How agroecology can empower women farmers: a study of a transition to natural farming in Himachal Pradesh, India

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Declaration of Original Authorship

I confirm that this is my own work and the use of all material from other sources has been properly and fully acknowledged.

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Abstract

This research provides new evidence, derived from the experiences of women in rural Himachal Pradesh in north India, that agroecology has the potential, under certain conditions, to facilitate women's empowerment within their communities. In 2018, the State of Himachal Pradesh in north India launched an initiative to convert all farmers to natural farming, an agroecological approach. The approach sought to address multiple challenges for rural livelihoods, such as high input costs, biodiversity loss, and environmental degradation. This study used this transition programme as a case study to qualitatively explore women's perspectives on the advantages and challenges of transitioning to natural farming. Data was collected iteratively from thirty-five villages across five districts in Himachal Pradesh between November 2021 and December 2023. To understand the context, challenges, crops cultivated, and mechanisms employed to engage with farmers and scale out practices, 210 farmers were interviewed, focusing on marginal women farmers. The use of life story interviews, semi-structured interviews, and ethnography enabled a nuanced understanding of their lives, constraints, and how the natural farming transition affected their lives at home and in the community.

The case study illustrates how an intentional equity focus on agroecology efforts has the potential to empower women. The research identified mechanisms that create new opportunities for decision-making, income-generating roles, and spaces for community learning, leading to higher levels of autonomy. Training in villages, participation in natural farming groups and networks, visits to conferences and model farms, and leadership roles offered new pathways to women farmers to gain confidence and capabilities. Furthermore, the areas where the mechanisms were inadequate for an empowerment approach were identified. These included the need to build communication agents' capacities in using a farmer-centred approach and participatory methods to foster a culture of enquiry and innovation. In addition, greater support for farmer seed systems is required to facilitate access to Indigenous seeds. The findings represent a valuable empirical case study and make a novel contribution in an emerging area of research that is currently underexplored but essential to delivering agroecology-based empowerment pathways in agriculture for marginal farmers.

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List of Abbreviations

ATM	Assistant Technology Manager
ATMA	Agriculture Technology Management Agency
BDA	Biological Diversity Act
BPKP	Bhartiya Prakritik Krishi Paddhati
BTM	Block Technology Manager
BRC	Bio resource centre
CAC	Campesino a campesino
CBD	Convention on Biological Diversity
CETARA	Certified Evaluation Tool for Agriculture Resource Analysis
CF	Conventional farming
CSO	Civil society organisation
FAO	Food and Agriculture Organisation of the United Nations
FYM	Farmyard manure
GR	Green Revolution
HLPE	High Level Panel of Experts
HDI	Human Development Index
IMF	International Monetary Fund
HYV	High yielding variety
ICAR	Indian Agricultural Research Institute
IPRs	Intellectual property rights
ITK	Indigenous technical knowledge
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
KVK	Krishi Vigyan Kendra
LVC	La Via Campesina
MLP	Multi-level perspective
MNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
NF	Natural farming

PBR	People's Biodiversity Register
SPIU	State Project Implementing Unit
SPNF	Subhash Palekar Natural Farming
TRIPS	Trade-Related Aspects of Intellectual Property Rights
TVs	Traditional varieties
TandV	Training and Visit
UN	United Nations
UNDROP	UN Declaration on Peasants' Rights and Other People Working in Rural Areas
UPOV	International Union for the Protection of New Varieties of Plants
WHO	World Health Organisation
WTO	World Trade Organisation

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1. Introduction

> *"I used to feel that I didn't know anything. I used to be afraid. But now, I have learned how to speak to people confidently, and my knowledge has increased. My husband noticed the change in me and now looks to me to make decisions. It is because of natural farming that I have become known and progressed in life. I will never leave farming."*

These words were spoken by SK, a 40-year-old woman farmer who has been practising natural farming for four years. Reflecting on her role as a farmer, she expressed a sense of empowerment, optimism, and a strong commitment to farming. This starkly contrasts with the numerous challenges and crises that farmers face in India. This research is essentially concerned with how farmers can transition from a state of crisis to a state of feeling empowered and optimistic about farming.

1.1. India as the context

Rural India is considered to be in a state of distress (Kumar et al., 2020). Multiple factors have led to this condition. Employment in the farm sector is declining. With the rapid rise in industry and urbanisation common to developing countries, men tend to migrate to cities or seek waged employment on large farms or in other sectors as they face fewer mobility and time constraints than women. This has been the case in India, where the agricultural sector faces significant challenges, which scholars characterise as an 'agrarian crisis' (Reddy and Mishra, 2009; Lerche, 2011). More than half of India's agricultural households, out of the estimated 93.09 million, were in debt, according to a 2019 survey (Satyasai and Jadhav, 2022). The survey found evidence of extreme indebtedness where farmers could not fulfil their household consumption needs from all their earnings, including wage work. More than half of the income of marginal farmers is from wages.

About 86% of farmers in India are smallholders with farms up to 2 hectares (GOI, 2019b). They are struggling with a farming crisis partly linked to the technologies of the Green Revolution (GR). The emphasis of this approach was on the cultivation of monocultures with high-input, energy-intensive agriculture. It resulted in the marginalisation of peasant farmers, soil

degradation, deteriorating human health and loss in biodiversity (Deb, 2009; State of Environment Report India, 2009; Patel, 2013). India is the fourth-largest producer and ninth-largest consumer of chemical pesticides, and pesticide use is increasing by 10% to 20% annually (Kumar et al., 2024). Besides posing serious environmental and public health risks, the high cost of inputs has led to many Indian farmers being caught in a vicious cycle of debt. This has resulted in increasing farmer suicides (Economic and Political Weekly, 2019).

Agriculture is the mainstay for most workers in rural India. According to the Periodic Labour Force Survey of 2017-2018, 70.7% of the population lived in rural areas (GOI, 2019b). There was a marked difference between male and female involvement in agriculture: 55 % of the male workers compared to 73% of the female workers The participation of both men and women in agriculture declined, and the rate of decline for men was greater than for women. Women's higher participation in agriculture in this period relative to the men's level of involvement is viewed as the feminisation of agriculture. According to Oxfam (2013), around 80% of farm work is undertaken by women in India.

The fact that 73% of female workers work in agriculture is in stark contrast to the number of farms owned by women, which demonstrates a strong gender bias in land ownership and women's access to resources. Female-operated operational holdings amount to only 13.87% of all operational holdings (GOI, 2019a).

The average size of holdings has been declining for both genders. About 86% of the farmers in India are smallholders with farms up to 2 hectares (GOI, 2019a). The number of smaller-sized farms is increasing while larger land holdings are decreasing. About 70% of all farms are categorised as 'marginal' as they measure less than one hectare, and this has increased from 39% in 1960–61. Indian agriculture is thus dominated by small and marginal subsistence farmers.

Kumar et al. (2020) argue that rural India urgently needs an alternative vision for the sustainability and well-being of most of its population. The rural economy and life must be seen as a part of a larger interdependent ecosystem that values farmers for the ecosystem services and the healthy food they provide. This would entail changing agricultural policies that have previously emphasised extraction, increasing agricultural productivity while undermining farmer agency and traditional knowledge systems.

1.1.1. A brief history of India's agricultural research and extension system

India's agricultural research, education and extension system is the largest in the world. The term "extension" was first used in 19th-century Britain to describe the process of disseminating useful information and knowledge from universities to the general adult population (Garforth, 2010). Both research and extension have been the domain of national institutions, namely the Indian Council of Agricultural Research (ICAR) and their regional stations. ICAR established Krishi Vigyan Kendras (KVKs) or research centres at the district level. The role of the KVKs is to assess, adapt and demonstrate location-specific technologies and disseminate new technologies as a local farm science centre. There are 75 State Agricultural Universities (SAU) and 106 ICAR institutes linked to 721 KVKs (Prasad and Dutta, 2022). From the 1960s, SAUs were modelled after the US land grant colleges, integrated much of the curriculum based on knowledge of GR practices, and provided extension education. SAUs are usually funded by the State governments (OECD/ICRIER, 2018).

The extension services played a key role in demonstrating the use of GR technologies, hybrid seeds and agrichemicals. In addition to extension services, input subsidies and government procurement support encouraged farmers to adopt the GR model during the 1960s and 1970s (Babu et al., 2013). The promotion of the GR technologies was based upon what Freire (1970) referred to as a 'banking' model of knowledge transfer, which discouraged critical thinking and a culture of inquiry:

> "*In the banking concept of education, knowledge is a gift bestowed by those who consider themselves knowledgeable upon those whom they consider to know nothing*' (Freire, 1970, p.72).

