberg Model. The Iceberg Model was developed in the 1970s by anthropologist Edward T. Hall to understand society's visible and invisible components. Today, the Iceberg Model is considered one of the most powerful tools for systems thinking by looking into what created the situation in the first place.



Using systems thinking to understand the agricultural sector in India

When we talk about agricultural systems, we must see and recognize the different components that constitute the system. Let's start by identifying the various components of a farming system. Farmers (prominent!) are one of the system's many parts. The other members include consumers, government at different levels (from local to national), research organizations, processing, distributing, and packaging companies, the fertilizer industry, civil society organizations, and NGOs, to name a few. All these different components interact with each other and thus form a network. Any change in parts will have implications for the whole network.

Let's take, for example, changes in the prices of fertilizers brought by the Central Government




of India. One of the most prominent policies has been the rollout of fertilizer subsidies to encourage farmers to use them for better productivity. This is a lucrative opportunity for the fertilizer industry as an incentive from the government starts large-scale production of fertilizers. Farmers buy more fertilizers as the prices are low, thus enhancing their productivity. The research organizations, NGOs, and civil society try to understand the impacts of chemical fertilizers on consumers and find alternative ways of achieving the same yield level with better management of resources.

## Using the iceberg Model

Now that we understand systems thinking, it is appropriate to see how the iceberg model can aid in understanding the system. We used the iceberg model to understand the working of the agricultural extension workers in the state of Jharkhand and Madhya Pradesh in India. It was seen that the agricultural extension workers needed to perform their job more effectively. During a discussion with women farmers in the Santhal Pargana district of Jharkhand, they explained that they had never met the Kisan Mitra (agricultural extension worker). Kisan Mitra aims to promote sustainable livelihoods for medium, small and marginal farmers by improving the last-mile delivery of farm support services. It is operated through volunteers, Farmer Collectives, NGOs, Entrepreneurs, and Field Staff.

Usually, the Kisan Mitras are blamed, and interventions are developed to expand their capacities. Additionally, women farmers would be considered as not knowing the farming system; hence activities to promote their knowledge would be undertaken.

However, the Iceberg Model suggests that the inefficient functioning of agricultural extension workers is only an event that is visible to us. But what is invisible is where the answer to this problem lies. If we understood why last-mile service delivery persons fail to do their job, we could be in a better position to address the issue.

After discussing the issues with government officials belonging to the village and block level across different departments in Jharkhand and Madhya Pradesh, the shortage of human resources is a serious issue. In many areas, Krishi Mitras have yet to be hired, and the organizational structure only facilitates hiring in some places. Additionally, many block-level officials have been managing the role and responsibilities of various positions. This translated to ineffective monitoring systems, thus needing full attention to the functioning and work of the service delivery persons. While interacting with government officers, the lack of funds was highlighted, which adversely impacts the officers' functioning, especially those who are at the last mile.

Digging deeper, we can analyze the structures that result in human resource shortages. Literature suggests that admission to different positions at the government level is difficult. There is a series of examinations that one needs to qualify for before they are appointed. Many people are unaware of the tests; the vacancy list and lack of information create gaps. The bureaucracy in government jobs does not make it easier to find employment. In the case of Krishi Mitra, it has been found that, more often than not, the positions are filled through networks and connections. It leads to more autonomy and less accountability by the KMs, leading to inefficient functioning.

In some cases, mindsets and mental models also play an essential role. Women farmers complain about KM's unavailability and lack of awareness and information about schemes. During an interview with one of the Krishi Mitra, he explained that since women are not considered farmers, the information channel does not reach them. However, their husbands and sons interact with KMs and are aware of the system's working.

## Way forward

There is no direct, linear, and simple solution to address such problems. Iceberg Models help us identify the reasons, which are deep below. As practitioners, we should be mindful of the existing patterns, structures, and mindsets that can influence the system's working. We must pay heed to such lessons and understand that visible things should not be considered, but efforts should also be made to understand the invisible forces.

# A CONVERSATION WITH BIMLA KUJUR: THE SAMVIDHAN SAATHI

Authors: Vinitika Lal, Arpan Mondal, Meghna Mukherjee, and Iqra Khan

Meet Bimla Kujur. Bimla hails from Marcha-Dautoli, a small village in India in Marcha Panchayat, Torpa Block, Jharkhand. Bimla has been working as a Samvidhan Saathi (literally translates to Constitution companion) for the last year, in the field of local democracy. The position of Samvidhan Saathi was created as part of an initiative by PRADAN, an NGO working in the most underdeveloped regions in India. The idea was for the Samvidhan Saathi to assist women interested in knowing and working on their rights and entitlements, and increase civic action through collective efforts.

Bimla was disturbed by the struggles encountered by the Gram Sabha, a village governing institution responsible for local governance-related work. In Bimla's experience, the Gram Sabha had poor attendance from the village community because they preferred their hamlet level or Tola Sabha for sharing their concerns. Since Tola/Hamlet Sabha covers a smaller geographical area, it becomes easier for women to share information without hesitation. The women are not aware of the work and proceedings of the Gram Sabha and hesitate to voice their opinions in a large forum[1].

Interestingly, self-governance is not a new concept for indigenous communities. The people from the Munda Tribe have been practicing self-governance since ancestral times, but not in a formal manner. Back then, the elderly people in the community would gather regularly and collectively resolve problems related to the village. Eventually, these self-governance platforms lost relevance as new formal institutions started evolving. These new formal institutions backed by the constitution worked in the same space as the self-governance institutions in the tribal communities. The Gram Sabha is one such formal institution. It is the general body of the Gram Panchayat, a democratic structure working as a cabinet at the grassroots level in India.

Bimla shares that the Gram Sabha had low participation from women since the meetings were usually held at inappropriate times for women. Women found it difficult to attend primarily because of domestic work and lack of mobility. Another reason was these meetings were dominated by male members, and women did not feel comfortable, especially since they were a minority and cultural norms made it difficult for them to voice their opinions.

People who are politically aware of their rights and entitlements can voice their opinion and utilize the potential of the Gram Sabha. As a result, only select people can maximize the benefits of the Gram Sabha. Often, this leads to biases and skewed information, which is detrimental to people who

may not be as aware of their rights within these processes and institutions.

Bimla saw this firsthand when her husband had to give up some of the financial benefits provided by the government because he had become employed. However, Bimla explains that many people who had connections with the higher authorities could enjoy the financial benefits even though they had fixed jobs. This inequality and biased behavior motivated Bimla to take a stand. She believes that true equality can be achieved only when everyone is aware of their rights and duties and conscious of the benefits of accessing forums like Gram Sabha. As a Samvidhan Saathi, she is working towards achieving this goal.

Due to the concerted efforts of individuals like Bimla, the Gram Sabha is active today. It has become a platform where social issues are also discussed. So far, in the Marcha Gram Sabha, three committees have been formed, viz. Krishi samiti (Farmer Association), Vikas evam nirman samiti (Progress and Development Association) and Swasthya samiti (Health Association) .

Bimla says, " I am proud that I am now recognized as a Samvidhan Saathi (Constitution companion)- people reach out to me when they require support with resolving matters related to formal documentation, access to government schemes and entitlements such as job cards, pension, birth and death certificates to name a few." She continues, "I have recently discussed and raised the issues of wage differentiation between men and women for the same amount of time and work. I am discussing the issue at Self Help Group, Village Organisation, and the Cluster Level Federation to advocate for equal wages". She has also played an active role in organizing Civic Literacy camps to build awareness of rights and entitlements available to citizens according to the Constitution of India and how people can address current issues such as delayed payment in the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA)[2] and receiving inadequate amounts of ration than allotted by the government.

Bimla proudly recalls, "I have also made efforts to ensure women's participation in the Gram Sabha. I attend the Self Help Group, Village Organisation, and Cluster Level Federation meetings and motivate women to attend Gram Sabha and discuss women's issues being neglected by the existing practices in the Gram Sabha".

When asked about her ongoing and future plans, she adds, without hesitation, that she intends to continue organizing special camps at the panchayat level to solve issues like making Ration cards, Aadhar cards, voter cards, birth certificates, job cards, pensions, caste certificate, and death certificates, etc. accessible to eligible candidates. She wants to prioritize working for vulnerable and disadvantaged people so that it is easier for them to avail of government programs.

Bimla concludes, ***"I am very happy being a Samvidhan Sathi where I am working on citizenship, people's rights, and entitlements. I am also proud to be working for people who lack access to forums where they can share their issues and needs".***

[1] Gram sabha is a governing body of a village (consisting of numerous hamlets) where village people come together to discuss issues of that village. Many tribal villages remain scattered, that's why Tola Sabha happens in hamlet level (which is a smaller forum in size). The insights from the Tola Sabha are presented in the Gram Sabha for approval.

[2] MGNREGA is a policy of the Indian government that aims to guarantee the "right to work." It aims to enhance livelihood security in rural areas by providing at least 100 days of wage employment in a financial year to at least one member of every household

whose adult members volunteer to do unskilled manual work.

# UNDERSTANDING MENTAL MODELS AND PERCEPTIONS

Authors: Meghna Mukherjee and Vinitika Lal

Mental Models, the basis of reasoning and decision making, is a widely accepted theory in the cognitive science and psychology literature. The notion of a mental model was originally postulated by the psychologist Kenneth Craik (1943) who proposed that people carry in their minds a small-scale model of how the world works. These models are used to anticipate events, reason, form explanations and react which is based on their experiences, perceptions, and understanding of the world. Numerous researchers have studied the influence of mental models on developing these external realities to interact with the world. However, such realities are unique to each individual.

Development practitioners in the field of Natural resource management have tinkered with the idea of studying mental models to reach a common vision. They believe that identifying and sharing a common understanding amongst different stakeholders is important to enhance the collective decision making process.

Understanding mental models is an important component of systems thinking (understanding of a system by examining the linkages and interactions between the elements that comprise the whole of the system) as it helps in understanding that each actor has its own unique perception of the situation. Researchers interested in systems thinking use the mental model as a tool to better understand similarities and differences between stakeholders' understandings of an issue and integrate different perspectives to improve the overall insights regarding the system.

## Mental Model in Regenerative farming

Regenerative agricultural practices are being promoted to revive the natural environment. There has been a push by the Government of India to transition towards regenerative agriculture. Different policies and practices have been implemented to achieve this goal. Despite the push, the uptake has been fairly low. In order to understand the reason, it is important to understand the mindset of the farmers who are the main actors in this system. Figure 1 shows a causal loop diagram which explains the broad perception of farmers in Jharkhand and Madhya Pradesh state of India. It is clear that two different mindsets cropped up during the initial round of discussions with the farmers.

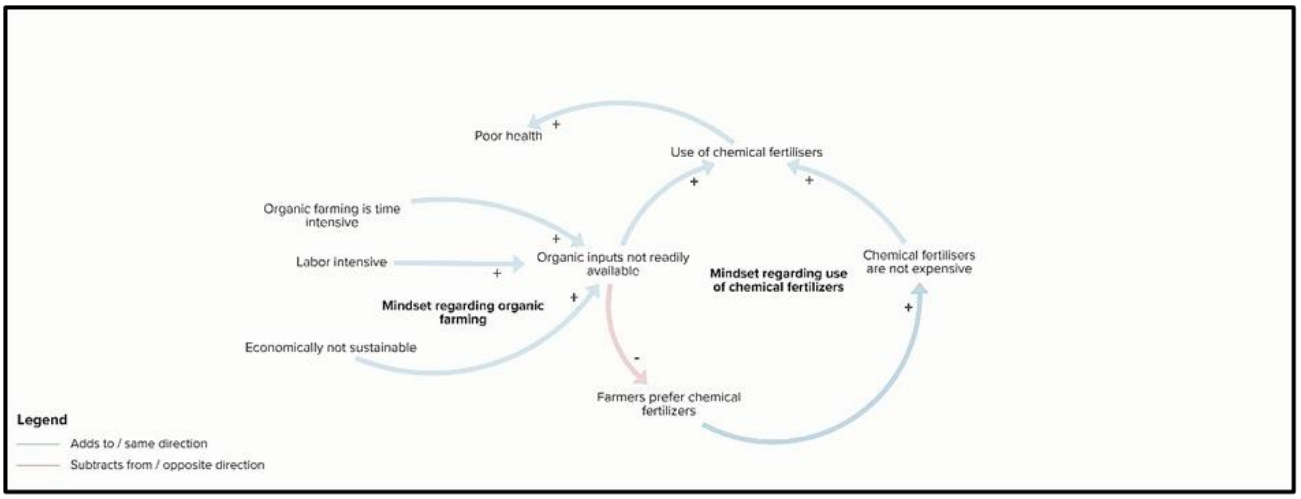
**Using chemical fertilizers:** The farmers were aware that the use of chemical fertilizers causes reduced levels of resilience in the body and overall deteriorates the health of the family. Since organic inputs are not easily available in the market, they

continue using the chemical fertilizers. Also, the chemical fertilizers available in the market are very reasonably priced compared to organic fertilizers. The government has put a subsidy on the fertilizers which makes inputs like Urea and DAP less expensive. This incentivises the farmer to keep using the chemical fertilizers. The fact that the use of chemical fertilizers has a good impact on yield favors the argument even though they understand that health gets adversely impacted.

**Mindset regarding organic farming:** The fact that organic inputs are not readily available does not help in motivating people to transition to regenerative farming. Additionally, there is a bias against regenerative farming as farmers feel that organic farming is time and labor intensive. Since the farmers have to make the fertilizers and pesticides themselves, they have to invest a lot of time in procurement as well as making the product. They also feel that it is not economically sustainable as the costs are higher than the income. They are of the opinion that the yield from using organic inputs are lesser than what they get from chemical fertilizers.

## Where do we go from here?

Through analyses of mental models, the objective is to understand where the bottleneck is, the weakest link in the chain which when addressed leads to the maximum change. Unless and until there is a thorough understanding of the mental models which drive visible behavior, stakeholders, despite good intentions, will continue to make surface level actions which of course will not demonstrate lasting change and maintain the status quo.



# HORIZONTAL LEARNING - AN EFFECTIVE WAY FOR DISSEMINATING KNOWLEDGE

Author: Arpan Mondal

There is a natural need for farmers to learn from each other which cropping patterns, cultivars, irrigation techniques, pest and disease control, or poultry/livestock rearing practices work and which do not work. In other words, what are 'Good Practices' to follow and what are bad practices to avoid. Such Horizontal Learning by farmers is practical and demand-driven, not undertaken for academic interest.

The term 'Horizontal Learning' is defined in many different ways in many different contexts but is essentially characterised as a peer-to-peer learning process. It is different from formal education systems where teachers and students are not peers but come from different walks of life. In formal education systems, teachers and students have a hierarchical relationship, in which teachers determine the topics and design the pedagogy. But in peer-to-peer learning systems, the peers set the learning agenda and pedagogy themselves as per

peers need. There has not remained any specific learning boundary.

In the context of agriculture, 'Horizontal Learning' is traditionally how farmers have been learning from each other since the first farming communities came into being. None of this is to suggest that Horizontal Learning systems are in conflict with or are superior to formal learning systems. They both have comparative advantages which complement each other. In Jharkhand and Madhya Pradesh, a system of formal agricultural education and research has been set up in the form of agricultural universities and research organisations (KVK, ATMA etc.). By any yardstick, these institutions and programmes are of good quality and have generated substantial amounts of useful research over the years. But the extension process of the government system is not so strong that output can reach up to farmers. Here, learnings can be shared through farmer made videos when farmers will document the story.

In order to better understand the scope for horizontal learning and integration into PRADAN's activities, a survey was conducted to understand the existing knowledge sharing process of PRADAN and challenges in sharing the knowledge. Firstly it was found that PRADAN is deploying a diverse range of mediums and methods to share, exchange and disseminate knowledge, in relation to communities:

1. Exposures visit to the areas where activities were placed efficiently.
2. Field Demonstrations (Seeing is believing) activity to enhance confidence among the farmers.
3. ·PRADAN has documented several success interventions by Experts through the form of Video, those are being used as Training material to motivate others.
4. Cadres (CRPs) mainly share pictures of good farmers plots in different whatsapp groups; as a result others cadres also get knowledge about it and try to implement that practice in other areas.
5. Sometimes they organise street play to disseminate the knowledge as a form of awareness creation specially for some social issue
6. Miking with Local languages
7. Organise some Experience sharing meeting or Reflective meetings for cross learning
8. Using of Flash Card, and some Modular training materials during meetings for easy understanding

However, the current methods are also met with the following challenges:

- Exposure visit is a very strong medium of Horizontal learning. But it includes a lot of cost as a reason sometimes teams failed to conduct the exchange visit.
- Sometimes video shows are organised. Those reflection videos are made by other organisations or any professional. But due to electricity problems at the village level, they face problems conducting the video show.
- Lack of Audio visual resources in local dialect. As a result farmers sometimes understand very little, it is one of the major problems.
- Professionals get very little time to document the stories or good practices. And it was shared that success stories do not reach farmers if it is in written form.

To complement the existing knowledge sharing process of PRADAN, the prospect of incorporating visual Horizontal Learning was explored. Horizontal Learning is an age old process; but videos are a relatively new medium. And yet, videos are remarkably well-suited as a horizontal learning tool. Being a visual medium, videos appeal to farmers across different levels of education. They break through barriers of language and literacy by literally 'showing' a thing or a concept rather than explaining it through words or still images. Videos are also suited for quick learning, being able to convey an idea in 5-10 minutes that could otherwise take much longer to flesh out. Thus, videos have been in use in agriculture extension for quite some time now. However, that has mostly been in the form of professional productions by big organisations. Useful as they are, there are some gaps they fail to fill. In this context farmer made videos can play a vital role for disseminating the knowledge widely and efficiently.

## Farmer Made Videos

Every video is a story, no matter how technical or mundane the subject matter. Producers of high-quality extension videos (organisations and individuals) are usually not from farming communities. Thus, they often fail to speak to communicate with farmers in a language, tone, and sensibility that they best relate to. Compounding this challenge in developing countries is the diversity in language and culture. When farmers themselves would make videos, they would be able to communicate more effectively to fellow farmers. Equally important is the fact that when it comes to videos advocating new practices, farmers find those made by fellow farmers more credible. It would be able to catch people's attention easily and learning would also strive for a longer time. And ultimately it would help in quick learning and engaging in an activity. Moreover, it would help to spread the learning widely.

The idea here is to supplement the stream of farmer-made videos in circulation through screenings and other means, with professionally produced videos. As discussed earlier, farmer-made videos and professional productions have their own comparative advantages. For example, farmers cannot be expected to make elaborate videos covering multiple stories or multiple locations; or to track the impact of an intervention over a period of time. Besides, their ability to analyse and present new, high-tech practices and technology is limited. Professional video producers can be engaged to cover all these bases. Additionally, such videos with high production values inspire farmer producers to make better videos, and act as reference points for best practices in shooting techniques. Some such videos produced in the GTP are set to be broadcast on the agricultural programme on local media. Thus, they will help disseminate good practices from the project area to other rural communities in India. PRADAN has a great ground presence comprising CRPs. It would be best to train these CRPs to capture the good practices and share these into farmers whatsapp groups or other social media as preferred.It would help to document the good practices without interference of such support, farmers would be able to see the video according to her/his preferred time. Ultimately it would help in quick learning and engaging in an activity besides spreading the learning widely.

# WHAT WENT WRONG WITH ORGANIC AGRICULTURE IN SRI LANKA?

Authors: C.M. Wijayaratna, Abraham Abhishek, Meghna Mukherjee

It would be fair to say that there is broad consensus at this point around the benefits of organic agriculture. Everybody understands and acknowledges the downsides of decades of farming based on intensive use of synthetic fertilizers and pesticides, and the need to regenerate the soil reeling from it. In markets across the world, organic produce and products are available at a markup. Organic sections at supermarkets are becoming larger and larger.

Where should we be headed? Should we try to get to a situation where all agriculture is organic agriculture and all produce is organic? Or should organic systems support/ be supported by more industrial systems of production? How do we advance towards that stage? What should the first steps be?

Although these questions are of global significance and have global implications, it is up to sovereign nations to address them and chart their own

courses. In April 2021, Sri Lanka decided to go cold turkey—then-president Gotabaya Rajapaksa announced that only organic agriculture would be allowed then onwards, imposing a nationwide ban on the import and use of synthetic fertilizers and pesticides (along with around 600 other food items such as oats, soy milk, and dairy).

Nobody would have expected any pathway to organic agriculture to be smooth and painless, but this particular top-down one has led to steep falls in agricultural production, farm incomes, and availability of agricultural produce in consumer markets. Prices of staples, such as rice, shot up by more than 50%. For the first time in more than 40 years, Sri Lanka had to import $450 million worth of rice.

Sri Lanka's political-economic crisis is broad-based, a result of failures on several fronts of the economy and governance. However, it is increasingly being foisted on the decision to switch to organic agriculture. The country isheld up as an example of the inadequacies of organic farming at scale, but it was the abruptness of introduction that explain the failure.

Neighbouring India is dealing with its own set of issues in its drive to promote organic farming. The organic inputs (fertilizers/pesticides) market is under-developed and tainted by products which are organic in name only. The extension system lacks the capacity to provide farmers the information and support they need to switch from conventional to regenerative farming. Even when all the information and all the inputs are available, most smallholder farmers do not have the financial cushion required to withstand the chance of lower yields and lower incomes which is inevitable if they switch to organic.

Nevertheless, slow progress is being made. India is a federation of states- the states have a fair amount of autonomy in determining and implementing their agricultural policy, and some states (such as Sikkim, Chhattisgarh, Andhra Pradesh) are doing better than others. Centre for Science and Environment's (CSE) report 'State of Organic and Natural Farming in India- Challenges and Possibilities' offers a good compilation of the state of affairs, which is far from ideal. However, the broad takeaway from a Sri Lankan perspective is that there are gains to be made when strategies are devised and implemented over a longer term. The organic transition in Sikkim—one of the smallest Indian states often held up as a poster child of organic transition—was rolled out over almost 10 years. This time was taken to carry out consultations, research, capacity building, creating value chains of organic farm inputs and produce, and developing market linkages.

Beyond the central message of 'taking the time,' Sri Lanka would have to chart its own specific course to organic agriculture, which corresponds to its own specific context. Following are some broad steps that could shape a pathway out of the ongoing crisis:

- **Resuming fertilizer import, phasing it out:** Sri Lanka's farmers are struggling to meet their farm input needs. This requires immediate redressal and the only way to do that is through resumption of fertilizer imports. At the same time, it would be important to phase out the imports over 10 years or so. During that period, steps should be taken to promote biofertilizers and ensure their availability.
- Restoring Soil health: Organic agriculture requires healthy soils. Sri Lankan soils are currently reeling under decades of chemical fertilizer use. Measures to restore soil health should be taken immediately; one of them

should be to roll out campaigns to plant leguminous crops. Besides, nature-based methods of enhancing soil microbial activity coupled with high-yielding climate-smart agroecological practices like the Systems of Rice and Crop Intensification (SRI-SCI) will accelerate the soil restoration process and improve crop yield.

- **Planning around natural boundaries:** Planning related to agriculture and the natural resource base around it currently happens at the level of administrative units (districts and divisions). Alternatively, watershed/contour-based planning and implementation would be much more effective in restoring the health of water resources, and addressing issues like agricultural pollution.
- **Empowering farmer organisations:** Cooperatives and farmers organisations around specific agricultural products do exist, but creation of more of them should be stimulated. Most important is the need to ensure the inclusion of a large number of smallholder farmers in such organisations, and that they truly represent their interests and visions.
- **Sourcing, heeding to expert advice:** A body of experts from various fields—agronomy, economics, the civil society, etc.—should advise the President on the country's organic transition.

# WHAT CAN WE LEARN FROM SIKKIM?

Authors: Meghna Mukherjee

Sikkim, a small mountainous region in India, is the world's first 100% organic state. It has transitioned from chemical to organic farming, and now all its farmland is certified organic. The transition has benefited at least 66000 farmers and converted 74,000 ha of land to organic cultivation. The Sikkim government has been applauded for its concerted efforts.

Though the use of chemical fertilizers was the lowest in the country, the state decided to transition from chemical to natural fertilizers to reduce the adverse impact on the environment. What started as an ambitious goal in 2003 was realized in 2015. Not many would have imagined the small mountainous state to achieve such a significant feat quickly.

## So, how did Sikkim achieve the transition to natural regenerative farming?

Sikkim took more than ten years to achieve the transition. The transition journey focused on working on the different components of the agriculture system. There were concerted efforts at the level of developing new policies, implementing better practices and resource flows, building relationships, tackling power dynamics in the system, and shifting mental models. By working on the different conditions of system change, Sikkim was able to achieve the shift to natural regenerative farming.

**Developing new policies:** The government reduced the subsidy on chemical fertilizers and pesticides by 10% each year and implemented a total ban in 2014. The ban was strictly enforced, and anyone not abiding by it was punishable under the law. Parallelly, policies to mainstream organic farming were also taken. Steps to make certification easier were taken by encouraging information and knowledge exchange and supporting farmers. To ensure holistic development, the government invested in education and the social sector to make people aware of the benefits of natural farming and the methods to improve the existing practices.

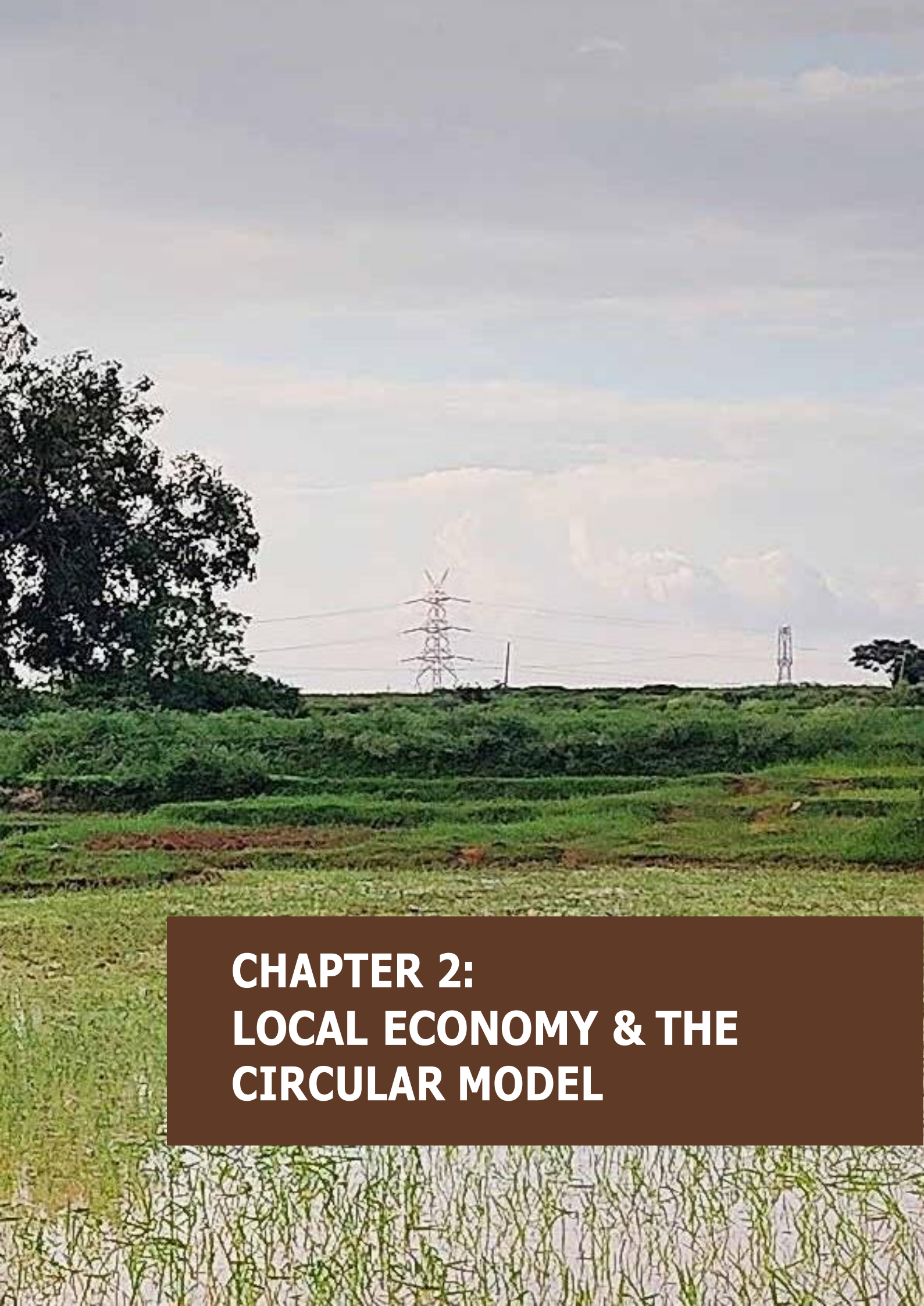
**Implementing better practices:** The plan to form a Sikkim Organic Mission (SOM) showed the commitment of the government to bring about this transition. The SOM encapsulated the provision of inputs, learning opportunities, and training on using organic inputs. The government also facilitated the development of scientific research, teaching, and vocational training in organic farming.

**Resource Flows:** The system was designed to promote resource flows (read: Financial flows) that would aid the transition. For example, government departments came together to provide training on organic farming and encourage research and development opportunities. They provided support to farmers in finding alternatives to chemical ways of farming. The government embedded other laws and policies (Agriculture Horticulture Input and Livestock feed regulatory Act, 2014) together to streamline the resources.

**Understanding the mental models:** The government worked to improve the structure and bring transformative change by focusing on shifting mindsets. By providing continuous training to farmers and educating them about the benefits of organic farming, they were able to change the perspective of farmers. Additionally, the government invested money to develop scientific research and promote vocational training to different cadres in organic farming. So through the twin pron strategy of working through the system and with local actors, the government's efforts became successful.

## Lessons to take forward

Exploring the different facets which were adopted by the government to bring systemic change helps us take forward crucial lessons for the future. To begin with, it is not sufficient to change the existing policies and practices but to go beyond to see how knowledge and money flow across the system. It should be aligned with the overall objective (in this case, it was transitioning to organic farming. Another important factor is to make concerted efforts to bring transformative change by working on deeply seated beliefs and assumptions present in the system. Therefore, the approach should be to work together holistically rather than working in silos through individual government departments and single level policies.



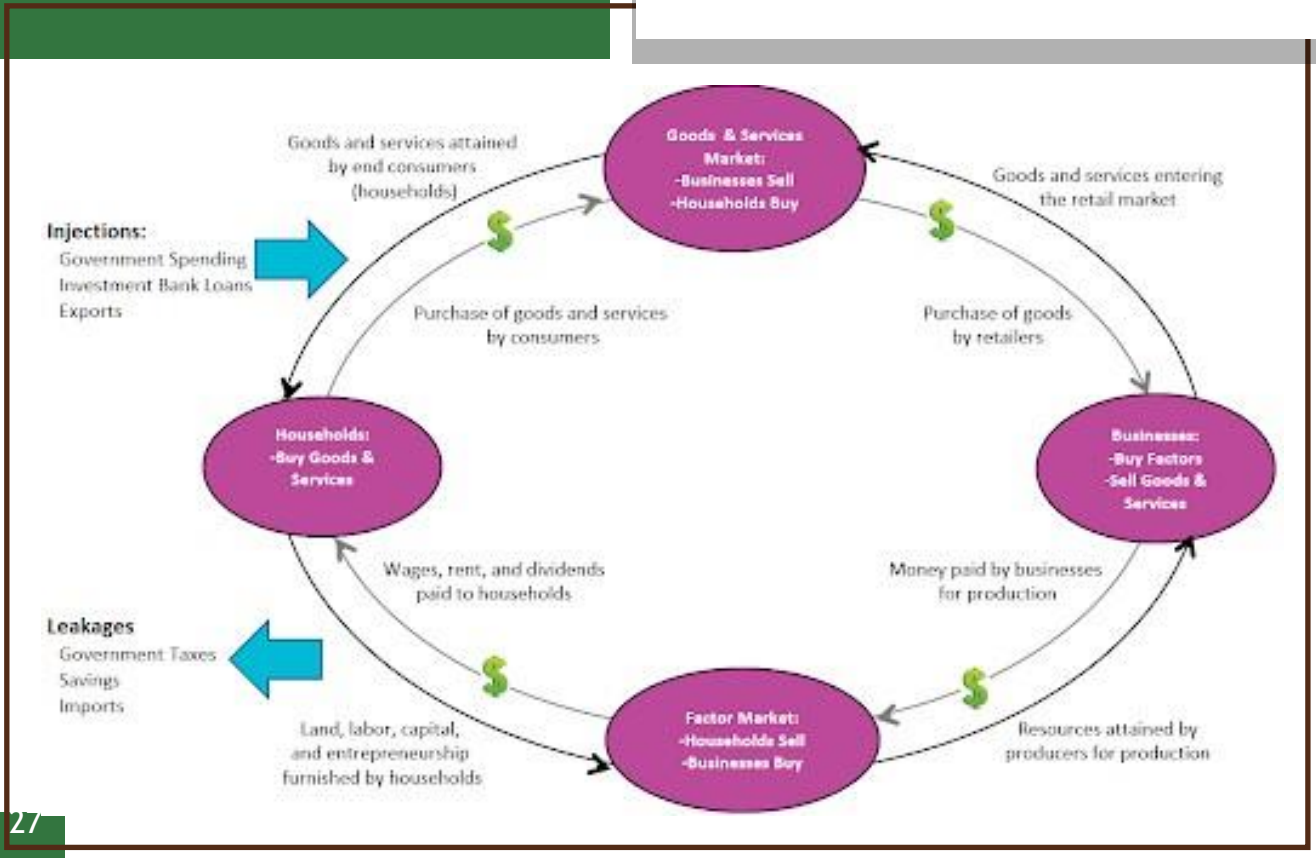
# CHAPTER 2:
# LOCAL ECONOMY & THE CIRCULAR MODEL

# INTRODUCTION TO THE LOCAL ECONOMY AND CIRCULAR MODEL WITHIN GTP

In an economy, firms and households interact to produce goods and services. While households provide the much needed factors of production like labour, firms convert these into products and services which are then sold in the product market. The consumers buy such goods and services from the wages they receive by selling their labour. In this simple model, the money flow remains circular as it moves from the household to the firm and back to the households. However, when we expand this model a bit more, we find that this circularity of money is disturbed as people spend money on imports, or if there are government taxes. These are referred to as leakages from the economy and it reduces the circular flow of money. On the contrary, any kind of "injections into" the economy like government spending or exports would enlarge the flow of money into the economy (Figure 1).

When we look at this concept from a local economy perspective (read: rural villages in India), though the basic idea remains the same,

Figure 1 Circular model of money



the actors involved and the goods and services produced changes. For example, firms can be seen as local shops or agricultural farmlands which use different factors of production like labour, land, technology to produce different goods and services. Households/consumers are the residents of the village who provide their labour and use their land who work on the agricultural lands to produce goods and services (like agriculture crops, horticultural crops, livestock etc.)which are then sold in the product market.

In GTP, the idea is to have a stimulating local economy which is self-sustaining and sustainable in the long run. The current COVID scenario has resulted in a large scale of reverse migration to villages in India. By taking advantage of this window of opportunity, we aim to promote different livelihoods and jobs so that people, especially the youth of the village, do not feel the need to migrate to urban areas for earning income. This can be achieved through adoption of different livelihood programs like developing the value chains, promoting processing units of agricultural/ horticultural crops, promoting alternative non-farm based jobs like livestock rearing, trade shops, grocery units, parlour, hardware stores (and the list can go on). To implement it is important to assess the current system, understand the needs of the villagers, promote capacity/skill development of the local people and lastly track the flow of money. All in all, we are aiming for a system where the interaction between households and "firms" is based on exchange of existing resources and there is continuous circulation of money.

From a systems change perspective, analysis of current bottlenecks and need assessment of people is the priority. A needs assessment will enable a ground swell by encouraging the local fora to take initiatives. Once the residents are sure of the needs and they are able to envision a future for them in the village, the next step would be to increase injections in the village. This can be done by leveraging the existing government schemes, convergence of different schemes and institutions and by collaborating with other organisations who are engaged in promoting different livelihood activities. Training/skills development is also an important criteria and once the people (specially youth) are trained in certain topics they will be confident to develop their expertise further. When we look at local economy and circular money through systems change lens, it is imperative to also tackle underlying social issues and other interlinkages which have an impact on the local economy one way or the other. As an example, lack of health and education facilities play an important role in driving migration and therefore leading to leakages from the economy. So, the umbrella goal should be to have a wider outlook rather than a narrow approach to the local economy.

The blogs bundled in this chapter result from GTP's local economy and circular model activities and explorations thus far. The blogs display several examples of local (female) entrepreneurship, increasing resilience and diversity in the local economy, and regenerative agricultural enterprises.

# LOCAL ENTREPRENEURSHIP IN KUREILI, MADHYA PRADESH

Author: Anushree Mitra

A local entrepreneur is an individual who starts a business in their local area. Entrepreneurs are important to market economies because they can act as the wheels of the economic growth of the country. Local businesses don't only build a stronger economy – they also build a stronger community. Relationships between small businesses are important in creating a cohesive, welcoming community identity, with businesses supporting each other.

One of the examples of this is set in a small village called Kureili in Madhya Pradesh's Dindori district.

This story starts from 2005, when PRADAN started their interventions in these areas by forming Self Help Groups (SHG) first. Chandrakali Didi wasn't willing to join it. She was so scared of talking to people that she used to run away from the backdoor of her house when people used to come to talk to her. It was her husband who actually signed up on her behalf. "I fought with him a lot and asked him why he put my name there. I don't know what they'll ask. What all I'll have to say. Why did you do this?"

She was very scared and confused as to what was happening. Didi along with other women of the village could not even speak up openly. They used to cover their mouths with scarves. "I didn't even know how to count money."

Post SHG formation, she, along with the other women, had to face a lot of hindrances. Their own people kept on discouraging them. Telling them to not be a part of this. There was a common fear that people would collect all their money and steal that. There were other attempts to make SHGs in the other villages but none were successful. When they used to sit for the meetings, relentless taunts and accusations had become a part of their daily lives. "They (other villagers) also started influencing our husbands against us. Questioning our activities and whereabouts." These things had started wreaking havoc in their personal lives as well. "We used to

discuss that by the time we came home, our husbands used to finish their food, put the plates that way and put out the fire in the chulha (gas). They didn't even leave food for our children or even make food for them." But Chandrakali Didi was determined to not leave the group no matter what. This had slowly started escalating to a point where domestic abuse had become a part of their daily lives. "When we used to go to collect the water, we used to ask each other, when our husbands had opened the door. It used to get so difficult," said Chandrakali Didi.

Chandrakali Didi didn't have money to contribute to the SHGs. They all started with contributing 50 paisa. "That time we didn't have money, we didn't have enough produce which would last for a year. We had to go to other fields for labour work."

She and 14 other women in her village started with the poultry farm with the help of PRADAN in 2007. "We joined the SHG but we needed extra income. We didn't have any other source of livelihood." Chandrakali Didi started with the thought process that with a poultry farm, they can take care of the household as well as their children and work in their fields as well.

"Initially we started with 15 women from my village and now it is 476 women from 23 villages in 2 blocks. (Amarpur and Samnapur)" She had to face a tremendous number of insults from the community after starting the poultry farm. "You have made this village a hell. This smells like hell." Despite such harsh comments and daily taunts, Chandrakali Didi didn't back down. She started with the poultry farm but started facing problems regarding marketing and transportation. "When I started with it, I had to face a lot of problems. I didn't even get proper fodder for the chicken. I used to buy rice and grind maize for them myself and feed them" Even during the lockdown, she along with other women used to walk in the villages and sell their chicken.

Presently, the situations have changed completely for Chandrakali Didi. "I started with 400 chickens and I took out a loan and scaled it to 700 chickens." She started earning for herself and her family. Today she is not only getting respect from society but also her own home. The fact that she is also helping in running the house is a matter of great pride for her and her family. Initially she couldn't even afford the things she required. She had to convince her husband day after day of her rudimentary requirements. "Now, I bought the bike in my name. I travel everywhere alone for exposure visits." Her family couldn't even earn 10000 INR in a year. The agricultural yields were also less. And now she alone earns 30000 INR just from the farm.