Traditional knowledge was ignored and undermined. Instead of enhancing farmers' capabilities to analyse and tackle challenges, perhaps through synthesising traditional and new scientific knowledge, the instruction from extension agents adopted a prescriptive approach.

There were several amendments and reforms to extension services over the decades with a view to improving productivity. A Training and Visit (TandV) system was introduced in 1974 funded by the World Bank. TandV was based on extension staff receiving regular training in agricultural practices. These were disseminated to farmers through regular visits, usually once

every two weeks. The extension staff were to bring farmers' problems back to the extension office for research into finding solutions (World Bank, no date). When the funding ceased, the TandV system was deemed unsustainable due to high costs, although elements of it continued to be used. After running a pilot scheme from 1998-2004, the central government established several hundred Agriculture Technology Management Agencies (ATMA) nationwide to assist the states with agricultural extension. ATMA brought in new concepts, tools, and approaches to extension planning, such as more localised planning at the block level with farmer involvement in decision-making and participatory rural appraisal. However, ATMA performance varied from state to state. It faced challenges due to funding shortages, planning, limited capacity, training, and weak links to the research systems established by KVKs. Moreover, small, marginal farmers and women farmers were largely ignored (IFPRI, 2011; Babu et al., 2013).

1.2. The rise of natural farming in India

Currently, multiple agroecology initiatives in India aim to address the fallout from the GR technologies. Agroecology is an ecosystem approach that applies ecological concepts and principles to the design and management of sustainable agroecosystems (Altieri and Nicholls, 2017). According to Anderson et al. (2021, p. 12), agroecology comprises the following set of production principles:

> "*Adapting to the local environment; building healthy soils rich in organic matter; conserving soil and water; diversifying species, crop varieties and livestock breeds in the agroecosystem over time and space from a landscape perspective; enhancing biological interactions and productivity throughout the system rather than focusing on individual species and single genetic varieties; and minimizing the use of external resources and inputs (e.g., for nutrients and pest management)".*

Some of these practices are common to other ecological or regenerative agriculture techniques, such as conservation or no-till agriculture and organic farming. However, agroecology acquired a socio-political dimension (discussed in Chapter 2), its key distinguishing feature from other sustainable agricultural practices. Agroecology emphasises the importance of local knowledge and the agency and power of small-scale farmers, including women. It has a holistic ecosystem

focus, aiming 'to build long-term fertility, healthy agroecosystems, and secure and just livelihoods' (Gliessman et al., 2019, p. 92).

Natural farming (NF) rose to prominence in 2016 when the practices recommended by a farmer promoter, Subhash Palekar, known as 'Zero Budget Natural Farming' (ZBNF), were popularised by a grassroots movement, the *Karnataka Rajya Raitha Sangha* in Karnataka (Khadse et al., 2017). In Karnataka, the ZBNF movement spread spontaneously through the collective efforts of small and middle-class farmers, which caught the attention of other States attempting to establish sustainable agricultural programmes. In 2018, Andhra Pradesh and Himachal Pradesh (Figure 1) began an ambitious plan to transition all their farmers from conventional chemical agriculture to NF. Subsequently, in 2020, a country-wide National Coalition of Natural Farming (NCNF), a network of civil society organisations (CSOs), activists, academics and farmers, was established. It defined NF as "the direction and process of transition towards a more local, resilient, and adaptive agroecology based farming" (NCNF, 2021).

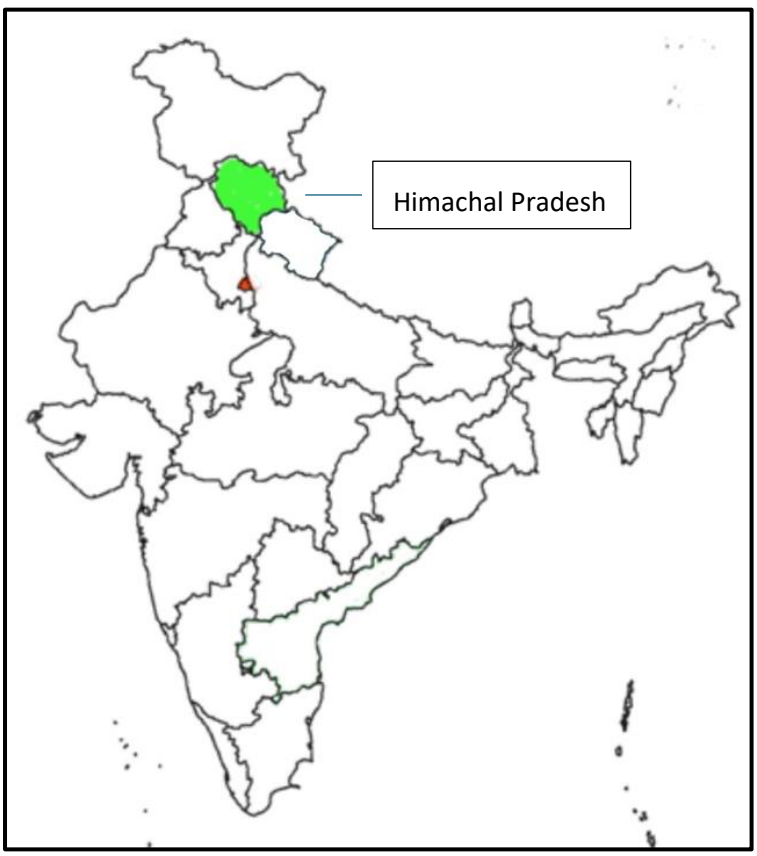

Figure 1: Map of India and location of Himachal Pradesh

The NCNF outlined the fundamental principles of NF: It promotes soil and planet-friendly practices; calls for the gradual reduction of synthetic chemicals; considers ecosystem services from a landscape perspective; encompasses a variety of biological approaches and frameworks; prioritises decentralised and community-friendly practices; and fosters a people's movement. These principles align with those of agroecology, which aims to create agricultural ecosystems that imitate local natural ecosystems.

1.2.1. Practices of natural farming

Palekar's methods were based on four essential practices to regenerate the soil microbiome, for which an indigenous cow was recommended (Table 1). Palekar believed that the urine of an indigenous cow offers the richest mix of microbes.

Table 1: Four essential SPNF practices

Jeevamrit – a fermented microbial culture of cow dung and urine, water, pulse flour, jaggery, and uncontaminated soil as a key component of soil regeneration. It provides nutrients and also acts as a catalyst to promote microbial and earthworm activity. The microbes make soil nutrients bio-available to plants. The microbial culture is also used in its solid form known as ghanjeevamrit. Jeevamrit is needed in the first 3 years of a transition, after which the system can become self-sustaining.
Beejamrit - treatment for seeds or planting material. It protects seeds and young roots from fungus, soil-borne, and seed-borne diseases that commonly affect plants after the monsoon period. It comprises local cow dung, cow urine, lime and soil.
Acchadan – this refers to mulching which comprises three types: soil mulch, straw mulch, and live mulch, which uses symbiotic ground cover intercrops and mixed crops. The mulch decomposes, forming humus through the activity of the soil biota and microbial cultures.
Whapasa - maintaining a porous soil environment and a microclimatic condition around the roots for water vapour to percolate. Irrigation is reduced and limited to particular times of the day.

Additional practices aimed at redesigning a system as a whole to regenerate the soil and promote integrated pest management included multi-cropping and intercropping, line sowing, trap crops, and several farm-made biopesticides. A popular technique suggested by Palekar is a self-sustaining five-layer agroforestry model. This consists of crop and tree combinations at five different levels of plant canopies.

1.2.3. Support for natural farming from the Government of India

The Indian government has made several attempts to promote sustainable agriculture over the past decade. In 2015, the Ministry of Agriculture and Farmers' Welfare launched a scheme called *Paramparagat Krishi Vikas Yojana* to promote organic farming. In 2020-21, a further sub-scheme to promote ZBNF practices called *Bhartiya Prakritik Krishi Paddat* (BPKP) *was announced.* BPKP invited proposals from interested states for funding purposes (GOI, no date).

Plans to include ZBNF in the syllabus at both undergraduate and postgraduate levels were announced in December 2021, followed by efforts by the education division of ICAR to develop a curriculum (DTE, 2021). A further initiative, *Krishi Sakhi*, was announced in 2021. This scheme was intended to train 50,000 women in natural farming, aiming to empower women with certification in natural farming. The trained woman, *Krishi Sakhi (*a farmer friend*)*, who is a farmer themselves, would work as a community resource person to promote NF (GOI, 2023). A 'National Mission on Natural Farming' was proposed in 2022 as an upscaling of BPKP. A provision of Rs 4590 million for 2023-24 was allocated.

NF has been supported by the right-wing Hindu nationalists in the ruling Bharatiya Janata Party (BJP) because it is indelibly linked to the indigenous Indian cows, which are considered sacred in Hinduism and hold religious significance. Hindu nationalism adheres to the Indian concept of *Hindutv*a, a political ideology and the belief in establishing Hindu hegemony within India. While the BJP's support for NF promotes the integration of farm animals and manure into agriculture, it is also highly directive, undermining the agroecology project. Advocates of agroecology criticise Palekar for insisting on the exclusive use of dung and urine from indigenous cows, arguing that this may not be accessible to all farmers. They view his approach as a one-size-fits-all solution driven by nationalist populism. Furthermore, Palekar overlooks other practices that align with agroecology principles. Instead, a national initiative to promote agroecology should move away from a centralised, prescriptive, top-down model, which is

characteristic of the GR approach (Munster, 2016; Saldanha, 2018; HLPE, 2019; Ramdas and Pimbert, 2024).

The GR deprived farmers of decision-making spaces. In contrast, agroecology relies on ongoing, participatory development processes that are incompatible with the short time frames set by state programs and targets. These programs often result in state officials and extension staff using prescriptive methods that undermine farmers' autonomy and creativity.

1.3 Study area and rationale for study

1.3.1. Research gap

Although the notion that the agroecology paradigm strengthens women's agency and decision-making is theoretically logical, limited research from India shows what benefits are derived. Most of the available information regarding agroecology and gender in India comes from reports by civil society organizations (Khadse, 2017). While Agarwal's (2020) research sheds light on how group farming can empower women, it does not delve into farming practices. There is a growing body of literature from Latin American countries that connects agroecology and gender studies, but relatively little has been published in English (Action Aid Brazil, 2011; Oliver, 2016; Benitez et al., 2020). No research has been published examining how natural farming, now practised in 16 Indian states, affects women farmers.

Given the problems with women's invisibility and subordination, a transition to agroecological farming alone may not be sufficient to overcome the barriers they face. While agroecology's principles and theoretical underpinnings are based on the promotion of equity, its practice does not always reflect this (Bezner Kerr, 2013; Montiel et al., 2020). An intentional equity focus is needed in agroecology efforts, or it runs the risk of increasing women's workloads in preparing and applying compost and bio-pesticides or transferring decision-making or control from women to men. In many other agroecology movements that do not promote initiatives specifically for women, women are seen to be present but only as farmers' wives (Khadse et al., 2017).

It is argued that a synergistic relationship between agroecology and the feminist movement is essential for agroecology to be transformative (Schwendler and Thompson, 2017). Larrauri et al. (2016) observed that agroecology work has not yet incorporated an explicit gender analysis

and proposed methodological designs and indicators with a focus on gender equity. Where a more thorough approach of agroecology with a gender focus has been used, the results show greatly enhanced life outcomes and empowerment for women.

1.3.2. Himachal Pradesh as the case study location

Himachal Pradesh had key features that make it suitable for my research as the case study location. Himachal Pradesh was one of the earliest states to introduce NF as an institutional programme. This allows researchers to investigate how farmers have experienced the transition over several years. Several farmers who had practised NF since its inception could be interviewed. The program is a relatively new initiative that allows women to discuss changes they've experienced since adopting NF, their challenges, the support they received, and how those challenges have been or are being addressed.

Himachal Pradesh was a preferred choice because I could communicate with the farmers in Hindi, which is an Indian language that I speak. This set it apart from Andhra Pradesh, which also had a comprehensive programme in NF since 2018. However, the language barrier made it unsuitable despite its notable engagement with village women's self-help groups for knowledge dissemination and monitoring.

The State has a diverse topography, with a climate ranging from subtropical to cold deserts. As a result, agriculture in the region is varied and includes a wide range of cereals, vegetables, and fruits. This diversity provides multiple options for comparing agricultural practices and the challenges that a transition to NF might present. Male out-migration is common in certain districts, providing opportunities to compare household decision-making in areas with male out-migration to those without.

The NF programme vision was presented in line with the FAO concept of sustainable food systems, which recommends holistic growth that is inclusive of gender, indigenous people, traditional cultures, health and nutrition (FAO, 2018). The state program stated gender equity and an empowerment approach as its goals, but little information was available in its policy releases regarding how these goals would be achieved. Additionally, the state’s NF initiative had not received much research attention. This presented an opportunity for my research to address gaps in a relatively unexplored and new area.

1.4. Study aim, research objectives and specific questions

This research aims to explore how agroecology can empower small-scale women farmers and understand the contributing factors and challenges to this process. In order to pursue the research, three objectives and specific questions were developed, as presented in Table 2 below:

Table 2: Research objectives and specific questions

Objectives	Specific questions
1) To investigate how processes or mechanisms support and empower women farmers during the transition to natural farming.	• What changes occur in terms of control over women farmer decisions about agricultural production? • What impact is there, if any, on women's leadership roles in the community? • Does natural farming increase economic opportunities for women, and if so, what are these?
2) To examine the relationship between rural communication services and a culture of enquiry and innovation in farming.	• How are women being supported to access learning opportunities and learning from peers? • How are farmers being supported to overcome challenges? • What opportunities do farmers have for generating innovative practices through the co-creation of knowledge?
3) To explore the role of state mechanisms in facilitating access to traditional seeds during the transition process.	• How are farmer seeds systems being supported? • What changes occur in choosing crops grown? • How do natural farming practices affect women's workloads?

1.5. Outline of the thesis structure

Chapter 1 sets the background of the study and briefly explains the context for natural farming initiatives in India. It introduces the overarching research aims and objectives.

Chapter 2 presents a review of the debates in the literature, in particular covering two key areas that offer the theoretical foundation for this study: agroecology and gender studies. Exploring the different academic framings and shifts that have taken place within this literature reveals the shared emphasis on justice and equity by agroecology and gender studies.

The methodology and research approach are explained in Chapter 3. The methods are discussed and provide details of the sampling strategies and phases of fieldwork.

Chapter 4 discusses the study context in Himachal Pradesh, India, including the socio-economic conditions and how land use patterns have changed due to development aims, which have had an adverse impact on ecosystems and the livelihoods of indigenous people. It also explores the agricultural programmes established by the State and any conflicts with agroecological approaches.

Chapters 5 to 7 present the results through a series of research papers, each addressing one of the three research objectives. The primary authorship of these papers remains with Punam Behl, who completed the research, analysis and writing with support from supervisors.

Chapter 5 is a paper published by the journal 'Sustainability'. This covers the processes and mechanisms utilised by the State programme and how these contributed to women's empowerment. Women's views were sought on whether the mechanisms increased spaces for decision-making, developed capabilities, such as leadership in the community, and expanded economic opportunities.

Chapter 6 analyses whether rural communication services promoted a culture of enquiry and innovation through participatory and farmer-centred learning modes. These modes are essential to an empowerment approach. They develop capacities to think critically, experiment, and innovate. This paper has been submitted to the 'Journal of Agricultural Education and Extension'.

Chapter 7 examines findings about the programme's efforts to support farmer seed systems and provide access to indigenous seeds. Three farmer case histories illustrate farmers' practices and crops grown. Farmer preferences related to traditional seeds are presented, and how these conflict with the use of hybrid seeds and cash crops that have been encouraged by the state. The chapter explores the premise that supporting farmers' traditional seed systems and access to seeds is a key enabling factor for agroecology. This paper has been submitted to the journal 'Agroecology and Sustainable Food Systems'.

Chapter 8 discusses four intersecting themes that emerge from the results in Chapters 5 to 7. The themes deepen understanding of how the NF program empowered women farmers and how the emancipatory potential could be further realised. The themes are 1) The importance of consciousness-raising in agroecology transitions; 2) Communication capacity building and pedagogical conflicts; 3) Women's empowerment as a holistic approach; and 4) How conflicting state agricultural programs undermine agroecology.