Currently the poultry farm is run by a cooperative made by the women themselves and Chnadrakali Didi is the Vice-President of it. Last term, she was the President as well. She feels extremely honoured that she gets elected for these positions. "I want my sisters in the village to also start earning like I do. They also become empowered and financially more capable like I have become." Today the people in her village are also inspired and want to have a farm of their own. The turnover of her cooperative today is 11 crores. She wants to scale the capacities of the existing farms and include more women in the cooperative. "I want to include more of my sisters but there is a lack of markets."

Chandrakali Didi is the true example of "Where there is a will, there is a way." Despite such harsh insults and continuous oppression, her relentless pursuit for herself and the women around her is an inspiration for us today. Women like Chandrakali Didi are the true champions of local entrepreneurship who are not only boosting their local economy but also bringing the communities together, one step at a time.

# ON CIRCULAR ECONOMIC GROWTH: PARADOX AND PROMISE

Authors: Frank van Steenbergen and Saheb Bhattacharya

First, a story with a traveler.

One evening a traveler arrives in a small town. His plan is to reach his family in the main city. Yet it is late and he does not like traveling at night. He knocks the door of a small town hotel and asks the owner if there is still a bed for the night. ``There is", the owner says, "but because you will leave early morning would you mind paying in advance?", he asks. And so it so happens. The traveler pays INR 1500 and retreats to his room.

As soon as the hotel owner has the money, he goes to the beer brewer who supplied it to his hotel. I still owe you INR 1500, the hotel owner tells the brewer. Now I come to pay you.With the payment from the guest, the local beer brewer runs to the barrel maker. You made this new barrel for me and I did not pay you yet, but here is your payment. The next step is for the barrel maker to go to the dress maker. "Remember you made the dresses for my daughter's wedding and I could not pay

you?" says the barrel maker. "Here is USD 1500," the barrel maker says. "Please accept it as a first payment."Thanks", says the dressmaker, who goes to the hotel owner. "I have been eating here for many nights and I owe you this INR 1500. Please accept."

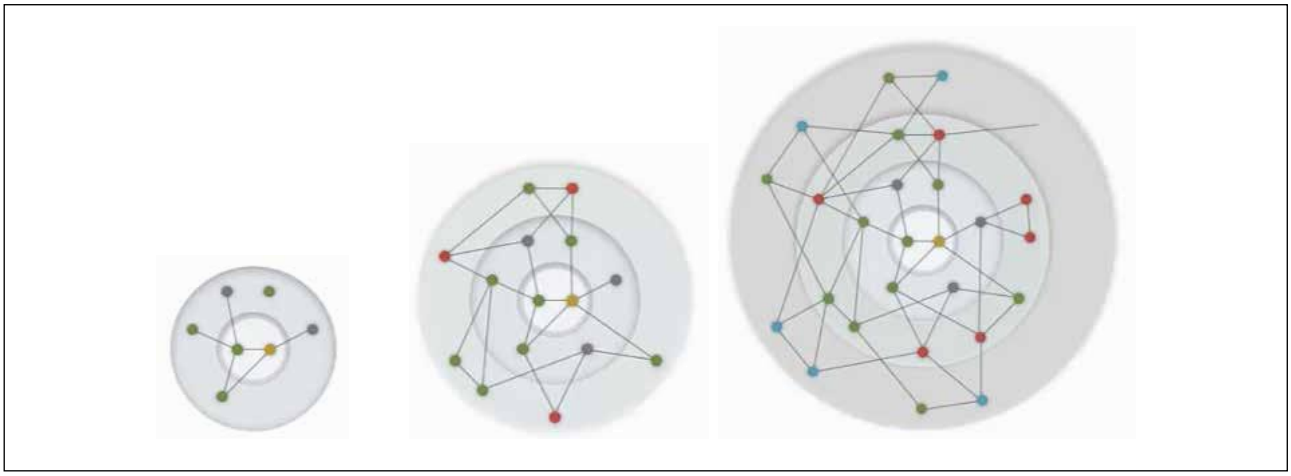
At that time the traveler comes to the reception. "My family called me," he tells the hotel owner. "I think it is better if I proceed and travel home tonight." "I understand," says the hotel owner. "Would you mind giving me the advance back?," asks the traveler. "Of course," says the hotel owner.

So this what money is about: a medium that goes around and that helps us to connect and exchange services and goods. The more the variety of goods and services locally the longer the chain in which money moves around. If no one brews beer, we will not spend money on it, nor are their brewers who may purchase things. If there is no barrel maker, then nobody will produce the useful barrels and no one will spend the money that is earned with making barrels. The economy will not roll. Same with the dress maker: if there is no one to make wedding dresses, weddings would be less exciting, but also no one would be able to spend the money that was earned with making the dresses. And so on and so forth. This is why diversity is important. It is a large driver in any economy. It is what creates the circulation, a continuously increasing web of services and products– with money being earned and spent. In the process more jobs are created locally, there is a higher quality of services and lives are better.

Diversity is not a given. Not every area has the same dynamism. In one area there may be a range of business and services, in another area little is happening. In the first area there may be hardware shops, food processors, transport business, input suppliers, financial service providers and more. In the second area the local economy is stale and all there is typically only general food stores and pharmacies. There could be many other types of useful business and services in the last area, but they are simply not there. It is not that there is no demand, and the local business is not viable. The services and the businesses are just not there and money cannot circulate. Causes can be many: competition from the public sector or outside business, regulatory constraints, export without value addition, no tradition of entrepreneurship. But an overriding reason usually is that the variety of services does not exist because no one started to create them. This is then the Big Paradox: on the one hand we have a lot of useful things that are not done, on the other hand we have many unemployed and underemployed people that are without income, frustrated, if not in despair.

Fortunately there is a Promise too in this Paradox. By increasing the web of local good and services, we can create stronger circular local economies. In strengthening circularity, we can have more jobs, a higher level of services and more well-being.. Diversity is often better than quantity – as competition means choices and diversity means additional options and added value. We think this local circular growth model is more appropriate for many parts of rural India, that have little to offer on global or regional markets, but have the potential for much more local interaction.

Regenerative agriculture can be a catalyst. In regenerative agriculture there is a large scope for such diverse local services: in making bio-inputs, in better storage and transport, in protection crops from rodents and pests, in vaccinating livestock, in producing local seeds and seedlings, They all help farming from being degenerative (depleting



Enhancing and expanding the circularity in the local economy

soils, reducing biodiversity, polluting water, high wastage). They also make money go around.

As such regenerative agriculture can address the Big Paradox and Promise in many remote economies. We need to look at the inner strength of local economies, rather than the external linkages. There needs to be more interest In economic theory in availability and circularity rather than competition. One should look at producers and customers not as separate entities, but consider that he/ she who is a receiver will also be a giver. We need to understand better how to promote this local diversity and circularity.

Here are some avenues:

- Invest in diversity of agriculture related skills and services – through training, contacts and contracts. Many rewarding opportunities exist in agri-services, in particular providing inputs for regenerative farming as well as in adding value to the produce. After all, farming is the main activity in rural areas, and needs to be dynamic and rewarding. Creating a service sector around it will enrich the economy and create aspirational jobs. There are many good starting points already with producer organizations and bio-resource centers.
- Go further in promoting local economic diversity. Make sure that what can be spent locally is spent locally and that the venues for this are there: in local shops, construction work, entertainment, the production of local luxury items and more. Where possible make sure inputs are produced locally rather than sourced from outside, and that things are done with attention, beauty and care, as this all creates work opportunities.
- Fuel up the local economy. Through local procurement of goods and services in large public programs we may inject money in the local economy. There have also been ideas in MNREGA to give cash grants to needy people. This may be expected to boost the local economy and as such have a ripple effect on poverty alleviation.
- Stimulate other sources of money: local credit systems at preferably low interest, so that it is accessed without complication and goes around easily
- Local money? This may sound far-fetched but over the years there have been encouraging

experiences with local currencies. This is money that can only be spent locally These may take different shapes, like special vouchers or phone credits, sometimes with a time-limit so one is encouraged to spend it quickly on others and not store it away. We may want to experiment with such local circulation systems.

- Be mindful of spoilers – public organizations and cooperatives providing low quality hand-out items that stand in the way of more vibrant and creative local business providing local products
- Understand regulation – regulation is good but sometimes works to dampen local enterprise. There are many regulations that support local circular growth: the organization of markets, land allocation of small business, the organization of supply lines and public procurement.
- Having adequate local roads and transport, so as to wire the local economy and keep all connected. A good road network may ease the effort to provide a local service and create opportunities for otherwise marginal inputs, such as agricultural by-products
- Promote entrepreneurship – the ability to seize opportunities and having the reserves to do so; to think that one can take things in one's own hand, that one can create something new. This is a matter of mindset and providing support and opportunities.

Selling agri-inputs in Torpa: adding to diversity

# A STEP TOWARDS STRENGTHENING WOMEN LED FARMER PRODUCER COMPANY

## STORY OF MANNONATI MAHILA KISAN PRODUCER COMPANY LIMITED

Author: Pratik Ranjan

Unlocking the power of small and marginal farmers that constitutes around 85 percent of the farming population, is one of the primary goals for the farmers welfare. This is the focal point on which the Farmer Producer Company (FPC) works as a vehicle to enhance farmer income. So far in India, more than 15,000 FPCs have been formed and another same number are in line for promotion in the coming years by 2025. Some of the federations in the form of FPCs in this context have shown positive and encouraging results through organising seed production, establishing a proper market linkage and initiating the procurement from the farmers at Minimum Support Price (MSP). However, recent years have also seen that the farmers have moved beyond just seed production and have started working on the value chain through processing of the primary products before selling it to the consumers.

FPCs with right amount of support can bring

Figure 1: A woman farmer from MMKPCL

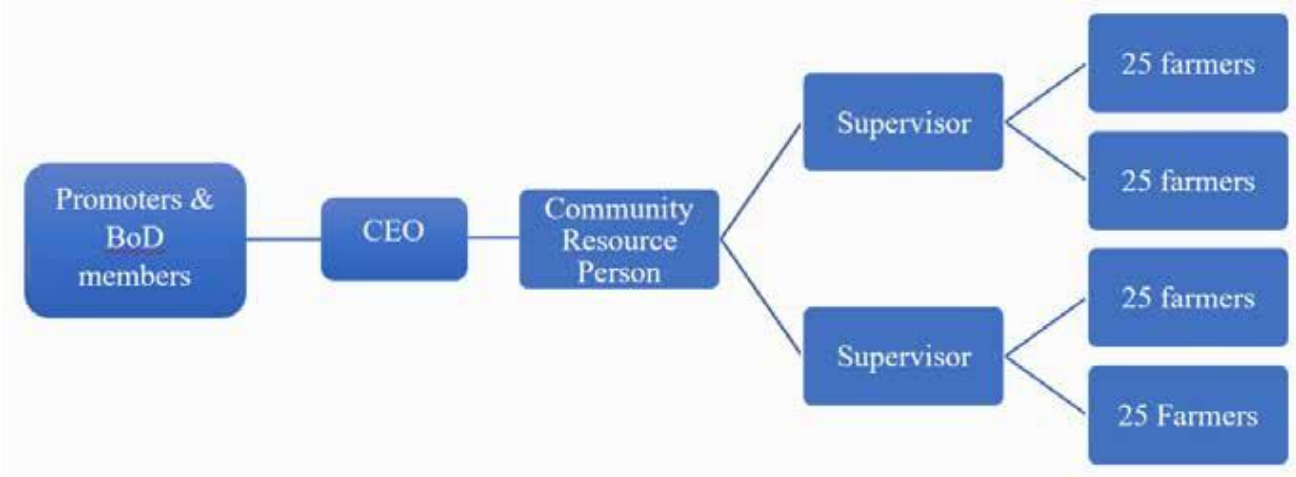
tremendous change in the field of agriculture and other allied & related sectors and this can be possible when the small farmers are mobilised and bought together to form a larger group under one umbrella, build their capacity and leverage the strengths collectively to enhance the overall production capacity and marketing opportunities.

In the similar line, the FPC namely Mannonati Mahila Kisan Utpadak Company Limited was formed by PRADAN, Peterbar team in Gola Block of Bokaro district in 2021. Within one year of formation, the company has shown positive growth in terms of volume of business and addition of shareholder members. In the last six months, the company has done a business of Rs. Twenty Lakhs which is expected to increase to Rs. Fifty Lakhs by the end of FY 2022-23. The FPC was registered with 845 women farmers initially now has increased to 3000 members from 52 farmers Producer Group as shareholders. Gola is the one of the many blocks where we can find diversity in the crops grown such as sweet potato, millet, paddy, maize, tomato, cauliflower, watermelon, ladyfinger and many more.

As we talk about the journey of this FPC, the Executive from PRADAN Peterbar team i.e., Akansha Mishra speaks that the initial days were quite difficult for them in adding more shareholders to the company. She speaks that a specific strategy was devised to add 2200 members in the FPC as till December 2021, there were only 845 members.

However, before diving deep into the strategy part and something which makes this FPC strong is that they have a proper hierarchy of members starting from Promoters, Board of Director (BoD) members, Community Resource Person, Supervisor followed by farmers for getting the demand and selling the products in the market.

Although the journey of FPC formation started in July 2021, but the speed with which it should accelerate was not there till December. This was because there was a clear lack of information regarding how the Producer Company will operationalise and function. Hence to overcome this issue, in December 2021 the officials involved in FPC formation from Peterbar went for an exposure visit to Khunti Block office of Jharkhand to understand the functioning of the FPC which includes seed procurement, marketing,



> There is one supervisor for monitoring 50 farmer members. A total of 52 Supervisors are there and per 10 supervisors, there is one Community Resource Person. These supervisors are reporting to the CRPs. As of now, there are 7-8 CRPs that are actively working with the FPC. They are reporting to CEO, FPC.

shareholders addition strategies adopted so far etc. The same what they learnt from the visit was taught to the Supervisor, CRPs resulting to which in a span of 3 months from January-March 2022, a total of 2155 members were added in the FPC following the strategies namely miking in the villages, pamphlet distribution, meeting at SHGs and VOs level by the supervisor etc.

Post-addition of members as shareholders in the company by March 2022, the next task was generating business for the FPC with the initial idea of working on the input side. To achieve this, the supervisor played a major role in doing a preliminary village survey for generating the demand for seeds, getting it from FPC and then distributing the same to the farmers. These seeds distributed to the farmers at the same time brought many advantages to the FPC like low cost of seeds for bulk orders during purchase, reduced bulk transportation cost etc which farmers also understood.

There was a proper synchronization which was seen in FPC that seed distribution, output procurement of produce, selling the same in market all came one after other. This same strategy from the input demand perspective which became successful in the first time only was adopted during the Rabi Season also.

Apart from training, one major point was that the supervisors during this time were constantly trained around the principles of governance, regenerative agriculture which included multilayer farming, use of organic input etc. The FPC got its seed license certificate also. The time from January to October 2022 was the phase where we saw everything being synchronised and channelised.

In Bokaro district, there are around 21 FPCs that are functioning and competing with them itself is a major challenge. Hence with all this competition of becoming the best, the FPC doing a business of Rupees Twenty Lakhs within six months from selling output produce of ladyfinger, maize, watermelon, bitter gourd shows how much effort each and every members are putting to make it a successful one. This company now has few vendors with whom they are planning to purchase the seeds next year also.

Under the GTP Project, the two important core objectives are regenerative agriculture that adds quality to life and strong feminised institutions.

Through this FPO, we can say that the first objective to some extent is fulfilled as the farmers, not all have started adopting the regenerative agriculture practices in their own land. The second objective is hundred percent fulfilled as the FPC is totally women centric. The long-term vision of the FPC is to become self-sustainable in the long run, hence slowly and steadily they have started moving in that direction also.

Figure 2: Training Session on marketing of the rural products conducted for the FPC members

Figure 3: Annual General Meeting conducted for the members of the FPC in presence of PRADAN Officials, BoD Members

# BUILDING SECTORS IN THE LOCAL ECCONOMY

Author: Meghna Mukherjee

A vibrant rural economy is the foundation upon which the country stands and prosper. In India, the rural economy is dependent on agriculture. There is a need to introduce diverse opportunities in the agricultural and non-agricultural service sector. The idea is that with more diversification of opportunities the wheel of income would start to rotate in turn circulating money locally.

Many farmers have transitioned toward different agricultural and non-agricultural activities like poultry keeping, fish rearing, goat keeping, and duck rearing, opening grocery shops, hardware stores among others. These activities provide income stability in uncertain times as well as provide employment to people from local areas. It reduces migration and leads to greater circularity of money. All these non-land activities should not be on-offs but can be organised in local economic sectors of their own.

PRADAN has been actively working with members of different self-help groups to foster non-farm based livelihoods to enable a better quality of life. Supply and demand services have been organized around the core agriculture/ livestock activity: this has helped to mature and add value to the core activity and helped to build up entire local sectors, creating more jobs and business opportunities, creating a more vibrant local economy. Below are three such examples:

## Poultry

PRADAN has been involved in promoting backyard poultry activity for a long time. It has supported individual farmers in managing poultry sheds and have facilitated linkages with markets. Over the years, they have helped in the formation of poultry cooperative societies to get better bargaining power in the market, which will, in turn, reduce the risks of members against fluctuations of input and output market volatilities. One such poultry cooperative known as 'Peterwar Grameen Poultry Self-Supporting cooperative society Ltd', situated at Peterwar Block in the Bokaro district of Jharkhand provide the smallholder poultry farmers with all the managerial and technical support and achieved economies of scale through collective procurement of inputs and marketing of produce.

The cooperative model of management and business is responsible for creating a range of employment opportunities, thus encouraging local talent to stay and contribute to the development and diversification of the economy. From CEO, accounting, marketing, technical, operations to last mile workers like producers are part of the poultry value chain. The amount of new jobs that has been created due to one cooperative has reduced migration as now people have a stable employment locally.

## Tussar cultivation

Tussar silkworm rearing is a forest-based activity involving many interdependent activities with a complex value chain. Most of the forested area in India is underdeveloped, covering Madhya

Pradesh, Chattisgarh, Jharkhand and Odisha. PRADAN promoted the set up of tussar sericulture which supplemented farmers' income. The development of the local sector value chain led to generation of local jobs in the areas. PRADAN has promoted a host of Farmer Producer Companies (FPOs) and trained several community service providers who can provide efficient services on input supply, production management and marketing of various products.

In Godda (a district in the state of Jharkhand), the work for Tussar sericulture is done under the leadership of the Tussar Development Board. The Board is responsible for supplying Disease Free Layings of silkworm eggs, promoting plantations on fallow lands, organising traditional rearers to protect and maintain the host tree, promoting scientific knowledge among silkworm rearers, and supporting women SHGs to participate in the sericulture activity, which has for long been a male-dominated activity. Apart from being a source of income, the practice of tussar rearing has helped the tribal groups to sustain their interest as the knowledge about tussar rearing is inextricably linked with their culture.

The benefits go beyond cultural and financial to ecological as well. Due to the trees which have been planted on the upland, the soil erosion has reduced which has lessened the damage to the crops. There is a claim that the plants have resulted in better microclimate in the area, more water percolation, and provision of more significant forage, which helps in soil fertility.

## Goat rearing

In many rural areas of India, goat rearing has always been part of the tradition. The demand for meat is also immense which provides the opportunity for investing. However, the farmers struggle as the mortality among goats is high (more than 20% of adults and 30% of young ones). Having less knowledge of modern practices, no insurance and vaccination/medication facilities available, makes goat rearing not a lucrative business. In order to make goat rearing a successful business model, PRADAN started providing training on maintaining goat health, medications, vaccinations, and on building sheds for goats, creating additional jobs.

In some areas PRADAN also developed Goat Trusts to provide different services like vaccination, Deworming and castration which would overall improve the mortality of goats.

The establishment of a trust facilitated a secure link

to the market. A robust value chain (vaccination and final product) was also taken care of. There was secured supply of finances as well which motivated the last mile workers (like Paravets and Pashu Sakhis or Friend of animals) to continue their job.

Gumla Goat farmers service and Welfare Trust is one such institution that was established to promote goat rearing and income of the people. As part of the initial study, they conducted a preliminary market analysis to understand the supply demand and wholesale price for the goats

It was decided that if the market analysis deemed feasible, the plan and vision will be co-created with the community so that it is taken up easily by them. The establishment of the Trust has opened up vacancies for at least 50 members for the organisation along with numerous shareholders. Their financial system involves charging nominal registration fees and service fees based on the service demanded. By allocating a certain percentage of profits for the future, they are ensuring financial stability which will in turn help in creating a resilient sector in the long run.

The idea behind having diverse livelihood options is to create an economy that is robust and resilient- something that is not dependent on outside forces to sustain itself. By systematically supporting these local economic sectors a circular stream of income generating opportunities (both farm and non-farm) is created, boosting the local economy. Useful services come into being, that anchor the sector in the 'terroir' of the local economy, creating an area of specialization and high value addition, making it possible to operate on larger markets as well.

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# BREAKING THE BARRIER: A STORY OF FEMALE ENTREPRENEURSHIP

Author: Pratik Ranjan

Figure 1: Poonam Devi, a woman entrepreneur

A woman, if she decides, can change the world. Poonam Devi, one such woman entrepreneur in the paper plate business is now becoming an example and inspiration for other women in the village. She says numerous barriers exist for a woman who wants to earn and make living for herself. She started with just one product and with her zeal and never I quit attitude resulted in expansion of her business to other products. She says, “there is not even one shop owner who doesn’t know her and take her product”. This one woman who was not able to speak fluently and confidently in public is now selling her products across the entire Peterbar, a block in Bokaro district of Jharkhand. She is also a master trainer when it comes to providing training on paper plate making

This is the story of Poonam Devi, a woman entrepreneur who proved that women can also run a business and support their family financially. Poonam received an initial training under the

Figure 2: Poonam Devi explaining to Grant Thornton officials about the Paper Plate

Local Enterprise Development Programme (LEDP) of National Bank for Agriculture and Rural Development (NABARD) in 2021 on paper plate making. The training session helped her understand the potential which paper plate has round the year demand, constant returns etc. She believed that a new venture, if succeeded, would give her a platform and new opportunity to earn. Poonam Devi adds, "My husband advised me to start the paper plate business and take it to another level with the support of Self Help Groups (SHGs)". With this support and determination, she discussed the idea among her own SHG members. Initially five members agreed but later on three backed off due to financial issues. Poonam Devi however was very firm with her decision of opening up a business.

Following her ideas and business plan, she availed a loan of Rs. 30,000 from Sanjeevani Village Organisation (federation of women SHGs at village level). Additionally, she contributed Rs. 65,000 from her own pocket to purchase a paper plate machinery. As being from a rural background family and starting the business for the first time, she got fooled by one person who said he will supply the machinery, even took the entire money of machinery but after four months, he backed off saying he won't. However, Poonam was not ready to stop from here. She then took help of smartphone and started searching on YouTube and other platforms from where she got the number of few suppliers from Jharkhand who helped them finally in purchasing the machinery. According to her, bringing the machinery home was the biggest challenge because she was not aware of whom to contact for purchasing the machinery. She also says that this less information about machinery and market taught her how to do things by own rather than depending on others.

During all these times, she didn't lose hope as it took almost 6 months to bring the machinery which clearly shows her dedication towards starting a business. She says for her, fifty percent of the challenge was bringing the machinery and this time she won that battle. The remaining fifty percent was the market penetration.

The initial days were quite difficult for her as she was not aware of where and how to sell the paper plate despite higher demands. For creating her own as well as product identity, she herself visited every shop in Peterbar and met their owners with her product for selling, which in some way helped her in coming out from the barrier of being introvert to becoming extrovert. Initially for the first six months after installing machinery, she sold the product with zero profit. She says our initial objective was not earning profit but to introduce our product in the market and increase its visibility, which now in the year 2022 is very much visible.

She started with just one product i.e., paper plate but now she is making four different products including Paper plate, Dona and Glass sets. These products have higher demand in temples, fast food local markets etc.

Before starting this business, she went to the nearby market and found that there is no paper plate manufacturing unit in Peterbar Block. This line of thought helped her understand that starting this business will give her an ample opportunity for growth as she can easily penetrate the Peterbar block market. She also got training by Professional Assistance for Development Action (PRADAN) officials, a leading NGO working in the livelihood sector since last 40 years, under the Peterbar Aadhunik Rojgar Aadarsh Sangha (PARAS) project which helped her to enhance knowledge of entrepreneurial skills, marketing skills, maintaining

books of accounts and expanding product line and business which she was not aware before. Maintaining books of accounts also helped her to understand the demand of any specific product, profit margin and accordingly planning for the next level. With all these supports, she has also become a master trainer when it comes to sharing knowledge and providing training related to paper plate.

Figure 3: Paper Plate & Dona

Today she is ready to expand her business within and outside Peterbar and also planning to purchase another machinery unit. She advises others also to invest on their own as this is the most straightforward way to earn money and work to its full potential. She herself prepares and packs all the products without compromising with the quality.

With only one machinery and loads of hard work she is able to earn a decent income for her family. Her average income in the last six months varies from Rs. 50-60 thousand (half yearly) depending on season. The best part is she is able to run business from home and establish an empire.

Looking at her journey can be an inspiration for young women entrepreneurs. Two years ago, she was a very shy and timid person who did not know how to deal with customers and shop owners, but now she is confident and capable enough to step out of her house, travel to different places to get raw materials. Through the initiative of PRADAN and PARAS, the women are not only becoming strong but at the same time also earning social status for themselves.

She says there is not even a single shop owner in Peterbar who doesn't know her. The entire Peterbar fast food market and very famous Khunta Baba temple who were earlier buying the paper plates from outside the district are now buying from her and demand of the same is increasing day by day which is giving her a positive energy to work more and more for them.

The story of Poonam Devi highlights the importance of local entrepreneurs in the development of the local economy. By taking loans from her village organisation (local input flow) and selling her products at local markets (local outflow of products), Poonam Devi has shown the power of a circular economy. By doing this, she ensures that the money is not moving outside the boundary of Peterbar block. Through her work, she has inspired other women to start their own business and at the

same time ensures that the product reaches to the people of Peterbar Block first, thereby promoting a circular economy.

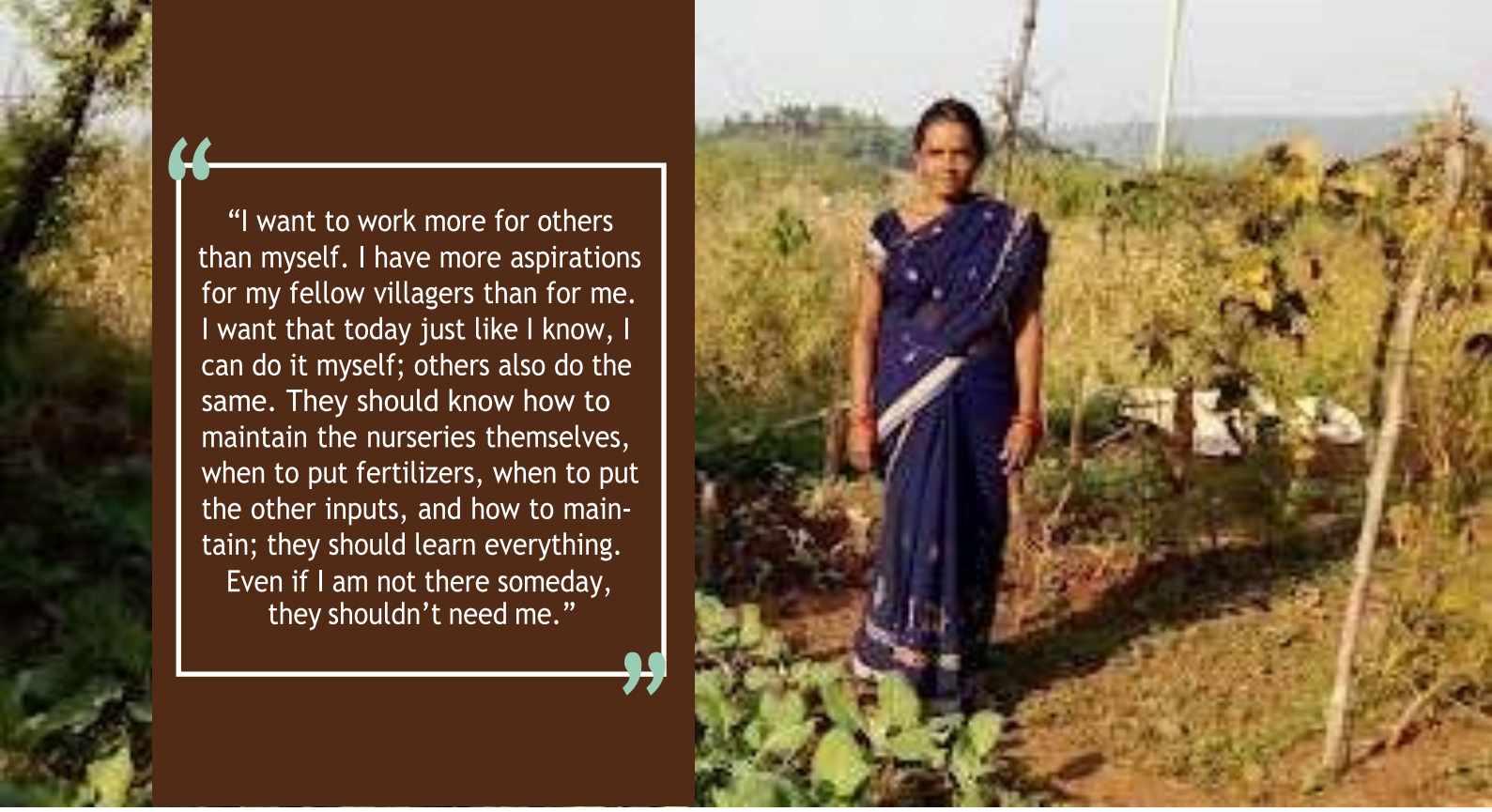
The motivation through the PARAS project for a woman entrepreneur like Poonam Devi has shown a positive impact in the Peterbar block. As of now, more than 40 entrepreneurs are working on the concept of local economy development on various products with the objective to reduce the dependency on the outside market like in the case of paper plate, the need to buy from outside has reduced a lot during the last year.

Figure 4: Training provided by PARAS team on marketing of rural products

# REGENERATIVE AGRICULTURE ENTREPRENEURS

Author: Anushree Mitra

Shakun Didi is a resident of Jhanki village in Dindori district of Madhya Pradesh. She had started taking the initiative of nurseries practiced under the principles of regenerative agriculture with the help of PRADAN. In Jhanki, they had to suffer quite a lot of losses when it came to agriculture be it due to the degrading quality of soil, late rains, quality of seeds, etc. After exposure visits to other areas, Shakun Didi took an interest particularly towards nurseries. It has been 4 years since she's been doing nurseries not only for herself but for the other farmers in the village as well. She prepares the nursery beds by using Matka Khaad (organic fertilizer) and sprayed waste decomposer (organic fertiliser. Used as a substitute for Urea during ploughing of the field). "The results are amazing after using a waste decomposer! The plants are so green and healthy," says Shakun Didi. These inputs are cheaper as well compared to its inorganic counterpart. "Inorganic inputs degrade the soil. It



> "I want to work more for others than myself. I have more aspirations for my fellow villagers than for me. I want that today just like I know, I can do it myself; others also do the same. They should know how to maintain the nurseries themselves, when to put fertilizers, when to put the other inputs, and how to maintain; they should learn everything. Even if I am not there someday, they shouldn't need me."

becomes hard. Organic inputs keep the soil alive.""I know one day the farmers will stop using inorganic inputs completely. Our lands are becoming barren because of them. Our soil cannot retain its moisture."

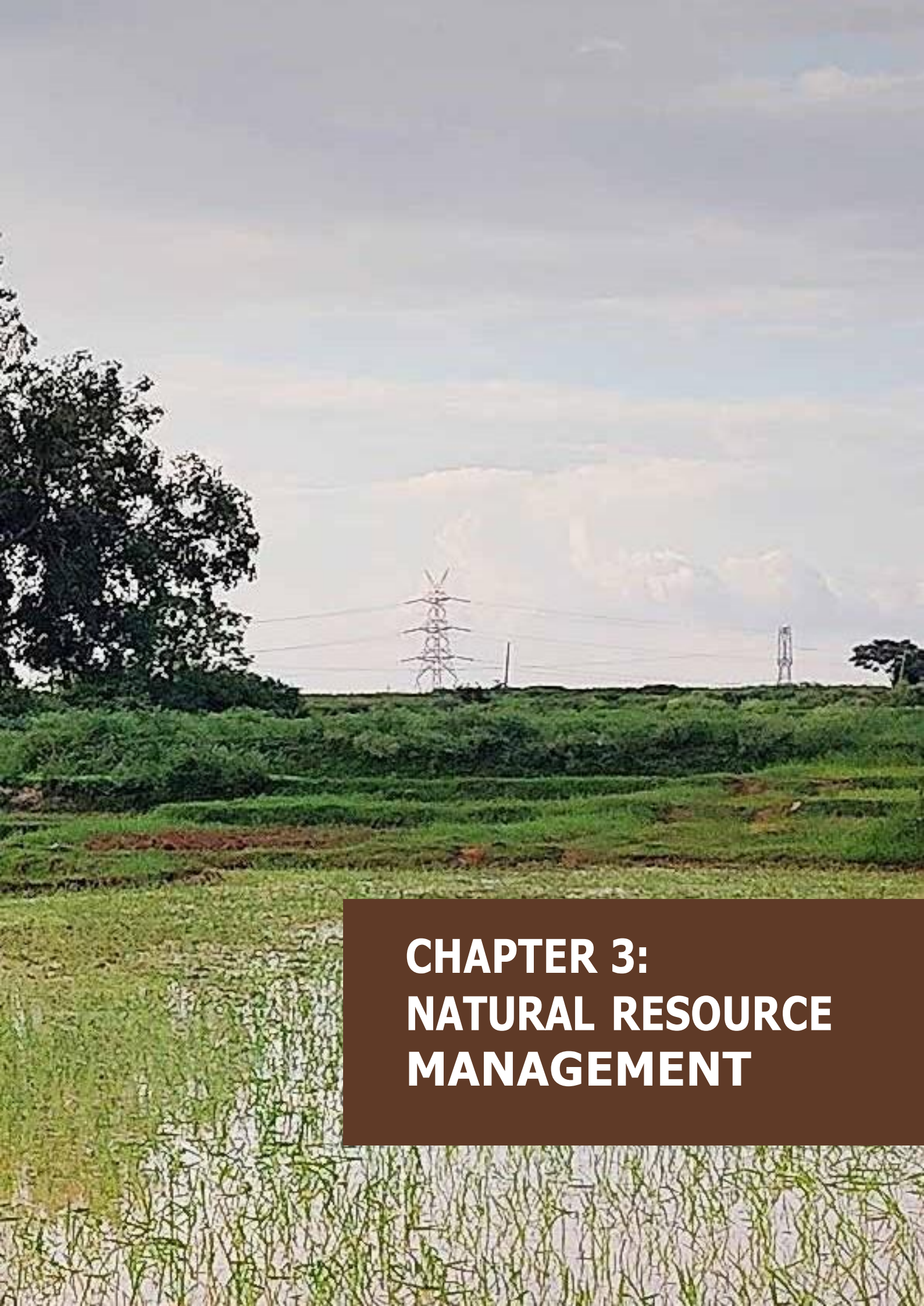
She has seen a significant difference after doing nurseries. After 20-21 days we transfer the plants from the nurseries to the fields. She grows cauliflower, tomato, and cabbage in her nursery. The plants become healthy in this process. After she started doing nurseries, she did not have loss in seeds. The number of seeds she plants, more or less all of them germinate. "Initially we used to practice broadcasting methods for seeds. If they grow, that's fine. Not a lot of maintenance used to go behind it. Now after nurseries, we do not need a lot of seeds and the number of seeds we plant, they all germinate."

This way the cost of labour as well as the money of seeds, pesticides, fertilizers everything gets covered. And they also have profits provided proper maintenance properly. "I started with this because I can take care of the plants properly, put the fertilizers, pesticides etc on time, and maintain it properly. Not only do I do it for myself, but if others are in need of plants, I provide it to them as well and get money out of that." She had opened a central nursery. In the monsoons the earning from that was 16000 INR and for Rabi it was 7000 INR.

> "My family members are very supportive. No matter how much work is there at home. They never stop me from doing my work. I am working for farmers, to increase their income. Why should anyone stop me for that?

Today she feels very happy and proud that other farmers are profiting from it. "The problems that the farmers have, the fact that I can give solutions for their problems, I am working for them, their conditions are getting better, I feel very happy to see that. I feel very happy to work like this. I feel great."

This time the villagers didn't have to take loans. They sold their vegetables and got their money whenever they needed it.

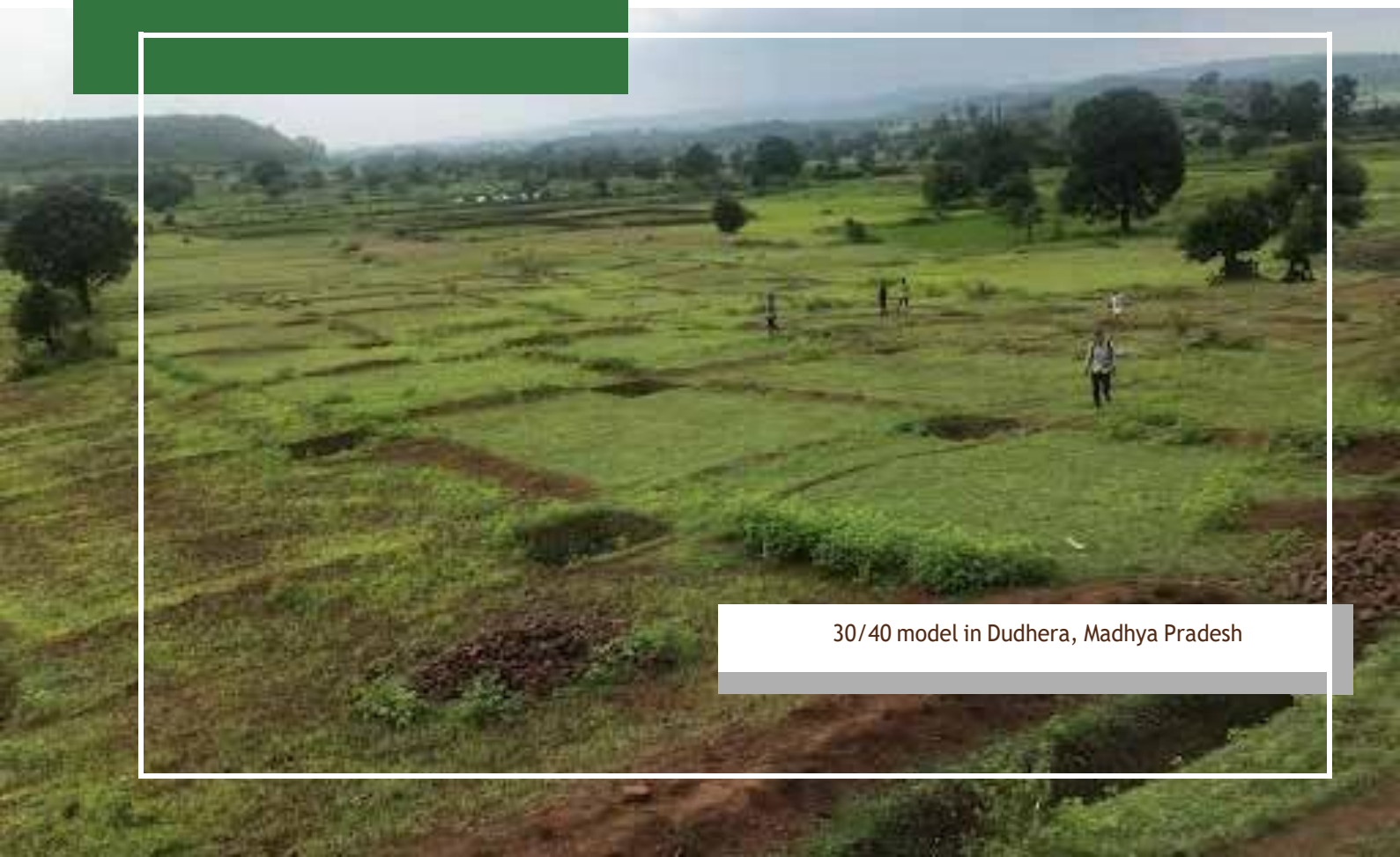


# CHAPTER 3: NATURAL RESOURCE MANAGEMENT

# INTRODUCTION TO NATURAL RESOURCES MANAGEMENT WITHIN GTP

Within the GTP project, Natural Resources Management (NRM) is defined as an approach to sustainably manage the interactions between the environment (and its capacity to provide natural goods and services), humans, institutions and practises that influence and regulate human-nature interactions and natural resources utilisation. Thus, NRM refers to the utilisation and management of natural resources (such as land, water, soil including air, energy, nutrients, and plant and animal biodiversity) in a way that the carrying capacity of ecosystems is sustained or even enhanced. This ideology fits well in the idea of enhancing climate resilience, which is all about creating systems that can cope and profit from future climate changes.