Finally, Chapter 9 draws together the conclusions from chapters 5 to 8, offering reflections on the implications of the research for policy, practice, and further research.

2. Literature Review

2.1. Introduction

This chapter aims to construct a coherent theoretical framework for my research. The chapter introduces the key notions of agroecology and gender studies, exploring the different academic framings and shifts that have taken place within the literature. It then considers how recent literature attempts to bridge agroecology and gender studies and builds on their common ground of justice and equity. The literature review is organised into three sections: 1) Agroecology, 2) Women in agriculture – this includes the notion of patriarchy, gender and women's empowerment, implications for development programs and the role played by women's groups in empowering women, and 3) Women farmers and agroecology. I will begin with a review of how the concept of agroecology has evolved from that of longstanding traditional practice and the science of sustainable farming into a discourse about whole food system transformations and food sovereignty.

2.2. The idea of agroecology

Agroecology has a particular normative positionality in addressing equity and sovereignty, especially for marginalised groups, such as women, which interests me in this study. Agroecology is a promising approach for achieving equity in agriculture and food systems. It has evolved from a traditional practice to a sustainable farming science and gained momentum from social movements to transform food systems and achieve food sovereignty. Examining its historical trajectory has relevance for understanding why it expanded into more political spaces and the meanings it acquired. I will end the literature review on agroecology with the latest developments in policy discourse.

Agroecology emerged as a scientific discipline combining elements of ecology and traditional agricultural systems to offer alternatives to the GR (Chapter 1). Agroecology has existed for millennia as a traditional farming practice with techniques developed by farmers for various local contexts around the world, such as those for maintaining soil fertility and conserving water. The maize/bean/squash system, *milpa,* of Mexico, is an example of biological efficiency,

as is the shrub-crop intercropping from the Sahel to relieve drought stress (Gliessman, 2015). Agroecology was defined initially as a scientific ecosystem approach by Altieri (2018) as the application of ecological concepts and principles to the design and management of sustainable agroecosystems[1]. The goal was to design agroecosystems that mimic local natural ecosystems. This agroecosystem is one that maintains its resource base and can recover from the disturbances caused by cultivation and harvest. It comprises the following production principles (Gliessman and Engles, 2015; Anderson et al., 2021):

- Building healthy soils rich in organic matter
- Conserving soil and water through a more closed rather than an open system
- Diversifying species, crop varieties and livestock breeds in the agroecosystem over time and space
- Adapting to the local environment
- Enhancing biological interactions in the system to maintain soil fertility, productivity and crop protection rather than focusing on individual species and single genetic varieties
- Minimizing the use of artificial inputs from outside the farm system (e.g., for pest and nutrient management)

Gliessman (2006), who was instrumental in establishing the science of agroecology in American universities, formulated the principles of agroecology by observing how small-scale *milpa* agriculture in Mexico was practised. This included corn-beans-squash intercrops, livestock integration, complex associations and crop rotations, agroforestry and home gardens (Gliessman and Engles, 2015; Altieri, 2018). Some of these practices are common to other ecological or regenerative agriculture techniques such as conservation or no-till agriculture and organic farming. However, agroecology acquired a socio-political dimension, which is its key distinguishing feature from other sustainable agricultural practices.

[1] An agroecosystem is a site of agricultural production, e.g., a farm, and includes interconnections of its component parts.

2.2.1. The emergence of agroecology as a social movement

In the 1970s, in Mexico, the first country where the GR was introduced in the 1940s, agroecology gained a social movement aspect. Here, small farmers, scientists and activists began their opposition to the high input and intensive GR technologies and championed the ecologically sound traditional farming practices. This brought about a focus on how traditional agriculture systems were examples of balanced agroecosystems, where the local context, local knowledge and the ingenuity of farmers take a front seat (Gliessman and Engles, 2015). In Brazil, an influential agronomist, Lutzenberger (1976), strove to move farmers away from the effects of agricultural modernisation towards promoting family farms and autonomy. Agroecology expanded rapidly in Latin America, adopted by hundreds of NGOs concerned with the ecological and social consequences of GR (Altieri and Nicholls, 2017).

In the 1970s and 1980s, peasant farmers in Latin America faced challenging conditions because of structural adjustment programs imposed by the World Bank and the International Monetary Fund (IMF). These programs demanded 'modernisation', that is, reductions in public expenditures, including withdrawing support for domestic agricultural sectors, elimination of subsidies and credit restrictions, privatisation of most state enterprises and trade liberalisation. Free trade agreements resulted in a rapid decline of crop prices. For example, due to the North American Free Trade Agreement (NAFTA) in 1994, rural Mexican farmers could not compete with cheap subsidised corn imported from the US and lost 1.3 million farm jobs (Bello, 2009; Martinez-Torres and Rosset, 2010).

Many protests worldwide were aimed at World Trade Organisation (WTO) rules and the International Union for the Protection of New Varieties of Plants (UPOV) that criminalised seed saving and seed exchanges by farmers, threatening farmers with fines and jail terms. For example, it bans farmers and peasants from producing or exchanging seeds unless they are registered seed producers[2]. Navdanya, a grassroots organisation in India, led a rally in

[2] In Europe, seed varieties can be sold and exchanged only if they are registered in the EU Common Catalogue. They must meet technical standards on distinctness, uniformity and stability (DUS) to be listed. In addition, field crops have to show a 'value for cultivation and use'. These requirements cater for plant breeders' seeds and are impossible to fulfil with farmers' varieties (Kloppenburg, 2010).

Bangalore attended by 500,000 farmers protesting against restrictive seed laws (Shiva, 1993). Since the 1994 Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), all WTO members must provide intellectual property protection for plant varieties, which developing countries believe should not be treated as private property on moral or cultural grounds. The requirements of TRIPS conflict with overlapping treaties in international regimes outside of the WTO: the Convention on Biological Diversity (CBD) and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) (Helfer, 2009; Kloppenburg, 2010; GRAIN, 2015).

De Schutter (2009) pointed out that the WTO allows its members who do not wish to assign patents or Plant Breeder Rights (PBR) under the UPOV Convention to opt for a 'sui generis' (of its own kind) protection suited to their circumstances just as India had done. At the behest of grassroots movements, India uniquely combined PBR with elements of CBD and ITPGFRA, permitting farmers to save, use, exchange and sell new plant varieties. However, in practice, developing countries are being pressured by the WTO to ratify the UPOV Convention as part of their trade agreements (GRAIN, 2015).

WTO and UPOV rules that criminalised seed saving and seed exchanges by farmers came to be viewed as the common enemy by a network of grassroots organisations in Latin America, Europe, Asia and Africa. Corporate rights related to food and agriculture institutionalised by the WTO were seen as taking precedence over the sovereign rights of states. In 1992, peasant organisations met in Ecuador, and the idea of a transnational peasant organisation, La Via Campesina (LVC), was conceived (Desmarais, 2002; Martinez-Torres and Rosset, 2010).

LVC was formally constituted in 1993 as a coalition of national and regional rural social movements composed of peasant and family farmers, landless peasants, indigenous people, fisherfolk, farm labourers, rural women and rural youth worldwide. LVC adopted a strategy of radical opposition to the WTO. It sought to put in its place an alternative model of agriculture and rural development framed as food sovereignty based upon local communities gaining greater access to and control over local productive resources. In 2007, a food sovereignty conference in Mali brought together advocates from 80 countries. The resulting declaration, known as the Declaration, established food sovereignty firmly as a political project (Alonso-Fradejas et al., 2015):

> *"Food sovereignty is the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems. It puts the aspirations and needs of those who produce, distribute, and consume food at the heart of food systems and policies rather than markets and corporations' demands. It defends the interests and inclusion of the next generation. It offers a strategy to resist and dismantle the current corporate trade and food regime, and directions for food, farming, pastoral and fisheries systems determined by local producers and users. Food sovereignty prioritises local and national economies and markets and empowers peasant and family farmer-driven agriculture, artisanal - fishing, pastoralist-led grazing, and food production, distribution and consumption based on environmental, social and economic sustainability. Food sovereignty promotes transparent trade that guarantees just incomes to all peoples and the rights of consumers to control their food and nutrition. It ensures that the rights to use and manage lands, territories, waters, seeds, livestock and biodiversity are in the hands of those of us who produce food. Food sovereignty implies new social relations free of oppression and inequality between men and women, peoples, racial groups, social and economic classes and generations"* (Nyeleni, 2007).