NRM combines the scientific understanding of natural resources, ecology, geology, geography, meteorology, with the sustainable use of those resources through land use planning, water management, regenerative agriculture, natural heritage management, among others. Moreover,



30/40 model in Dudhera, Madhya Pradesh

NRM practices recognise that people's livelihoods rely on the long term sustainable productivity of the environment. Therefore, the adaptability of institutions and human's practises, behaviours and understandings is crucial to foster sustainable natural resources management and influence systems change.

The degradation of natural resources has a direct negative impact on the livelihoods of especially marginalised communities. In India, neoliberal reform policies have left farmers dependent on genetically modified seeds, chemical external inputs and trapped in a cycle of debt. Natural resources degradation greatly contributes to the worsening of the agrarian crisis and rural communities livelihoods vulnerability[1]. In the states of Madhya Pradesh and Jharkhand women and tribes suffered from the consequences of natural resource degradation and the grain crisis. On the one hand, women are associated with natural resource management practices and increasingly work on agricultural related jobs. On the other side, tribes depend on natural resources and associate spiritual and non-tangible values to them. Nonetheless, in Madhya Pradesh and Jharkhand states around 35% of the land area is degraded, 41% of households live below the poverty level and 85% of the women work in agriculture but only 13% are landowners (Oxfam India).

Consequently, the GTP project implements NRM practices in the project area that are crucial to restore soil, biodiversity, and hydrology while reducing communities dependency on external inputs and providing alternative and sustainable livelihoods to women and tribes. Moreover, GTP informs policy for a more sustainable and community centred NRM respectful to the views, needs, and values of the communities.

Focus Group Discussion with villagers based on the resource map, Garkamatta, Madhya Pradesh

[1] https://niti.gov.in/planningcommission.gov.in/docs/aboutus/committee/wrkgrp11/wg11_agnrm.pdf

Improving and making resource productivity sustainable through NRM practises is not automatic. Previous NRM programmes in India failed to address an improvement in the livelihoods of women and tribes partly because they failed to address the issues of the landless. From Indian NRM past projects it has become clear that future NRM strategies need to be based on area-specific analyses of resource use at the household and community level[2]. Moreover, GTP involves women and tribes in the design of NRM interventions and the management of communitarian areas. NRM interventions are centred around two main domains of action:

## 1) Land management interventions:

area specific land use plans for different landscapes are being developed. The management of common areas such as forest and grazing areas by the communities contribute to the sustainability of alternative livelihoods. The combination of NRM practices, with regenerative farming and microclimate management practices will influence the situation of women working on agriculture. The interventions tackle soil erosion, low soil fertility, water shortage, mono crops extension and deforestation by implementing water conservation techniques, multi-layered agroforestry systems which incorporate multipurpose trees (firewood, medicine substances, food, etc.), silvo-pasture, crop diversification, among others.

## 2) Integrated water resources management (IWRM) interventions:

watershed catchment interventions will be designed to tackle water allocation problems, water shortage, flooding and low water quality. Recharge, Retention and Reuse (3R) systems, together with Multiple Use Systems practices (MUS), efficient irrigation systems and roads for water are implemented.

The blogs bundled in this chapter result from GTP's NRM activities and explorations thus far. The topics included are ranging from developing climate scenarios to strengthen climatic resilience, to practical interventions such as ponds within a landscape and fodder production. The microclimate management and green roads for water concepts are also covered. The GTP's NRM approach and practices are informed by a deep understanding of the local context and beneficiaries' realities. Since communities are directly involved in the design and implementation of NRM these foster a change of paradigm of how the women and tribes involved in the project perceive as beneficial NRM practises. This informed behavioural change is key to foster system change in the project areas. The new practises, behaviours and organisational manners will be passed on to younger generations contributing, with the rest of the aspects of the GTP, project to foster system change.

[2] https://cdn.sida.se/publications/files/sida2187en-natural-resource-management-in-india-2003-2007.pdf

# HOW TO ENVISION THE FUTURE OF COMMUNITIES: CO-CREATED CLIMATE SCENARIOS

Authors: Marijn van der Meer, Femke van Woesik

Predicting future climate so that farmers know exactly how to adapt and transform their agricultural practices to maximise livelihoods. This sounds like an ideal scenario, but in reality, this is of course not easy as the climate is unpredictable and changes annually. Where one year, there can be excessive amounts of rain, and the other year can be characterised by large periods of drought. Although precise predictions are not feasible (yet), using a set of climate scenarios can function as an expectation and decision-making tool, both on a large and small scale. This blog shows the use of climate scenarios in the context of communities within the Green Transformation Project (GTP) in Jharkhand and Madhya Pradesh in India.

## What are climate scenarios?

Scenario development already has a long existence and widespread applications, for example in

economic, policy, and environmental models (citation). Scenarios aim to inform policy so that grounded choices can be made. In general, there are two forms of scenario development, the ones that explore futures with different alternative circumstances (including business as usual and extreme scenarios), or the ones that focus on a desired future and the path that needs to be taken to reach this future[1]. According to the IPCC[2]: ''a scenario is a coherent, internally consistent and plausible description of a possible future state of the world. Scenarios are not predictions or forecasts but are alternative images without ascribed likelihoods of how the future might unfold". In climate research, these scenarios (models) are often large-scale (global/ national) and long-term scenarios, as the global scale fits best with the interactions within the models (large-scale atmospheric and hydrological cycles). However, a key issue is how to fit these global scenarios in local community contexts.

## Climate trends and projections in Madhya Pradesh

For MP, a large study has been conducted to show spatial climate (mostly temperature and precipitation) trends from 1951-2013[3]. Additionally, climate projections are done under four Representative Concentrations Pathways (RCP 2.6, 4.5, 6.0, 8.5) with five General Circulation Models (GCM) that show the least bias within the monsoon season[4,5].

In this study, Table 1 shows the main conclusion for climate trends (1951-2013) and climate projections (up to 2100). Detailed information about all the spatial maps in MP can be found in the study.

Although some conclusions were drawn, the study also shows the uncertainty of climate projections. Nevertheless, there is a high chance that the threat of climate change will become more severe and irregular. Generally, the research corresponds well with the farmer's perspective of climate (change). During Focus Group Discussions (Dindori District, MP), farmers' perspective was mostly a lack of rainfall, delayed start of the Kharif season, more frequent and longer dry spells, and extreme rainfall. Besides, on average higher temperatures are also perceived by the farmers.

[1]B\radfield, R., Wright, G., Burt, G., Cairns, G., & Heijden, K. (2005). The origins and evolution of scenario techniques in long range business planning. Futures, 37, 795-812. https://doi.org/10.1016/j.futures.2005.01.003
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[3]Mishra, Vimal & Shah, Reepal & Garg, Amit. (2016). Climate Change in Madhya Pradesh: Indicators, Impacts and Adaptation. IIM Ahmedabad Working paper. WP2016-05.
[4]Pielke Jr, R., Burgess, M. G., & Ritchie, J. (2022). Plausible 2005-2050 emissions scenarios project between 2 °C and 3 °C of warming by 2100. Environmental Research Letters, 17(2), 024027. https://doi.org/10.1088/1748-9326/ac4ebf
[5]van Vuuren, D. P., Riahi, K., Moss, R., Edmonds, J., Thomson, A., Nakicenovic, N., Kram, T., Berkhout, F., Swart, R., Janetos, A., Rose, S. K., & Arnell, N. (2012). A proposal for a new scenario framework to support research and assessment in different climate research communities. Global Environmental Change, 22(1), 21-35. https://doi.org/10.1016/j.gloenvcha.2011.08.002

Table 1: Explanation of climate scenarios and trend/projection of different climate factors. Note: when a climate factor does not show a not for a trend or projections does not mean that it has no data in the study

| | Explanation | Average precipitation | |
|---|---|---|---|
| **Historic climate** | Climate trends in MP from 1951-2013 | The mean monsoon precipitation has declined in MP, especially in the eastern parts. The five driest years were 1979, 1965, 2007, 1966, and 2009 respectively. The most amount of monsoon rain was in 1961 with 1372 mm and the least in 1979 with 597 mm on average for MP. | |
| **RCP2.6** [6] | Climate projections up to 2100 under a radiative force of 2.6 W/m-2 | Precipitation is projected to increase during monsoon by 5-15% for short and long term projections | |
| **RCP4.5** | Climate projections up to 2100 under a radiative force of 4.5/m-2 | Especially in the eastern part of MP, a decrease is projected under RCP4.5 till 2045. | |
| **RCP6.0** | Climate projections up to 2100 under a radiative force of 6.0 W/m-2 | Precipitation is projected to increase during monsoon by 5-15% for short and long term projections | |

## Translate large-scale climate projections to local scenario development

Armed with the basic knowledge of state-level climate data, a link should be made to the local scenario development of the communities.

A good example of local scenario development is the co-creation of scenarios with indigenous people in Canada[7]. The main drivers of change were climate change and resource development. Together with the community, four different scenarios were created for 2030 in the form of oral narratives, illustrations, and key discussion points. The researchers often noted that the people saw climate change as beyond their reach. However, there are many ways that people can create improved climates in their field (see blog about

[6] The RCP scenarios are coupled with a temperature increase worldwide. For RCP 2.6 the increase is around 2˚C worldwide, whereas RCP8.5 reflects an increase of around 4.5˚C worldwide . The increase in temperature pushes other climate conditions, like wind speed, and relative humidity to change as well.

[7] Cradock-Henry, N. A., Diprose, G., & Frame, B. (2021). Towards local-parallel scenarios for climate change impacts, adaptation and vulnerability. Climate Risk Management, 34, 100372. https://doi.org/10.1016/j.crm.2021.100372.

| | Average temperature | Extremes |
|---|---|---|
| | State averaged mean air temperature had most significant increase during the post-monsoon season (0.8 °C)<br><br>Mean air temperature did not significantly change in the pre-monsoon, monsoon (0.03°C), and winter season | • Droughts have increased in many districts of the state<br>• The frequency of extreme temperatures has increased, with the number of hot days peaking after 1990 and the number of cold night peaking after 2005<br>• Maximum temperature has changed in the South East and North West of the state |
| | | • Extreme rainfalls are projected to become more frequent<br>• Because of the projected increase in monsoon precipitation, the frequency of droughts is projected to decrease<br>• Extreme temperatures are expected to increase |
| | By 2035, 10% of the state is projected to have a temperature increase of 2°C. | • Extreme rainfalls are projected to become more frequent<br>• A more frequent number of droughts is projected<br>• Extreme temperatures are expected to increase |
| | | • Extreme rainfalls are projected to become more frequent<br>• Because of the projected increase in monsoon precipitation, the frequency of droughts is projected to decrease |

Microclimate Management). Through the scenario development process, the researchers recognized social learnings, as people started identifying what is needed to adapt to climate change threats in order to avoid the worst-case scenarios. This resulted in recognizing a few technical adaptation options, but simultaneously some cultural, cognitive, and behavioural barriers. All in all, due to the prioritisation of people's scenario understanding, some reflection was possible on people's current needs and capacities to change or transform.

To some extent, the Community-Based-System-Dynamics tool (CBSD), applied by the Foundation of Ecological Security (FES), connects with the scenario development of resources in villages. With CBSD, the past trends of different resources (forest, water, animals, etc.,) are discussed with farmers and future projections (either fear or hope, so decrease or increase in quality/ quantity) (Figure 1).

Of course, some external factors should not be underestimated when developing the village's future scenario. Next to climate, policy decisions and market prices determine the (future) outcome partially. In interviews with PRADAN it is mentioned that if all stakeholders make arrangements that are in the favour of the villages, significant changes can be done in approximately

2 years. However, with the current movement (in which stakeholders are not aligned), fundamental changes should be expected only after 6-8 years. Besides, the functionality of the MGNREGA scheme, a financial scheme under which most NRM interventions are performed, has a big factor in the future outlook of the villages.

Nevertheless, with the use of co-creation of scenarios (e.g., business as usual scenario, flourish village scenario, catastrophic scenario) people's understanding of the different future paths is triggered. Scenario development can help in expectation building, but also could give a feeling of grip over the current situation. Additionally, it gives a better understanding of the capacity and needs of a community to reach a certain scenario. All in all, co-scenario development helps in stimulating the transformative capacity of a community.

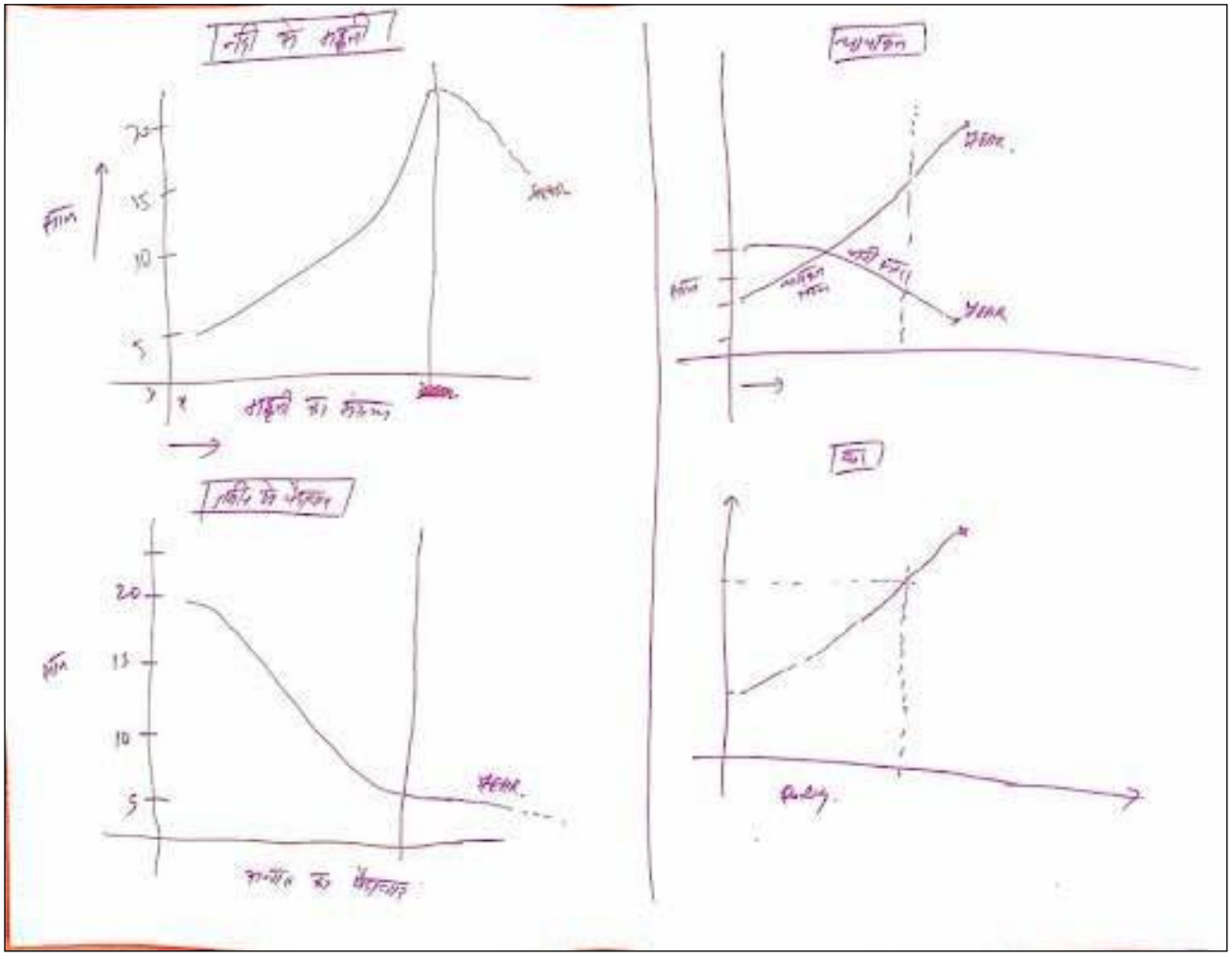

Figure 1: Community trend analysis of different resources (from upper left to lower right, availability of river, availability of handpumps, vegetable production, quality of houses), developed in a Natural Resource Management workshop in Bodachapar, Jharkhand, India. The x-axis presents time (past and future), the y-axis presents the state of the resource (low and low) (Source: MetaMeta)

# 3 PILLARS FOR MICROCLIMATE MANAGEMENT

Authors: Femke van Woesik, Marijn van der Meer, Shubham Jain, and Niels Lenderink

Microclimates are the result of the interplay of climatic factors such as soil and air temperature, solar radiation, air humidity, soil moisture, wind, and rain at local levels (Figure 1). Microclimate management at the local level can complement climate change mitigation and adaptation efforts and increase agricultural resilience against climate change. With good management practices, conducive and buffered microclimates can be created that enhance crop production. But how to integrate this microclimate perspective into natural resource management? This blog discusses 3 pillars.

## Pillar 1 – Think small

Natural resource management often has a strong focus on big structures and large interventions. These actions are, of course, of high importance and will have significant impact once implemented

well. However, the higher costs associated with these interventions result in high dependence on subsidies and existing government schemes. Microclimate management with low cost structures and small interventions, on the other hand, is quicker to implement and is less costly. The one should not replace the other but rather complement. For example, while a village is waiting for the government subsidy to built a large check dam, individual farmers could already grow hedgerows or grass strips on their plots to reduce wind erosion and maintain soil moisture.

Smaller scale interventions can also be done more microclimate specific and should be implemented according to the needs of a specific local situation. A farm with high wind speeds can place a wind break perpendicular to the prevailing wind direction for example. Figure 2 shows more examples of small scale microclimate management practices.

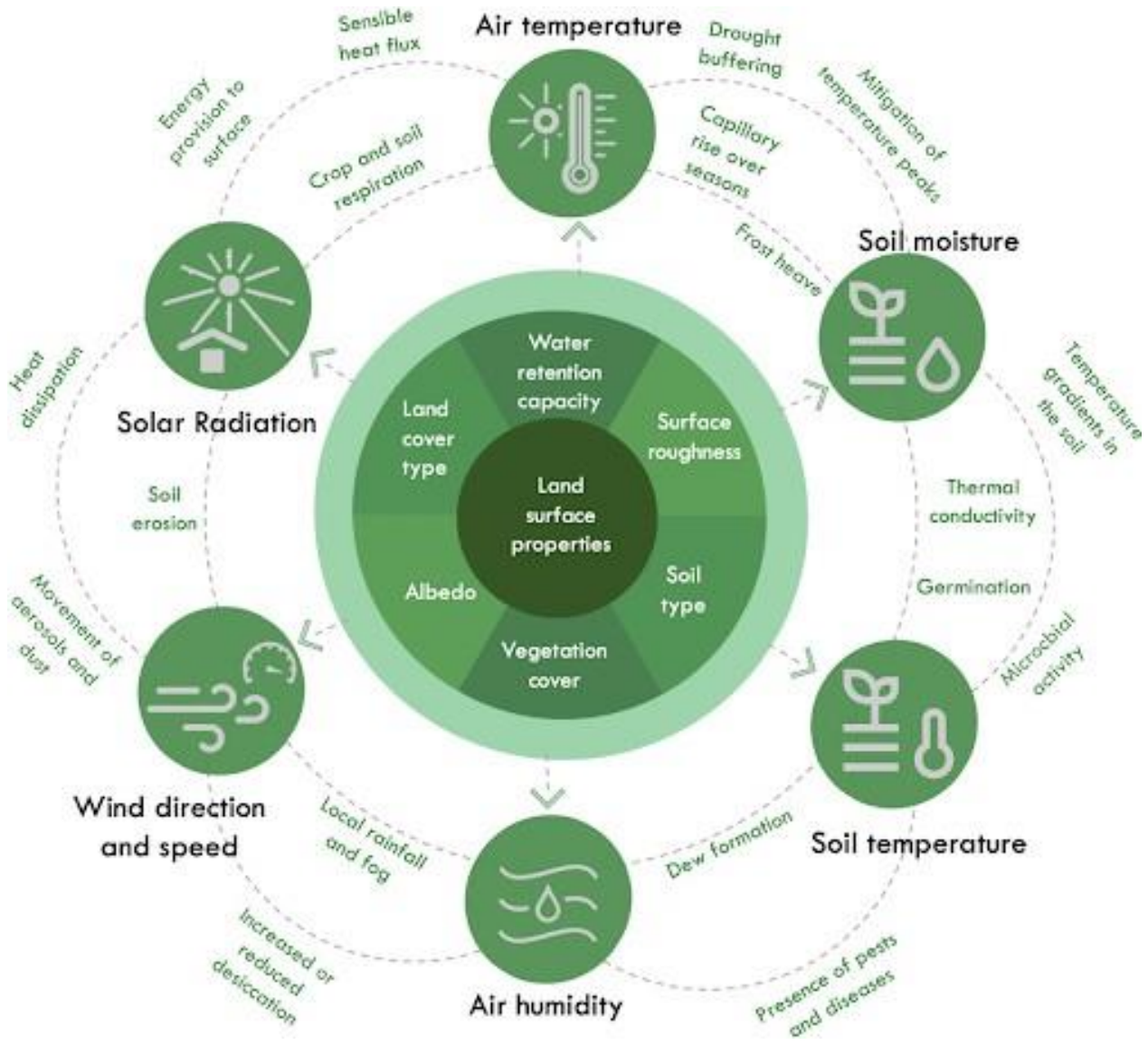


Figure 1 - Overview of the interlinkages of the local climate system and processes relevant for farming practices. This overview is meant as a concept visualisation, actual processes are more detailed.

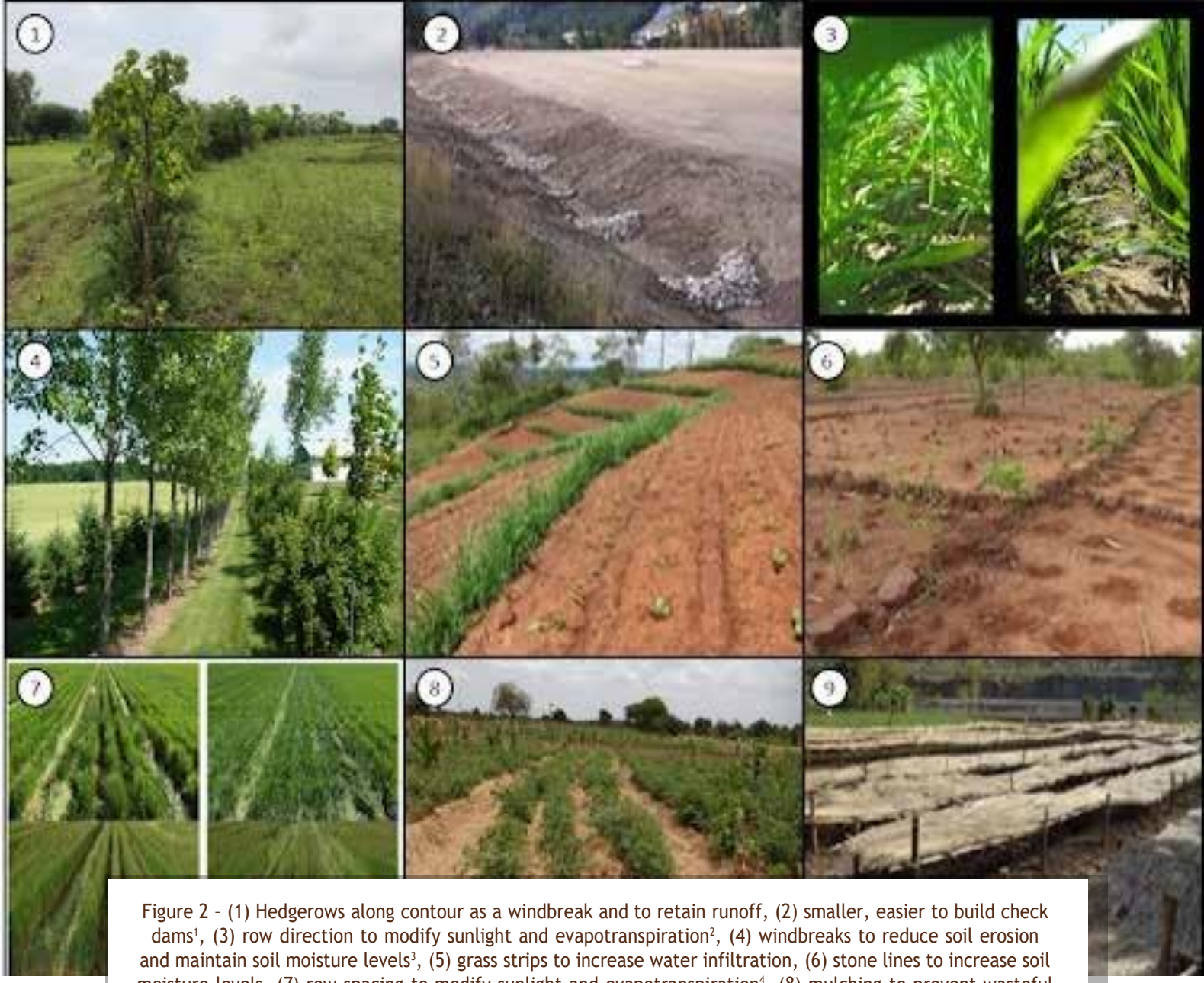

Figure 2 – (1) Hedgerows along contour as a windbreak and to retain runoff, (2) smaller, easier to build check dams[1], (3) row direction to modify sunlight and evapotranspiration[2], (4) windbreaks to reduce soil erosion and maintain soil moisture levels[3], (5) grass strips to increase water infiltration, (6) stone lines to increase soil moisture levels, (7) row spacing to modify sunlight and evapotranspiration[4], (8) mulching to prevent wasteful evapotranspiration, (9) shading to prevent soil moisture depletion

## Pillar 2 – Consider commons

Whilst microclimate management at the small farm scale level is a great way to create conducive local conditions, larger landscape components such as large common ponds and forests are great factors in local climate buffering. A nearby forest can attract local rainfall through the biotic pump effect and buffers local temperatures. A common large pond replenishes the soil moisture levels of the village and also buffers in temperatures. During natural resource management, the important role of these 'commons' should be considered to enhance their positive effect on local climates. Photo 1 shows an example of a regenerated forest through Farmer Managed Natural Regeneration (FMNR). After deforestation practices, this hillside was completely bare and villagers around the forest noticed higher temperatures and dryer soils.

[1] https://udfcd.org/wp-content/uploads/2014/07/EC-12-Check-Dam.pdf
[2] Why consider sowing east-west? - WeedSmart
[3] Windbreak planning & design – The Green Directory
[4] PFR Report (beckshybrids.com)

This is why they decided to bring the forest back to buffer the temperatures and bring back the rainfall.

Photo 1 – Common forest regenerated through FMNR (Farmer Managed Natural Regeneration), Madhya Pradesh, India

## Pillar 3 – Mapping and monitoring

Natural Resource Management with a microclimate perspective requires good understanding of the microclimate and identification of certain hotspots that require improvement (For example, a part of a farm that is very dry or where it is warmer because of less shading). Identifying these hotspots can be done with a resource map focus group discussion (Photo 2).

Once these hotspots are identified, certain interventions can be linked to these places. Some examples are to create shade in areas where crops and soil dry out from the sun, place bunds in an area with high runoff and low soil moisture, place windbreaks in areas where the wind blows hard and dries out the soil. After these interventions are implemented, monitoring allows us to keep track of how interventions are doing and if their effects are significant. This also allows for better and more consequent maintenance of structures. Pre-monitoring can also be done to assist in intervention planning. Table 1 gives an overview of monitoring tools.

Photo 2 – Resource map of Garkamata village, Madhya Pradesh, India

Table 1 Overview of monitoring tools

| Monitoring tools to keep track of microclimatic changes | |
|---|---|
| **Field sensors** | Close monitoring on specific spots in farms (For example: tensiometers that measure soil moisture, thermometers that measure soil temperature, hygrometers that measure air temperature and humidity) |
| **Remote sensing** | Use of satellite to monitor on a larger scale |
| **Face validation** | Talking to land users to collect their views on how the landscape around them changed after specific interventions were done |
| **Temporal map evaluation** | Annually updating village maps to visualise the differences in land uses, conditions per year |

# PONDS AS AN ASSET FOR AGRICULTURE: HOW TO KEEP THEM FULL

Authors: Marijn van der Meer, Femke van Woesik, Nitesh Dhiman, Shubham Jain, Lalit Kumar Nirmalkar, Laxmi Sharma, Shubham Kushwaha

It is well known that large water bodies such as oceans and rivers affect the climate. Although to a smaller extent, ponds also impact the surrounding climate; the 'local climate'. The opportunity here lies in the fact that, unlike large oceans and lakes, ponds are easier to create and to manage. With good management and design choices, ponds can be significant assets in creating conducive local climates in (agro)ecosystems. Simultaneously, ponds, when filled, are crucial water sources for agricultural practices. Farm ponds serve as water harvesting structures that capture surface rainwater runoff to support protective irrigation during lean periods. These ponds have a proper inlet for collecting the surface runoff from its catchment and may have an outlet for delivering water downstream. Ponds thus play a significant role in the landscape and crop growth through irrigation water supply and local climate effects. This blog elaborates on how ponds can be an asset for agriculture. Moreover, it provides concrete and practical solutions to keep ponds full for a longer period of time. These solutions are presented within a case study of the Dindori district, Madhya

Photo 1: Pond in Gubari, Madhya Pradesh, India. This pond is used to produce fish for 65 households.

Pradesh, Central India. As a significant part of the cultivated areas in India are rainfed, farm ponds are of high importance for increasing crop production by increasing irrigation in these areas.

## How ponds can create conducive local climates

Ponds can moderate the surrounding area's temperature – reducing high and low extremes. The effects and sphere of influence of ponds differ according to the type of weather, the seasons, and the year. These effects were empirically measured in the Brenne in France; an area dotted with many small water bodies. The temperature differences between the pond areas and the surrounding lands were found to be relatively consistent in the order of 4-5°C higher in the winter, and a temperature decrease was found in summer, tapering off over the sphere of influence that extended from 100 to 200 meters around the water bodies[1]. This temperature buffering effect results from evaporation processes and head exchanges of the water body with the atmosphere. Water has an exceptional ability to receive and maintain heat. Additionally, wind over the pond can help cool areas near the water's surface and increase humidity in dry areas. Given this capacity to buffer climatic variabilities, ponds are vital components to integrate into the fight against climate change[2]. On top of that, ponds also play an essential role in supporting biodiversity[3] and providing ecosystem services[4].

In managing the local climate, water bodies may be planned systematically with essential decisions on their size, depth, and distribution, as far as the local terrain allows. As the water bodies have a climate-regulating impact extending up to 200 meters around them, it can be assumed that a higher number of water bodies spread over a landscape has the most optimal effect on the local climate. The larger the water volume, the larger the protective buffer zone (e.g., lakes were found to protect from frost up to 5 kilometers[5]). The buffering effect might also be enhanced when water bodies are designed parallel to the prevailing wind direction. During the day or summer, the wind cools down while blowing over the water and brings a cooling breeze to the downwind area. Following the same temperature buffering principle, water bodies can be a critical factor in controlling frosts.

Photo 2: Private pond used for irrigation. This pond increases soil moisture levels in the nearby fields, which allows one more rabi crop to grow. The pond is also used for fishery. When the wind blows over the pond it cools the area around it - Paudi, Madhya Pradesh, India.

[1] Nedjai, R., Azaroual, A., Chlif, K., Bensaid, A., Al-Sayah, M., and Ysbaa, L. (2018) 'Impact of ponds on local climate: a remote sensing and GIS application contribution to ponds of Brenne (France),' Journal of Earth Science and Climate Change 9(12)
[2] Rosset, V., & Oertli, B. (2011). Freshwater biodiversity under climate warming pressure: Identifying the winners and losers in temperate standing waterbodies. Biological Conservation, 144, 2311–2319.
[3] Hassall, C. (2014). The ecology and biodiversity of urban ponds. Wiley Interdisciplinary Reviews Water, 1(2), 187–206.
[4] Miracle, M. R., Oertli, B., Céréghino, R., & Hull, A. (2010). Preface: Conservation of European ponds-current knowledge and future needs. Limnetica, 29(1), 1–8.
[5] Louka, P., Papanikolaou, I., Petropoulos, G.P., Kalogeropoulos, K., and Stathopoulos, N. (2020) 'Identifying spatially correlated

patterns between surface water and frost risk using EO data and geospatial indices', Water 12(3): 700

Photo 3: Common pond installed under a government scheme. The aim was to increase irrigation in Rabi season, however, due to the shallowness the pond dries up already in October. It thus failed its promise. Nevertheless, an increase in soil moisture and well water has been noticed downstream. Paudi, Madhya Pradesh, India.

Also in the case area, the Dindori district of Madhya Pradesh, India, ponds are familiar sights in the landscape and are often used as a rainwater source for agriculture (Photos 1-3). The Central and State Governments of India have promoted farm ponds to secure agriculture through various subsidized schemes. In Madhya Pradesh, three distinct growing seasons can be recognized: (1) The Kharif season (monsoon period) is dominated by a large amount of rainfall which can get as high as 1000-1200 mm[6] (with extremes above). In this season, water-intensive crops like paddy are cultivated in the lower parts of the land, while the higher parts (upland) are sometimes used to grow crops like millet, niger, or maize. Ponds, when constructed correctly, start with the filling of water from the watershed area. (2) After the harvest of the Kharif crop, the Rabi season starts. The Rabi season is characterized by cooler and dry air. Precipitation rates drop, as the average monthly rainfall shifts to 1-3 days[7]. Smaller ponds or ponds with extensive evaporation and seepage rates start drying up directly, leaving no irrigation possibilities for later in the season. Rabi crops like lentils can only be sowed when soil moisture levels are not too high, but simultaneously soils should not get too dry during the season to stop crop growth. This situation results in a system that is sensitive to climate change. Buffering capacities, but also the availability of external water of ponds could help in risk management. (3) Lastly, like the Rabi season, the Zaid season is dry yet warmer. In this season, almost all ponds dry up and often only fruits in homesteads are grown (when enough irrigation water is available) (Figure 1).


Figure 1: Overview of the different crop growing seasons and corresponding expected water levels in ponds (Source: MetaMeta).

[6] Dindori Climate, Weather By Month, Average Temperature (India) - Weather Spark. (n.d.-a). https://weatherspark.com/y/110378/Average-Weather-in-Dindori-India-Year-Round

[7] Climate Change Dindori. (n.d.). Meteoblue. Retrieved 6 October 2022, from https://www.meteoblue.com/en/climate-change/dindori_india_1272540

## How to keep ponds filled for a longer time

The longer farm ponds remain filled with water, the higher the irrigation and local climate buffering potential is outside Kharif season. In intervening to prolong the time that ponds are filled with water, there are two phases that require attention. The first phase is the construction and design phase, in which the location and characteristics of the ponds are addressed. The second phase focuses on reducing water losses from the ponds after these are constructed and filled during Kharif season.

### The designing and planning of ponds

The pond's location and characteristics are essential to have sufficient retention capacity. Factors in the site selection are soil type, infiltration rate, slope (topography), and drainage patterns. Together with surrounding vegetation and rainfall patterns in a particular village, these factors can help in the retention expectations of a pond. At all times, ponds should be located where most of the water within the catchment area drains into the pond. Next, to prevent water shortfalls, the characteristics of the pond are important. Primarily, the volume size (depth and width of the ponds, so in other words, the water capacity) is a big determinant. To prevent the rapid decline of pond volume, installing efficient silt traps at the inlet of farm ponds is crucial. Good design and planning of ponds will make taking care of water losses easier. In other words: 'Well begun is half done'. An example for this is the relation between the volume size and the surface area of a pond, as with the same volume, a shallow pond (a large surface area) will have more evaporation than a deep pond (small surface area). With the right circumstances, a terraced pond could be interesting, as the surface area reduces when the water table lowers. This means that evaporation will decrease when the volume of the pond decreases. Additionally, the drained terraces usually contain high soil moisture values, so can be used for the growth of crops.

### After installation: taking care of water losses

There are two main ways water goes out of ponds: (1) evaporation (through solar radiation and enhanced by wind speed) and (2) seepage to the soil (dependent on soil properties of the edges and floor of the pond). Please note that the latter can also be an asset as seepage recharges the groundwater levels, which can serve as a moisture source for crop production, next to irrigation (Figure 2).

In a study conducted by Mahalle & Adhau (2014) in the Purna valley (Vidarbha district in Maharashtra, India, which has a similar climate as Dindori district), evaporation lowers the water table of unlined (no impermeable sheet at the edges and floor) farm ponds with almost 60 cm on average between October and December (Rabi season). In the same period, the losses were nearly 13 cm through seepage[8].

Now that we know the two main water losses from ponds we can think of ways to prevent this. In terms of seepage, a way to prevent this is to line the ponds (Photo 4). Here soil properties are important to take into account. Clayey soils like Vertosols face negligible seepage, so lining of the pond is not a necessity for irrigation purposes[9].

[8] Mahalle, Y. R., & Adhau, G. W. (2014). Study of evaporation and seepage losses from farm ponds in saline areas. International Journal of Agricultural Engineering, 7(2), 402-409.
[9] Rao, Ch. S., Rejani, R., Rao, C. A. R., Rao, K. V., Osman, M., Reddy, K. S., Kumar, M., & Kumar, P. (2017). Farm ponds for climate-

resilient rainfed agriculture. Current Science, 112(3), 471–477. http://www.jstor.org/stable/24912425

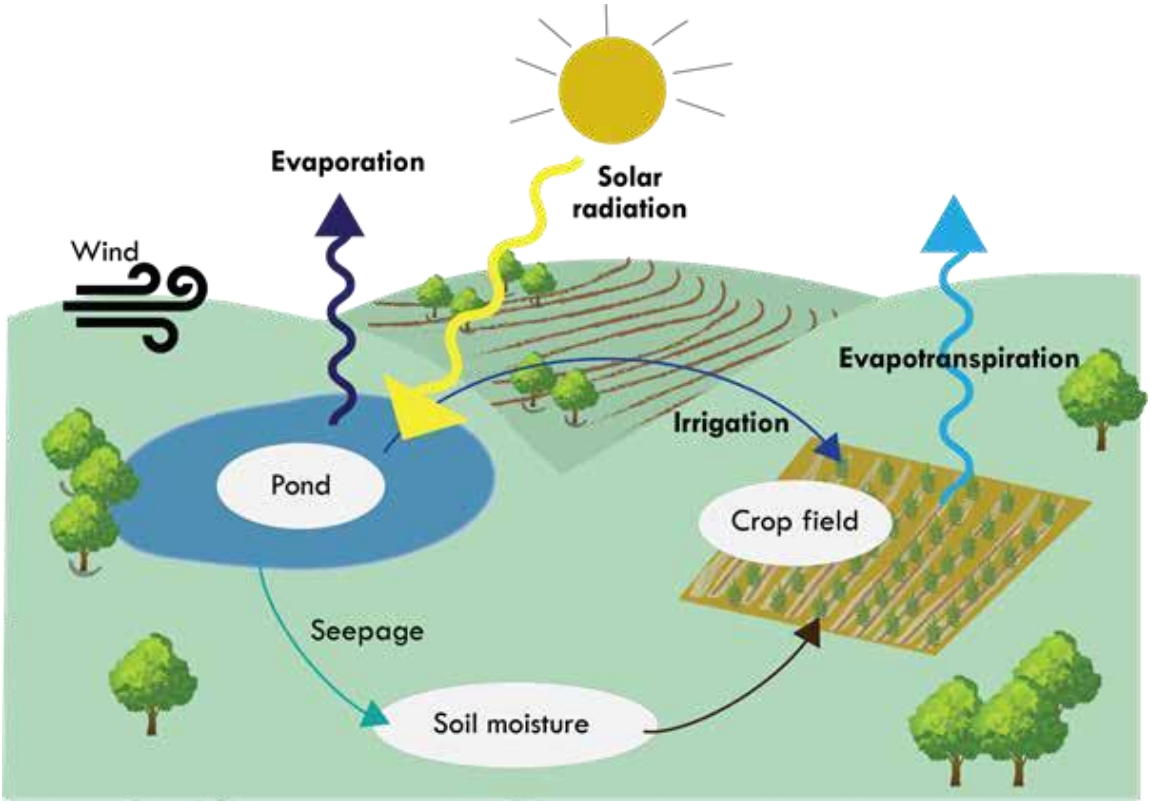


Figure 2: Overview of the use of the pond and the main water losses (evaporation and seepage) (Source: MetaMeta).

Present coarse soils like Alfisols, on the other hand, may require lining to minimize seepage. But again, it should be noted that seepage can also contribute to the recharge of soil moisture levels. To maximize this effect, ponds could be placed higher than a crop field so that the soil moisture flows down towards the crops.

The second cause of water losses from ponds is evaporation, enhanced by solar radiation and wind speed. Several measures can be taken to decrease evaporation. In the next section, some examples are provided. Nevertheless, location and pond specific, other measures might be relevant.

Pond covers ( biological or physical) can help reduce the impact of solar radiation. There is a wide array of physical pond covers used. Some examples are floating modular covers such as aquacaps (Photo 5) or shade balls (Photo 6). Aqua Caps are round, dome-shaped floating modules of about 1.1 m in diameter. A study by Youssef & Khodzinskaya (2019) showed an evaporation reduction of 80% relative to the uncovered water surface. A study in the Nehru pond in Namakkal district, India conducted a 43-45% reduction of evaporation in the reservoir as a result of shade balls[10]. Other physical covers are shade cloths; suspended structures installed over water surfaces with supporting poles and cables (Photo 7). This cover reduces the action of wind and blocks incoming solar radiation, thus reducing the evaporation rates from water surfaces. Shadecloth is used for small reservoirs. The main disadvantage of these physical methods is the relatively high capital costs

[10] Youssef, Y. W., & Khodzinskaya, A. (2019). A review of evaporation reduction methods from water surfaces. In E3S web of conferences (Vol. 97, p. 05044). EDP Sciences.
[11] Haghighi, E., Madani, K., & Hoekstra, A. Y. (2018). The water footprint of water conservation using shade balls in California. Nature Sustainability, 1(7), 358-360.

for construction and materials. Also, production of these tools might have adverse environmental impacts[11].

Photo 4: Example of a lined pond in Kitui, Kenya (Source: MetaMeta).

Photo 5: Example of Aqua Caps (Source: Youssef, Y. W., & Khodzinskaya, A. (2019). A review of evaporation reduction methods from water surfaces. In E3S web of conferences (Vol. 97, p. 05044). EDP Sciences.)

Photo 6: Example of shade balls (Source: 'Shade Balls' Roll their Way into the Spotlight | Energy Vulture)

Photo 7: Example of shade cloths (Source: Day, J., Barnes, R., Groves, K., & Weissenfluh, D. Klamath Falls Sucker Assisted Rearing Program 2016 Update)

An easier and cheaper solution can be biological covers from locally available plants. In Saudi Arabia, for example, locally available palm fronds (Photo 8), a massive agricultural waste and an environmentally friendly by-product, were used as a biological cover. A single layer of these palm fronds reduced evaporation up to 50%[12]. Depending on the locally available options, plant covers can be used instead of the physical barriers mentioned above. Next to plant cover, other biological solutions are the growth of aquatic plants or creepers over the pond. Aquatic plants were found to have an average evaporation suppression efficiency of almost 40%[13]. Important in choosing a fitting aquatic plant is the consideration of the plant's effect on water quality (like eutrophication) and/ or flora dynamics, but also the water needs of the aquatic plant.

[12] Alam, S., & AlShaikh, A. A. (2013). Use of palm fronds as shaded cover for evaporation reduction to improve water storage efficiency. Journal of King Saud University-Engineering Sciences, 25(1), 55-58.

[13] Abdallah, A. M., Parihar, C. M., Patra, S., Nayak, H. S., Saharawat, Y. S., Singh, U., ... & Shalaby, M. M. (2021). Critical evaluation of functional aspects of evaporation barriers through environmental and economics lens for evaporation suppression-A review on milestones from improved technologies. Science of The Total Environment, 788, 147800.

The above-mentioned covers help in reducing evaporation caused by the sun. The wind is the other important factor causing high evaporation rates from water surfaces. Placing windbreaks can thus function to reduce local wind speeds and decrease evaporation. The orientation, spacing and type of the three/shrub are important in the set-up of windbreaks. A study conducted in Australia showed that well-designed wind shelters could reduce evaporation from open water bodies by 20-30%[14]. The key here is to design the shelterbelts in such a way that just enough air can penetrate through to prevent eddying on the lee side.
Also, the vegetation used should be considered. When deciduous trees are used, the leaf index changes throughout the seasons, resulting in less windbreak effect in winter because of a low leaf index. This can be solved by, for example, planting multiple rows or using a combination of evergreen and deciduous species.

Photo 8: Example of palm fronds to cover ponds (Source: Alam, S., & AlShaikh, A. A. (2013). Use of palm fronds as shaded cover for evaporation reduction to improve water storage efficiency. Journal of King Saud University-Engineering Sciences, 25(1), 55-58)

Another key factor in getting the most out of ponds as assets for agriculture is good maintenance. As mentioned above, the depth of the water bodies should be enough to prevent water shortfalls from maintaining optimal buffering results. Maintaining the water bodies and removing build-up sediment is thus important. Silt removed can also be used for fertilizer purposes as it has high nutritious value. An extra incentive for doing this maintenance, next to the irrigation water source, could be to keep fish in the pond as an extra income or to cultivate crops on the terrace banks. Figure 3 gives an overview of all measures discussed in this blog.

There is no single golden solution, instead, a combination of measures could lead to synergies. For example, planted trees could function both as a windbreak and as a shading mechanism. All in all, reducing evaporation prolongs the time ponds are filled with water, improving growing cycles starting from the Rabi season. This will eventually result in an increase in productivity and thus income security.

[14] Hipsey, M. R., Sivapalan, M., & Clement, T. P. (2004). A numerical and field investigation of surface heat fluxes from small wind-sheltered waterbodies in semi-arid Western Australia. Environmental Fluid Mechanics, 4(1), 79-106.

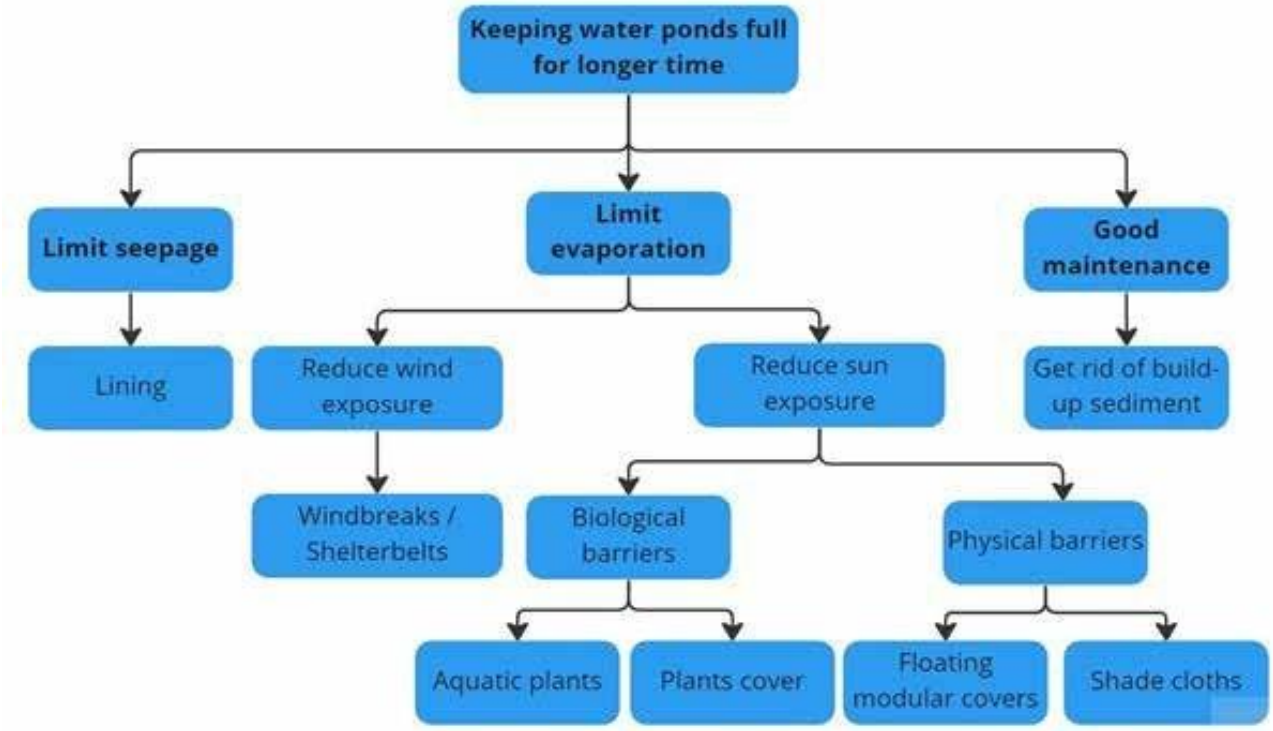


Figure 3: Overview of measures to keep water in ponds for a longer period of time (Source: MetaMeta).

# FODDER PRODUCTION FOR INCREASED LIVESTOCK PRODUCTIVITY AND REGENERATION OF DRYLANDS IN INDIA

Authors: Luwieke Bosma, Ashutosh Mishra and Ishan Agarwal.

Livestock is an integral component of rainfed farming systems in India, 106 million hectares of rainfed areas supports more than 60% of the livestock population. “Statistics reveal that resource-poor small and marginal farmers and landless laborers own 71% of cattle, 63% of buffaloes, 66% of small ruminants, 70% of pigs and 74% of poultry in India. Livestock provide food, fiber, fuel, and draught-power and their wastes are used as manure which is a critical resource for crop production. Most importantly, in rural economies, livestock act as cash, and are considered potential savings and an insurance against crop failure.” [1]

- India has 15% of the world’s livestock population [2]
- The agricultural sector in India, including livestock, feeds 1.3 billion people. It employs 54.6% (Census, 2019) of the Indian population, out of which almost 50% are livestock keepers.
- India’s total livestock is 535.78 million. It

is an increase of 4.6% over the last census in 2012.

- India is currently the 3rd largest beef exporter of bovine meat (cow and buffalo). (Agricultural Outlook 2017-2026", published by FAO & OECD )
- India is the largest exporter of sheep and goat meat to the world (APEDA, 2021)
- India at present, it is the largest producer of milk in the world, contributing 21 percent of global milk production[1].
- The Gross Value Added (GVA) of livestock sector FY 2020-21 which is about 30.87% of Agricultural and Allied Sector GVA and 6.17% of Total GVA. [3]

Despite India's large livestock population, one of its notable characteristics stemming form a study by Yadav et al. (2017) is the large share of feed requirement being met from crop residues. It revealed that the fodder requirement in India is "883.95 Mt of green fodder and 583.66 Mt of dry fodder whereas the estimated fodder production is 664.73 Mt of green fodder and 355.93 Mt of dry fodder." Meaning an additional 219Mt of green fodder and 226.53 Mt of dry fodder is required. Land allocation to cultivation of green fodder crops is limited and has hardly ever exceeded 5% of the gross cropped area. Hence, the supply of feed has always remained short of normative requirement. Feed scarcity was found as the main limiting factor in the task of improving livestock productivity. Furthermore, crop-residues are often under-nutritious, less palatable and low digestible. The low nutrient content in forage crops is a major reason causing weight loss, low milk production, and occurrence of disease in animals [4] [5]. However, there is debate on this premise that livestock production heavily depends on crop residues in India. Most of livestock production in India is from states which have large lands under

Figure 1: cows roaming in mango plantation area, pasture in combination with agroforestry has big potential

[1] https://www.india.com/business/india-from-a-milk-deficit-country-to-worlds-largest-producer-5632166/

commons. India became largest dairy producers and net exporters and recently, third largest meat exporters in just 3 years when government opened exports. The paper by Yadav is highly technical and not fully addressing the social-ecological realities of the country.

Though the situation is more nuanced, there are large deficiencies in the livestock sector for quality feed. There are multiple factors that could contribute to this situation. One factor could be the low availability of quality seed in fodder crops. Quality seed production is an important area to strengthen to stimulate fodder and pasture production, and the larger silvopasture sector. Currently a large area is sown using poor quality uncertified seed that gives poor fodder yield. And farmers usually do not produce these seeds. [6]

Another factor could be the expansion of semi-arid areas in India, to about 34% of the country's total area. "An increasing trend in aridity was observed in central India, including Rajasthan and Madhya Pradesh, among others. The eastern boundaries of the semi-arid region in north India have expanded in recent decades, converting the dry sub-humid regions into semi-arid regions." Researchers stressed that climate change, especially changing rainfall patterns and increased temperatures, could cause changes in aridity. Along with extensive land use practices, this can cause land degradation, leading to further desiccation of the land. [7]

One of the other reasons for this, especially in the tribal belts of Santhal Pargana could be non-usage of the bigger livestock for milk. Traditionally, the Santhal tribes have been avoiding milking of animals. Occasionally, for the sick or for the children, a pint or two is taken out. Otherwise, the cattle are left without milking. Thus, a no short-term profit withdraws the community's empathy towards quality feed. Subsequently, growing quality feed on the private land would also be input and labor intensive. Some other major factors for reducing fodder or crop residues for livestock are:

1. Commons and other grazing resources that are the major source of fodder for livestock in India are fast diminishing. More than 70% of its meat and more than 50% of its milk is produced on common property resources in traditional Systems'[2].
2. Grazing restrictions in forests
3. Drastic shift from food crop cultivation to cash crop cultivation - this resulted in dramatic reduction of crop residues. One example is reduction in cultivation of dual-purpose crops (which provide food and fodder) such as millets and sorghum.
4. High labor crops also prevent crop farmers from harvesting crop residues & selling them - also a loss of a good income source. Farm mechanization also prevents proper extraction of crop residues.
5. Fodder deficit is being caused more by mismanagement

   a. Lack of regional coordination between areas that produce large amounts of crop residues to other fodder deficit regions - eg. Huge amounts of paddy straw or maize crop residue is produced in several parts of India . but this is not harvested or sold to farmers – it is in fact burnt down by farmers due to high labor costs.

   b. In 2021, India exported 28 lakh tons of maize and 18 lakh tons of oil meal cakes, two of the largest requirements for intensive livestock keeping. Further the production of food grains in the country is estimated at a record 338.31

[2] Kullu-Call-Brochure.pdf (rln.org.in)

million tonnes which is higher by 3.77 million tonnes than the production of food grain during 2020-21. And the production during 2021-22 is higher by 23.80 million tonnes than the previous five years' average production of food grains.

## Relating our experience in Kenya on fodder production with road water harvesting in African drylands.

Now we take a side-step and move to Kenya. In Kenya and larger East-Africa, drylands provide a vital livelihood stream to people across the globe through a range of goods, products and ecosystem services. These arid and semi-arid lands (ASALs) are characteristically very fragile and are facing increased land use and land use change pressure compounded by high climate variability. Land degradation, reflected not only by the reduced capacity of the land to sustainably produce ecosystem services but also its economic value, is widely recognized as one of the most serious global challenges of our time. It directly affects over 250 million people and puts some one billion people, mainly pastoralists, at risk (Wessels et al. 2007). MetaMeta with partners conducted a project from 2017-2020 with 2 main objectives 1) restoration of degraded drylands with indigenous grass species and road water harvesting, and 2) improve livestock productivity through improved quantity and quality of feed.

Vegetation degradation in the dryland environments is a worldwide phenomenon and is recognized as an important measure of degradation over different spatial and temporal scales (Visser et al. 2007). Changes in the composition of the herbaceous vegetation cover, grasses and herbs, exemplify the short-term indicators of vegetation degradation which are reversible (Mganga et al. 2018). However, a shift in state from herbaceous to bushy dominated vegetation types is indicative of more permanent degradation (Bennett et al. 2012). Natural vegetation change from 'excellent condition' to 'poor condition' in the dryland environments triggers a subsequent but comparative increase in the dominance of unpalatable plant species over the more preferred palatable plant species (Angassa 2014; Kassahun et al. 2008). Grass reseeding has been used successfully as a means of restoring degraded drylands in Africa (Nyangito et al. 2009; Mganga et al. 2010; 2015; Opiyo et al. 2011). As a rule of thumb, the best grasses for any reseeding program are those that are native and found on range sites similar to those to be reseeded. Some of the common indigenous grasses commonly used for reseeding programs in Kenya are African foxtail grass (Cenchrus ciliaris), Bush rye grass (Enteropogon macrostachyus) and Maasai Love grass (Eragrostis superba - see photo). (read more here)

The main results showed that Chloris gayana cv Boma and E. superba produced significantly higher dry matter biomass yields and attained higher seed production than other species. High biomass and seed production indicate their suitability to support livestock production and replenish depleted soil seed banks, respectively.

Enteropogon macrostachyus and C. ciliaris displayed significantly higher values for components of establishment and ecological restoration success, that is, plant densities, tiller densities and basal cover. Overall, C. roxburghiana ranked lowest in the measured morphoecological characteristics.

Successful restoration of degraded African semi-arid rangelands using indigenous grass reseeding can best be achieved through careful selection of grasses to take advantage of their specific

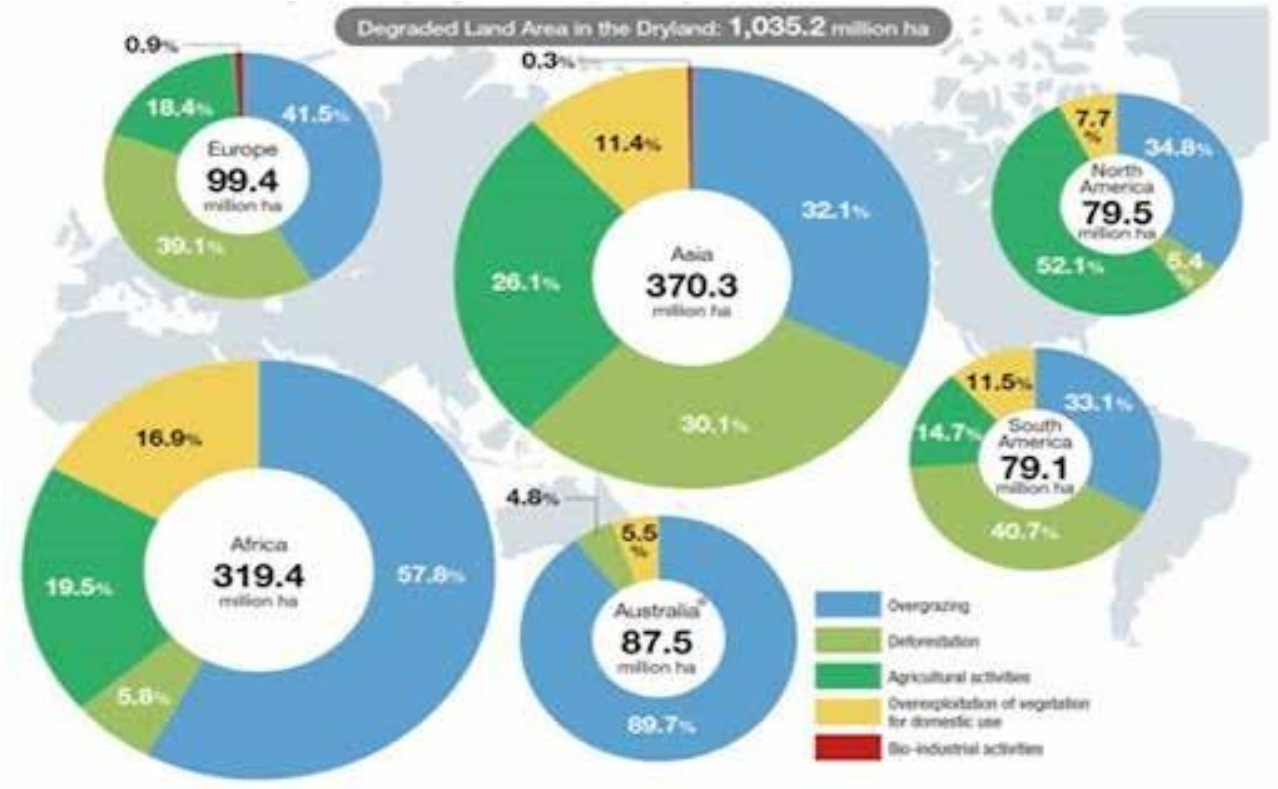


Figure 2: causes of land degradation in the drylands (source: World atlas of land degradation, 2nd edition, UNEP)

morphological characteristics. This selection should primarily be informed by the intended use of the rangeland and the specific challenges of restoring each site.

Reseeding programs aim at improving existing ground cover and pasture biomass to an extent or in a manner not possible by grazing management. This can be accomplished by over-sowing into existing vegetation with a superior species, reseeding a denuded land and establishing a completely new pasture, with or without the aid of irrigation. Flood based irrigation and road water harvesting are two viable and low-entry methods to boost fodder production in drylands.

Systematically introducing the spreading of short-term floods from ephemeral rivers and from road drainage combined with water retention in trenches will lead to increase of soil moisture levels, as water is allowed time to infiltrate slowly, this water will move in both vertical and lateral directions (depending on soil characteristics). This can revitalize drylands into a highly productive production system – in terms of return to labor. Growing fodder with flood and road drainage water has several advantages: (1) it turns a threat (flood/drainage water) into an asset; (2) it relieves the pressure on the dry rangelands and creates an economically rewarding production system, and (3) it requires almost no land preparation and hence it can also be applied in areas that are short in skills and labour. [8]

Now, before we move back to India there are two important notes. First, it is important to note that the sub-humid climate in AEZ 7 is different from dryland agriculture, thus some ground issues may be different, and the solutions must be aligned with the sub-humid conditions. Second, the conditions of formal tenure for communities over community lands in Kenya is different from India, this would change the role of communities and community institutions.

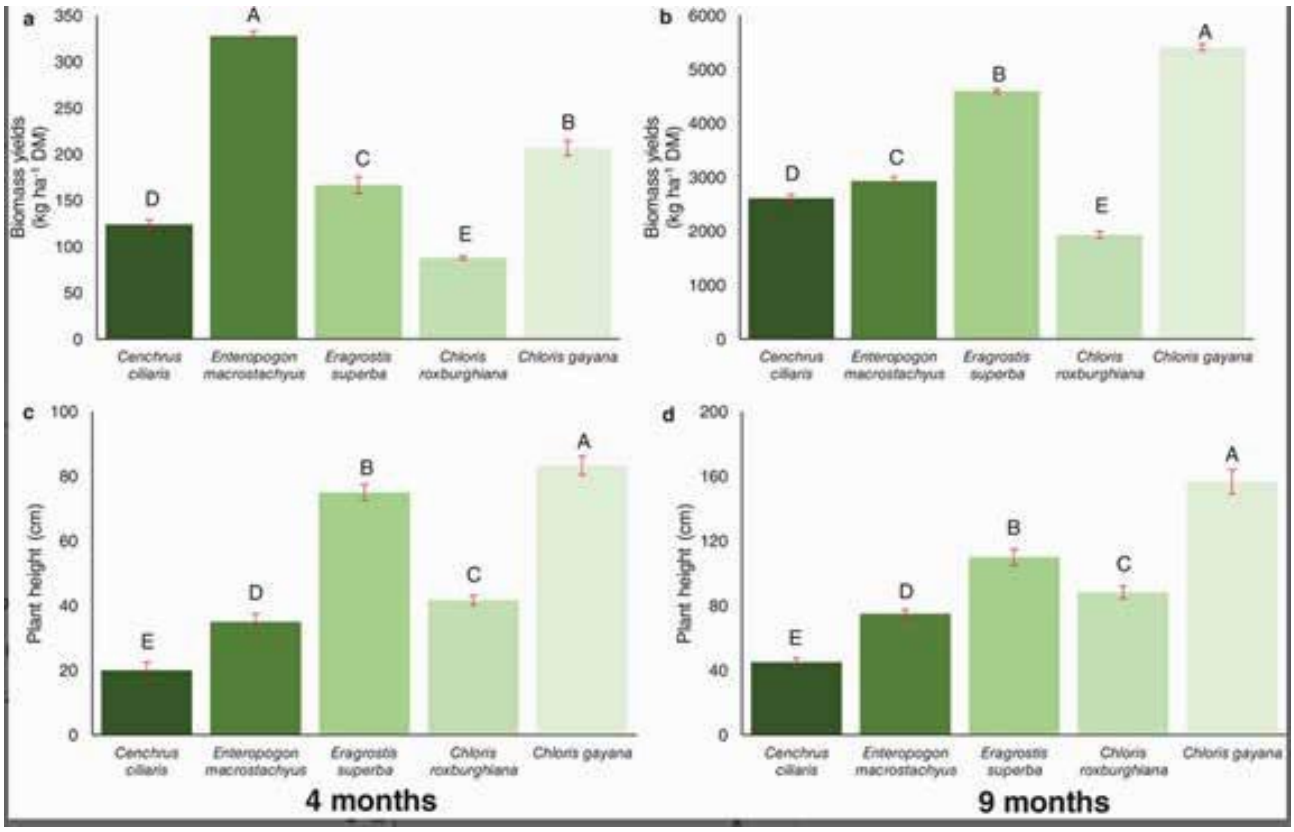


Figure 3: Biomass yields (a and b) (kg ha-1 DM) and plant height (c and d) (cm) of the selected grasses four and nine months after sowing. Error bars represent standard error of means (±SE). Bars with different lowercase letters indicate statistically significant differences at α = 0.05

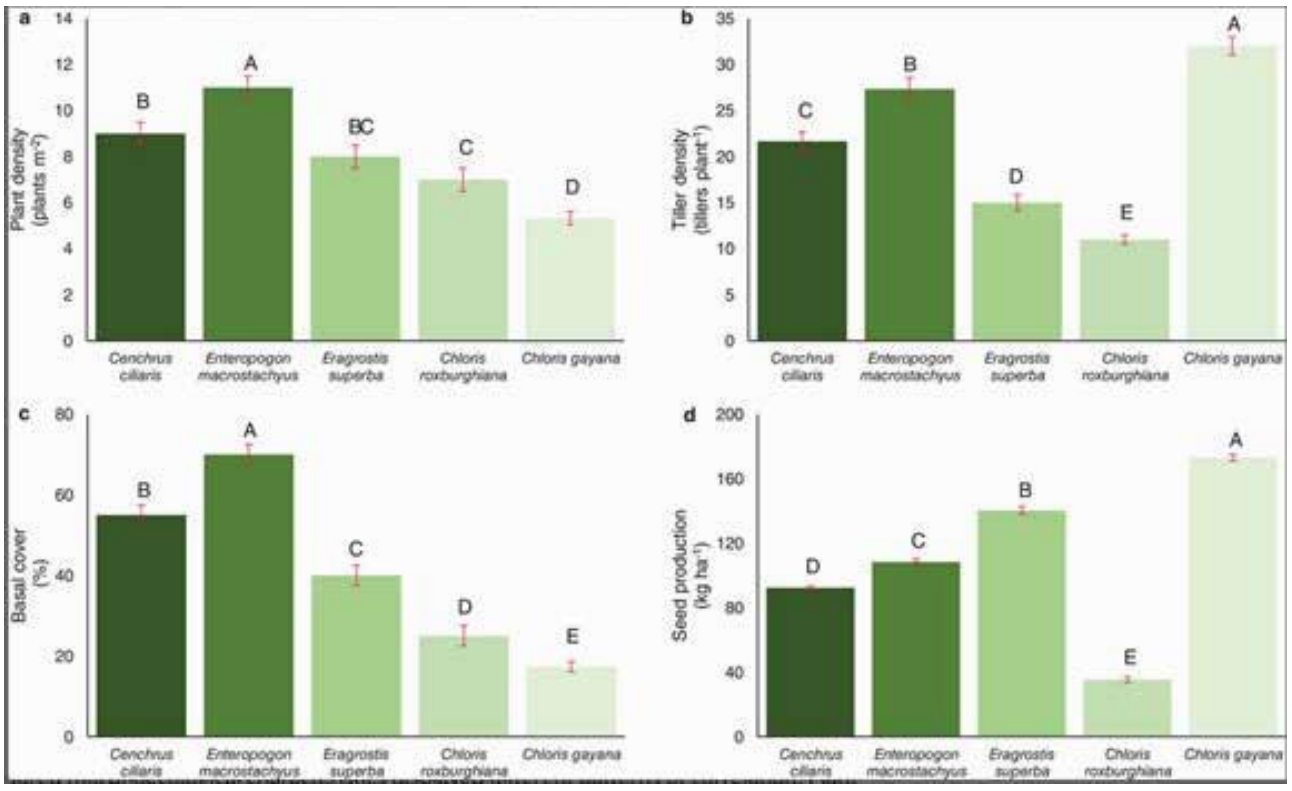


Figure 4: Plant density (a), tiller density (b), basal cover (c) and seed production (d) of African rangeland grasses after nine months. Error bars represent standard error of means (±SE). Bars with different lowercase letters indicate statistically significant differences at α = 0.05

What lessons can we take from Kenya? The interventions of growing fodder with flood and road drainage water in Kenya was taken up by champion farmers who spread the idea to their communities. Moreover, the County Government of Kitui has taken up the approach in their policies which enabled wide-scale uptake and promotion of fodder production in their jurisdiction. Furthermore, the project team consisted of University, Private organisation, Community/ champion farmers and the regional government. This enabled co-creation of knowledge and immediate fine-tuning to needs and requirements of each partner involved. Fine-tuning of such an approach to the specific social-ecological context in India's states of Jharkhand and Madhya Pradesh, coupled with a focus on indigenous fodder species and management of commons with low-cost water harvesting interventions, is needed to explore its potential for India.

## What lessons can we take to Madhya Pradesh and Jharkhand in India?

The states of Jharkhand and (eastern parts of) Madhya Pradesh receive an average rainfall of 1200-1400 mm annually, however, they suffer from droughts and water stress during non-rainy months (NITI Aayog, 2015). Undulating terrain, high rainfall and depletion of forests resulted in large scale land degradation in both the States. The agro-climatic zone 7, in which both states fall, is hardest hit on several scores: around 35% of the land area is degraded and 41% households living below the poverty line; the highest amongst all the zones.

In India, the common lands constitute 25% of the total geographic area with almost half of this being divided between community pasture and grazing lands, village forests and woodlots. Whereas more than half of the annual fodder requirement is met from the cultivated fodder and crop residues, the balance is from open grazing and fodder availability from common lands. Sustainable intensification of livestock production systems might become a key climate mitigation technology. It can provide quality green biomass at low cost and high yield. Intensive cultivation of fodder trees is also a key method to get green biomass throughout the year and increase livestock productivity. [4]

This leads us to the question: How can we better utilize the commons for quality fodder and pasture production, creating a win-win scenario to protect these lands from degradation? We do not have answers yet, but we like to share a few pointers to further dive into:

- Investigate indigenous grass species and other

Figure 5: trenches ensure water can slowly infiltrate and thereby prolong duration with higher soil moisture

types of fodder. Rank them on key criteria, e.g. drought tolerance, biomass, plant density, seed production, nutrition, etc.

- Focus on low-cost, small-scale and widespread water harvesting methods, integrate capturing runoff from roads, and link this specifically to regenerate low-productive common lands, so they can be revitalized into fodder-baskets.
- Explore options for specialization in the following production streams: quality hay & silage, and indigenous grass seeds. This can support existing systems of beef and dairy production.
- influencing policy on institutional level to develop fodder management policy with dedicated agency to steer management of grazing lands and fodder resources in India.
- Increasing awareness among the community members and its subsidiaries like PRI (Panchayati Raj Institution) regarding the ownership of commons and its utilization as a key natural resource.
- Increase understanding of cultural aspects around livestock keeping.
- Explore linkages between increasing productivity of livestock systems to crop farming through manure provision.

These are some ideas we think are worth deeper investigation. We wish to extend an invitation to everyone with interest in fodder production systems to reach out to us so we can explore the opportunities for Jharkhand and Madhya Pradesh.

Please reach out to: Luwieke Bosma (Lbosma@metameta.nl)

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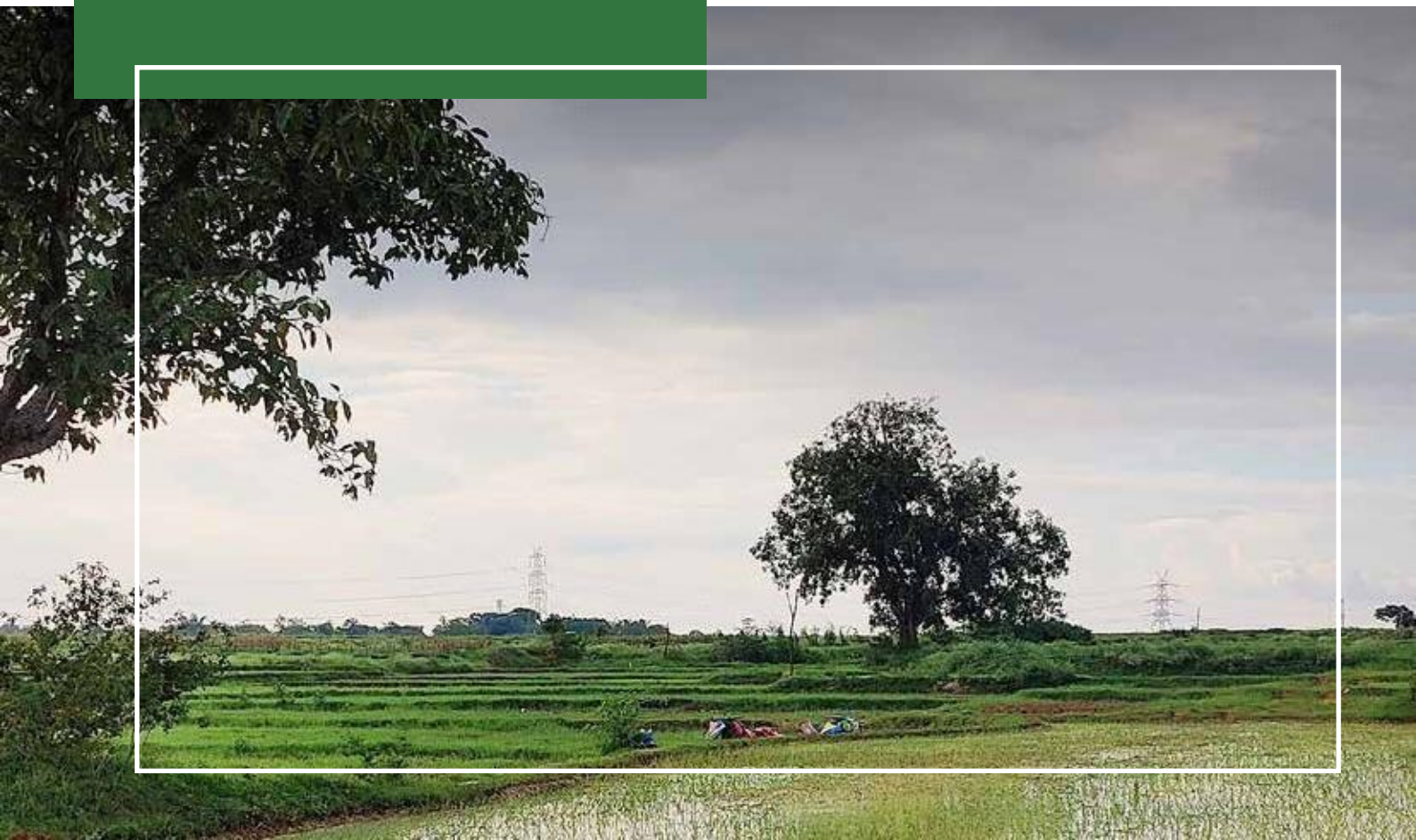
# GREEN ROADS FOR WATER (GR4W)- A FIRST OUTLOOK IN MADHYA PRADESH, INDIA

Authors: Saroj Yakami, Anurudh Kumar Shastri, Khusbu Bisen, Nitesh Kumar, Supriya Sharma, & Luwieke Bosma.

The basic idea of “roads for water” is to make roads instruments of beneficial water management and resilience. Roads make a major imprint on hydrology. They block and guide water, concentrate runoff, interfere with subsurface flows, and change flooding patterns. The impact of roads on landscapes and surface hydrology is often negative. Roads cause erosion and local flooding and trigger sedimentation. Road bodies are a main reason for drainage congestion and waterlogging.

Water is also considered the prime enemy of road infrastructure and the single greatest factor in road damage. A commonly used estimate is that for unpaved roads, the damage caused by water is around 80 percent (Chinowsky & Arndt, 2012) and for paved roads the proportion is 30 percent. There is a strong case for road-asset management to better manage water around roads and to see roads as an integral part of the watershed and landscape in which they



are situated. The negative impact of roads on the surrounding landscape can be turned around and how roads can become instruments of beneficial water management. Roads provide an enormous opportunity to contribute to better water management and climate resilience. This will create the triple benefit of less road damage, less land degradation, and more beneficial use of water..

Many measures can be taken to manage water with roads. These are the main opportunities:

- In arid areas, roads can be used to harvest water (van Steenbergen et al. 2018). The water intercepted by road bodies can be guided to recharge areas or surface storages or can be applied directly on the land. With the enormous lengths of roads being built, roads present the main opportunity for water harvesting and water buffer management in semiarid areas (Salman et al. 2016).
- Roads can also be used to manage water catchments by controlling the speed of runoff, compartmentalizing and mitigating flood runoff, and influencing the sedimentation process in the catchments. The choices of where to place a road in a catchment and additional measures to include have a major impact on how a catchment is managed.
- Roads can improve pastoralist areas for instance by combining the concentrated run-off from roads with planting native grass species. Similarly, the road run-off can be used to rekindle the roots of useful tree species under farmer managed natural revegetation programs in very dry areas. Under such programs dormant tree shoots that come up after a sporadic watering event are systematically pruned and local tree stands in such harsh environments.

## Roads and Water issues in Madhya Pradesh

Madhya Pradesh (MP) has an agrarian economy and a considerable proportion of the population is dependent on agriculture and forest resources for their livelihood[1]. But the state is largely rainfed where drought has been a frequent phenomena in a recent decade. In 2016, 46 out of 52 districts were declared as drought affected. Similarly, in 2019, 36 districts faced acute drought and water scarcity. Again, the spatial distribution of the rainfall remains highly skewed with some districts experiencing drought situations, while the rest of the state reels under heavy rainfall and floods[2]. Further the monsoon season lasts for 4 months (June-September) and the remaining period is hot and dry. This brings out two major issues, post-monsoon water availability is very low, and the uplands suffer from high erosion, resulting in runoff bringing siltation to the fertile lowlands. Both issues compromise the cultivation practices, thus livelihoods of people.