Subsequently, the Declaration of the International Forum for Agroecology[3] was held at Nyéléni, Mali, in 2015, to arrive at an understanding of agroecology as a key element in the construction of food sovereignty and to develop joint strategies to promote agroecology. It was acknowledged that the science and practice of agroecology can only transform agriculture and food within the framework of food sovereignty, as this requires engagement with power in many parts of the industrial food system, such as regaining control over farmer seeds

[3] The International Forum on Agroecology was organized by the following organisations: Coordination Nationale des Organisations Paysannes du Mali (CNOP Mali) as chair; La Via Campesina (LVC), Movimiento Agroecológico de América Latina y el Caribe (MAELA), Réseau des organisations paysannes et de producteurs de l'Afrique de l'Ouest (ROPPA) , World Forum of Fish Harvesters and Fishworkers (WFF), World Forum of Fisher Peoples (WFFP), World Alliance of Mobile Indigenous Peoples (WAMIP), More and Better (MaB).

(Gliessman et al., 2019). The idea of agroecology has thus evolved into a multi-scale and transdisciplinary approach to include the science and practice of agroecosystems as well as social/political aspects of a movement (Wezel et al., 2009).

Several authors take a critical perspective on food sovereignty. They argue that many small farmers may not be interested in working towards food sovereignty and may prefer to grow cash crops, while others may want to leave farming in search of urban life (Agarwal, 2014). Several challenges can impede collective action within communities and the equality promised by food sovereignty, such as divisions based on class and ethnicity (Alonso-Fradejas et al., 2015). The role of long-distance trade in an agroecological food system and to what extent food supply can be localised is debated. While the move towards greater localisation may be necessary to mitigate climate change, it must address how food-deficit regions can achieve greater self-sufficiency (Edelman et al., 2014). This implies that food sovereignty might not only be about defending food cultures but also about reinvigorating or even rebuilding them and consciously working to enhance 'food literacy' and modifying consumer tastes.

Given that humanity confronts a multi-dimensional ecological crisis encompassing climate change, deforestation, ocean acidification, and biodiversity collapse, the 2018 Intergovernmental Panel on Climate Change (IPCC) special report suggests that high-income nations must slow down the material production and consumption rate to stay within safe carbon budgets (Hickel, 2018). Hickel (ibid) argues that reducing material and energy constitutes degrowth, which could be accomplished as a planned, coherent policy to reduce ecological impact which can enhance people's quality of life even in the face of reduced overall economic activity.

2.2.2. Agroecology transitions

Over the last decade, agroecology and its multiple benefits have featured significantly in global discussions on sustainability, food security and climate change (IAASTD, 2009; IPCC, 2022). De Schutter (2011), in his role as the UN Special Rapporteur on the Right to Food, called for an urgent move to agroecological modes of production. The 2nd FAO International Symposium on Agroecology, held in 2018, emphasised its multiple benefits: it increases resilience to climate change, strengthens local food systems and nutrition, boosts local economies and livelihoods,

revitalises the resource base and ecosystem functions, contributes to women's empowerment and preserves traditional knowledge systems.

The question of how to scale agroecology up and out has been addressed increasingly (Mier y Terán Giménez Cacho et al., 2018; Anderson et al., 2019; Ferguson et al., 2019). An agroecology transition, a process of continuous transition based on core principles, can be scaled along three dimensions: horizontal scaling or scaling out refers to spreading practices to more farmers or family farms; vertical scaling or scaling up refers to pro-agroecology changes that may be brought about in policymakers and institutions, and deepening or depth of scale refers to the degree of integration of farming systems through the use of diverse crops, rotations, intercropping or agroforestry.

Gliessman's (2006) 5 levels of conversion form a widely used framework to understand the steps farmers can take to transition from conventional to an agroecological system. Gliessman borrowed the first 3 levels from Stuart Hill (1985), the first two focusing on technical aspects of transitions from conventional to fully integrated agroecological systems at level 3. He added two additional levels to include a wider food system change and food sovereignty:

Level 1: Increase the efficiency of industrial/ conventional practices to reduce the use and consumption of costly, scarce, or environmentally damaging inputs. Examples would include optimal crop spacing and density, improved timing, drip irrigation and precision farming.

Level 2: Substitute practices of industrial/ conventional inputs with more environmentally benign ones. Examples would include practices from organic farming, such as botanical pesticides, and alternative practices, such as nitrogen-fixing cover crops and rotations and the move to reduced or minimal tillage. At this level, the basic agroecosystem structure is not significantly altered, and many problems in conventional systems also occur in those with input substitution, such as diseases, weeds, and pest insects. Sustainable intensification approaches focus mainly on aspects analogous to levels 1 and 2. They privilege productivity while reducing the negative environmental and health impacts often within monoculture systems (Levidow et al., 2014; HLPE, 2019).

Level 3: Redesign the agroecosystem based on a new set of ecological processes, encouraging synergisms that generate natural soil fertility, biodiversity, natural pest regulation and crop

productivity. The system is managed by using rotations, multiple cropping, livestock, agroforestry and integrated pest management. It serves to eliminate the causes of many of the problems that still exist at Levels 1 and 2. Promoting biodiversity is the cornerstone of a systems redesign. Gliessman (2006) observed that large growers and corporations cultivating organic production did not move to Level 3. Rosset et al. (2011) witnessed that the greater the agroecological integration, the greater the total value of production. According to Barucha et al. (2020), the Andhra Pradesh Zero Budget Natural Farming program (ZBNF, later referred to as APCNF) in India is an example of a systems redesign, where at the early adoption stage, farmers begin with input substitution using the ZBNF formulations. Success with these encourages further experimentation, and farmers transition to the next level. In their evaluation of several emblematic cases of agroecological scaling, Mier y Terán Giménez Cacho et al. (2018) noted that simple changes in practices that show relatively fast results appeal to farmers. In turn, a systems redesign is slower in revealing benefits and tends to be introduced once farmers have been motivated by initial successes of input substitution.

Level 4 focuses on bringing together the two most important food system actors—the producers and consumers. This means establishing links with consumers, different marketing structures and incentives so consumers value locally grown food and, with their food purchasing, support the farmers striving to move through conversion from Level 1 to Levels 2 and 3. These may be direct marketing, farmers' markets, and community-supported agriculture (CSA).

Level 5 calls for transformation - to build a new global food system that is sustainable and helps restore and protect eco-systems based on equity, justice and democracy:

> *"The depth of change is more than mere conversion or transition and enters into the realm of full reform or transformation in how we live and our understanding of what a good life is…. to a full re-thinking, shifts in values, and changes in the spirit and the heart of how we all relate to each other and to the earth that supports us" (*Gliessman et al., 2019, p. 95*).*

They argue that ecological sustainability could not be isolated from the broader context in which food systems exist, such as the globalisation of markets. Similarly, Anderson et al. (2021)

maintain that change in governance dynamics, control and power must be central to a transformative approach. The expanding awareness of the importance of farming and food to societies as a whole extends to how agriculture and food can help reduce our ecological footprint. This awareness also points to the potential for food and farming to regenerate ecosystems. It encourages a shift from an obsession with growth to a true understanding of sustainable living.

The transition levels are neither distinct nor linear, and several overlaps and entry points may exist. According to Rosset et al. (2011), Cuban farmers, when faced with the collapse of the socialist bloc in 1989 coupled with the US trade embargo, had to make a rapid transition to agroecological systems. They began the transition at Level 2, moving to Level 3 while supported by institutional policy changes, such as progressive land reforms. Similarly, Barucha et al. (2020) found the Andhra Pradesh ZBNF program, which begins with substitutions, i.e. Level 2, progressing to a systems redesign, i.e. Level 3, involved new relationships and forms of social and political organisation, participatory forms of learning and communities sharing resources. In both instances, Level 5 features about a wider community and food system changes were present from the start. Anderson et al. (2021) also note that Level 3 changes are deeply shaped by the political, economic, cultural and social dynamics that help or hinder farmers' capacity to act. The framework became a commonly used reference frame and was later adopted by UN institutions.

Anderson et al. (ibid) suggest that the multi-level perspective (MLP) on sustainability transitions provides a more helpful framework for understanding the power and governance shifts underlying level 4 and 5 transformations. The MLP framework consists of three analytical levels: niches (the locus for radical innovations or alternatives, such as agroecology), dominant regimes (the locus of established practices and associated rules of the corporate food regime) and an exogenous landscape (Geels, 2011). The landscape level represents the macro-scale, often slowly unfolding contextual factors such as climate change and macro-economics. Friedman and McMichael's (1989) food regime theory helps us understand the foundational and broad shifts in the global political-economic landscape over time. They defined the current

period, which began in the 1980s, as the 'corporate food regime'[4]. This period has been marked by a shift of power and sovereignty to corporate actors and the efforts of the WTO to expand free trade agreements, intellectual property rights (IPRs) and the influence of agri-businesses. De Molina et al. (2021) argue that political change is essential to transform the institutional framework that supports, despite its unfeasibility, today's corporate food regime.

In the MLP, transitions are driven by interactions between the three levels, especially the niche and regime. Niches may influence the regime, while the regime may act in ways that enable or obstruct the niche's growth. The regime works to maintain the status quo and may marginalise or co-opt emerging alternatives. The corporate food regime, for example, is characterised by a productivist mentality and unjust aspects of governance that are particularly prejudicial against minority groups such as women and indigenous peoples. Anderson et al. (2021) identify six complementary, interdependent domains of transformation or spheres of activity that come into conflict with the dominant regime as critical in agroecological transformations. These are:

1) **Rights and access to nature** – land, water, seeds and biodiversity - are essential for agroecology transformations to take place. To build overall sustainability and resilience, agricultural policies must address the long-standing structures of agrarian injustice to include a meaningful redistribution of resources and land (Holt-Giménez et al., 2021). Agroecology focuses on genetically diverse, traditional and locally adapted crops, so access to farmer seeds is vital to the practice. Any efforts by globalised business-driven institutions to impose IPR systems are a mechanism of dispossession and erode food sovereignty (Kloppenburg, 2010). Similarly, land and water grabs, taking place in the guise of economic development, oppose the much-needed land reforms for agroecology. Insecure land tenure does not encourage farmers

[4] Friedman and McMichael (1989) identify three such regimes: (1870-1914) – 'colonial-settler regime'; (1945-1971) – the 'mercantile-industrial regime', and (1980-present) – 'the corporate food regime'. The 'mercantile-industrial regime' is marked by US hegemony in the post-war world economy. Farming transitioned to chemically intensive agriculture and Green Revolution technologies.

and communities to invest in agroecology for the long term. There is strong evidence that land tenure security positively impacts women's empowerment, environmental sustainability, and reduction in poverty and hunger (Agarwal, 1994; Higgins et al., 2018). This domain is particularly important for subsistence farmers and indigenous peoples. The FAO Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security, known as VGGT, provides guidelines on navigating complex land reform processes to increase social justice, including addressing gender inequality. The guidelines have been used by countries and regional governance (Anderson et al., 2021).

(2) **Knowledge and culture** – mainstream knowledge systems privilege top-down processes of knowledge transfer and often invalidate farmer and indigenous knowledges. Instead, traditional knowledges of local systems coupled with horizontal and participatory forms of learning have been found to be vital in spreading agroecology. The farmer-to-farmer (Campesino a Campesino) methodology that originated in the 1980s in Central America based on the work of Freire (1970) was instrumental in transitioning farmers in Cuba to agroecology in 1989 (Rosset et al., 2011; Mier y Terán Giménez Cacho et al., 2018). To advance agroecological knowledges, LVC has developed a worldwide agroecology learning network with dissemination through peasant-to-peasant processes.

(3) **Systems of economic exchange** – the absence of appropriate systems of exchange poses a significant barrier to developing agroecology. Growth of specialised, export-oriented value chains, demands for large product volumes, standardisation and policies that reward economies of scale pose barriers for agroecological producers (IPES-Food, 2016). Instead, agroecology needs new markets, economic processes and networks that are embedded, or 'nested' in local territories and social relations, for example, where food quality and diversity are mutually agreed between producers and consumers. Examples of nested markets include labelling under participatory guarantee systems, restaurants and public bodies purchasing food directly from farms and CSAs. However, since millions of smallholders are dependent upon exports and to provide for food-deficit regions, some distant trade would be inescapable.

(4) **Networks** - transformative agroecology develops mostly through networking and community self-organizing; in turn, it strengthens social networks and collaborations with individuals and groups (Mier y Terán Giménez Cacho et al., 2018). On the other hand, the

absence of appropriate networks can limit agroecological transitions significantly. State entities may obstruct such processes through budgetary, legal and political means, leading to exhaustion and disengagement. In the early stages of transformation, official recognition has been critical for successful networks (Anderson et al., 2021). Also, divisions along class, gender and ethnic lines can act as a barrier to collective action and the egalitarianism promised by food sovereignty (Alonso-Fradejas et al., 2015).

(5) **Equity** - Anderson et al. (2021) view transformative agroecology as one of the most promising pathways for pursuing equity within agriculture and food systems. In contrast, GR approaches marginalised and disadvantaged women and poor farmers. Women are still largely responsible for cooking, caretaking and agricultural tasks worldwide but continue to have less access and rights to various resources and decision making (Pattnaik et al., 2017). The 'Women in Agriculture' section will explore gender equality in greater detail.

(6) **Discourse** – this domain is about ways in which language is used to frame debates and policies which become critical for agroecology transformations (Anderson and Maughan, 2021). For example, the 'feed the world' discourse, which posits the need to increase food production by at least 50% by 2050 compared to 2012 levels, while in sub-Saharan Africa and South Asia, the output will have to more than double, is alarmist and based on questionable calculations (Tomlinson, 2013). The discourse is used to promote policies supportive of large-scale monoculture production, technological packages, and liberalised international trade by governments and private sector actors (IPES-Food, 2016). How discourse plays a key role is illustrated further in the next section.

2.2.3. Recognition and advancement of socio-political aspects of agroecology

In 2014, in response to a wide alliance of actors calling for FAO's commitment to agroecology, the FAO held the 1st International Symposium on Agroecology at FAO in Rome. Bruil et al. (2018) noted that the FAO has historically promoted green revolution technologies and industrial agriculture worldwide, and this still continues. Its agenda has been influenced by the powerful agri-business lobbies and governments promoting large-scale, export-oriented, high-tech corporate-led agriculture. Despite their influence, agroecology as an alternative paradigm is being established within the FAO.

The 2014 symposium set in motion a four-year process of political dialogue through seven regional seminars about the benefits of agroecology in different regions worldwide, culminating in a 2nd symposium in 2018. The regional meetings produced a key recommendation to develop an evidence base on agroecology to identify successful experiences in scaling up and enable greater policy and financial support for agroecology. Another influential institution that has raised the profile of agroecology as a socio-political movement since 2015 is the International Panel of Experts on Sustainable Food Systems (IPES-Food). It influences decision-making at the UN. In the FAO report (2018, p. iv), an advancement of agroecology as a social and political movement is clearly evident:

> *"The explicit focus on the social and economic dimensions of food systems is one of the specific characteristics of agroecology as compared to other approaches to sustainable agriculture. This is achieved by taking a human rights-based approach, with a strong focus on equity and the rights of women, youth, and indigenous peoples, as well as prioritising support for small-scale and family farmers."*

The FAO selected ten primary 'elements' to frame agroecology, from diversity and resilience to human and social values, and focuses on interdependencies between them (Figure 2). Anderson et al. (2021) regard the 10 elements as impressively nuanced and reflective of FAO's consultations with civil society in different regions. However, they do not address political and economic changes central to the transformations needed due to constraining political influences within FAO itself. The framework is being used by governments and policymakers who are choosing to transition to agroecology, such as the state of Himachal Pradesh in India. They use the FAO diagram to map how their programs fulfil agroecological aims (Chandel, 2021).