MP has an excellent roadways network which comprises national highways, state highways, district roads and village/rural roads. The 2019 data shows that MP has 365,045 km of roads[3] and the mean density of roadways is 22.14 km per 100 sq

[1] https://mpforest.gov.in/img/files/GIM_Revised_Plan_finaly_18_07_16.pdf
[2] https://www.indiawaterportal.org/articles/madhya-pradeshs-recurring-droughts-measuring-responding-and-reducing-vulnerabilities
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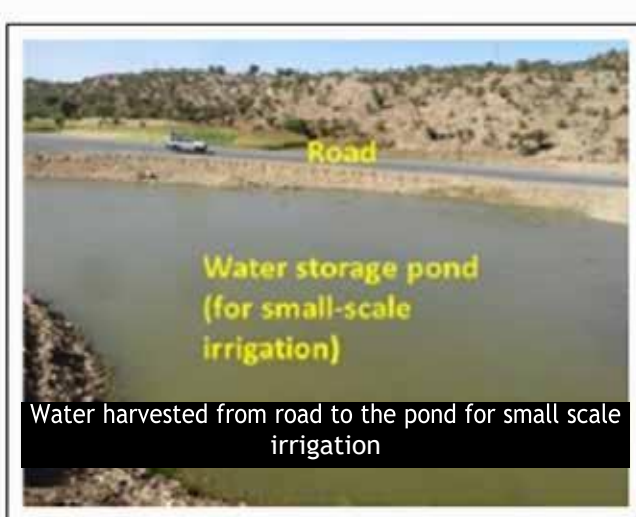
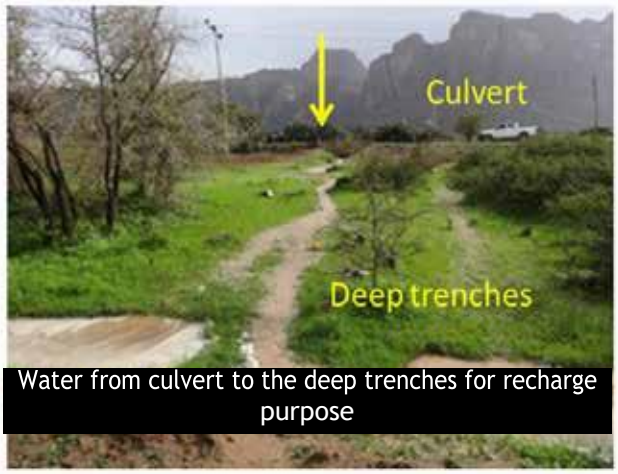
[4] https://www.mapsofindia.com/maps/madhyapradesh/madhyapradeshroads.htm

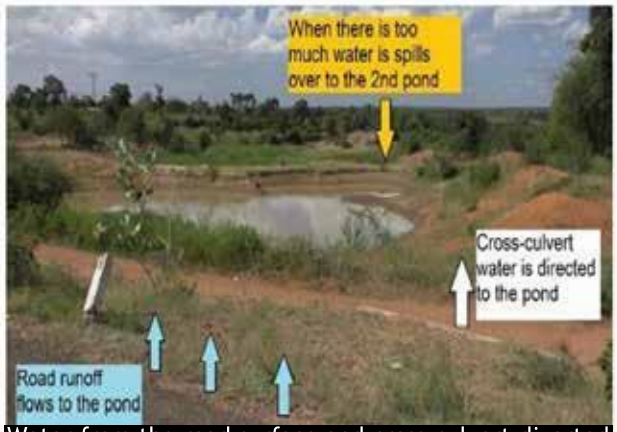


Water harvested from road to the pond for small scale irrigation



Water from culvert to the deep trenches for recharge purpose


Cascade of soak pit and water harvesting pond along the road for recharge and irrigation



Water from the road surface and cross-culvert diverted to a series of ponds downstream

km in comparison to the countrywide mean of 37 km[4]. The different types of roads are regulated by different Authorities (see table below).

Panchayats at district and village level and PMGSY are responsible for the construction and maintenance of rural roads. PMGSY programme was initiated in 2000 AD with the objective of developing rural roads and connecting all villages having populations over 500 (and over 250 in hilly areas). Interesting fact of the rural road in MP was that most of the roads connecting one hamlet to another were concrete roads.

| Types of road | Managing Authority | Remarks |
|---|---|---|
| **Village/rural road** | **Panchayats and Prime Minister Gram Sadak Yojana (PMGSY)** | • connect one village to another<br>• connect the village to the market.<br>• connect village to high level roads |
| **District Roads** | **Public Work Department (PWD) of State** | |
| **State Highway** | **PWD of State** | |
| **National Highway** | **Ministry of Road, Transport and Highways** | |

## What is the work done on INRM and how could GR4W be integrated?

PRADAN has a long experience in developing Integrated Natural Resource Management (INRM) village plans, where it adopts the Ridge-to-Valley approach. This approach seeks to detain, divert, store and use available rainwater, starting from the ridge, the upper section of a catchment. The idea is to conserve every drop of water starting at the ridge and reduce to considerable extent both the surface run-off volume and the velocity of water. Under ridge-to-valley approach, soil and water conservation activities are taken up as area treatment and drainage line treatment (Swami 2021).

The Ridge-to-Valley approach has been the main driver for the INRM village planning process.
In the NRM village planning workshop in MP (September 2022), a wide range of measures was observed in the village. For instance, structural measures such as staggered trenches in upland, 30*40 model, field bunding, water harvesting structure, dug wells, check dams in streams, ponds etc. However, it was also observed that the focus had been on valley lands, while ridge or upland areas were not sufficiently addressed to ensure the complementarity of ridge and valley.

Further, we had observed huge quantities of roads being constructed that connect villages and hamlets (most of them were paved roads) in the rural context of MP. These roads divide the drainage and divert and concentrate water to other directions which could be used when properly managed but it creates havoc during monsoon time.

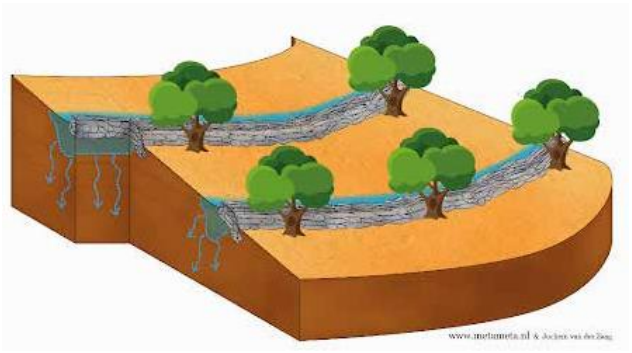
Looking at the context related to water and the huge quantity of roads in MP, there is a big scope for green roads for water (GR4W) to deal with drought, irrigation issues and siltation and to improve the livelihood of rural communities in MP. Below we selected a few structures that can especially be useful to increase water conservation in the upland/ridges and to connect roads for improved water management and harvesting.

## Opportunities of GR4W in MP

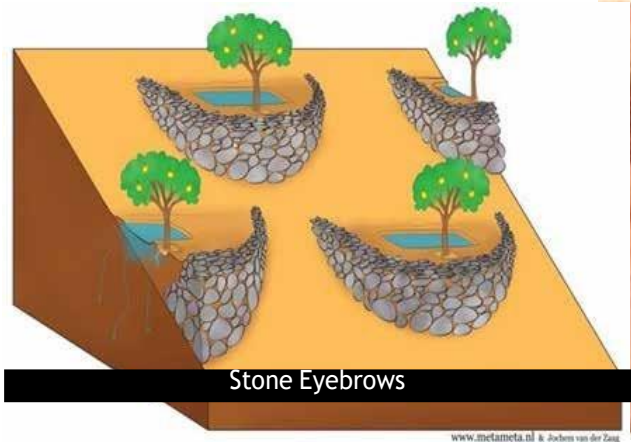
### Contour bunds

Contour bunds are designed to collect enough water to recharge soils and provide water for plant growth during the dry season. They also protect soil from erosion and collect debris during peak rain events. The contour bund slows runoff, and intercept sediments and build up soil layers. Design criteria for determining the distance between bunds include slope gradient, rainfall intensities and infiltration rates. In the dry areas trees can be grown above the bund. In more humid areas plant trees on the downside to avoid risk of waterlogging.

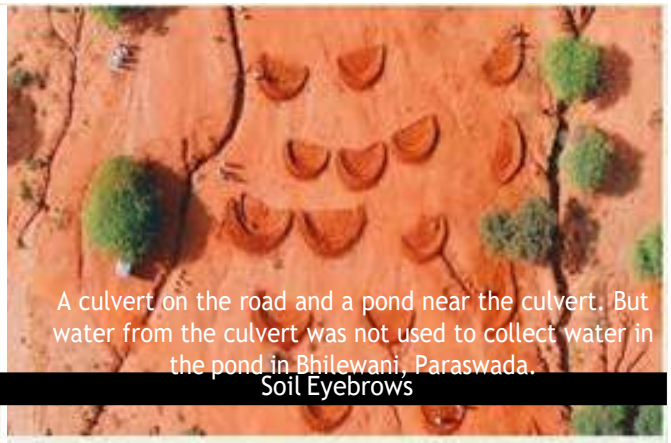
- Stone- & stone-faced soil bunds (In 3-35% slope land)
- Soil bunds (In 3-15% slope land)



### Eyebrows



Stone Eyebrows

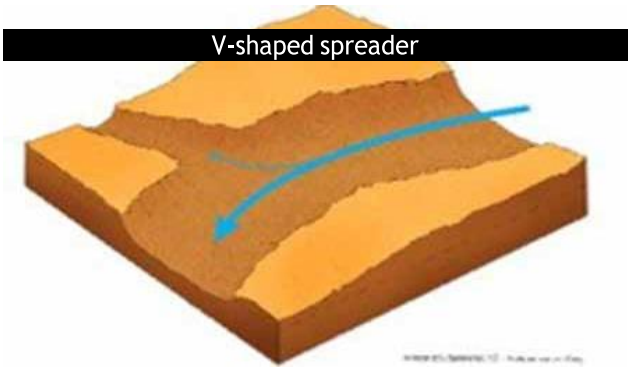


A culvert on the road and a pond near the culvert. But water from the culvert was not used to collect water in the pond in Bhilewani, Paraswada.

Soil Eyebrows

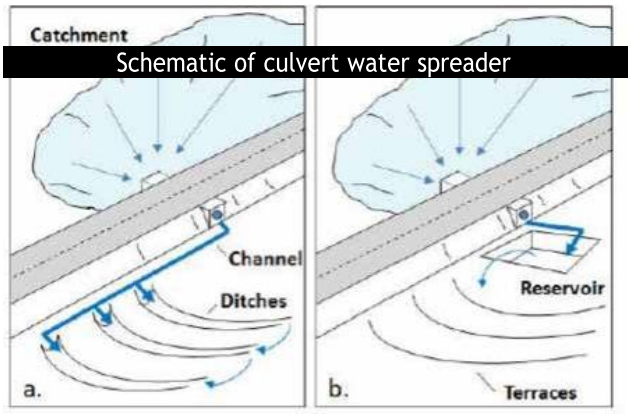
Eyebrows are small, semicircular, stone-faced structures that open in the direction of the runoff. They can be built on steep slopes, usually with a maximum preferred slope of 50 percent. Eyebrow terraces can be complemented by stone strips or rock bunds, particularly on slopes that are relatively even and not too steep (less than 50 degrees). Eyebrows contain a water soaking pit and a planting pit as shown in the picture. Eyebrows function as micro-catchments for water harvesting.

V-shaped spreader



### Culvert water Spreader

Water from a culvert can be channelized into farmland away from roads and used for farming, groundwater recharge by diverting it to ponds, and improving soil moisture. In steep areas a V-shaped spreader ensures water is guided gently in two directions and no gullies are developed.

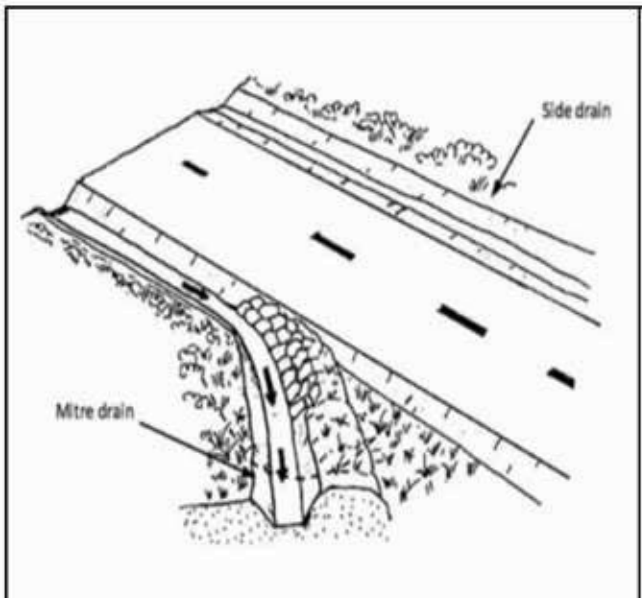



Schematic of culvert water spreader

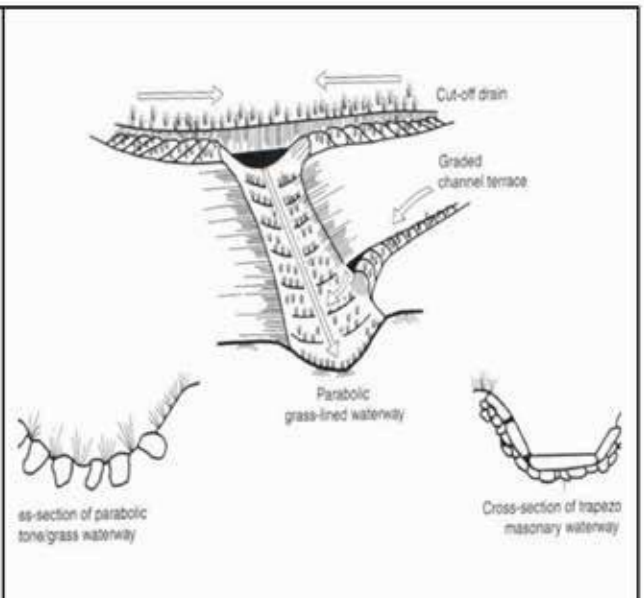
Culvert Water spreader

### Mitre drain/cut-off from side drain

The Mitre drains lead away the water from the side ditches to lower areas. In principle, the more mitre drains the better. Figure below shows water from Mitre drain leads to a pond with a silt trap.




Sketch of Mitre drain




Cut-off from side drain

Mitre drain leading water to pond

**Pasture Production from water harvested from road**

A cascade of low-cost and small-scale water harvesting measures capturing runoff from roads, and linking it specifically to common lands (common land consists of 25% of total geographic area in India), could prove to be a good fodder-baskets for livestocks and improve the livelihood of communities linked to livestocks.

## Main lessons and next steps

**Upland area in INRM village planning**

One of the difficulties implementing Ridge to Valley approach/treatment in INRM village planning is the upland areas. In MP, a large chunk of upland areas are under the Forest department. Forest department has its own rules and regulations to treat upland areas. At present, INRM village planning is done by PRADAN together

Preparation for road water harvesting

Water collected from roads used for fodder production

Trenches in farmland to collect water from road

Increases moisture in farmland and more water available during post monsoon

Before: dry land and no greenaries

After: re-seeding and water harvesting from roads

with communities only and in the presence of MGNREGA, a panchayat. This has limited the planning process in the downstream area or the low land areas within the village boundary only. Forest department is the main stakeholder for INRM village planning process in MP due to following reasons

- major chunk of upland area of the village comes under forest department

- Sediments and debris from forest area are big issue for communities
- Water from the upland areas, if managed properly, could be good resources for agriculture during post monsoon period
- Non Timber Forest Products (NTFP) from the forest is a good source of income and livelihoods for the communities.

At this time, there is no consultation with Forest department or Forest department is not considered a stakeholder while performing INRM village planning. Collaboration with the Forest department is essential to complete the Ridge to valley approach/treatment or planning process in upland areas for the INRM village planning process.

### Enhanced learning and piloting

It came out from the online sessions and INRM village planning workshop that GR4W concept and measures require more in-depth learning. In order to integrate GR4W into the larger INRM implementation in the villages specific knowledge on: i) the range of GR4W options focusing on the conveyance of road runoff water for retention and recharge, ii) governance approach with new group of stakeholders, and iii) integration into INRM village planning, commons and fodder production. We therefore propose to work on developing a series of training sessions on GR4W coupled with piloting in selected villages. Such learning by doing would greatly improve co-creation of knowledge among multiple stakeholders and can improve the practicality for on-the-ground implementation.

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# EVERYTHING USED TO BE 'BETTER' - HAVELI CULTIVATION RAINWATER MANAGEMENT: THE USE OF A TRADITIONAL SURFACE-WATER HARVESTING STRUCTURE TO INCREASE CLIMATE RESILIENCE IN MADHYA PRADESH, INDIA.

Authors: Marijn van der Meer, Saroj Yakami, Anurudh Kumar Shastri, Khusbu Bisen, Nitesh Kumar, Supriya Sharma, & Luwieke Bosma.

## Introduction

Groundwater recharge, decreasing water run-off, irrigation, local climate buffering, and fishery. These are some of the many functionalities and benefits of farm ponds in areas where agriculture is primarily rainfed (like Madhya Pradesh, Central India) (see blog 'Ponds as an asset for agriculture: how to keep them full'[1]). Using the bed of a farm pond to cultivate a Rabi crop is a potentially new (actually very old) way to utilise a pond and increase food security and climate resilience. In this blog, this traditional rainwater management system (or runoff farming), the Haveli structure, will be explained. In this view, it can fit into a bigger picture in which forgotten traditional ways of agricultural practices or indigenous vegetative species could have a central role in strengthening climate resilience.

Let's first dive a bit deeper into the traditional usage of the word Haveli, as it could bring different recognitions. For people knowing the word, a first thought will probably go to the ancient Haveli architecture, used as a generic word to describe a traditional mansion or townhouse (the word haveli means private space in Arabic) in India[2]. Although these architectural structures have great historical significance, this blog elaborates on a Haveli structure that is used for surface water storage. As a water harvesting structure, Havelis originate from Madhya Pradesh (MP). Many structures can still be found around Jabalpur (the upstream area of the Narmada) and in the North West of MP (Bundelkhand region)[3 4 5].

## Idea of the Haveli structure

Haveli cultivation started 300-500 years ago. Within the landscape, Haveli cultivation

was primarily found in upstream, permanent fallow fields. Depending on the field size, slope and characteristics, water is harvested in fields (preferably with Vertisols) by constructing earthen embankments on all sides (in the range of 0.2 and 1.2 m high)[6]. The width of the bunds varies from 1.5 to 3 metres and the length from 40 to 110 metres[7]. To cope with the pressure of the water, the bunds downstream are generally higher and wider to make them stronger. So in terms of the current set of interventions, the Havelis could be seen as a mix between the current bunds structures (although a bit higher) that are used to capture water for paddy production and the water ponds that are used to harvest water (for irrigation purposes). To deal with extreme rainfall, the Haveli structures are often equipped with spillways and drainages. The catchment area of the Haveli is normally 10 to 200 ha.

Although the characteristic properties might overlap with current bunding and pond interventions, the agricultural use of the Haveli structures/fields is definitely different. In the Haveli structure, water is harvested during the monsoon season (June-September) (Figure 1), turning it into a shallow water storage structure. When the rain stops (Post-monsoon, October) and the Rabi crop is ready to get sewed, the water still standing in the field gets drained. This leads to a transformation of the field from a shallow water body to an agricultural field. Although on a smaller

Figure 1: Haveli cultivation in monsoon season (left picture). Crop cultivation on the Haveli bed by using residual soil moisture, organic matter, silt (right picture). Source: Garg, K. K., Singh, R., Anantha, K. H., Singh, A. K., Akuraju, V. R., Barron, J., ... & Dixit, S. (2020). Building climate resilience in degraded agricultural landscapes through water management: a case study of Bundelkhand region, Central India. Journal of Hydrology, 591, 125592.

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scale, in terms of practice, Haveli structures are comparable with flood-based irrigation. But why use Haveli structures when some parts of the field are submerged in water during the valuable Kharif season (paddy cultivation)?

## Benefits of Haveli structure

With current climate change, Haveli cultivation offers large agricultural flexibility, multi-diverse application and an increase in soil health, all essential elements in fighting climate change. To highlight this, some examples are provided that focus on the agricultural and groundwater benefits.

**Agricultural practices:**

Current livelihoods are large depending on the yields of paddy during the Kharif season, as this is the main cash crop. However, the future productivity of paddy is highly questioned, as paddy yields are expected to reduce in the future[8]. Take this year (2022) as an example, where Greenpeace announced an expected decrease in Indian paddy yield by 20-35% due to the disturbed rainfall pattern, droughts and extreme heat[9]. A change towards more diverse and varied cropping patterns is needed and Havelis could help with this.

Let us start with the benefits of the Haveli field itself. Just like flood-based irrigation, leaving a small layer of water on a field for some time gives large benefits to the soil properties. First of all, the field is left full of soil moisture, resulting in a 50% reduction of irrigation requirements (some studies even mention no watering needed[10]) in the Rabi season iv. Moreover, the organic matter decomposition and silt deposition lead to increased productivity and soil health. Post-drainage, the fields show an increase in nitrogen mineralization, microbial populations, soil enzymes, and thus fertility (30-40% increase). Another benefit is the control of weeds, mentioned in the field as a big problem currently. The weeds drown under anaerobic conditions, leading the remains to decompose and form extra hummus. With all benefits, Rabi crop yield increases by 15-25% compared with nearby fields. Besides, tillage and external inputs are less needed, leading to a reduction in labour and costs. Whether the total crop production makes up for the current practice depends on the situation (current health of soil, loss of paddy due to climate change, etc.).

Next to the benefits on the Haveli field itself, depending on the water availability and infrastructure, post-monsoon drained water can be used for pre-irrigation by farmers downstream or the water can be diverted into another nearby field (that was cultivated in the Kharif season) to be stored there, leading to a cascade of ponds.

In Addition to the soil properties, Havelis give flexibility on a temporal scale. Take Ghunghasa village (Jharkhand, India) as an example, where monsoon rain started in August this year, which is really late. Therefore, all supposed paddy fields were left fallow, as the risk of sowing was too high. Applying Haveli cultivation as plan B, so flooding the fields in the monsoon that still came in August and September, increases the chances of having a profitable Rabi crop. And because the fields gradually dry out due to drainage, Haveli structures even help in setting the right timing for seeding this Rabi crop, as the seeding period can be manually prolonged (when having sufficient surplus water in the Haveli. The possibility to rotate from season to season or from field to field gives an interesting option to strengthen the climate resilience of villagers.

### Groundwater recharge

Apart from direct agricultural benefits, a study of the effect of Havelis on groundwater levels was conducted in Bundelkhand, Uttar Pradesh iv. In this study, they found that natural recharge rates of shallow groundwater aquifers and dug wells are significant during the season. With the introduction of the Haveli, a single wet-year groundwater recharge could maintain enough water supply for two successive years after. This means that farmers experienced less harm during drought years. For example, in 2015, an extremely dry year, 6% of the wells were dry in the Haveli watershed, compared to 30% in the watershed without intervention[11].

To visualise and reflect on the differences between different options, let us take a simple situation in which a marginal Indian farmer has two fields (not representative of a real-life situation), one

Table 1: A simple situation overview that displays the potential strength of the Haveli structure.

| | Plot | Kharif season | Rabi season | Groundwater |
|---|---|---|---|---|
| **Farmer 1** | 2 plots for cultivation | Growth: paddy (water-intensive) in both fields. **Note**: without a water source nearby (preferably surface water, as groundwater extraction has long-term negative effects), the harvest will increasingly fail in the next years. | Growth: winter crop (mustard, lentil) on both fields. **Note**: soil nutrition and moisture are low due to the Kharif crop (high fertilizer inputs necessary). Harvest is very uncertain. | No recharge, potential extraction because of a shortage of water |
| **Farmer 2** | 1 plot for cultivation (lowland), 1 plot for permanent surface water storage (upland) | Growth: paddy on the lowland field. **Note**: surface water irrigation is nearby to cope with droughts | Growth: winter crop (mustard, lentil) on the lowland field. **Note**: soil nutrition is low due to the Kharif crop (high fertilizer inputs necessary). Harvest is very uncertain. | High recharge due to seepage of the ponds. Additionally, soil moisture is higher in the surrounding fields. |
| **Farmer 3** | Haveli structure | Growth: paddy on downstream field **Note**: surface water irrigation is nearby to cope with droughts | Growth: winter crop (mustard, lentil) on the upstream field. **Note**: because the bed of the field has high moisture and organic matter content, hardly any inputs are necessary (productivity is high) | High recharge in monsoon. Additionally, soil moisture is higher in the surrounding fields. |

[8] Palanisami, Kuppannan. (2017). Climate Change and India's Future Rice Production: Evidence from 13 Major Rice Growing States of India. SciFed Journal of Global Warming. 1. 10.23959/sfjgw-1000010.
[9] Adil, A. (17-09-22). Changing rainfall patterns impacting India's rice crop: Experts. Retrieved November 3, 2022, from https://www.aa.com.tr/en/asia-pacific/changing-rainfall-patterns-impacting-india-s-rice-crop-experts/2687444
[10] Gupta, Anil & Nair, Sreeja & Singh, Swati. (2014). Traditional Water Management Systems for Drought Mitigation in India. Water Digest. 36-45
[11] Rejuvenation in Bundelkhand: How an upland watershed got its groundwater back – ICRISAT. (2022, November 4). https://www.icrisat.org/rejuvenation-in-bundelkhand-how-an-upland-watershed-got-its-groundwater-back/

more in the upland and one in the lowland (Table 1). Although it should be mentioned that this situation presents an oversimplified (does not present a cost-benefit) analysis, it still presents an idea of the climatic resilient strength.

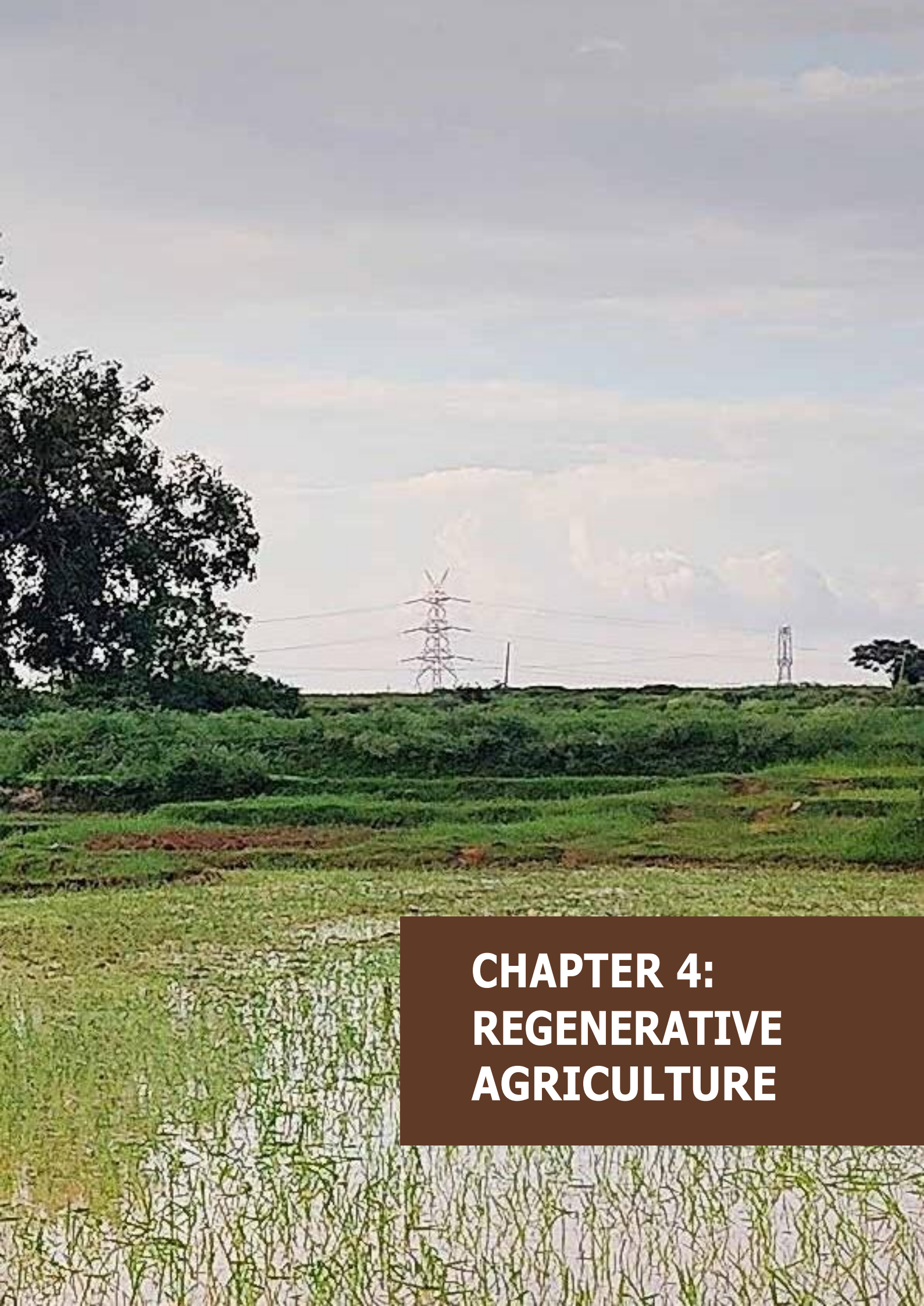
### Disappearance of the Haveli cultivation

So why is this traditional way of water harvest not widely applied anymore? For the dysfunction, multiple reasons are mentioned to be underlying. First, as a structure to meet the demand for freshwater, at some point there was large disintegration of large private water user groups and rural institutions v. Under the subsidy of the government, large investments were done in pumping technologies and dug wells, leading to a shift towards groundwater resources. This shift together with apathy and lack of maintenance resulted in many structures that were not built or maintained properly. In times of heavy rainfall, the embankments became destructed. Positively about this abandonment is that there is a large potential in repairing and modifying these, as this would be less expensive than new interventions vi. There might be other reasons for the disappearance of the structures, so extensive research should be conducted with the farmers.

## Conclusion

Although a few recent studies bring attention to the rejuvenation of the Haveli structure, there are still some uncertainties regarding the scaling-up potential, community carrying capacity, governmental funding, and overall agricultural productivity. Besides, for the Haveli structures to thrive, community responsibility and incentive need should be present to properly maintain the structures. Nevertheless, due to their long-standing usage and benefits, Haveli structures might help create thriving, climate-resilient villages.

Haveli cultivation might be a good way to start exploring how traditional structures were once sustainably managed. That being said, there are potentially more traditional hidden gems that could strengthen climate resilience in Central Indian villages.



# CHAPTER 4: REGENERATIVE AGRICULTURE

# INTRODUCTION TO REGENERATIVE AGRICULTURE WITHIN GTP

Regenerative agriculture is gaining ground as a global movement. It has been adopted by many practitioners, companies, and organisations and there is a growing interest also among national governments and international bodies. Yet, its boundaries are not well defined as it was found by recent research efforts[1]. There are hundreds of initiatives that make the concept theirs and adapt it to their situation. However, some common trends in terms of program outcomes and processes emerge (see the table below).

It is important to define what regenerative agriculture means for the GTP project in order to guide our efforts in Madhya Pradesh and in Jharkhand. The defining statement about Regenerative Agriculture adopted by PRADAN in 2019 and adopted by GTP up to now is:

***"The essence off regenerative agriculture lies in its capacity to revive key landscape functions: the water cycle, soil nutrient cycle and the biodiversity"***

| Outcomes | % | Processes | % |
|---|---|---|---|
| To improve soil health | 86,4 | Reduce tillage | 40,9 |
| To increase carbon sequestration | 63,6 | Integrate livestock | 40,9 |
| To increase biodiversity | 45,5 | Use cover crops | 36,4 |
| To improve water health (hydrology, storage) | 45,5 | Use crop rotations | 31,8 |
| To improve social and/orr economic well-being | 40,9 | Use no or low external inputs; Maximise on farm inputs | 31,8 |
| To improve food nutritional quality | 31,8 | Use compost, mulch, green manure or crop residues | 27,3 |
| To improve ecosystem health | 31,8 | Incorporate perennials and trees | 27,3 |

In the left column are the most cited (in %) outcomes of regenerative agriculture initiatives (adapted from Newton et al, 2020). In the right columns instead is the ranking of most cited regenerative processes.

Regenerative farming incorporates many elements from organic agriculture, but it differs in very distinctive ways. Organic agriculture is centred on the substitutions of inputs. Where inputs are mostly of industrial origin in conventional farming, in organic agriculture they are non-synthesis products. Still the aim is to provide what was taken out from farmland at harvest, year by year, limiting inputs to what is economically feasible. The logic is the same: sustain production to acceptable levels. The origin of the inputs is what differs. With nuances, organic agriculture very commonly sustains the use of heavy tillage practice, sometimes even more than conventional farming. Tillage in fact remains the only method to control weeds, when herbicides can't be used.

In regenerative farming instead, plant nutrition is seen as closely connected to soil dynamics and everything is done to make sure that these dynamics are safeguarded and improved. It is now common knowledge that much of plant nutrition is mediated by soil microbes and accordingly everything is done to allow soil microbial diversity. Practices that harm the soil capacity to sustain this plant/microbe dynamics should be avoided (excessive tillage, pesticides, leaving the soil bare).

We may compare soils to an underground city. Careful addition of organic matter makes the soil more porous and with water stable aggregates, which are where microbes thrive, reproduce and link-up with plants in symbiotic relationships. In regenerative farming we act as a responsible city mayor, trying to mediate the interest of microbes, plants and people. We know that by supporting the microbes, they will support the plant, which will finally be more nutritious and profitable for people. In mainstream farming instead we usually bomb the underground city (repeated tillage, pesticides, bare ground fallow) and take microbes out of the picture. As a consequence we need to spoon feed plants with external inputs. This may still bring good results in terms of production for some years. However the hidden costs have recently surfaced and are now well documented.

We are losing our soils at a disarming speed due to erosion and chemical pollution. Higher and higher amounts of inputs are required to meet production targets. These inputs are not only damaging the environment when used in excess, but they are very often not affordable to poor people. Regenerative farming provides some valid alternatives to the mainstream system. Regenerative farming promotes circularity. It advocates for the reuse of nutrients and energy within the landscape. Nothing should go to waste. Good composting techniques and production of cheap fertiliser substitutes, by reusing farm and household waste are key to sustaining good soil microbial life.

The blog bundled in this chapter results from GTP's regenerative agriculture activities and explorations thus far. The topics included are first an overview to understand regenerative agricultural practices better, followed by blogs on rodent damage and management, biomass resources, cropping patterns, use of hand tools, and large-scale composting practices.

[1] Newton, Peter et al. "What Is Regenerative Agriculture? A Review of Scholar and Practitioner Definitions Based on Processes and Outcomes." Frontiers in Sustainable Food Systems (2020).

# DOWN TO EARTH: UNDERSTANDING THE REGENERATIVE AGRICULTURAL PRACTICES

Author: Meghna Mukherjee

A green transition is underway in the Indian agricultural system. Policymakers and practitioners have been promoting different approaches and techniques which are sophisticated and down to earth. The underlying principle of such methods is that they mimic and work with natural processes rather than creating new procedures which tend to replace them. These natural processes will in turn help in the regeneration of the soil and the ecosystem paving the way for a greener, sustainable, and more resilient economy.

The smallholder farmers in Agroecological zone 7 of Jharkhand and Madhya Pradesh are working with such innovative and

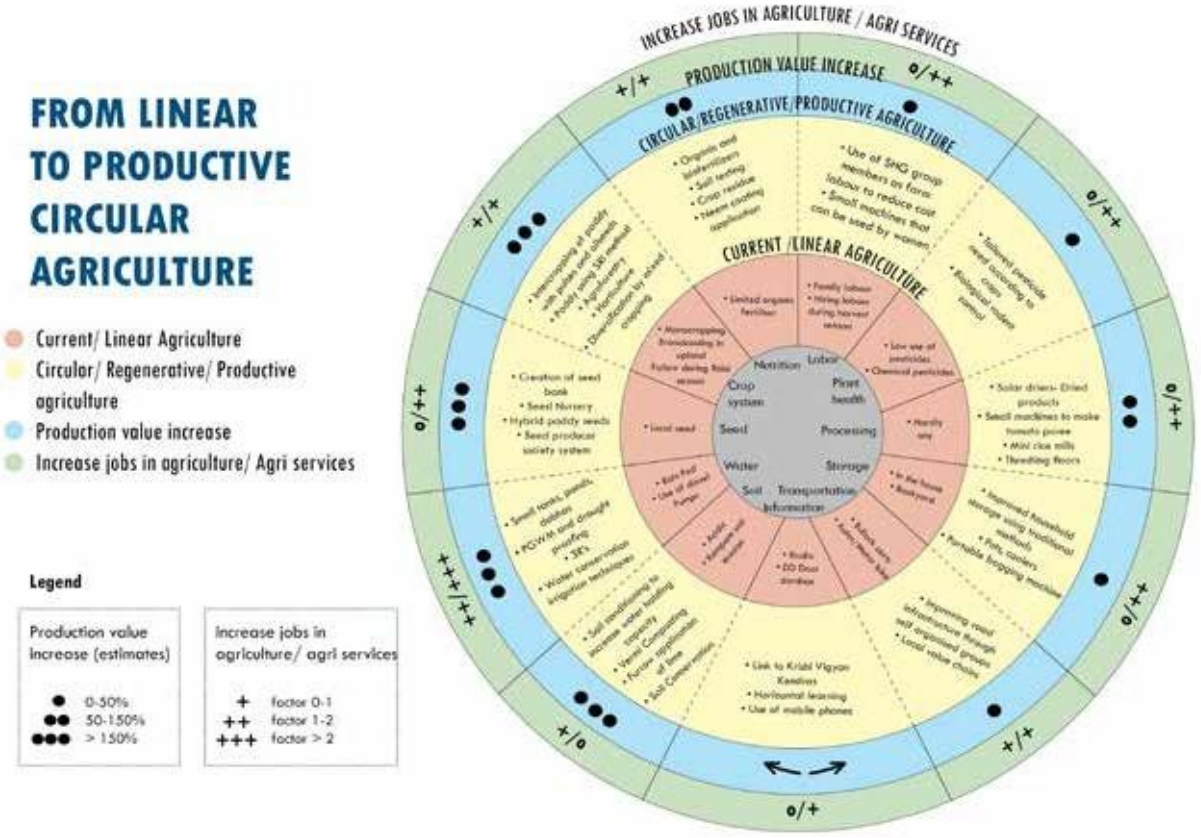



Figure 1: Regenerative Agriculture Wheel

sophisticated methods of production. They are encouraged to switch to regenerative farming methods which encompass different approaches and tools which can be applied to various stages in the agricultural production cycle. PRADAN has come up with a list of interventions to apply innovative methods on the ground. The farmers (read: women farmers) are given training on the technical know-how of various regenerative agricultural practices. The aim is to encourage farmers to adopt these methods at a small scale, enabling them to apply the inputs in their farms so that in the long run the ecosystem is regenerated.

## Regenerative Agriculture practices

This regenerative agriculture wheel (figure 1) provides a broad framework for shifting the current agricultural system from linear to circular. The main elements are plant health, nutrition, soil, water, labor, storage, transport, information services, and processing. By working along the different aspects, we aim to regenerate the system through applying biofertilizers and biopesticides, good quality seeds, using customized labor tools, promoting good and safe storage, innovative processing mechanisms, and creating better market linkages. Therefore, the focus is not just on going back to traditional organic farming methods but on going a step further to include the other elements of the agricultural system.

Regenerative agriculture as a concept and practice has become very rich and sophisticated over the years. It is seen as a path to the future by borrowing ideas from the past and adding innovations to make it work. The examples given below are not an exhaustive list but a few early and successful examples of how regenerative agricultural practices are being adopted and promoted in different geographies in India. There is much more to regenerative agriculture than the examples listed and many more options that have the potential to bring a positive transformation in the current way of practicing agriculture.

**Multi-layer cropping:** Through multi-layer cropping, farmers can grow two or more crops simultaneously (Photo 1). The approach is to grow leafy vegetables like spinach in the ground and crops like bottle gourd, bitter gourd, and other varieties of gourd in the upper layer by making use of a temporary structure. By using the same amount of fertilizers, farmers can grow more crops. Thus, leading to more yield, income, and soil health. The multi-layer cropping system of leafy vegetables and gourd enables replenishment of soil nutrients and efficient use of water.

A farmer practicing multi-layer farming

**Making bio-fertilizers:** Another approach and one of the most critical is providing training and spreading awareness on making bio-fertilizers and bio-pesticides at a decentralized level. A few members from the different community

A member of the BRC making bio-fertilizer

institutions come together to form a Bio-Resource Centre (BRC). The members are responsible for making fertilizers and pesticides at the local level. They are given training on making the different products, and regular monitoring of the quality is also done by Community Resource Persons and PRADAN staff members. Farmers can purchase the other fertilizers/pesticides from the BRC directly.

**FPO as extension workers:** Farmer Producer Companies (FPOs) were created to have better market linkages and enable farmers to get reasonable prices by removing the presence of middlemen. The farmers complained of not getting a fair price, weakened bargaining power, and less incentive to produce organic produce. With FPOs working as extension agents who provide farmers with fertilizers, seeds, and pesticides and a space to sell their organic produce, farmers are willing to take up regenerative agriculture practices. They are sure of the quality of the input and are assured of a fair price for their produce. Thus, the FPOs work as change agents toward regenerative agriculture by taking care of input supply and market access.

**Soil testing:** Taking good care of the soil is one of the most essential components of regenerative agriculture. Undertaking practices which replenish the soil health and regularly monitor soil health are equally important. Farmers are linked with Krishi

Vigyan Kendras (Farmers Knowledge Institutes). The KVKs are responsible for collecting soil samples to determine the nature of the soil and what kind of crops can be grown. It also highlights what steps need to be taken to ensure that health is restored in case the results are unfavorable. Soil samples have been taken in many areas across Jharkhand and MP; however, many farmers are still awaiting results.

**Building water harvesting structures:** Access to secure water is critical for agriculture. Many interventions like building farm ponds, contour trenches, and check dams and wells have been undertaken to store the rainwater, which can then be used for agriculture in the dry season. A ridge-to-valley approach is adopted to ensure that water does not run off but instead gets percolated to replenish the groundwater. New innovative irrigation mechanisms like drip irrigation and lift irrigation have also been promoted to ensure that water is available throughout the year.

**Compost unit:** A composting unit has been developed in the Khunti district in Ranchi, which aims to provide 100 tonnes of compost to farmers at a subsidized rate. Currently, no system in place enables easy access to compost at an affordable rate. By removing the supply constraints, the compost unit will meet the demand for farmers who want to adopt regenerative farming methods.

Different water harvesting structures present in the field areas

Regenerative agriculture is considered a highly productive method of doing agriculture. The examples above highlight that while some processes take a longer time to show their impact fully, there are others whose impact is visible in a shorter term. The regenerative agriculture wheel also focuses on the increase in sustainable livelihoods in agriculture and Agri services. It gives a rough idea of how the changes in agricultural practices can help revive the economy. For example, adopting different practices like mechanical harvesting, on-farm processing, better transport facilities, and safer storage for crops will help promote various livelihood activities. Additionally, the decentralized process of making organic inputs will impact local businesses by creating more reliance on local services and information. Last but not least is the power of regenerative agriculture to increase the productivity and quality of crops, contributing to better health and nutrition for everyone.

The composting unit with three rows of compost in Khunti, Ranchi.

# SMALLHOLDER FARMERS ADOPTING REGENERATIVE FARMING IN POREYAHAT BLOCK OF GODDA DISTRICT

Authors: Himadri Das & Satyabrata Acharyya

Regenerative Agriculture (RA) is built around the principles and practices that seek to promote healthier soil and water, promote biodiversity and restore ecosystems. Replacing traditional farming by RA is gaining its importance specially to protect, manage and restore nature. Various studies have shed light on the criticality to revitalize soil and the hydrology of farm landscapes to mitigate the effects of climate change and to sustain agriculture production systems.

The case provides a narrative on the adoption of regenerative farming by a large number of smallholder farmers, especially women, in the Poreyahat block of Godda district. The case outlines the key steps and the main drivers

Application of regenerative methods in tomato field

Meeting with the community members

to facilitate practice adoption among farmers. The case narrates the roles of the PRADAN team, engagement of major stakeholders, challenges faced and key learnings and reflections.

## Case of Satbandha Village:

Satbandha is a village in Poreyahat block with predominance of ST households. There are 243 households having 1187 individuals. The village is fairly remote; situated at a distance of 12 km from the block headquarters. The village economy is based on agriculture, livestock, wage earning and rearing Tasar silkworm. The village has a total agricultural land measuring 218 Acres. The average annual household income is in the range of Rs. 60,000 to 70,000, with about half of the income coming from wages earned locally from MGNREGS and income through migration.

PRADAN introduced the concept of RA in the year 2019. It started with concept sharing in SHG meetings and setting up small demonstrations in the village. A farmer named Jewel Murmu showed interest in adopting the use of Bio-Inputs. In the previous year (2018), his paddy crop suffered a setback as he applied chemical fertilizers in higher doses, resulting in profuse vegetative growth and very low flowering and grain formation. Jewel incurred major losses. The next year in 2019, following his discussions with PRADAN staff, Jewel dropped the practice of chemical-based inputs and used only cow dung as fertilizer and sindwar leaves (Vitex negundo, a shrub known to repel plant hoppers that spread virus in Rice plants) as pest repellant to grow paddy. He received a yield of 210 kg of paddy grains from a small plot of 4.00 decimal of land, which is equivalent to 5.25 MT of Paddy grains per Hectare; considered a very good yield.

In 2020, getting inspired by Jewel Murmu, 60 farmers took keen interests to practice chemical-free farming in paddy.

In the same year (2020), at Poreyahat block, PRADAN started engaging with SHGs and VOs to promote the knowledge and expertise of RA among local farmers, especially women. In the training, the farmers were facilitated to reflect on current farming practices and the challenges faced. Farmers have shared a common concern on the decline in soil fertility, crop yields and diminishing returns. People commonly understood the harmful effects of chemical fertilizers in farming, yet they were unable to see any substitutes to produce crops. At that stage, the training focused on sharing real experiences of farmers on practices to enhance soil fertility and crop yields. People identified a number of practices that helped in soil building, such as the use of cow dung and organic manures, cultivation of legumes, crop rotation and in-situ water harvesting. These trainings helped in defining RA principles in the local context and built discussions among farmers as to what was good for their farming in the long run. Some of the farmers showed resolve to adopt RA principles.

Coming to Satbandha, in 2020, there were 60 farmers to adopt RA practices. They collectively deployed 29 acres of land for paddy cultivation. They decided to replace 20% chemical fertilizers with higher quantities of organic manures. The result was very satisfactory. Paddy yield was sustained, thus allaying the initial fear of yield reduction among farmers. The cost of cultivation was reduced by 15 percent. The crop showed much less susceptibility to various pests.

Applying beejamvrit in maize cultivation

In 2021, a total of 100 farmers had adopted RA practices in an extended area of 50 acres of land. They decided to further reduce the application of

[1] PRADAN conceived the idea of setting up Bio Resource Centres (BRCs) owned and operated by Agriculture Entrepreneurs (AEs). AEs are rural youth, women and men, who are interested in building a business / enterprise that has a market in their neighbourhood. With awareness and demands for bio-inputs increasing in the area, there was a market created for various bio-formulations that could be manufactured locally with infusion of some knowledge and skills among the AEs. The Bio-inputs mostly used locally available materials. The products manufactured and sold through BRCs included vermi-compost, beejamrit and shivansh; pesticides like neemastra and agneyastra. Some of the items such as pseudomonas, trichoderma viride, mycorrhiza, rhizobium were sourced from local markets.

chemical inputs by 50% and applied an average of 2 MT of organic manure per Acre for paddy crops.

In 2021, the Green Transformation Pathway (GTP) project was launched in Poreyahat. Building on the existing momentum, PRADAN emphasized on expanding RA practices on a wider scale, covering the block. The focus was on building awareness on advantages of RA in the short run and how it can be cost effective and more rewarding in the long run. Training events were intensified and a large number of women farmers were taken to Madhya Pradesh on exposure visits and orientation. The Poreyahat team had planned to support 6,000 farmers (all women) to grow paddy through RA. An additional 7,000 women were to cultivate an array of vegetables during kharif.

Meanwhile, seeing the increased demands for various bio-inputs, the Team had set up 9 (Nine) Bio-Resource Centres (BRCs)[1] in the Poreyahat block. Each such BRC was supposed to cater to 700 farmers. Other materials such as paddy and vegetable seeds were also organized in required quantities through the support of a block level Farmer Producers Organization (FPO).

However, due to the very poor monsoon, a large majority of farmers could not sow / transplant paddy in Poreyahat block. As per the assessment of the district agriculture office, only 26% of the paddy areas could be sown / transplanted with the crop. The remaining was left to fallow. In Satbandha, about 56 farmers (out of the planned number of 106 farmers) could cultivate paddy, following regenerative principles.

With the kharif crop facing a setback, the farmers

Seed treatment with Beejamrit and Trichoderma viride

were supported to undertake rabi (winter) crops to make use of the late monsoon showers. In Satbandha, 100 farmers are continuing with RA methods in mustard, covering a land area of 28 acres.

68 farmers are cultivating different vegetable crops; chilli, brinjal, tomato, spinach and cauliflower. There are 12 farmers who have completely stopped using synthetic chemicals, now replaced by organic manures and bio-formulations.

In October 2022, a Producers Group (PG) named Jahar Jharna Sichai Samiti, Satbandha was formed with involvement of all the women farmers of Satbandha. The PG is supported by the block level FPO named Sagenbaha Women Farmer Producer Company Limited (FPC). The need of the formation of the PG was to collectivize the farmers, develop marketing channels and benefit the farmers from economies of scale. As the PG is new, till date the FPC provided good quality seeds like paddy, mustard, chickpea and ensured end-to-end services like production support, aggregation and marketing. The members expected the FPC to streamline marketing of farm produce, both in terms of selling in bulk volume and fetching fair prices for its members. There is a need to support members to gain access to government schemes for development of productive assets such as orchards, farm implements and irrigation systems.

The farmers initially focused on organic manures only for yield increase. Later on, they realized the need for various bio-formulations required for soil building, better germination of seeds, enhanced water retention in the soil and for mitigating pest

Preparation of shivansh compost in the village

attacks. After the adoption of RA practices, they could see certain changes like improvement of soil structure. The soil has become more friable and moist and the overall texture has become smooth and heavier. There are frequent appearances of earthworms. The residual moisture in the soil for extended periods helps in supporting a second crop like mustard or lentil with little irrigation post monsoon. Farmers aimed to increase their productivity by reducing the use of chemical fertilizers and focus on making the soil more `lively'. They feel the need to develop and maintain soil microbes as their presence improves soil fertility and moisture retention.

## Stakeholder engagement:

In the past 2-years, there is a national discourse being built around organic farming / regenerative Farming or Zero Budget Natural Farming. In 2020, when the PRADAN team met the Krishi Vigyan Kendra (ICAR) and the District Agriculture Department, there was a common ground / common agenda that already existed among the stakeholders. The emphasis was on soil health and the KVK had the mandate of carrying out soil tests to prepare soil health cards of a large number of farmers. The district agri department was mandated to promote crop diversification and promotion of bio-inputs among farmers. With PRADAN joining them, they gained ready access to a large number of women SHGs and a pool of Community based extension agents (Community Service Providers- CSPs) and Agri Entrepreneurs. KVK has so far trained 22 CSPs to conduct soil collection and soil tests. 16 Agri-Entrepreneurs were trained in the preparation of Bio-Inputs and were connected to the suppliers of microbe inoculums (Azatobactor, Pseudomonas, Trichoderma etc.). The Agriculture Technology Management Agency (ATMA under the Agriculture Department) has been supporting women SHGs to prepare bio-formulations such as beejamrit, neemastra, jivamrit by organizing training and provision of vats (drums) for preparing the botanical culture. Over 200 vats have been given to the SHGs by ATMA. Covid had restricted movements in the field. Still, by May 2022, over 250 soil tests have been conducted, the results were explained to the farmers by PRADAN staff. It is almost universal to find soils, seriously deficient in soil organic carbon (SOC). The test results further reinforced the need for paying great attention to the soil health. KVK and PRADAN team jointly conducted training of farmers for application of different bio-inputs. With the guidance of KVK and PRADAN, Agri-Entrepreneurs have started preparing bio-inputs in the BRCs.

Considering this year's drought, the State Government has initiated a Relief Programme where a farmer household is entitled to get Rs. 3,500 per household. The District Agri Department has enlisted the names of farmer households in Poreyahat, supported by the SHG collectives. Further, in order to catch the rabi season and promote diversified crops, it was decided by the Government (the agriculture departments and KVK) to provide seeds to the farmers through the SHGs. The following shows the seeds of various crops supplied in different quantities to farmers.

- Short duration paddy: 250 Kg to 50 Households (HH)
- Yam (Ole) crop planting material: 6,000 Kg to 300 HH
- Groundnut seeds: 1,650 Kg to 150 HH
- Bengal Gram seeds: 1,890 Kg to 500 HH

- Mustard seeds: 1,400 kg to 600 HH

During our recent discussion with the KVK, the station in-charge appeared quite hopeful of positive outcomes. According to him, the impacts of RA will be visible / perceived by the farmers after 4-5 years of adoption. In order to bring the change, the focus should not be on scale rather a persistent focus on soil health and shift in priorities will not help in sustaining the momentum. “To bring systematic changes for the sustainable development of the village, every external stakeholder should collaborate for improving the lives and livelihood of tribal communities”, said the Station In-charge, KVK, Godda.

## Challenges Faced:

- The farmers are mostly small and marginal landholders with landholding highly fragmented. On top of that, farming is predominantly rain dependent. In small parcels of lands, the efforts are geared towards increasing the yield in order to ensure year-round food security and some income. Chemical fertilizers and pesticides along with hybrid seeds come handy in the overall schema. While the effects on soil and diminishing returns are understood at the level of the farmers, breaking the status quo and adopting alternative practices are not easy.
- The farmers had the notion that RA required more labour which they would not be able to provide. Further, there were concerns about shortage of cow dung / organic manure in the area. Cattle population is reducing owing to a shift towards mechanical means of tillage and other operations. Inadequate

Preparation of shivansh compost in the village

availability of cattle dung affected preparation of adequate quantities of bio-inputs for RA. Further, changing climates create great distress among farmers to manage farm operations on time. This results in lack of food sufficiency at household and income losses.

- Regenerative agriculture takes time to result in enhancement of crop yields. People had the notion of a reduction of crop yield in the initial years of adoption. Further, there is no price differential in the market for the crops produced through RA.
- The women farmers had to deal with their self-doubts in their capacity to assert in decision making at household level. Especially in farming, the decision-making rests with the men, who are not positively inclined to shift to alternative practices.

## Reflection: suggested way forward:

- The farmers, over the years have looked at farming purely from the viewpoint of cost-economics with hybrid seeds, fertilizers and pesticides being the critical factors of production. The focus was always on crop yield. The awareness building / training events of PRADAN were designed to help farmers look at farming as a dynamic system with soil health being the vital factor in farming, both as means as well as an outcome. This shift in perspective helped in building a dialogue with smallholder farmers around RA and setting goals for sustainability and enhanced crop productivity.
- In the initial 2 years (starting from 2019), focus was on creating intensity around training, exposure visits and organizing demonstration sites and identifying potential farmer leaders among women. This was followed by building campaigns with involvement of SHGs, VOs and CLFs to reach out to women farmers.
- As we know women make significant contributions in agricultural operations especially in smallholder farming and often remain invisible. The training and orientation around RA from the year 2019- 2022, have been focused on SHGs and VOs (women-owned and women-managed) where a number of women are engaged in the process. The CLFs educate the community on RA, develop Community Resource Persons (CRPs) to facilitate the meetings, planning and execution of seasonal crops with SHGs. The entire campaign to propagate the idea of RA in Poreyahat was led by the VOs and CLFs.
- Role of BRC acting as a nodal point for knowledge extension. VOs organize periodic reflection on RA where farmers reflect on practices, efficacy and crop performance. These meetings are facilitated by CRPs. These are also the fora to discuss soil testing results from KVK and soil health. CLFs constantly focus on training, organizing field demonstrations, conducting exposure visits and sharing results. While additional efforts are required to bring a large-scale change and review on the application of Package of Practices (PoP) for every seasonal crop; there has been a conspicuous of farmers' perception to replace the chemical inputs by chemical-free inputs like application of beejamrit, neemastra, jivamrit, aagneyastra.
- By the beginning of 3rd year (2022), the project team was able to mobilize around 7,000 farmers. By November 2022, the project outreach in RA suggests the following:

1. Number of farmers in Kharif Paddy: 3,680.
2. No. of farmers in Kharif Vegetable: 3,3,68 (Vegs: Chilli, Bitter / Bottle Gourd)
3. No. of Farmers in Kharif Pulses: 3,162.
4. No. of Farmers in Rabi Oilseeds (Mainly Mustard): 6,000.
5. No. of Farmers in Rabi Pulses (Mainly Black Gram): 4,000.

- The Cluster Level Federations (CLFs) of women SHGs and the FPO played a key role in farmer mobilization, building campaigns and mobilizing inputs (seeds, gypsum) from the mainstream. The FPOs played an important role in doorstep delivery of various inputs pertaining to RA (organic / bio formulations, seeds, organic manure etc.).
- Promotion of BRCs had led to an easy availability of all the bio-inputs at affordable costs. This built confidence among women in RA, leading to a faster adoption of practices.

Regenerative methods and practices in bitter gourd cultivation.

# INTERCROPPING WITH PLANTATION IN UPLANDS

Author: Satyabrata Acharyya

## 1. About the Case study:

The case is to describe an initiative to promote a new land use for vast chunks of uplands in Agro-Ecological Zone VII to restore degraded lands and create robust livelihoods for small and marginal farmers. At the core, the initiative is built around plantations of certain permanent tree species that serve as the hosts for Tasar silkworm. The case captures an attempt of PRADAN to integrate intercropping withpPlantations through a number of field trials. The objective was to validate a set of assumptions that intercropping practices could trigger vigorous growth in tree plantations in the degraded

Fig. Vast uplands in Amarpur

Meeting with the community members

lands, thereby overcoming the chronic problems of tree stunting due to nutrition and moisture stress. Robust plantations of Tasar host trees could help in enhancing economic returns to the farmers from silkworm rearing, thereby making this land use a viable proposition.

## 2. Context: Problem Setting:

As per the Land Use Data[2] of India, out of a total of 307 Million Hectare of Reporting Area for Land Utilization Statistics (2014-15), about 55 Million Hectare of land comes under uncultivated / culturable waste / fallow categories with various extents of degradation. A vast populace, living on these lands for their sustenance, are frequently impacted by food insecurity, livelihood loss and loss of resilience to withstand the effects of climate uncertainties. The impacts are most pronounced among the Schedule Tribes, women and children.

Coming to the context of Agro-Climatic VII, out of a total area of 26.8 million hectares (representing 8.2% of the total geographic area of India), an estimated 6.70 Million Hectare (25% of the total area) comes under Uncultivated / Culturable waste categories with fallowing being the predominant land use. These lands are mostly unbunded / unterraced with terrain showing gentle slopes (2%-4% gradient) to sharp undulation (>7% slope). The region receives between 1,000 to 1,500 mm of rainfall annually. High rainfall coupled with sharp slopes trigger a rapid erosion of the soil, thereby causing further land degradation. Different studies indicate almost 70% water run-off from the landscape resulting in a poor hydrology in the region. Moreover, regular deposits of coarser soil particles from uplands to the low-lying farm lands causes considerable harm to farming.

[1] Tasar silk is extracted from the cocoons of an indigenous silk insect called Antheraea mylitta Drury. Tasar silk worms eat the leaves of a range of tree species such as Terminalia arjuna, T. tomentosa and Lagerstroemia speciosa. These trees are abundantly available in the tropical sub-humid forests of India, Bangladesh, Sri Lanka, Thailand and Cambodia.

[2] Agricultural Land Use Statistics (2014-15, Ministry of Agriculture and Farmer Welfare, Government of India.

Uplands are mostly owned by small and marginal farmers. PRADAN's internal studies (mainly the village studies done by Development Apprentices) show that uplands constitute a third of the total landholding in smallholder households. People are paying taxes for the uplands without any perceptible returns. The changing climatic pattern, manifested by fewer rainy days with intense precipitation exacerbates the process of land erosion and pose threat to farming in low lands. The land-owners lack wherewithal to conserve the uplands and come up with alternative land use (than fallowing) that is sustainable and rewarding.

## 3. Interventions by PRADAN:

PRADAN's Tasar sericulture project[3] envisaged promotion of Tasar sericulture-based livelihoods outside the forest areas. The idea was to support local people to raise Tasar host tree plantations in large stretches of degraded uplands, owned by them. In 3-4 years, the plantations were to become ready to host Tasar silkworms every year for the next 50 years. Cocoons are harvested and sold by the silkworm rearers to earn livelihoods.

Plantation raising for sericulture promotion: The idea of raising plantations of Terminalia spp. in waste / fallow lands was received from the Central Silk Board that demonstrated the model in their research stations situated in the same geography. However, taking the model to the farmers' field required a number of changes in the technical model, including plant spacing, schedule of intercultural operations, maintaining tree height and shape etc.

So far, PRADAN has promoted 6,460 hectares of Tasar host tree plantations in the wastelands owned by smallholder farmers and other marginalized sections. Tasar host trees are hardy plants and can grow under rainfed conditions in depleted lands. Tasar silkworm rearing in plantations is an attractive livelihood proposition for marginalized households as (a) it utilizes idle assets—wastelands / fallow lands, (b) requires low operating investment (c) involves family labour and (d) offers high returns from silk cocoon sale.

Over the years, PRADAN has evolved a comprehensive method of promoting large scale Tasar host plantations in privately owned waste / fallow lands of smallholder farmers. The method seeks to involve local communities at all stages of planning, implementation and long-term plant protection and maintenance. On an average, each smallholder household would deploy between 0.30 and 0.50-hectare land area for raising plantations. The plantation farmers take keen interest in sustaining the plants as it is a source of major livelihood earning. On an average, each hectare of plantation could potentially offer a net annual earning to the tune of USD 1,200. With a measure of success, the entire model of plantation raising and silkworm rearing, has been demonstrated

[3] In 1988, PRADAN had set up a project in erstwhile Bihar (now Jharkhand) to promote Tasar sericulture-based livelihoods for smallholder farm households, most of whom belong to Schedule Tribe (ST) and Other Backward Communities (OBCs). Tasar sericulture was a traditional vocation of the local communities, mainly the people living in forests and forest-fringe villages. Tasar silkworm was reared in certain host trees i.e. Terminalia arjuna, T. tomentosa that were available in the natural forests, managed by the Forest Departments. The silkworm rearers faced problems of accessing the host trees in the forest. The natural forests were in decline owing to poor maintenance and lack of tree replacements. These resulted to an overall decline of Tasar sericulture in the forests and loss of livelihoods of the local communities.

Fig. Tasar plantation in Amarpur

in the project locations spread over Jharkhand, West Bengal and Bihar. This resulted to significant demand creation in the villages.

In a number of States, such as Jharkhand, Bihar, Odisha, Madhya Pradesh and West Bengal, the department of Sericulture and the office of the MGNREGA Commissioner took up Tasar host tree plantations in private lands to expand the scope of Tasar sericulture and create livelihoods for rural communities. PRADAN was often asked to offer expert support in scheme design, training of government functionaries and in the monitoring of the programme.

## 4. Resource Mobilization:

So far, PRADAN mobilized investments for plantation raising mainly from the private donors, philanthropic foundations and later on, from the Government programmes such as Swarna Jayanti Gram Swarajgar Yojna (SGSY) and Mahila Kisan Swashaktikaran Yojana (MKSP), both under the Ministry of Rural Development, Government of India and Special Central Assistance to Tribal Sub-Plan Areas (SCA to TSP) as also from NABARD.

## 5. Shortcomings in the model:

PRADAN started promoting silkworm rearing in plantations from the year 2000 onwards. The initial years were spared for building good learning experiences in the community along with setting up systems for egg supply, aggregation and marketing of Tasar silk cocoons. Over the years, it has been realized that the productivity / carrying capacities of the Plantations are about 60 percent of the original design. Though the income generation out of Tasar rearing continues to attract smallholder farmers, yet there exists considerable scope to enhance income. Also, it is important to match the income with the growing need and aspirations of the farmers. The plants, mostly grown in the fallow / degraded lands show an overall reduced growth with lack of uniformity observed across the plant stock.

Consultation with experts from the Central Silk

Board and ICAR along with plantation farmers suggested that the growth of plants gets affected most significantly when the trees face problems of stunting in the initial 3 years. At later stages, the plants would never recover fully. It was evident that stunting was caused owing to nutrient and moisture stress in depleted soils and young plants are most vulnerable to such stresses.

For several years, PRADAN tried out a number of measures to safeguard young plants from moisture and nutrition stress. Increase in pit size / volumes, application of higher quantities of manures, watering plants in the summer season were the salient measures. Though proven effective, these measures required at least 35% higher investments that became difficult to mobilize from the mainstream.

## 6. Promoting intercropping in the plantations:

In the summer of 2022, PRADAN planned to introduce the practice of intercropping with legumes / pulses in the plantations. The hypotheses behind the interventions included the following:

- Light tillage in between the plant rows will break the hard soil crust to allow water to enter deeper soil layers,
- Intercropping will result to ground coverage by crops to regulate micro-climate, specially prolonging moisture retention and check soil erosion,
- Intercropping with pulses will help in nitrogen fixation and faster growth of intercrops will


Fig. Intercropping of Black gram with Tasar plantation

cover the ground quickly to control growth of weeds and reduce tree-weed competition,

- Nitrogen fixation, moisture retention and addition of bulk volume of biomass through pulse crop residues will enrich the soil to support Arjuna plants to attain growth and vigour,
- Tasar silkworm rearing in plantations start after 3-4 years of planting. Meanwhile, the farmers would be benefited in the immediate term by ways of pulse harvest and income. This is important to strengthen their attachment to the plantation activity.
- Intercropping activity would be less costly and could be included in the unit cost of the plantation scheme.

## 7. Description of activities:

A total of 120 hectare of plantation area was selected in Godda district of Jharkhand to undertake intercropping trials. The total area was constituted of 7 plantation plots, with sizes in the range of 10 hectares and 26 hectares. Lands were undulating. Soil was coarse gravelly to sandy types. The soil was apparently quite depleted.

Fig. Smothering of Dhaincha and mixing in soil

- There were 3 (three) treatment measures applied; Intercropping with (i) Sesbania bispinosa (local name Dhaincha), (ii) Vigna radiata (Common name Black Gram), (iii) Vigna mungo (Common name Green Gram).
- PRADAN hired the services of an expert Agronomist in designing the field trials. The treatment plots were selected, based on consultation with plantation farmers and PRADAN staff. In all the plantation plots, plant (Tasar hosts) age varied between 12 months and 14 months.
- It was decided that the input and other costs required for the trials will be fully borne by PRADAN, from a project supported by the Department of Science and Technology, Government of India.
- The agronomic package of practices were finalized in late May. It was decided that Sesbania trial will be undertaken in 20 hectares in the 2nd half of June, followed by 60 Hectare of Black Gram in late July and 40 hectare of Green Gram in August. Seeds of Sesbania were procured from a supplier in West Bengal. The remaining were organized locally.
- Rhizobium culture was recommended for seed treatment. The same was procured from local Krishi Vigyan Kendra, an extension unit of ICAR. Farmers were trained to carry out seed treatment with Rhizobium.
- Soil was tilled with the help of tractor. It required an average of 5 tractor hours to till the soil in 1 hectare of land.
- Rain came much delayed. There were very scanty rains (rain deficit >50% of the average)

in June. Sesbania seeds were sown towards the end of June and beginning of July. Black Gram seeds were sown on an extended period starting from 15th July till 1st week of August. Green Gram seeds were sown in the 1st half of August. All the three crops faced major moisture stress owing to poor rainfall. Proper monsoon showers were received in the middle of September, before that rain was extremely sporadic and low.

Fig. Smothering of Dhaincha and mixing in soil

- Identical plots were retained as control that received the common intercultural practices such as hoeing and organic manuring supplemented with Diammonium Phosphate (DAP) @ 50 g per plant.
- Poor rainfall affected the initial germination and growth of the crops. In certain plots, profusion of weeds was observed. However, with the arrival of normal rain in September, the crops outgrew the weeds and covered the ground.
- Sesbania was to be smothered in-situ at an age of 35 days (as the plants attain 2.5 feet height) and mixed with the soil. However, slow growth of the crop delayed the start of smothering operation to 9 weeks. By that time, there was profuse growth of nodules in the roots of Sesbania, proving very healthy rate of nitrogen fixation by the plants.

Preparation of shivansh compost in the village

- Sesbania plants were cut and mixed with the soil by using rotavator, that took 2 hours to complete the operation in 1-hectare land area.
- Black gram and moong crops were harvested by the plantation farmers. At the time of our visit to the villages, the crop was not fully harvested. The women were picking the pods manually. The harvest data thus could not be compiled.
- According to the villagers, the yield has been satisfactory. The area in Amarpur is so large (30 hectares) that it became difficult for the plantation farmers to manage the harvest. They have left it open to everyone. Apparently, any villagers could go and collect the moong pods from the field.

Fig. Nodule formation in Sesbania roots

Fig. Harvesting Black Gram

## 8. Measuring Tree Growth in the sites of Intercropping:

On 10th November, 3 villages were visited namely Amarpur, Parsoti and Kerabari in Poraiyahat Block in order to assess the impact of intercropping on Tasar host trees. We had selected 5 out of 7 plots for taking data. The parameters were (i) Plant height, (ii) Plant girth at collar region and (iii) Plant girth at 1.5 ft above the ground. Data were gathered randomly from different parts of the field to minimize sampling error. The following table provides the sample size in each of the 3 villages:

## 9. Visual Observation:

- In Amarpur, the plants in Sesbania treatment sites showed remarkable growth both in terms of height and girth and are significantly different from the control plots. The leaf lamina of the plants in treatment plots were greener, smooth and were at least 1.5 times more compared to the control plants,
- The plant height and girth in the plots under green gram intercropping in Amarpur were conspicuously better compared to the plants in the control plots.

Regenerative methods and practices in bitter gourd cultivation.

| # | Village name | Crop-wise sample number | | | | |
|---|---|---|---|---|---|---|
| | | Sesbania | Moong | Urad | Control Samples | Total samples |
| **1** | Amarpur | 12 | 10 | 0 | | |
| **2** | Parsoti | 0 | 0 | 10 | 12 | 34 |
| **3** | Kerabari | 0 | 0 | 10 | 10 | 20 |
| TOTAL: | | 12 | 10 | 20 | 10 | 20 |
| | | | | | 32 | 74 |

- Same trends were observed in black gram intercropped sites in Parsoti and Kerabari.

## 10. Statistical analysis: Parameters Plant Height and Plant Girth:

In the following tables, we are providing statistical analysis of the raw data gathered from the field to draw inference:

Fig. Smothering of Dhaincha and mixing in soil

The statistical analysis validated visual observations. Intercropping has significant positive impact on the overall growth of the plants. The mean difference in height varied from 55% (Parsoti Black Gram) to 100% (Amarpur Sesbania) vis-à-vis control. The most conspicuous different in Plant Girth at collar region could be seen in Sesbania intercropped fields. In Green Gram intercropped sites, the mean girth at collar region is thicker by 38% compared to the control. In Kerabari, the plant height and girth are higher and thicker by 78% and 49% respectively vis-à-vis the control.

To our understanding, Sesbania intercropping started in June, which means the effect of soil manipulation (through tillage), moisture absorption and nitrogen fixation is more prolonged with Sesbania compared to Green and Black grams. Therefore, the impact of Sesbania intercropping is more pronounced as manifested through plants heights and girth thickness. For the local communities, the benefits received from the harvests of green and black gram are most substantial / appreciable.

## Cost Comparison: Intercropping and Conventional Alternative:

We have considered the actual costs of various operations and the projected cost increases in the next 2 years. The cost comparison is between Intercropping and other conventional alternatives (increasing pit size, application of higher dose of manures etc.). The following table depicts the cost compilation for 3 years till the plants are fully established. (After 3-years, the farmers will maintain the plantations from the revenue earned from silkworm rearing).

| Parameter: Plant Height | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Village** | **Treatment** | **N** | **Mean** | **Std. Deviation** | **Std. Error Mean** | **T** | **Df** | **Sig. (2-tailed)** | **Mean Difference** |
| **Amarpur** | Sesbania | 12 | 2.343 | 0.362 | 0.105 | 7.622 | 22 | 0.000 | 1.17667 |
| | Control | 12 | 1.167 | 0.393 | 0.114 | | | | |
| | Green Gram | 10 | 1.830 | 0.251 | 0.079 | 4.600 | 20 | 0.000 | 0.66333 |
| | Control | 12 | 1.167 | 0.393 | 0.114 | | | | |
| **Parsoti** | Black Gram | 10 | 2.264 | 0.323 | 0.102 | 3.565 | 18 | 0.002 | 0.65100x |
| | Control | 10 | 1.613 | 0.479 | 0.151 | | | | |
| **Kelabari** | Black Gram | 10 | 2.162 | 0.253 | 0.080 | 9.839 | 18 | 0.000 | 0.94500 |
| | **Control** | 10 | 1.217 | 0.168 | 0.053 | | | | |

| Parameter: Plant girth at collar level (cm) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Village** | **Treatment** | **N** | **Mean** | **Std. Deviation** | **Std. Error Mean** | **T** | **Df** | **Sig. (2-tailed)** | **Mean Difference** |
| **Amarpur** | Sesbania | 12 | 13.417 | 4.144 | 1.196 | 5.575 | 22 | 0.000 | 7.41667 |
| | Control | 12 | 6.583 | 2.429 | 0.701 | | | | |
| | Green gram | 10 | 13.700 | 2.263 | 0.716 | 3.009 | 20 | 0.007 | 3.11667 |
| | Control | 12 | 9.917 | 2.712 | 0.783 | | | | |
| **Parsoti** | Black gram | 10 | 14.400 | 1.350 | 0.427 | 1.557 | 18 | 0.137 | 1.60000 |
| | Control | 10 | 12.900 | 4.228 | 1.337 | | | | |
| **Kelabari** | Black gram | 10 | 13.700 | 2.263 | 0.716 | 4.657 | 18 | 0.000 | 2.90000 |

| Parameter: Plant girth at 1.5 ft above ground (cm) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Village** | **Treatment** | **N** | **Mean** | **Std. Deviation** | **Std. Error Mean** | **T** | **Df** | **Sig. (2-tailed)** | **Mean Difference** |
| **Amarpur** | Sesbania | 12 | 17.333 | 3.725 | 1.075 | 5.575 | 22 | 0.000 | 7.41667 |
| | Control | 12 | 9.917 | 2.712 | 0.783 | | | | |
| | Green gram | 10 | 9.700 | 2.406 | 0.761 | 3.009 | 20 | 0.007 | 3.11667 |
| | Control | 12 | 6.583 | 2.429 | 0.701 | | | | |
| **Parsoti** | Black gram | 10 | 10.700 | 1.337 | 0.423 | 1.557 | 18 | 0.137 | 1.60000 |
| | Control | 10 | 9.100 | 2.961 | 0.936 | | | | |
| **Kelabari** | Black gram | 10 | 10.400 | 1.647 | 0.521 | 4.657 | 18 | 0.000 | 2.90000 |
| | Control | 10 | 7.500 | 1.080 | 0.342 | | | | |

The cost of treatment through intercropping in plantations is significantly less compared to the conventional alternatives. The Difference is (Rs.72,720 - Rs. 42,962=) Rs. 29,758 in a period of 3 years. This makes the unit costs of plantation raising more attractive for potential investors.

## 11. Impact of Intercropping on weed control and soil health:

Intercropping with fast growing legume / pulse crops proved to be effective in limiting the weed growth. Initially, due to the poor rains, growth of the intercrops was affected and there were profusion of weeds in the plot. However, with rains, the growth in intercrops peaked to rapidly covering the ground and substantially outgrowing the weeds. Further as the crop residues were thrashed and mixed with the soil and left for decomposition in November, it is expected to further reduce weed population. The soil appears different; there has been an improvement in the texture, moisture content and friability. In certain patches, people have sown mustard in rabi, to use the residual moisture. However, this appears little ambitious, given the overall deficits in monsoon and first depleting water levels.

(We had collected soil samples from all the plots (treatment and control) for assessing Soil Organic Carbon, pH, Nitrogen, Phosphorus and Potash and comparing the same with that of control plots. The test is being done at KVK, Godda District. The results are awaited).

## 12. Conclusion and Way Forward:

- Integration of intercropping with plantations in degraded lands is beneficial on several counts:
  1. It triggers significant growth in the young plants thereby helping the plants to overcome stunting in young stages. After 3-years, the plants will grow on its own into full size,
  2. The practice of intercropping is far more cost effective compared to other conventional alternatives, therefore, its adoption will be faster among farmers and possibilities of investment will be higher,
  3. The overall plantation site undergoes positive changes; reduced weed growth, improved soil texture and better moisture retention.
  4. Intercropping, the way it is designed, is far less labour intensive, considering that the ploughing was done through mechanical means. Therefore, for smallholder farmers, who struggle to prioritize allocation of family labours in agriculture and plantations (all major operations happen in monsoon season), it is easier to adopt intercropping in plantations rather than carrying out hoeing / manuring manually in large plantation plots.
  5. For marginalized households, gain from pulse grain harvests is much appreciated. This provided nutrition and cash earning to the household (we need to compile the harvest figures and assess the gains). This is important as Tasar host trees take 3-4 years to mature to host Tasar silkworms. In the interim, the farmers do look for some returns from the plantation plots that build their sense of ownership.
- Tasar host tree plantation raising is an established scheme among donors / investors,

| Intercropping | | |
|---|---|---|
| **Sl.** | Practices | Cost Per Hectare (Rs.) |
| **A.** | Year 1 | |
| **A.1** | Pit digging-normal size | 10,962 |
| **A.2** | Intercropping (Ploughing, seeds, labour etc.) | 9,500 |
| **B.** | Year 2 | |
| **B.1** | Intercrop-ping | 10,500 |
| | | |
| **C.** | Year 3 | |
| **C.1** | Intercrop-ping | 12,000 |
| | **Total (Rs.):** | 42,962 |

| Conventional Alternative | | |
|---|---|---|
| **Sl.** | Practices | Cost per Hectare (Rs.) |
| **A.** | Year 1 | |
| **A.1** | Increased Size of Pits | 19,392 |
| **A.2** | Hoeing+ Increased Manure per pit | 14,544 |
| **B.** | Year 2 | |
| **B.1** | Hoeing + In-creased Manure per pit | 16,968 |
| **B.2** | Watering | 4,848 |
| **C.** | Year 3 | |
| **C.1** | Hoeing + In-creased Manure per Pit | 16,968 |
| | **Total (Rs.)** | 72,720 |

though the livelihood outcomes did not reach full potential. With the integration of Intercropping, plant growth will be significantly better. The same will increase predictability of higher income gains for the farmers on a sustainable basis, thus making it attractive both for the farmers (to deploy their lands for plantation) as also for donors / investors interested in livelihood impacts.

- It is planned to share the data with a number of stakeholders. PRADAN have been discussing the initiatives with the Central Silk Board, the apex sericulture institution in India. CSB is keen to undertake multiple locational research trials in their research stations.
- It is also planned to share the outcome of Intercropping in Tasar plantations with other mainstream agencies, positioning it as a potent model for restoration of degraded lands and generate sustainable livelihoods.

Fig. With the harvest of Black Gram

# RODENT DAMAGE IS REAL - AND CRITICAL TO UNDERSTAND BEFORE ONE CAN CURB THE LOSSES

Authors: Luwieke Bosma, Anushree Mitra, Dikhyani Konwar, Poulomi Mallick, Saroj Yakami, and Dr. Neena Singla.

This is the first blog out of two where we will learn about rodent characteristics in four villages in Madhya Pradesh. The people in these villages taught us about the rodent species and how these small mammals damage crops at an average 25%. In the next blog we will dive deeper into rodent management options. Seeking to understand the traditional systems and how Ecologically-Based Rodent Management methods could be integrated and by who.

Rodents are a major but often unseen problem in food systems. Despite rodents negatively impacting human health, welfare and food security, their management remains neglected by development policies. More than 400 million people are affected by rodent-associated pathogens (e.g., Lassa fever, plague, leptospirosis, typhus, hantaviruses) each year [1,2]. Field and post-harvest agricultural losses may reach 100% during rodent outbreaks, with chronic global crop damages estimated at 5-25% for major cereal and horticultural crops. Globally, an additional ~279 million people would be nourished with cereals gained from effective rodent management [3].

People adversely affected by rodent pests are often the poorest and most marginalised since their housing and storage are made of local material easily breached by rodents, and they have little access to knowledge and methods to manage rodents effectively. For low-income families, damage caused by rodents can amount to 2-3 months of food or a substantial loss of income and health. Men and women are both affected by rodent problems; however, some commodities and crops vulnerable to rodent attacks have a strong link to women's livelihoods and source of income, particularly stored products and home-garden vegetables.