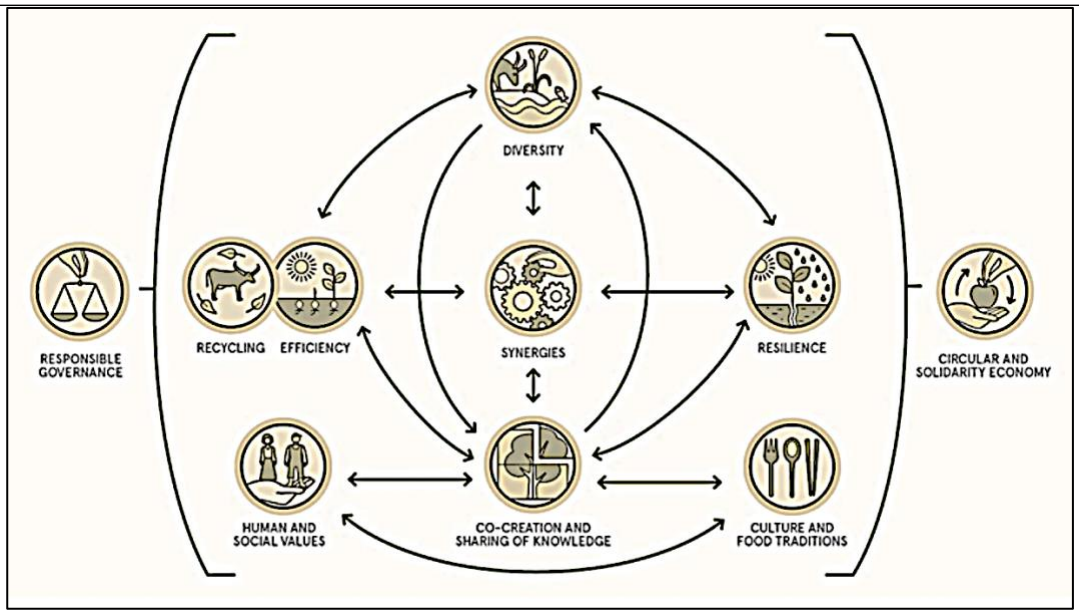

Figure 2: FAO's 10 elements of agroecology (FAO, 2018)

The High-Level Panel of Experts of the Committee on Food Security (HLPE, 2019) recognised deficiencies in the FAO ten-element model. It defined the 13 principles of agroecology which referred to resilience and social equity/responsibility and introduced "agency" and "ecological footprint" as important concepts. These principles include the ten elements of agroecology from FAO [2018] and can be related to Gliessman's transition levels. The first seven principles relate to Levels 1 to 3. Principles from 7 to 13 relate to whole food systems change (Table 3).

Table 3: 13 principles of agroecology (HLPE, 2019)

Related to Gliessman's Levels 1 to 3	Related to Levels 4 and 5
(1) recycling	(8) co-creation of knowledge (embracing local knowledge and global science)
(2) input reduction	(9) social values and diets
(3) soil health	(10) fairness
(4) animal health and welfare	(11) connectivity (between producers and consumers
(5) biodiversity	(12) natural resource governance
6) synergy (managing ecological interactions)	(13) participation
(7) economic diversification	

In 2021, concerns that mainstreaming agroecology would deprive it of its political and social underpinnings, which distinguish it from other sustainable agricultural practices, led to the formation of the Agroecology Coalition (IDS and IPES-Food, 2023). To define agroecology more precisely, it adopted the 13 principles of agroecology suggested by the HLPE.

Anderson and Maugham (2021) note that the HLPE report argued for food system transformation and framed agroecology in a way that reflected many of the tenets of food sovereignty. Unfortunately, the policy recommendations based on it watered down the messages of the report (Committee on World Food Security, 2020). Anderson and Maugham (2021) found that political discursive strategies are used by detractors of agroecology and warn against the innovation discourse as it often undermines the framing of agroecology as a radical alternative to industrial agriculture. The innovations imperative side-lines the collective protagonism, voice, agency and autonomy of food producers and their communities in decision-making, which are central to agroecology.

The HLPE (2019) report defines agroecology as:

> *"approaches that favour the use of natural processes, limit the use of purchased inputs, promote closed cycles with minimal negative externalities and stress the importance of local knowledge and participatory processes that develop knowledge and practice through experience, as well as more conventional scientific methods, and address social inequalities. Agroecological approaches recognise that agrifood systems are coupled social–ecological systems from food production to consumption and involve science, practice and a social movement, as well as their holistic integration".*

Anderson et al. (2021) observe that new methods and indicators for evaluating success that recognise the complex and multifunctional benefits of agroecology are needed. In this light, FAO is developing a global analytical framework - the Tool for Agroecology Performance Evaluation (TAPE). It borrows from various existing frameworks and attempts to measure each of the 10 agroecology elements. The elements are treated as dimensions, with each further broken down into core criteria. For example, the core criteria for Society and Culture are women's empowerment and youth employment opportunities. Women's empowerment is evaluated by using the Abbreviated version of the Women's Empowerment in Agriculture Index

(A-WEAI) (Alkire et al., 2013) with one indicator per domain: (i) Input in productive decisions (ii) Ownership of assets, (iii) Access to credit (iv), Control over use of income, (v) Group membership, (vi) Workload. Governance is evaluated through land ownership or secure land tenure, highlighting the importance of land tenure for policymakers.

TAPE is elaborate and is undergoing testing by policymakers and communities in the hope that it will offer greater consistency and better-aligned evaluations in the future. For example, although the FAO awarded the state of Sikkim in India the 2018 Future Policy Award for Best Policy Promoting Agroecology, Meek and Anderson (2019) found that its governance policies contradicted many of the key ecological, social and political principles of agroecology.

However, the A-WEAI survey has been criticised for ignoring sociocultural contexts, relational dynamics and collective agency. It disregards forms of agency derived from particular socio-cultural contexts and does not consider the complexities of women's day-to-day lives. Furthermore, the notion of empowerment is premised on a male-female dichotomy that neglects the importance of collective and intra-household decision-making (Addison et al., 2021).

The evidence from the literature demonstrates that agroecology not only offers solutions that can address the ecological crises but it is also an alternative paradigm for building food systems that aspire for social justice and sustainability. It is an approach that emphasises the importance of local knowledge and places the agency and power of small-scale farmers above powerful external actors. Its socio-political dimensions distinguish it from other approaches to ecological farming. Furthermore, agroecology has found favour with intergovernmental organisations, policymakers, and social movements, although many challenges persist with preventing agroecology's transformative potential from being watered down.

For this thesis, I will adopt agroecology's normative construction as a transformative vision and practice which addresses power asymmetries and socio-economic inequalities, especially for marginalised groups such as women. In the next section, I will review the literature on the role women play in agriculture, particularly in India, with a view to exploring several questions. If GR approaches have marginalised and disadvantaged women farmers, how have agroecological transitions and practices positively impacted women? Do the positive benefits expand women's livelihood choices or enable women to play a meaningful role in decision-making? If the goal is

for farmers to become the architects and actors of their own development, how can the potential be realised for women farmers?

2.3. Women in agriculture

In this literature review section, I will first introduce the concepts of patriarchy and gender, as well as review how feminist theoretical perspectives or frameworks have defined problems and proposed solutions to create social change. Next, I will examine the gender gaps in agriculture in India, where women play an increasingly prominent role, and how unequal norms, particularly regarding land tenure, present challenges for women farmers. Following this, I will discuss the concepts of agency and empowerment, along with their implications for development programmes. Finally, I will outline key literature that examines the role of women's groups in empowering women, which I aim to build upon in this thesis. Together, these elements will enable me to assess which initiatives support women farmers and why critically.

I will commence by examining the concept of patriarchy as this relates crucially to the gendered approach of my thesis. Patriarchy is a system of social structures[5] and practices in which men dominate, oppress and exploit women (Walby, 1989). It has many elements in common with other systems of domination, such as colonialism, racism, imperialism and capitalism. Post-colonial feminist theories and research have shown how patriarchy was intrinsic to European imperialism, colonisation, economic exploitation of indigenous people, and cultural entanglements (Spencer-Wood, 2016). What these systems have in common is control of territories, domination of indigenous people in order to obtain resources through dispossession, economic marginalisation, labour exploitation and racism. The corporate industrial food regime, similarly, imposes a new imperialism. It uses IPR systems as a mechanism of dispossession, thus eroding food sovereignty; it prioritises the modernisation of agriculture and rejects peasant and indigenous knowledge. At the same time, it makes women's knowledge and work in agriculture invisible (Harvey, 2003; Trevilla Espinal et al., 2021).

[5] The term 'social structures' is important here since it implies rejection of biological determinism.