## BOX 1: RAT FACTS

- Rats multiply quickly, from one pair of rats, 1250 rats can be born in one year.
- Rats greatly depend on the availability of good quality food and shelter to breed
- Rats all over the world cause 15-25% of damage to crops in the field and in store
- Rats usually move within 30-100 meters of their shelter each day, depending on food/mate availability.
- Rats play a role in the transmission of more than 60 types of diseases.
- Rats are very clever animals and can learn to avoid measures taken against them.

Photo1: different types of contamination and damage caused by rodents.

In India, major changes in agricultural systems have increased the rodent problem in recent decades. The major rodent pests prevalent are Bandicota bengalensis, Milardia meltada, and Mus booduga. It is reported that the overall losses of grain to rodents in India were approximately 25% in pre harvest and 25-30% in post harvest situations bringing the loss to at least US$ 5 billion annually in stored food and seed grain in India [4].

Generally, it is assumed that tribal communities in India had less incidence, due to predatory feeding habits by these communities, i.e. catching rats for food. However, based on anecdotal evidence this is doubtful, as people shared they can lose a quarter to half of their crops to rodents. Furthermore, we found there is a big gap in data and knowledge on rodents in the state of Madhya Pradesh.

Therefore we initiated 4 Knowledge Attitude Perceptions (KAP) semi-structured surveys in 4 different villages in Madhya Pradesh, to start closing the knowledge gaps. The KAPs were conducted in a Focus Group Discussions (FGD) setting with 10-20 village representatives, both men and women. The villages visited are Dhamanpani, Kumharra, Dudhera and Paudi; which are dominated by Gond and Baiga tribes. Their main livelihood sources are agriculture, non-timber forest produce, labour work and livestock rearing. Rats are considered a serious problem in all villages, both in homesteads and in fields.

Photo 2: conducting KAP surveys in the villages

## Rodent species

Many different rodent species were identified by community, indicating the rich knowledge they have of these animals.

- The Tharela/Tareli rat (likely the Bandicota bengalensis, lesser bandicoot rat) was called the 'boss of the rats', the strongest rat around that can even fight snakes.. It is a large rat, lives alone, is active at night and weighs 250-500 grams. One animal itself can destroy 20% on a 10 decimal (1 acre = 100 decimal) land. It does not only eat whatever it cuts, it stores a lot of food in the burrows that can be up to 3 feet deep. Out of 100 cuts it may only eat 10, that other 90 is stored in the burrows.
- Kotheli species (likely the Indian gerbil, Tatera indica) is found in the forest, they live in groups, and are night-active. Its belly is white, the upper is light brown, with a white tail. They can make a very big hole and pierce holes in foundations of houses.
- Chaura (either soft furred field rat, Millardia meltada or Indian bush rat, Golunda ellioti) is also found in the forest and is night-active. They have a white tail, resemble Kotheli, but are a bit smaller in size. They live under small bushes.
- Gharwala, also called chuha (likely the house rat, Rattus rattus), the most common rat to see.
- Chote (likely a field mouse, Mus booduga, or house mouse, Mus musculus / Mus domesticus), very small in size but they can cut the stems of paddy rice.
- Other forest species include: Bhaisadal and Baanskata. Other species mentioned are: Gharuli, Ghuus (shrew, Suncus murinus), Bandrachote, and Chuchundar.

Photo 3: from top to bottom: Lesser bandicoot rat, field mouse, and Indian Gerbil.

## How much is the damage?

Frequent damage occurs both at home as well as at field, especially during harvest time for the Kharif (October-November) and Bari crop (March-April). During those times there is ample food available at the field, and in the storage. The household items that are damaged in all the houses include: clothes, papers, electric wires, floors, unbaked walls, plastic drums and food containers, and rats bite small chicks.

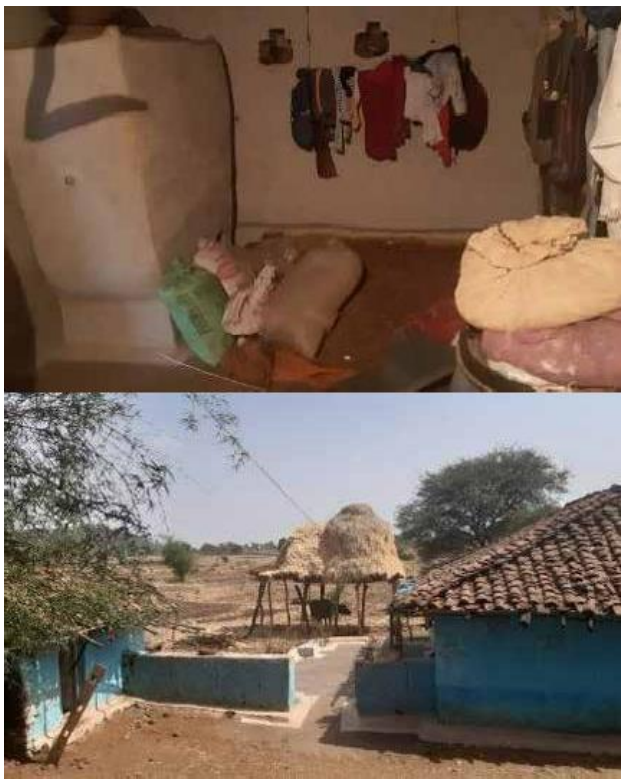


Photo 4: examples of inside storage structure (Kothi) and outside storage structure

The following table shows the damage for the village of Kumharra, on average the overall damage in all the villages is 25% on average. The crops with highest damage are maize and paddy rice.

Communities shared that rats literally eat everything that a human eats. Though rats also have dietary preferences, especially regarding the crop stage. Pulses for instance are eaten by rats when the plants are very small, in seedling stage, this is when they are a little soft and are very juicy. To reach the sweet maize, rats climb up all the way to the top to eat from the cob, or rats eat it when it is stored at the house. Leafy vegetables grown in Kharif season are eaten when they are stored in dry form.

Photo 5: examples of rodent holes in the field.

Table 1: rodent induced damage to crops in field and storage for Kumharra village.

| # | Crop | Normal produce (kg) | Lost produce (kg) | % loss | Price/kg | Monetary loss (INR) |
|---|---|---|---|---|---|---|
| **1** | Maize | 350 | 175 | 50 | 9 | 1575 |
| **2** | Paddy | 500 | 150 | 30 | 13-14 | 2100 |
| **3** | Pulses | 350 | 100 | 29 | 45 | 4500 |
| **4** | Millets (kodo) | 250 | 50 | 20 | 18 | 900 |
| | Total | 1450 | 475 | 32,25 | | 6975 |

Paddy rice is clearly a favourite of rats and eaten at any growth stage, though harvest time is when most of the crop is cut by rodents. Reason being that rice is often cultivated through the transplanting period, whereby the fields are put under water. Rats generally do not like water, so they stay put, until the water dries up and harvesting begins, then rats grab their chance. Farmers share that rat populations are growing incessantly since they started with paddy rice cultivation. At the time when farmers only cultivated millet and finger millet, rats were also a problem, but not as big as today. Wheat is not grown as much in the villages, but people share that rats really enjoy wheat, even over paddy rice. The rats wait until seeds start to come out from the wheat plant, that is when they come to take advantage.

The two basic requirements for rodents to thrive is to have enough food and a space to live and hide, while during their movement to and from, they remain unseen from natural predators. As we have seen, there is a diversity of food available for the rats. On top of that, habitat options are plenty in the villages we visited, there are ample soil- and stone-bunds where rats take shelter. From their shelter they can directly access the crops in-field. Stone bunds in bari and khet lands are different. In khet you first put up soil, on top you add stones, so this is a water conservation structure. In bari you just pile up stones to remove them from the field. Furthermore, rodents can be found in vacant houses, old houses are good hiding places for rats. People shared that most likely a lot of rats will live in those houses. Rats are also found in a majority of residential houses under the roof, and along walls and in floors. Rats can gnaw through baked clay, and can therefore enter houses by digging through the walls or floors. During the dry and lean periods rats often take shelter in homestead lands, they stay either in the field bunds or burrows.

## Main lessons:

Traditional knowledge of communities on the different species and their behaviour is very rich. In Rodent Green we believe that to manage rodent populations and minimise their negative impacts, we need to clearly understand the ecological requirements of the rodents. Rodent populations are known to grow exponentially given the right conditions. Therefore we must together assess how environmental circumstances are created in which rodent populations expand beyond acceptable levels.

It is critical to understand the huge losses incurred by rodents, it is something that is normally not shared, only after making the calculations together the real losses come out, which can surpass losses due to other factors. It brings a direct loss to food availability for the family, while there are Ecologically-Based Rodent Management (EBRM) methods that can prevent rodents access to food and shelter, thus safeguarding crops and assets. In the next blog on rodent management options we will dive deeper into traditional management methods and how EBRM can be integrated.

Do you want to know more? Contact Luwieke (lbosma@metameta.nl) or have a look at www.rodentgreen.com

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# OPTIONS FOR EFFECTIVE ECOLOGICALLY-BASED RODENT MANAGEMENT IN INDIA

Authors: Luwieke Bosma, Anushree Mitra, Dikhyani Konwar, Poulomi Mallick, and Saroj Yakami.

In the previous blog we learned about the rodent species in 4 villages in Madhya Pradesh and how these small mammals damage crops at an average 25%. In this post, we will dive deeper into rodent management options. Seeking to understand the traditional systems and how Ecologically-Based Rodent Management (EBRM) methods could be integrated and by who.

But, before we dive in, let us first sketch a picture of the cultural beliefs and perceptions around rodents and rodent control behaviours. Since an understanding of these is crucial in order to implement management changes to more environmentally friendly practices. Some examples of cultural beliefs and other customs that are important to understand:

- People kill snakes when they see them, they know they kill rats, but they are scared of snake bites. Two people from the village have already died from snake bites, since for instance kraits are poisonous.
- Very few people in Kumharra village sell produce at one time for an income. In most of the cases, farmers sell their produce when in need of money to buy other products. So they store their produce themselves and only sell the products little by little.
- Example of a spiritual/religious tradition: In the Baiga tribe, in the beginning of Kharif season, people do proper praying of “Thakur Dev”. During the praying, there are different types of crops that are grown in the area. At the end of the praying, they distribute seeds/grain to all the community members. During the sowing time, they also sow these seeds/grain in the farmland as a blessing to the land. There is a belief that when they do

## BOX 1: RAT FACTS

There was a legend shared by an older man. There once was an old person in a house who used a rope to tie a mouse, so it could not eat the stored food. But then his yield started to decrease. So they concluded it is not good to keep mice away from food, i.e. we can’t control mice completely, they also need to eat. Tribal people say, for all animals, everyone has a place in the food chain, we do not wipe out, every species has a right to live, thus every species must be able to get something.

it well, there is less damage by animals, e.g. rodents, to the crops in the farmland. They believe that if a puja was not done well, they can have more problems with rodents.

- Owls are seen as ghosts, they represent death. There are many beliefs around this, e.g. you should not go out at night, because then if you hear the call of an owl, bad spirits will find you. If someone gets scared from the sound of an owl, that person will get a fever. Etc. (photo shows barn owl that caught a rat)

## How are rodents currently managed by the communities?

The main control method used is the application of chemical synthetic rodenticides (CSR) (photo shows locally bought CSR). It is applied mainly during October and November: CSR is mixed with rice or tomato, so rats are attracted to eat it. However people indicate that this method is very ineffective and rats are very clever, they quickly learn to avoid the poison. This is a very common drawback of chemical synthetic rodenticides, rats quickly develop a bait-shyness, and on top of that also build up resistance since the poison is applied in small amounts, making them sick, but not killing.


The other methods used are mainly mechanical or cultural, it comprise the following methods:

- Close or clog rat holes with stones in the field. But rats come out from other holes (or they make other holes to escape). It helps occasionally, but rats mostly find a way out.
- Use of catapult for rats that stay under the roof in the house.
- Some people catch rats which are prepared for eating. Not the house rats, since they smell. Each species has its own taste.
- Another indigenous way to catch rats is to smoke them out of the burrow. A fire is started at the 'main entrance', the biggest hole is normally picked. Then they blow the smoke into this burrow, while closing off other exits. Then at one remaining exit someone will be there to trap/kill the rodents that come out, since they have nowhere else to go.
- Usage of a bucket trap, applied at the time

when humans go to sleep, as then rats get hungry around 10-11pm. The bucket trap was applied manually.

## Now, time to learn more about EBRM, what is it and what determines its success?

With Ecologically Based Rodent Management (EBRM) we propose integrated control mechanisms that greatly improve agricultural production standards in quantity and quality, and improve healthy living conditions. In EBRM, our first step is to 'prevent' the surge of rodent populations by managing the local environment in such a way that rodent populations never grow beyond the tolerance levels. This means controlling access to food and water, reducing shelters and preventing migration. This requires hygienic, operational and construction measures. The second step is 'to control'. In case of infestation, the population is reduced by using natural enemies, mechanical measures and by applying bio-rodenticides.

The three main activities in controlling rodents are:

1. Ensuring the cleanliness of grain storage areas and household compounds and preventing rats from entering these areas and structures.
2. Controlling the environment in the agricultural fields:
    - Improving cultivation practices such that there are fewer opportunities for rats to thrive
    - Destroying the habitats of rats and ensuring they have no place to hide
    - Improving the quality of soil and water conservation structures
3. Taking specific actions to control and kill rats:
    - Using plants with repellent or toxic traits
    - Promoting natural predators
    - Installing trap barrier systems

With these three main activities, there are three essential aspects:

1. timing (rodent management is most effective in the lean season when they are fewer), It is advised to initiate frequent campaigns and individual rat control measures at the time when the rats are few, the vegetation cover is low, and the rains are little (pre-season). In crop fields that are under rain-fed conditions, the rat population numbers are lowest in the peak of the dry season, a few weeks before the start of the rainy season (cropping season). Before the rains come, there is not much food or crop/grass cover in the fields. Therefore, rats will not start reproducing and they are weaker. As a rule of thumb, rat control measures should be done at the end of the dry season and at the beginning of the rainy season. In the dry season, you target the weak animals, reduce their numbers, and prevent them from reproducing. At the beginning of the rainy season, you target the rats that have survived, applying different measures as part of land preparation and destroying rat habitats. In addition, one can spread different rat control measures over time. When rats retreat to the homesteads, crop fields, or ridges nearby, for instance during heavy rainfalls, farmers can focus on rat control measures in those specific areas.
2. collective approach (rodents can only be controlled if everybody is in; otherwise the clever animals will find a way to escape, survive, and thrive),

3. combining methods (as rodents are clever, a combination of control methods is required whereby the focus should be foremost to reduce access to food and shelter before going into direct killing). [1]

## What is the scope for integrating EBRM concepts in Madhya Pradesh?

Currently the communities in the four villages of Dhamanpani, Kumharra, Paudi and Dudhera in MP, did not know any effective rodent management method, nor did they get support from any department on how to effectively control rodents. EBRM methods can be a low-cost effective alternative that can be implemented to curb rodent populations. Here we present a short-list of EBRM methods which were deemed feasible based on village level discussions.

### 1. General cleanliness and garbage disposal

Rats are a major problem in many houses. Rats damage clothes, furniture, electric wires, and paper. Rats eat from the household's food stores and contaminate them. Therefore, they should always be kept away from the house, homestead, compound, and storage areas. They should not be given any reason to come near; therefore, it is key to ensure that they cannot smell food and cannot get access to a shelter. A first and essential measure to take is keeping clean!

In managing rats in and around houses, the first important requirement is to keep the house and the areas around the house (garden, grain storage areas, fences, hedgerows, etc.) clean. There should be no open left-over food, no open piles of garbage, no open stored product or open storage. These are food sources that attract rats and provide shelter. One should keep food locked away and air-tight so rats cannot smell it. All items that attract rats should be eliminated or stored in closed-off containers/boxes/jars/other. The below pictures showcase some bad and good examples.

Figure 1: bad example with open garbage on the left, good example with clean/open compound.

### 2. Rodent-proofing of storage areas

The second method is to have a rat-proof storage area and storage material for grains and other harvested items. Rats should not be able to get access to stored items.

Placement of outside storage: The storage should not be placed under trees, because then rats can jump in from the top. Also, there should not be bushes, garbage, or watering places around the storage system, because these will attract rats.

Figure 2: examples of keeping house and compound clean and removing rodent harbourage sites.

Figure 3: examples of rodent proof storage structures, on the left it is raised on poles, while in both examples metallic discs are placed on the poles.

Raise storage structure on poles: it is important to make it impossible for rats to get into the storage structure. The best way to do this is to raise the storage structure on poles, for example 0,5m from the ground, and to put iron or metal pins or disks, or barbed wire on the poles on which the storage structure stands. This prevents rats from climbing up, either because the surface is too slippery and rats will slide off, or because the barbed wire is too prickly.

Good materials for your storage structure include wood/bamboo, dung, grass roof, and wood poles to raise the structure.

### 3. Destroying, smoking out or flooding burrows

Destroying rat habitats and shelters denies rats protection from predators, breeding grounds, and temporary safe havens. This results in a decrease in rat survival rates and density, and ensures that rats can only occupy crop fields later in the cropping season.

Some rats make burrows and tunnels to shelter underground, especially those species that are active at night. It is advisable to flood these burrows and tunnels with water first to kill the rats inside just before planting seeds. Another method is to smoke the tunnels.

Deep ploughing can destroy the rat burrows and tunnels. Rats can dig burrows up to 50cm deep. The ploughing depth preferably would reach this

depth to destroy a large part of the rat population; however, ploughing at 20cm depth, for example, would also considerably disturb rat burrows.

In other cases, search for rat burrows and destroy these by stabbing/poking in the burrows with a pole or hayfork/prong. This can be done during the tilling and ploughing stages. When you find a rat burrow, you can also set kill-traps in front of the burrow on the runway.

Check regularly for evidence of rodent infestation (burrows, tracks, and runways) to undertake measures.

**4. Promoting natural predators**

Natural enemies of rats function as highly effective biological control agents. Natural enemies of rats include domestic cats, wild cats, mongoose, genet, owls, other avian predators, jackals, and snakes. This approach involves no killing, no chasing, but protection of habitats of the predator species, and active promotion of wildlife presence.

As a farmer, you should actively promote and try to attract these predators to your fields. For example, installing artificial perches (poles of up to 3 m or more) and nest boxes in [LB1] the fields helps to attract raptor birds such as owls, buzzards, and falcons. Do this especially in open fields devoid of trees and shrubs. Erect the poles in such fields so that the birds sit on them and hunt down the rat population.

## Last, but not least, who can be involved and how?

As we have read, effective rodent management requires a collective approach, with appropriate timing and a combination of measures. In order to achieve this, we must work together and

Figure 4: example of perch sites and nest boxes for avian predators, and on the bottom right examples of predator species for rodents.

combine our strengths. One first step is to increase awareness on rodent ecology and damage. When we understand how rodents can thrive, we can also learn how to keep them from thriving. We make a first suggestion of how a small selection of actors can be involved, knowing there are many other actors who can make this a success!

- MetaMeta Research: services we provide include, initiate campaigns to increase awareness on rodent issues, rodent inspection and monitoring, developing tailored EBRM toolkits, training and material, setting up living labs and sharing our experiences.
- PRADAN teams: work closely with CRPs in steering fieldwork on EBRM in villages, share lessons learned among field-teams, piloting of EBRM methods and integrating into standard farming calendars and models.
- Community Resource Persons (CRPs): be the go-to persons in the village with knowhow on rodents and their effective management, support farmers with monitoring and implementation of EBRM methods.
- Agricultural service provides/agro dealers: become aware of effective rodent management methods and provide these services/products to farmers locally.
- Government: incorporate EBRM into integrated pest management, contribute to the shift from chemical to ecological methods nationally and make it part of agricultural extension curricula.

Do you want to know more? Contact Luwieke (lbosma@metameta.nl) or have a look at www.rodentgreen.com

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# BIO-RESOURCE CENTERS AS A TOOL TO TACKLE THE FERTILIZERS CRISIS

Authors: Marina Vara Gutiérrez and Rubén Borges Robles

India has seen a rapid growth in the use of chemical fertilizers and pesticides over the last decade as the country's population increased. In Madhya Pradesh and Jharkhand, two states in central India, farmers use more than twice as much fertilizer per acre as farmers in other parts of India. This overuse has led to a number of negative consequences for both soil quality and human health.

In recent years, there has been a number of Indian farmers adopting regenerative agricultural practices as a way to counter part of the negative effect of decades of agricultural chemical input uses. One of these practices is the use of bio fertilizers and bio pesticides produced locally with available natural resources in the area. As part of the GTP project, the concept of bio-resource centers (BRCs) has been introduced in rural areas

where access to information about regenerative agricultural practices and bio inputs is limited or nonexistent.

The Bio-Resource center model is in a piloting phase. The main challenges the BRCs are facing at this stage relate to the accessibility of resources (there is a scarcity of certain inputs depending on the season), the production process (the preparation process is very labor intensive and differs greatly between BRCs), the product formulation and use (different ingredients and cooking process are used between BRCs, there is a lack of application calendar or clear indications about the right dosage and effectivity of each formulation) and use and the distribution and business aspects of the model (the BRCs are not a profitable and independent business model at this stage).

BRCs centers can be a great tool to foster the use of regenerative farming practices in the states of Madhya Pradesh and Jharkhand. They can be especially successful in remote areas that lack good road connectivity and in which therefore, there is no access to chemical inputs for agriculture. In order to strengthen the BRC model is important to focus on reducing the labor intensity and homogenizing the preparation process of the products, to define the right application dosage of each product and integrate its use in the cropping calendars of the area, and to develop a business plan to make sure the BRC model is profitable and self-sustainable. During the next months Rockinsoils, PRADAN, FES and MetaMeta, will develop a set of interventions to improve the BRCs model and the formulations they prepare to get the model ready for upscaling.

# ZOOMING INTO THE MAIN CROPPING PATTERNS

Authors: Marina Vara Gutiérrez and Rubén Borge Robles

The Indian government's agricultural policies are primarily focused on the promotion of conventional agriculture, on monocropping production schemes paired with chemical agricultural inputs into the food production system. These practices had led to an increasing soil fertility problem in India over the last decades. As a consequence, there has been a rapid increase in the number of Indian farmers and state governments adopting and promoting regenerative agricultural practices. This has increased awareness about sustainable agriculture among farmers that live in rural areas where access to information about these practices is limited or nonexistent.

The design of -multiple- cropping patterns, as a regenerative agriculture practice, helps to restore soil fertility by rotating and associating crops with different nutrient

needs, as well as by providing a variety of ground cover which increases organic matter in the soil while promoting biodiversity. The strategic combination of crop rotations, crop associations and cover crops are key principles to compose a regenerative cropping pattern. A crop rotation is an agricultural technique that manages crops so that different types of plants are grown each year on a given piece of land reducing the depletion of nutrients in the soil and fighting crop pests infestations. A crop association is an agricultural technique that manages crops so that different plants are grown close together. Each crop from the group has different root systems and nutrient requirements and access to a different niche. Thus, productivity increases without depleting the nutrient content of the soil. Finally, cover crops are usually used alongside crop rotations and associations to increase soil fertility by adding nutrients and improving the structure and moisture retention capacity of the soil. As part of the GTP project, regenerative agriculture is explored as a framework to propose interventions to enhance more sustainable food production and foster soil fertility in the states of Madhya Pradesh and Jharkhand in central India.

The states of Madhya Pradesh and Jharkhand present a broad diversity of agroecosystems. Different crops (paddy maize,millets, pulses, cabbage, tomato, eggplant, etc.) are grown during the main cropping seasons kharif (June - October) and rabi (March- June) in the different agroecosystems (lowlands, homesteads, midlands and uplands) used by each community. On the one hand, the state of Madhya Pradesh most of the agriculture is rainfed, being millets and pulses the main traditional crops. On the other hand, the main crop in the state of Jharkhand in paddy and PRADAN has been promoted during the last years in the introduction of mango and tasar plantations at scale. In both states, solar lift irrigation has been introduced in some areas generating the possibility to cultivate a broader change of vegetables throughout the whole year.

Although the project area's landscape is so diverse, most farmers face similar challenges when it comes to food production. While farmers that cultivate in the uplands need to find strategies to produce on shallow soils (affected by erosion), farmers in the lowlands and midlands need to find practices that allow them to increase the moisture capacity of their soils or access irrigation.

Increasing and maintaining organic matter and soil fertility is another main constraint for food production in the project areas. Also, pests and diseases frequently affect monocropping in the area, reducing food productivity. Moreover, extreme weather events associated with climate change increasingly affects food production, the dry season becomes longer and harder and rainy events become more extreme and erratic.

After discussing with the PRADAN field officers, the team came to the conclusion that interventions that look at the farm plot like a small ecosystem through the lenses of regenerative agriculture (increasing soil moisture retention capacity, fertility, biodiversity) should be considered to strengthen the resilience of cropping systems in Madhya Pradesh and Jharkhand. But what does that mean in practice? For instance, it means that if we want to increase the soil moisture holding capacity of the soil introducing the regenerative farming technique of cover crops we should consider microclimatic factors (like sun, wind and water exposure) together with the soil type to inform the decision of which is the most suitable cover crop for that specific plot. Overall, promoting

interventions that look at a farm plot like a small ecosystem through the lenses of regenerative agriculture will allow the design and management of more sustainable farming systems in the project areas.

Based on these lessons learned, in the coming months staff members from PRADAN, FES, MetaMeta and Aidenvironment together with Ruben Borge (Rockinsoils) are developing a set of cropping patterns and complementary interventions to tackle the main challenges identified. During the next year these interventions while specifically focused on the understanding of the characteristics of the main agroecosystems in the project areas, to research suitable and context specific crop rotations and crop associations per season per agroecosystem, the integration of farmplot microclimate management techniques and the consideration of new habitats/niches for food production and resilience of the agroecosystem.

# WOMEN FRIENDLY AGRICULTURAL HAND TOOL TO IMPROVE THE QUALITY OF LIFE OF RURAL WOMEN FARMERS

Authors: Marina Vara Gutiérrez, Rubén Borges Robles and Francesco Sambalino

Agriculture is the backbone of the Indian economy. Agriculture in India is largely dependent on manual labor and hand tools, as mechanized farming methods are not commonly used. Although in other parts of rural India farmers use hand tools for many farming operations, in the states of Madhya Pradesh and Jharkhand manual agriculture is still the most common practice. Manual agriculture employs a large number of rural women, the so-called 'hand laborers'. Specially in these areas, well thought tools have the potential to make agricultural operations faster, thus improving the household economy. Moreover, appropriate tools reduce the labor intensity of some agricultural taks (like weeding) and improve the farmers' quality of life by reducing body pain.

When we discuss regenerative agricultural practices is it common to forget about the

socio-economic aspects of making regenerative agriculture mainstream. Regenerative agricultural practices are most of the time labor intensive. Therefore, when implementing them in a rural context it is key to develop interventions that will favor the integration of these practices in the farming system without adding too much additional labor. In the states of Madhya Pradesh and Jharkhand in India, this means developing women-friendly hand tools that are affordable, ergonomic and that will make farming more efficient.

Although we would expect that hand tools were commonly used among rural women in the states of Madhya Pradesh and Jharkhand most of the agricultural related activities were done manually. In the cases in which hand tools were used they were not always the most appropriate ones. Since hand tools are designed based on the male body proportions, women farmers experience body pain after their use. Therefore, designing a broad range of hand tools that are suitable for women farmers to be used and that are affordable and locally accessible is the main challenge faced in the project areas.

The introduction of women-friendly hand tools will make agriculture more efficient and will improve the quality of life of women farmers. During the next months Rockinsoils, PRADAN, FES and MetaMeta, will develop a circular design model in which women groups co-create tools with blacksmiths in a reiterative process that will allow for the development of efficient, ergonomic and affordable hand tools.

# LARGE SCALE COMPOSTING UNITS: A SOLUTION TO UPSCALE REGENERATIVE AGRICULTURE?

Authors: Marina Vara Gutiérrez and Rubén Borges Robles

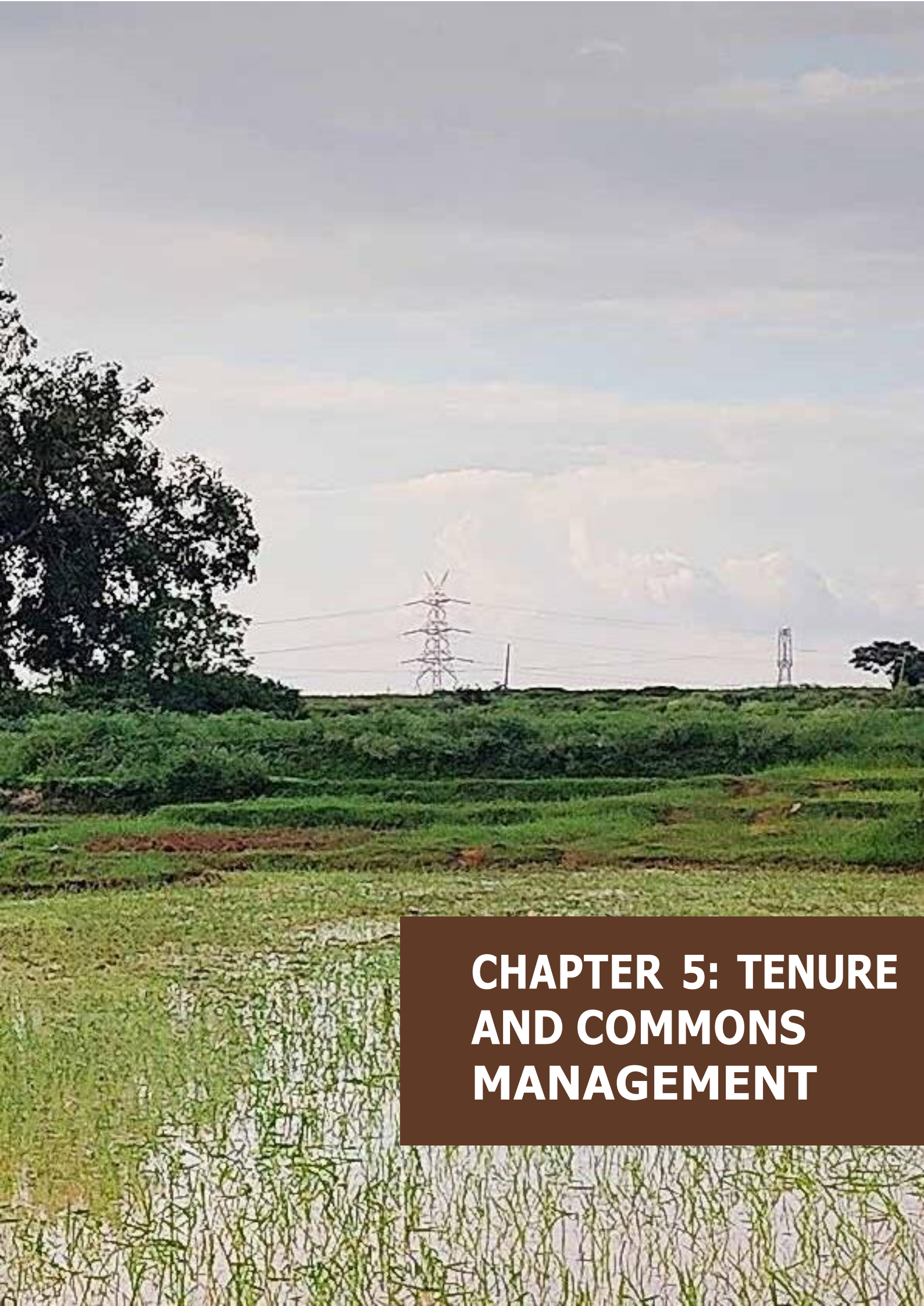
India has been facing a problem of soil fertility for decades. The Green Revolution was one of the first attempts to solve this problem, but it had many shortcomings that have only become more apparent as time went on. The Green Revolution was based on heavy use of chemicals and an increase in crops grown per acre, which caused farmers to lose their traditional knowledge about how to maintain soil fertility without relying on chemicals. Farmers in the states of Madhya Pradesh and Jharkhand, after realizing the negative effect of chemical use in soil, animal and human health, are looking into new ways to improve the soil quality and make them fertile again.

In recent years, there has been a number of Indian farmers adopting regenerative agricultural practices as a way to counter part of the negative effect of decades of

agricultural chemical input uses. The goal of regenerative agriculture is to restore soil health and fertility by introducing a set of integrated farming practices. One of these practices is the application of organic compost to the farm plot. Compost is a soil amendment made out of decomposed organic matter that improves the aeration and moisture retention capacity of the soil while enriching it with essential nutrients that enhance the soil microbial activity. Thus, allowing essential plant growth nutrients to be available for plant uptake in the soil. As part of the GTP project, the concept of Large-Scale Composting Units has been introduced in the states of Madhya Pradesh and Jharkhand where access to information about regenerative agricultural practices and access to the production of organic compost is limited or nonexistent.

When designing a Large-Scale Composting unit the characteristics of the selected plot will influence the quality of the compost produced and the efficiency of the logistical production process. Factors like slope, sun and wind exposure, space between the windows, designated testing areas need to be considered to make the Large-Scale Composting unit more efficient and reduce production costs. In terms of production, the compost formulation needs to be adapted to the seasonal availability of materials and changing weather (dry or rainy season) of the production location. Moreover, the Compost Unit staff should be able to visually monitor the composting process and the quality of the final product. Additionally, the machinery used in the compost production needs to be adequate in terms of size and production volume and need to be maintained and fine tuned (if needed) to facilitate constant and consistent compost production. Finally, it is crucial to develop a business and marketing plan for each Large-Scale Composting Unit and consider how the product will be distributed and introduced into the local market.

The production of quality compost at an affordable price in Large-Scale Composting Units in the states of Madhya Pradesh and Jharkhand will improve soil fertility and increase food production. During the next months Rockinsoils, PRADAN, FES and MetaMeta, will develop a set of interventions to improve compost production in existing Large Scale composting units and to set up new ones in other project areas.



# CHAPTER 5: TENURE AND COMMONS MANAGEMENT

# INTRODUCTION TO COMMONS MANAGEMENT WITHIN GTP

The GTP defines commons or common-pool resource (CPR) as a particular type of good consisting of a natural or human-made resource system that groups of people manage (communities, user groups) for individual and collective benefit. Examples of CPR are pastures, forests, rivers, ponds, trails, groves or even religious and spiritual places. Commons often face problems of congestion or overuse because they are subtractable. A CPR typically consists of a core resource, which defines the stock variable, while providing a limited quantity of extractable fringe units, which defines the flow variable. While the core resource is to be protected or entertained in order to allow for its continuous exploitation, the fringe units can be harvested or consumed. If we take a forest as an example, the core resource (tree regeneration) is to be protected or entertained to allow for the harvest or consumption of its fringe units (wood, non-timber products, climate regulation processes, etc.).

Roughly 25% of the Indian landmass is de-facto commons. It supports the bonafide livelihood needs of 350 million rural poor, especially women and marginalized groups like forest dwellers, pastoralists, and indigenous communities. Annual contribution made by commons to communities is to the tune of USD 99 per year as food, fodder, firewood, non-timber forest produce, medicines, and other ecological services like carbon sequestration, regulating hydrological cycles and nutrition flows. Unfortunately, there are dominant policy tendencies and approaches which hijack sustainable management and result in neglection of the commons.

The dominant conservation approaches see nature conservation in isolation. They pitch conservation and development as well as forest and people against each other. They do not balance the interests of preservation, conservation, and exploitation of natural endowments. Dominant livelihood approaches on the other hand, are based on rationalities of surplus generation, profit maximization and individualization which often result in adverse social, economic and ecological outcomes. Therefore, to foster sustainable commons management there is a need to better link ecosystem services and functions with farming systems development and to address the long-term sustainability and resilience of livelihood strategies associated with production systems.

Good common management includes ensuring tenure security over commons, establishing processes of democratic governance of resources with community participation, eco-restoration of degraded commons and ecological monitoring.

The blogs bundled in this chapter result from GTP's common management activities and explorations thus far. The topics included are the socio-ecological systems approach and examples of management of the commons.

# A SOCIO-ECOLOGICAL SYSTEMS APPROACH TO AGRICULTURE

Authors: Shubham Jain, Laxmi Sharma, Jyoti Mishra

Social and ecological systems are interconnected. Private resources and livelihoods are dependent on common resources as natural resources (i.e. land, water, plants, and animals) provide functions and services. Commons perform various functions like regulating nutrient and water cycles, reducing soil erosion, maintaining soil organic carbon, stabilizing soil moisture, flood control, local climate regulation, and over improvement of production systems. This shows the dependency of each natural resource on the other. To have livelihood security we need the food, fodder, water, social, and economic security which comes from having ecological security. 250 privately held hectares of land need service from 750 hectares of common land for its sustainability.

Forests on common lands serve many purposes. In addition to providing livelihoods, the forest resource can contribute to household income during lean seasons:

1. Goods: Fertilizer, Firewood, Fodder, Food, flower, fence, Fibre (7Fs), seed, medicine, honey, leaves, etc.
2. Services: Pollination, pest management
3. Functions: Regulating water cycle, Climate change mitigation, habitat, cultural significance, carbon sequestration.

The natural regeneration process of commons is threatened by cutting trees, fire, unsustainable harvesting mechanisms, unregulated grazing, encroachment, mining, etc. Here society and social processes play an important role: without active support from the community, ecological restoration is difficult.

Livestock plays an important role in regenerative agriculture and is also considered an essential part of the circular economy. The manure from livestock constitutes a very important component of both agriculture and forest economy. In pastoralist society, animals spend their day time in the forest. They graze and do dungs, dropping and urine in the forest area, which acts as manure for commons. During the rainy season, this manure comes with the river/drainage line of the agricultural lands. Flowing manure with rain brings a lot of nutrients and carbon organic matter which improves the soil health and thus fertility of the soil. The fertile soil provides higher productivity, yield and income for the farmers.

To find the impact of commons on soil fertility, a study was done to develop insight and orient around the geo-spatial findings on the impact of commons (forest) on soil health on a landscape. A measure to understand the soil health trends is showing the Soil Organic Carbon levels using the Soil Health Cards which are tagged to the exact

field on a geospatial map and can be viewed. It shows precisely where the soil sample was taken. The findings suggest that the locations nearer to the commons or forest (Angul, Odisha) have more organic carbon than the farms away from the commons. With regenerative agriculture as a core focus, it was an attempt to enhance our understanding by focusing on soil organic carbon as the most critical indicator.

Apart from understanding impact of the commons on different natural resources it is also important to understand the perspective of the community regarding the different resources and one of the useful tool is CBSD (Community Based System Dynamics) ,which draws on a mix of methods such as Participatory Rural Appraisal and Group Model Building, offering scope for a visual representation of mental models of the community in the form of informal causal maps to better understand the different interconnections in the system. It helps the practitioner to understand various mental models that the community carries around resources and their management. It is an effective way of understanding the village-level dynamics and how one can engage with the community while working on ecological/natural resources.

It is also important how communities succeed or fail at managing common pool (finite) resources such as grazing land, forests and irrigation waters. Ostrom principles stresses on the existing eight principles formulated by Ellinor Ostrom for governing and working on commons and it effectively answers popular theories about the "Tragedy of the Commons", which has been interpreted to mean that private property is the only means of protecting finite resources from ruin or depletion. She has documented in many places around the world how communities devise ways to govern the commons to assure its survival for their needs and future generations[1].

The first step when we are working on securing the common property's status is to define clear group boundaries, which is also one of the Ostrom principles, with use of the (CLM)Common Land Mapping app . This GIS-enabled tool does not just provide an overview of all the commons in a village but the GIS tagging can help monitor the common land remotely through satellite. The tool also helps in understanding and processing the land status and its uses. This helps regarding mapping out areas, creation of boundaries, area calculation, etc.

The main objective of the Social and ecological system approach to agriculture is to understand the different steps for working on commons, processes associated with it and the different informative tools to complement the process. This also helps to develop insight on working on commons, starting with identifying, claiming, securing, governing, restoring and monitoring. Figure 1 shows the interconnectedness of different aspects of Commons

[1] https://www.onthecommons.org/magazine/elinor-ostroms-8-principles-managing-commmons

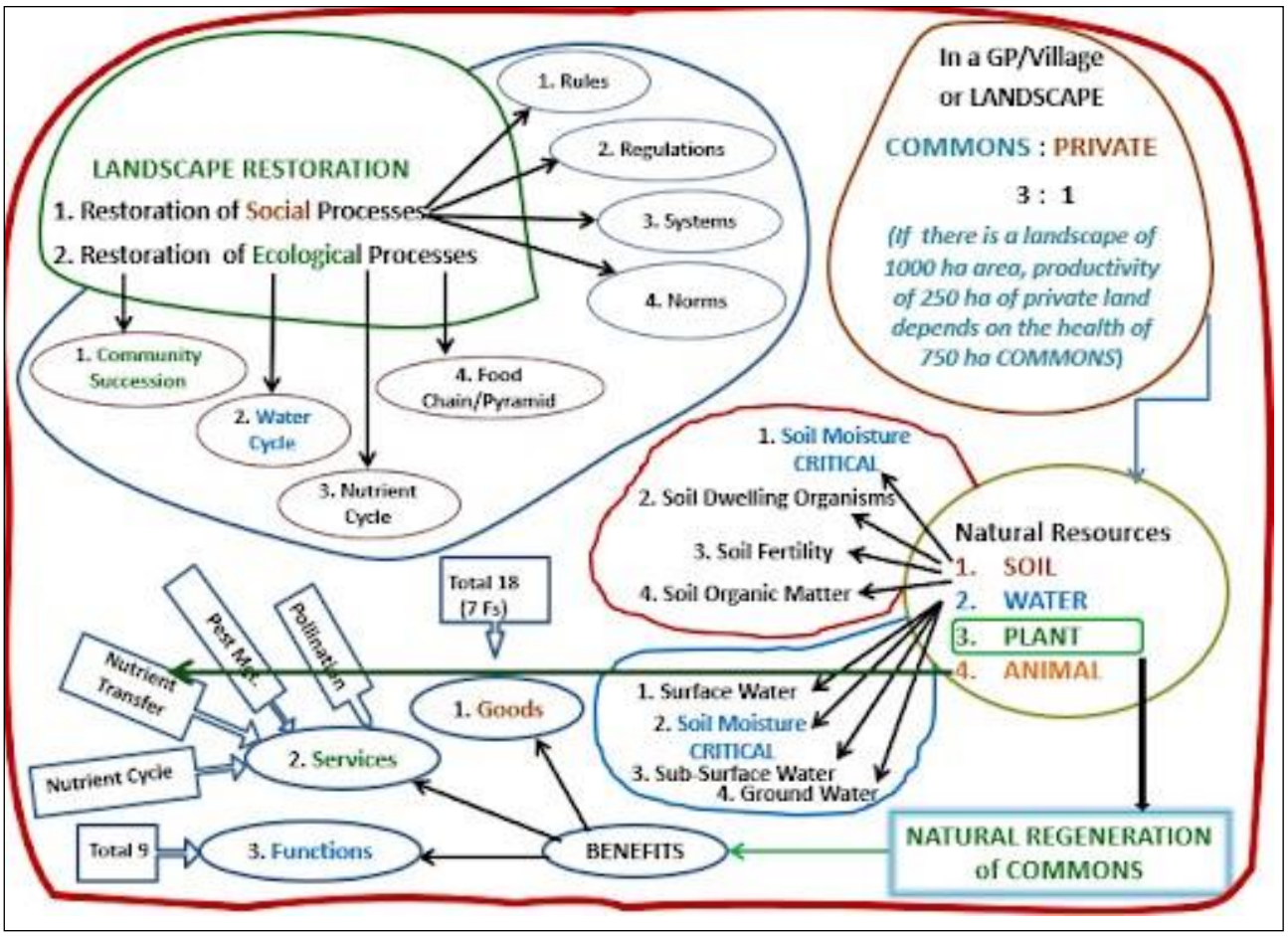



Diagram 1: Interconnectedness of different aspects of Commons

# EXAMPLES OF COMMON MANAGEMENT BY COMMUNITIES

Authors: Shubham Jain, Marijn van der Meer, & Femke van Woesik

Figure 1: The invasive species Lantana

Common pool resources, popularly known as "commons", are those resources which are accessible to the whole community or village and to which no individual has exclusive ownership or property rights. Drawing on village-level data from the 2011 census, it is estimated that India has over 66 million hectares of land classified as common land; a quarter of the total land area including forest, permanent pastures and other grazing lands, barren and unculturable lands and culturable wasteland[1]. Therefore protecting and caring for common resources is essential in creating flourishing socio-ecological systems.

But due to deforestation, overgrazing and exploitation of water resources, commons are facing issues of overconsumption and under-investment, leading to their depletion. This often results from individuals trying to maximise their own gains rather than work towards collective outcomes, which is referred to as the tragedy of the commons.

When we want to establish the protection of the commons, it is impossible to do so without involving the community and different stakeholders in the process.

"You cannot protect a forest by installing surveillance cameras. It will only be protected when the eyes of all stakeholders are open" [2].

Although many patches still need special attention, a great and diverse set of examples is visible in Bichhiya Block, Mandla District, Madhya Pradesh, Central India. This blog discusses 2 cases where the community played an important role in restoring the commons.

Due to deforestation and overgrazing for many years in Central India, the land has become barren, and the invasive plant species of Lantana Camara has been growing uncontrollably (Figure

1). Although Lantana Camara is used for fencing, the plant can have many negative side effects. Lantana Camara competes with native plants for space and resources, and because the species grows in large densities, no grasses or small plants are able to grow. Moreover, the plant alters nutrient cycles in the soil[3]. Extensive feeding on lantana has led to diarrhoea, liver failure and even animal death. Sometimes excessive growth of these weeds also results in forest fires during summer. Therefore, it is mentioned as one of the most damaging invasive species in India. In some villages, large-scale Lantana Camara removal projects have been executed by the community with the help of Gram Paryavarn Samiti and Van Suraksha Samiti (Village Environment and Forest protection committee) facilitated by Foundation for Ecological Security (FES). These projects aim to regrow forests again. Reforestation projects have been done in multiple ways, of which one manual reforestation. Another example is that after cutting all Lantana Camara, the underground forest (roots still present in the ground) was able to grow back with the help of large conservation efforts such as Farmer Managed Natural Regeneration (FMNR) (Figure 2).

This common area vegetation shift, from Lantana to forest, has benefited in multiple socio-ecological ways. For example, at the sight of Figure 2, a cremation place was present. Back in the day, the people suffered from the heat during the important cremation rituals, leading the place to be identified as unsuitable. With the forest present, the rituals can be performed comfortably again. Additionally, the reforested areas are suitable for grazing, extraction of fodder/ leaves for mulching, and provide an overall improved situation to live in (lower temperature, more diverse nutrition, increased water tables etc.) (Figure 3).

"With the guidance of our Gram Paryavarn Samiti and Van Suraksha Samiti, we have protected and nurtured 17.29 acres of our common land by removing invasive species like Lantana, which has allowed the native Ladiya to regenerate. Today, they flourish and give us shade and fodder. We have imposed a community ban on the cutting and felling of trees, and formed rules and regulations to manage these lands. This has helped native species regenerate and we are very happy to see some trees grow to 20 feet."

Manohar Dhurwe,

Bhanpur, Mandla

Another good example of common restoration is a large pond/lake and forest combination implemented in Gubari village. In this village, large efforts have been made to develop a large

[1] Sandhu, H., Zhang, W., Eldidi, H. & Meinzen- Dick, R. (2021, 19 maart). International Forests Day: The crucial value of India's common lands. ifpri. https://www.ifpri.org/blog/international-forests-day-crucial-value-indias-common-lands
[2] Pradhan, N. & Tripathy, S. (2022, 3 augustus). How 36 villages in Odisha came together to protect their forest | IDR. India Development Review. https://idronline.org/ground-up-stories/how-36-villages-in-odisha-came-together-to-protect-their-forest/
[3] Sekar, S. (2020, 18 augustus). Lantana invasion threatens 40 percent of India's tiger habitat, reports study. Mongabay-India. https://

india.mongabay.com/2020/08/lantana-invasion-threatens-40-percent-of-indias-tiger-habitat-reports-study/

common pond with good conserved forest upstream. This pond was primarily used by farmers living nearby for irrigating their farms and by some other households for domestic purposes (bathing), it was decided to use the pond for undertaking community fishery. After obtaining permission from the Panchayat, the community undertook de-siltation of the pond and removed the shrubs through Shramdaan (voluntary contribution of labour) and the village institution collectively framed rules for the governance and management of these water commons. Now the water is retained, and the pond has sufficient water all year round and also helped improve the community's food diversity (fish for 65 households) and nutrition intake while also helping them save a part of their income (Figure 4).

With these examples, we hope to give insights into ways/ practices of communities and institutions to treat common land such that it provides resources for the whole (or at least a large part) community. This gives a community incentive to maintain these common resource pools.

Figure 3: Forest located on a hill. Together with three (?) villages, the forest is conserved, providing common resources for all villages

Figure 4: Common pond that provides multiple common benefits (fish, bathing, etc.) Gubari village, MP.

# A CONVERSATION WITH SHOBHA TIWARI: A CHAMPION OF TRIBAL LAND RIGHTS

Authors: Anushree Mitra, Meghna Mukherjee, Poulomi

Meet Shobha Tiwari. Though she hails from Chattisgarh state in India, she has lived and worked in Samnapur Block, Dindori district of Madhya Pradesh (MP), for most of her life. After her post-graduation, she was preparing for her M.Phil when she joined Ekta Parishad in 1999. During that time, there was a walk regarding land rights from Chambal to Raigarh in MP. She was a part of that for 15 days. During that time, she visited Dindori, a Baiga[1] (The Baiga is an ethnic group found in central India, primarily in Madhya Pradesh) dominated area. There she noticed that the lives of the Baiga community are entirely dependent on the forests.

During her interaction with the Baiga community, Shobha realized the extent of dependence the community had on the forest produce. Though the community had access to most of the resources to sustain their living, they still lacked resources. Grains, for example, were such a commodity. Additionally, they did not have access to education or credit, which made their lives difficult.

When she saw all of these, she realized that working with them is crucial so they can be empowered without losing their culture, knowledge, and traditions. Traditions and indigenous knowledge form an integral part of the Baiga Community. “But traditions will stay alive only when their stomach is full. Even if they migrate, they cannot adjust because their lives are always forest centric. They were nomads. They had no clothes, house, education, or grains. Forest was their only resource,” said Shobha Tiwari. She added that the problems were exacerbated when the central Government implemented rules and regulations to access the forest and its produce. The Forest Department was the sole authority on all matters related to forests. The shift in power to the formal government authorities adversely impacted the Baiga community. Seeing the challenges faced by the people, Shobha Tiwari decided to leave her home and education and dedicate her life to working on these issues.

The most critical challenge was to provide them with the right to their lands. Shobha adds, “If they get the right to the lands, they will be able to grow their crops. Two important things will happen if the Biagas start growing their produce. One is that they will stop with their nomadic life and settle in one place, and the second is that their debts with the moneylenders will stop.” Struggles over land rights take a lot of time. There was much back and forth between the community and the forest department. The authorities levied fees, fines, and punishments to discourage people from clearing the forests for farming activities. However, the people did not give in, and nothing could deter their spirits. In 2007 when a land rights movement was taking place in the country, Shobha Tiwari and the community saw it as the perfect opportunity to make their voices heard.

Remembering the struggle, she says, “We wanted the rights to the land we are farming on. We wanted our land documents. The Government stated that the forest lands were theirs, but these lands have always belonged to the Baigas. To get what is ours, 4000-5000 people went to Delhi from Dindori to demand their rights from the Government. After a long struggle, finally, in 2008, people started getting their documents.”

A relieved and happy Shobha Tiwari says that it makes her immensely happy to see that Today people have their land documents- they can farm on their land and eat what they grow. Some people can produce 40-50 quintals of rice, while there was one time when people did not even have 1 kg of rice to sustain their lives.

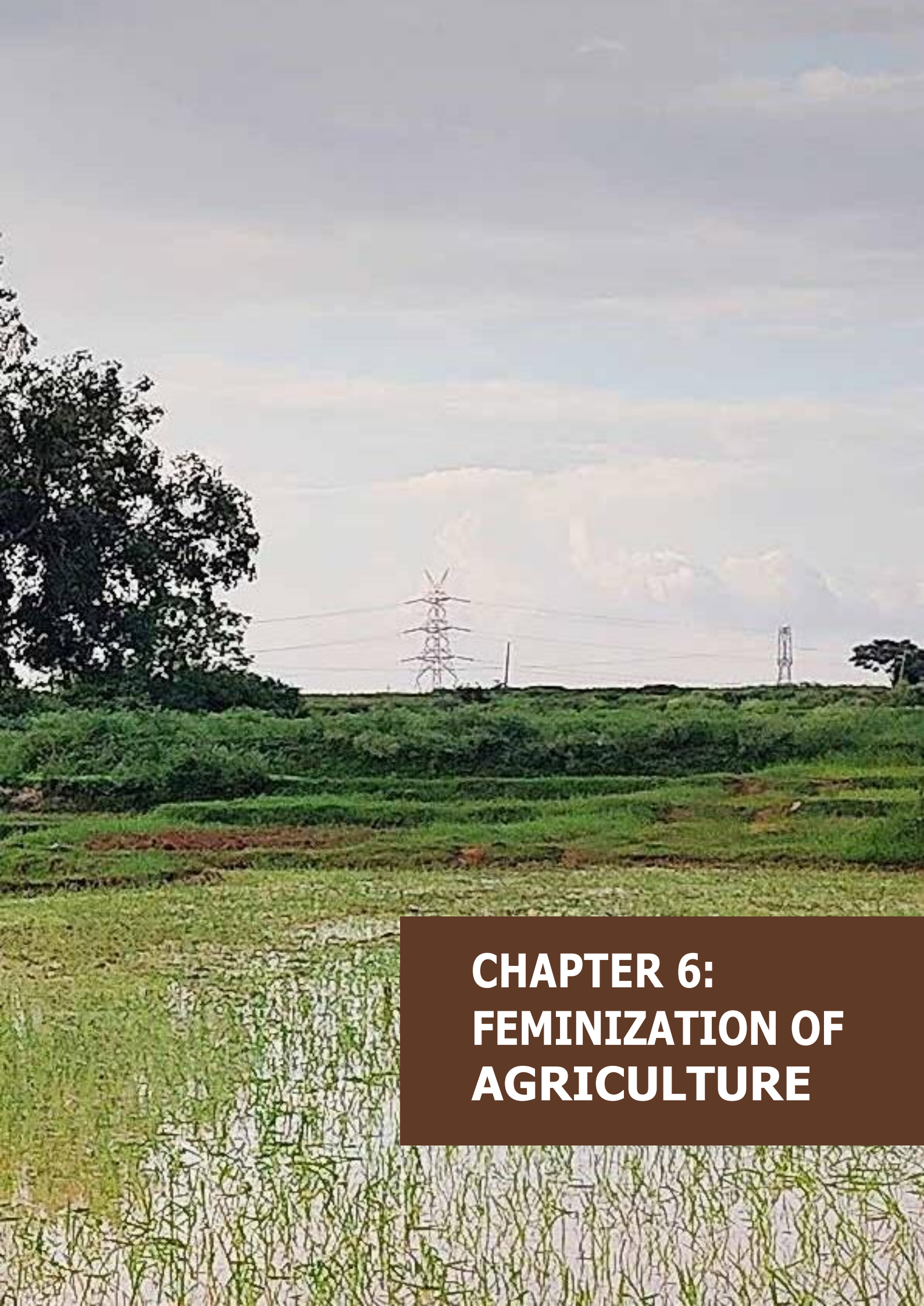
As people started becoming more food secure, they were able to improve their lives on other fronts. Education was the next important thing; the children were sent to school to receive formal education. It was seen that “If the children have awareness, the parents have awareness.”

Another significant milestone was to start working with women. The approach was not to work only in finance but to empower them holistically. This led to the creation of the Mutual Help Group. The group would save money and take loans and voice their opinion against the evil of society and social injustices. They would fight for their rights. Shobha Tiwari proudly says, “Today, a lot of women have become very active, and a lot of organizations have started working with these women only. The journey from bringing the women from the kitchen to the roads was long and full of struggles. A journey for the women to express their opinions.” Now, elected women officials have the autonomy to make their own decisions and have space to work freely without the fear of their husbands taking their place.

The community and the people are now more vocal about their demands and do not hesitate to ask the Government for their rights. They demanded water supply, fertilizers, and seeds from the Government since most of the land they received were not fertile. The Government was able to comply with the demands. Shobha Tiwari says, “The Government and the politicians have never directly opposed us. They were not sympathetic to our cause but never went against us. The Forest Department never sympathized with us because we were fighting against them. Maybe the department wasn’t in favor of us but the members working there were always supportive because they knew they also came out of these areas. They know what the situations and conditions of these areas are.”

Looking back at her struggles, Shobha Tiwari says that though life was difficult and everything felt impossible, the community’s love and trust kept her going. After 20 years of work, she is proud and relieved to see that the tribal communities can do farming and are self-sustainable. They can produce enough to sustain their family. They have schools and hospitals and are slowly reaching a good quality of life. With a warm smile, she concludes, ***“The objective that I had when I left home; Today, it is more or less complete. I feel very content that Today no matter what happens, they are ready to fight their fights. They understood that these were my struggles and I needed to fight for them. And I feel pleased when I see them Today.”***

[1] Baiga tribe. (2022, October 28). In Wikipedia. https://en.wikipedia.org/wiki/Baiga_tribe



# CHAPTER 6: FEMINIZATION OF AGRICULTURE

# INTRODUCTION TO FEMINIZATION OF AGRICULTURE WITHIN GTP

Feminization of agriculture is the increase of the percentage of women in the agricultural labor force relative to men, either because more women are working or because fewer men are working in agriculture. It also refers to the extent to which women define, control and enact the processes of agriculture. Predominantly, the increase in agriculture feminisation relates to high poverty levels (women are forced to work as agricultural laborers to provide their families with extra income) as well as agrarian distress and migration to urban areas (rising shift of men from farm to non-farm activities, women have got absorbed in agricultural and allied activities). Nevertheless, the patriarchal structure of families, communities and states in India has led to the neglect of the lives and the labor of women farmers. Women's work is not recognised as that of a farmer and they also have been taken for granted in their multiple roles such as caregivers and domestic providers

which are unacknowledged and unpaid. Therefore, it is clear that social relationships of power and inequality shape the hierarchy of workers, especially women workers.

When engaging in agriculture, women in India therefore face four main problems. Firstly, gender disparity in land ownership. The increase in the women workforce in agriculture has not translated into a change in decision power regarding property, inheritance and marriage. Still, only 13% of women own landholdings. Secondly, inadequate access to credit. Credit, insurance and other government schemes are not granted in the absence of land ownership leaving landless women and female agricultural workers on the fringes. Thirdly, access to markets. Fragmented and unregulated markets make the scenario less 'women-friendly'. Plus, limited access to mobility, cultural norms and gender inequality make it difficult for women to access the market areas. Lastly, limitations in access to justice. Under India's new agricultural reform, agricultural conflicts are not settled by local courts but rather by external agricultural boards. Women who lack access to information, transport and money to travel are at a greater disadvantage. The enhancement of the capacity building of women farmer producer's organizations, the strengthening of local institutions, developing agricultural tools that reduce labor intensity, and the creation of agricultural value chains is thus of high importance to strengthen the position of women farmers.

The blogs bundled in this chapter result from GTP's feminization of agriculture activities and explorations thus far. The blogs include several examples from women and elaborations on the identity of women farmers in India.

# IDENTITY OF WOMEN FARMERS IN INDIA

Author: Anushree Mitra

In Jharkhand there is a common belief related to ploughing and tilling of the land that if a woman even touches the equipment, it will not rain.

When we talk about farmers, often a common picture that comes to mind is that of a male farmer. More often than not, the women are left out of the main picture; an alarming problem that we are dealing with. Women make up 48 percent of the Indian population but have not benefited equally from India's rapid economic growth[1]. During visits to tribal belts of Jharkhand and Madhya Pradesh, there was a major concern that kept coming up- women either hesitate to express their identities as farmers or are not aware of it. This reluctance stems from the age-old traditions and practices that hold a very strong place in their mindsets.

An interesting fact to note in this context is the division of labour. Not only are women here strictly not allowed to till or plough the land, they are not allowed to even touch

the equipment. According to them, only a man is supposed to perform this task. During focus-group discussions in Madhya Pradesh, one male farmer stated that since the land is very rocky and undulating, it is very difficult for a woman to till it. Nevertheless, on a daily basis a woman is engaged with unaccounted household chores like cooking, cleaning the house, washing dishes, clothes, preparing children for school, taking care of the livestock and grazing them. Apart from this they also perform most of the tasks in the fields such as sowing, harvesting, de-weeding, applying insecticides, pesticides, etc. Since the advent of Self-Help Groups (SHGs), they also involve themselves in meetings of the groups and work of local NGOs. They are already overburdened with work and despite such hard, accounted labour; the identity of women as farmers is still very obscure in their own minds and as well the society's. Women in the context of agriculture are more labourers than decision makers. One of the reasons for this is the land ownership traditionally remaining with a man.

***"God made night only so that women could sleep. Had he not made night for us, maybe we wouldn't even have slept"***

- Woman farmer in Jharkhand

The land ownership is always legally a man's and never a woman. Women do not inherit the properties of their father or husband, only the male heir does. And if there isn't a male heir, it gets passed onto some other male member in the family. Women even to this day are not the decision makers in agriculture. Although the situation is better than before but more often than not, a woman's views and opinions are not considered.

This is not just the case in Jharkhand and Madhya Pradesh states. Women of our society have been left out of the main picture for the longest time. Only in the recent past things have started changing and the recognition of the 'other gender' has been brought into the mainstream ideas. Local Civil Society Organizations (CSO), Community Based Development Organizations (CBDO), the

[1] https://www.worldbank.org/en/news/feature/2019/03/08/working-for-women-in-india

Central as well as the State governments are promoting women farmers. Various schemes, interventions and projects planned around the central focus as women farmers, trainings, various incentives, handholding support and a lot more of such plans are being implemented.

In India the central as well as the state governments are providing huge benefits to women farmers. If the land is in the woman's name, the government is giving incentives like low registration costs, loans, etc. For example, the Central government has a scheme called MKSP which recognizes the identity of "Mahila" (women) as "Kisan" (farmers) and strives to build the capacity of women in the domain of agro-ecologically sustainable practices. It has a clear vision to reach out to the poorest of poor households and expand the portfolio of activities currently handled by the Mahila Kisan (women farmer). Like this, there are many benefits for women farmers such as support for Women Food Security Groups (FSGs), representation of women farmers in decision making bodies, provision of seed money /revolving fund, capacity building, skill development and support services, etc.

Despite these development, very little progress has been made in this aspect overall. One of the reasons is traditional and cultural values. When we asked a group of male farmers in Jharkhand's Godda district what their idea of women as farmers was, interestingly most of the men there agreed that women are also farmers. Some even acknowledged that women do most of the work related to their fields, yet none of them promoted ownership of land under women in their family. When asked why, a lot of them stated 'if the woman abandons us, our land will also go with her.' One male farmer above the age of 60 in the group said that '...we can never transfer the ownership of the land to the women. Only when the women walk behind us, will they walk with us.'

Hurdles such as these are expected to come our way but we shall not stop. As we can already see, the interventions of Self-Help Groups, Micro Finance Institutions; effect of higher literacy rate, training in gender sensitization and bringing abuses under the purview of the law have been nothing short of a revolution in its own way for these women. Although this is still a long-drawn battle, hope is infinite.

When we interacted with various stakeholders like women farmers, male farmers, government officials, local governance functionaries, various other CSOs, something very interesting to observe was how each and all stakeholders think about the issues related to regenerative agriculture, women's identity as farmers, government systems in the country, etc. Women farmers have started acknowledging themselves as farmers, especially after the intervention of FPO (Farmers Producer Organization). But there is still some reluctance to accept this due to the traditional belief that only men are farmers. But here and there we can see small acts of rebellion like, a particular woman who had fought with her husband and sold their produce alone in the market without anyone's help and sold it at a much better price (women do not have access to markets Another interesting aspect that came out of the FGDs was the attitude of the government functionaries towards the women, especially the ones who had a strong voice. On one hand, the government is on a mission to promote women farmers. On the other hand, some functionaries get angry at women who complain.

When asked about issues regarding women, one can see a lot of blame games coming. While some officials say that the women don't raise their voice; others blame the system and the ignorance of the government on the ground. Similarly in the case of local governance and functionaries, a lot of negligence and corruption has been found. They also blame the system and stated that no one ever listens to them. But in reality, a lot of times we have seen that they do not let the women come forward and voice their opinions.

In the context of Jharkhand and Madhya Pradesh, women and their contribution to agriculture are undeniable. In the area of organic farming or regenerative agriculture, currently with the help of a local NGO, PRADAN, numerous women are making and selling organic inputs as well. Various trainings are going on to strengthen their capacities in agriculture, especially regenerative practices. Thus, from producing farm inputs, to selling, to applying them to the fields, to managing their households, families and fields--- in every aspect we see the protagonist to be a woman. When properly analysed, we can see a lot of gaps, lacunas, discrepancies, corruption, and negligence in the systems. Right now, our focus should be more on analysing the systems enough to come up with interventions and plans which will not only impact at scale but also shall be sustainable. We should hope for a future where when people talk about farmers, they shall think of a woman as well. I'll end this with a quote from a woman farmer in Jharkhand. This one shall stay with me for a long time.

***"You study the books and learn agriculture. We practice it on land and learn agriculture."***

# A CONVERSATION WITH MEERA BAI: A BRC BUSINESS MANAGER

Authors: Meghna Mukherjee and Vinitika Lal

Meet Meera Bai from Kutela Gram in Dindori District in MP. Meera has been running a Bio-Resource Centre (BRC), which makes and supplies organic inputs like biofertilizers and bio-pesticides. A BRC is a small organization promoted by PRADAN. The objective behind promoting a BRC was to have a centralized system of producing and distributing organic fertilizers and pesticides among other farmers.

Meera Devi worked as an Ajeevika Sakhi (literally translating to Livelihood Friend) before starting her business as a BRC manager. As an Ajeevika Sakhi, she received training on the benefits of organic agriculture and the role a BRC can play in promoting organic agriculture. She slowly realized the financial impact of running a BRC on her personal life. Meera recalls, "Earlier, I used to ask for money from moneylenders, and it was not a good feeling. Then I joined a self-help group and would take money on loan from there and repay the money on time. I felt good. I am running this Bio-Resource Centre, and I can proudly say that I am earning a good amount of money to support my family. And this is the best feeling."

When asked if financial independence was the only thing that inspired her to take up this role, she nodded in disagreement. She added that through the training, she was made aware of the harmful effects of chemical fertilizers on the crops. And as a farmer, she has witnessed firsthand how soil quality has deteriorated over the years. "I wanted to promote good agricultural practices among farmers, and that is why I started making different organic products and supplying them to farmers." Currently, Meera Devi is involved in making four different products: Matka Khad (___), Waste Decomposer, Agni Astra (___), and Vermi Astra (___). The application of DAP and Urea has deteriorated the soil and is unsuitable for human health. These chemical fertilizers are expensive, while the organic fertilizers made at her BRC are less expensive. "It is my goal to supply low-cost natural fertilizers and pesticides to farmers in and around my village," she adds.

But was everything easy and smooth in her journey from Ajeevika Saathi to a BRC businesswoman? Reflecting on her journey, Meera Devi said she faced many challenges. When she first proposed the idea of starting a BRC, the first challenge was collecting funding for the same. While most of the SHG members agreed to join at first, everyone took a step back a few days later. But Meera Devi was confident. She knew running her own business center for a good cause would reap her returns. She says, "I discussed my problems with my family. My husband was very supportive. He encouraged me to take a loan, and he also took a loan so that we could fund the investment." After gathering money, she procured the required materials to start her business. And within a short time, she could repay her and her husband's loan. However, things

got more challenging. The raw materials required to make the different fertilizers and pesticides take a lot of work.

Water, cow dung, cow urine, and other green leaves are not easy to find, collect and store. The village did not have a secure water supply. To fetch water, women have to walk and carry water from long distances, which is cumbersome. Also, raw materials like neem leaves and others are difficult to accumulate. Chilli and garlic are added to form a paste that involves hard work. Collecting cow urine and dung is the most difficult as it must be planned and arranged before making bio-fertilizers and bio-pesticides. The women who collect cow urine must be informed before making it, as they can manage only a certain amount daily.

Despite facing these challenges, Meera Devi is cheerful. She believes that awareness raising on the benefits of natural fertilizers is necessary. Once farmers are aware, training would be essential regarding how to apply it, in what quantities, and when. She is hopeful that her products will have a good customer base. She feels that women farmers should adopt natural fertilizers to improve their family's health and reduce the land's degradation- even if it's on 0.5 acres of land, they should start applying it.

Meera Devi is proud of her journey and the kind of impact she has been able to make through her business. She reflects that the business has helped her become more assertive. She has interacted with people from all over the world and is now recognized as a businesswoman. She is respected in her society, and her opinion is considered valuable for matters of importance. When asked where she sees herself in the next 5 years, she smiles coyly and says, ***"My business expanded to 54 villages in my block where PRADAN is involved."***

# A CONVERSATION WITH SUMITRA DEVI: THE REGENERATIVE AGRICULTURE PIONEER

Authors: Akanksha Mishra, Meghna Mukherjee, and Marina Vara Gutiérrez.

Meet Sumitra Devi. She hails from Chatugada village in the Bokaro district of Jharkhand. Since 2007, PRADAN started promoting self-help groups (a self-help group is an intermediary financial institution usually composed of 12 to 25 local women. The main idea was to ease access to credit and finance) in Sumitra's village. PRADAN has promoted a total of 7 self-help groups (SHGs), and she was part of one SHG namely Jiyad Jharna Mahila Mandal.

She says, "My husband, Naresh Manjhi, and I have been cultivating paddy and maize in the Kharif season (June/July to September/October) and growing potato in the Rabi Season (October/November to January/February) in the 60 decimal[1] of land that we own. After receiving training from PRADAN on better agricultural practices, we have started growing different crops like tomato and brinjal during the Kharif season".

Planting new crops has resulted in an increase in their income which has boosted their confidence to experiment with the farming of other crops. From 2007 to 2021, Sumitra Devi and her family invested their time in growing different kinds of crops. During all those years, one lesson which stuck with her was how the use of chemical pesticides and fertilizers was decreasing the soil quality of their land. To understand the steps she can undertake to revive the soil quality she connected with PRADAN officials who organized a village demonstration on preparing organic fertilizers and associated crops by adopting the principles of regenerative farming. These new activities, in addition to the installation of solar pumps which secured access to water, helped in tackling the problems farmers were facing due to the use of chemical fertilizers and pesticides.

After gaining confidence, Sumitra Devi with the support of her husband set out to experiment with new activities like multilayer farming. "In the Kharif season, my husband and I decided to pursue multilayer farming in 10 decimal of land by cultivating bottle gourd and radish". However, the process of setting up a multilayer plot was not easy. Sumitra Devi had to make some initial investments like purchasing nets, poly wire, and new seeds to put into the multilayer structure. She also started purchasing organic inputs from the OPU unit (a smaller version of the Bio-Resource Centre where all the organic inputs are locally prepared)to apply to the crops established in their own village. She applied Jeevamrita and Dhanjeevamrita (liquid organic fertilizers) for growing gourd and radish, and at an interval of every ten days, she used Agniastra and Brahmastra (organic pesticides for chewing pests) to protect the crops from pests. She says that to protect the crops and as a safety

precaution she used Nimastra (an organic pesticide for sucking pests) on their land. All these organic inputs started showing a positive result from the beginning.

The installation of the multilayer system has been a success for Sumitra. Despite the high rainfall over the last season, she harvested gourds 15 times in 3 months. She was able to sell a total of 600 kg of gourds from which she earned Rs. 18.000. Radish was more affected by the changing weather conditions, but she still managed to earn an additional income of Rs. 20.000 from radish. This additional money helped Sumitra Devi to continue improving and investing in her farm.

Boosted by her initial success, Sumitra wants to continue innovating by practicing new techniques and growing new crops. This Rabi season, she plans to grow beans and bottle gourd on her multi-layer farm. She has also planted papaya plants around her multilayer farm as a boundary. The papaya plant will act as a windbreaker and also provide shade to the crop apart from the financial return on it. She is also excited that the leaves from the papaya plant will help her prepare organic pesticides at home and will also be consumed by the family: leading to a healthy life.

Sumitra concludes;

***'Since I started practicing regenerative farming I produce more crops on the same piece of land, I am earning more money and I am protecting the soil fertility of my land'.***

[1] 1 decimal is equal to 1/100th of an acre

# THE START OF SOMETHING GOOD!

Author: Nivedita Kashyap

## Introduction

It was the 1960s. India was struggling with food insecurity. Growing population, limited agricultural land, climate issues like drought, lack of innovation in new agricultural technologies was creating a situation of severe starvation in India. Something was to be done!

The Green Revolution was a period that began in the 1960s during which agriculture in India was converted into a modern industrial system by the adoption of technology, such as the use of high yielding variety (HYV) seeds, mechanised farm tools, irrigation facilities, pesticides and fertilizers.

India started producing crops in bulk, we were (are!) self-sufficient now, capable of producing and feeding our growing population. However; there was also a problem lurking from behind the success of the green revolution. The extreme use of pesticides and chemical fertilizers!

## The struggle. The confusion.

This is the story of Josephine Kisku from Beltuppa in Poreyahat block of Jharkhand, India who decided to take a step in the right direction and fight against the overuse of chemical fertilizers in agriculture.

To take care of a family of five, Josephine Kisku along with her husband Sunil Besra cultivates their land of about 12 acres, rears livestock like poultry, ducks, and pigs earning a combined family income of Rs. 1.2 lakhs/year. Supporting her husband in these activities, Josphine Kisku had always wanted to do something by herself. She has been an active member of her Self-Help Group, working as both, AKM (Aajivika Krishi Mitra: Community Resource Person) and AE (Agricultural Entrepreneur[1]) to provide training and facilities at the village level for a while now.

“PRADAN floated the idea of BRC (Bio Resource Centre) in June, 2021 to us. Everybody was unsure. I did not know what to do. We have been using chemical fertilisers for years now, how can we suddenly switch to organic farming? Will we get enough produce to feed our families? Where will we get raw materials for production of BRC products? Who will buy these BRC products?”, were a few apprehensions of Josephine Kisku along with the other Agricultural Entrepreneurs.

Before we get into the details of BRC, and how it operates in the agricultural economy of a village, it is important to understand what BRC is exactly.

## What is BRC?

PRADAN conceived the idea of setting up Bio Resource Centres (BRCs) owned and operated by

Agriculture Entrepreneurs (AEs). With awareness and demands for bio-inputs increasing in the world and India, there was a market created for various bio-formulations that could be manufactured locally with infusion of some knowledge and skills among the AEs. The Bio-inputs mostly used locally available materials like jaggery, gram flour, neem leaves, gaumutra (Cow urine), etc. The products manufactured and sold through BRCs include vermi-compost, beejamrit and shivansh; pesticides like neemastra and agneyastra. Some of the items such as pseudomonas, trichoderma viride, mycorrhiza, rhizobium are sourced from local markets.

Fig. Products available at a BRC centre

## Introducing BRC in the villages

Initially, the idea floated by PRADAN under the GTP project was dealt with apprehension. Finally, a few Agricultural Entrepreneurs in the area decided to attend the training to understand the concept. The training is being organised from June 2022. Later on, an exposure visit to Madhya Pradesh in August, 2022 for 14 members of the block was also organised.

The importance of BRC was realised! Josephine Kisku decided to produce the BRC products at her home. “We realise the bad effects of chemical fertilizers, the quality of soil in our land has decreased tremendously but we did not know what else to do. When PRADAN introduced us to the concept of BRC, I decided to take it up. I thought I will use them in my land if nobody buys it, I will earn a little but at least I will learn something new”.

This was the beginning of something good!

Josephine Kisku started procuring raw materials from the villagers. Earlier wasted products like cow urine or neem leaves, had (has) a value now. Farmers selling these to Josephine Kisku were also earning money out of it. Also, the BRC set up is facilitating a circular economy as the model of production and consumption involves sharing, leasing, reusing, and recycling the existing resources and products as long as possible is happening.

Josephine Kisku is being provided with all the technical support under the project. Training, support, raw materials (at the initial stage), all was provided to Josephine Kisku to start her business.

## he shines (despite the struggles)!

The creation of a market to buy organic fertilizers is tough. “Even with the awareness around the harmful effects of fertilizers on the soil and on health, the farmers use the same as they can-not compromise on productivity”, says Ranuka Kisku. Executive, PRADAN while talking about the difficulties to create the market for BRC products.

Josephine Kisku started visiting SHGs (Self-Help Groups) and CLFs (Cluster Level Federations)[2] to make farmers aware of the new organic fertilizers

[1] Agricultural Entrepreneurs are rural youth, women and men, who are interested in building a business/enterprise that has a market in their neighbourhood.
[2] CLF or Cluster Level Federation is an aggregation of village organisations, typically twenty to thirty village organisations spread over 3-4 panchayats.

that she is making. She is also helping and training fellow farmers in the village to take up organic farming and regenerative agriculture. “In September 2022, the leaves from chilli farms of one of the women farmers started dying forcing her to discard her entire crop. I asked her to use BRC fertilisers once or twice and check if something happens. We saved her chillies”, says Josephine Kisku with pride while narrating the story of how she could save the chillies of a women farmer with the help of her BRC products.

Fig. Josephine Kisku: Preparing BRC products

The stories of her producing these products are reaching far areas. She has sold her product in the 10 villages till now earning Rs. 9,000 since September 2022. She aims to earn a minimum of Rs. 1 lakh per year in the future by spreading her business to more villages and panchayats.

Fig. Chilli plantation treated with BRC products

The farmers using these products are also reporting an improvement in water retention capacity and the quality of the soil. “Using BRC products has several benefits. Not only it improves the soil quality but also it will bring back the insects and other natural organisms earlier present in the soil which help with better productivity”, informs Renuka Kisku. A deeper analysis of the trend of the farmers buying the BRC products tells that the farmers are also giving it a try as they are a cheaper investment as compared to the chemical fertilizers (the continuous availability of these in the market is also a challenge!).


Fig. Josephine Kisku at the front of her shop

Fig. Joephine Kisku selling BRC products to a farmer

## The Challenges

"Organic farming takes a minimum of two to three years of investment (financial, behavioural, marketing, etc.) to show proper results. The villagers do not want to give two to three years as they are already struggling with low incomes and can not afford even lower earnings for consecutive years even if it will yield results later", says Rakesh Kumar Deputy Project Director, ATMA (Agriculture Technology Management Agency), Godda.
The government has set up several institutions with regard to understanding the needs of the traditional agricultural system and is conducting research & training around it. Institutes like KVK (Krishi Vigyan Kendra) and ATMA are one of the several stakeholders involved in implementing regenerative farming and BRC in the villages but the challenges remain. The risk-taking capacity of the farmers remains low!

Another added woe to the adoption of BRC in rural areas is the lack of proper marketing linkages for the product which is unanimously accepted by all the stakeholders including the government and the community members. "Marketing is a problem for now. Since not a lot of people know about this, the selling of the product also reduces", says Josephine Kisku.

It also must be noted that despite prioritising women to lead these BRCs, right now only 2 out of 9 women own BRC centres in the area. The women even after working on their farm lands as an equal to men do not consider themselves as a farmer.

## Way Forward

Even with several challenges, the future of BRC in Godda looks bright. The future plans of Josephine Kisku include reaching out to different SHGs (Self-Help Groups), CLFs (Cluster Level Federations) and give training around regenerative agriculture and get farmers acquainted with the idea of BRC. She also plans to open a shop in the market of the town for better marketing and making it easier for villagers to access these products.

"Now, even if PRADAN takes itself out of the ecosystem, I will continue working around BRC", says Josephine Kisku happy with her selling, improved quality of soil in her own backyard as well others whom she sold the product.

For PRADAN, it plans to create more BRC entrepreneurs, increase the demand of BRC products so that the quality of soil improves and also, people like Josephine Kisku find a market

to sell their products. And for all the other stakeholders including the community members and the government, it is the time to work together to negate the bad effects of chemical fertilizers while continuing to maintain the productivity of the agricultural land.

The future awaits!

Fig. Inside Josephine Kisku's shop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