Often forms of appropriation in one system reinforce those in another system, such as men's expropriation of women's labour in poorly paid jobs (Walby, 1989). Spencer-Wood (2016) observes that a system of 'patriarchal economic colonialism' privileges men's occupations with higher wages, while women's work is devalued with low or no wages. The needs of capital reshapes the construction of nature as a commodity and results in reinforcing patriarchal domination and the appropriation of women's labour and land to support the capitalist project (Mitra and Rao, 2021).

Walby (1989) distinguishes between two main types of patriarchy – private and public. In the private sphere, women's services are appropriated by the patriarch privately and directly in the home, where women are excluded from certain arenas of social life. However, women also exercise 'power over' according to social norms – a typical example is an older woman who dominates her daughter-in-law. In contrast, public patriarchy subordinates women in all spheres collectively and represents a pervasive and more insidious acceptance of male privilege. It ensures that women's unpaid labour subsidises capital and mutes women's resistance to land use. Modernisation[6] through capitalism has further widened inequalities and exploited poorer women (Beneria and Sen, 1981; Mitra and Rao, 2021).

In the 1970s, American liberal feminists bought into the modernisation/industrialisation paradigm to improve living standards in developing countries. They advocated for women to be better integrated into economic systems by legal and administrative changes to minimise women's disadvantages in the productive sector. It was assumed that women's position would improve if women had the same tools and opportunities as men (e.g., access to education, credit and technology). However, these efforts failed to consider the totality of women's lives and work and how deeply entrenched patriarchal norms would impact production processes

[6] The modernization approach to economic development is based on a perception of change as progressing from backwardness to modernity as modelled by capitalist countries in the West. It encourages private ownership of resources and accumulation by dispossession which takes many forms: forcible expulsion of peasant populations from their lands; deprivation of common land rights; suppression of traditional and alternate forms of production and consumption; proliferation of property rights; and appropriation of assets, including natural resources (Harvey, 2003).

and result in women's subordination and oppression. This was particularly evident in microcredit programs, which I will discuss later in this section. In the 1980s, there began a shift towards considering women's multiple roles, but the continuing subordination of women within patriarchal systems was not addressed. It was later, in 1995, at the Conference on Women in Beijing, that a decisive shift in terminology from '*women'* to '*gender*' occurred, recognising that the problem of inequality rested fundamentally on women's relationships with men and related social structures. The term 'gender' refers to socially constructed attributes of women and men and ideas of masculinity and femininity, while gender analysis aims to address inequalities that arise from the different roles assigned to women and men within patriarchal systems.

Nevertheless, mainstreaming the notion of 'gender' was not an unqualified success. There was a backlash from religious and conservative groups as well as a reluctance in development programs to analyse power relations between women and men. CSOs and donors have argued that women have been empowered economically through their projects, but, in reality, the patriarchal relations within communities and households have remained intact (Rathgeber, 2005).

The UN Human Development Report (UNDP, 2020) placed India in Group 5 - the lowest group for equality in Human Development Index (HDI) achievements between women and men[7]. The HDI is a summary measure for assessing progress in three dimensions of human development: a long and healthy life, access to knowledge and a decent standard of living. Its assessment of India's Gender Inequality Index (GII), which reflects inequalities in reproductive health, empowerment, and economic activity, revealed wide gender disparities: only 13.5% of parliamentary seats are held by women, while 27.7 % of adult women had reached secondary

[7] The Gender Development Index (GDI) measures gender inequalities in achievement in three basic dimensions of human development: health (measured by female and male life expectancy at birth), education (measured by female and male expected years of schooling for children and mean years for adults aged 25 years and older) and command over economic resources (measured by female and male estimated GNI per capita).

level of education compared to 47 % of men. This ranked India 123 out of 162 countries in the 2019 index.

In patriarchal societies, as in much of India, women are exploited in the intersection of capitalism, gender, class and caste inequalities in both the private and public spheres. These intersecting and overlapping social identities may cause individuals to experience power dynamics differently. Women may experience different forms of inequality, which operate together and exacerbate each other. A critical race scholar, Kimberley Crenshaw, used the term *intersectionality* in 1989 to explain the oppression experienced by African-American women. If a woman belongs to a marginalised caste and is poor and living in a patriarchal system, she experiences multiple types of oppression. According to an intersectionality perspective, inequities result from '*interdependent forms of privilege and oppression shaped by colonialism, imperialism, racism, homophobia, ableism and patriarchy"* (Hankivsky, 2014). In rural programmes, social categories will interact with gender and affect the outcomes. Women may be constrained differently on account of their caste, their household structures, or marital status. Kabeer and Santos (2017) observe that spatial inequalities often overlap with intersecting inequalities where minority groups often reside in disadvantaged areas, such as remote and challenging rural terrains.

Many scholars stress the importance of an intersectional approach as an analytical tool to understand the challenges and experiences of inequality (Collins and Bilge, 2020). This requires that the methodologies used, the choice of subjects, the questions asked, and subsequent data and results be placed within a nuanced context that considers the multiple identities held by women (Mitra and Rao, 2019). The specific needs and difficulties faced by particular categories of women need to be considered to ensure equality. For example, Pradhan et al. (2019) found that household relations were often more significant than other wider identities, such as caste, for women's property rights and empowerment in Nepal.

I will next demonstrate how caste, social norms, gender, and marital status intersect to condition women's lives in agriculture, which employs 55% of the workforce and is the primary source of income in rural India where 70.7 % of the population lives in rural areas (GOI, 2019c; Khurana and Kumar, 2020).

2.3.1. Feminisation of agriculture

A particularly crucial issue is ensuring farming remains viable for marginal farmers, who are increasing in number in the face of the declining profitability of small-scale farming (Lerche, 2011). A 2006 survey by the Ministry of Agriculture found evidence of extreme distress and indebtedness where farmers could not fulfil their household consumption needs from all their earnings, including wage work. More than half of the income of marginal farmers is from wages, with agricultural production only accounting for 45% of total household income (Narayanamoorthy, 2006). In 2013, 50.9% of agricultural households were indebted (GOI, 2019c).

The increasing outmigration of farmers in search of jobs has decreased the proportion of rural male agricultural workers from 80.6% in 1977-78 to 55% in 2017-18. In contrast, female agricultural workers decreased to a lesser degree, from 88.1% to 73.2%, in the same period (GOI, 2019c). Although the participation of both men and women in agriculture declined, the rate of decline for men has been greater than it has for women. Women's higher participation in agriculture in this period relative to the men's level of involvement is viewed as the feminisation of agriculture.

The statistics, however, do not fully recognise women farmers' work. The India Census, which takes place every 10 years, distinguishes between cultivators and agricultural labourers, and these together comprise the total population engaged in farming. The broad category of labour does not reveal types of activities and tends to trivialise the roles played by women in agriculture or make their contribution invisible. As a result, women are not being recognised as farmers despite contributing more labour to agriculture than men do. Primarily, women conduct farming, and subsistence farming produces half of the food grains and three-quarters of the pulses in rural India (Anandi, 2015). Their work includes land preparation, seed preservation and selection, the production of major grains, sowing, applying manure and pesticides, weeding, transplanting, threshing, winnowing and harvesting. As the statistical invisibility is not being addressed and women's contribution is not recognised, women's agricultural work and productivity are ignored in policy issues and resource allocations (Bhasin, 2007; Pattnaik et al., 2017). Rather than macro-level data, detailed data through activity codes needs to be collected to recognise women's work on farms and farm-related work within the home (MAKAAM, 2018).

When male out-migration occurs, women are left behind to shoulder the burden of production work on the family plot of land, in addition to the reproductive work: providing for household food security needs and care work for children and the elderly. Research by Pattnaik et al. (2017) demonstrated that the feminisation of agriculture did not positively correlate with indicators of women's social or economic empowerment. Instead, feminisation had occurred under duress and was strongly related to indicators of poverty. It has brought about a double burden of work and care, thereby diminishing women's well-being. For example, in Uttarakhand, with prominent male out-migration resulting in increased work burden for women, Bhandari and Reddy (2015) found little or no capital formation on farms of migrant households. Where migration periods were short, men kept in touch on mobile phones and retained their decision-making authority, thus depriving women of decision-making in their absence (Pattnaik and Lahiri-Dutt, 2021).

Furthermore, women's farming work is made more difficult because of constraints imposed by patriarchal norms. In Moorkanad in Kerala, 47 % of women were heads of households because of male out-migration for many years. Even though women were carrying a heavy workload, they were viewed by state institutions and petty bureaucracy as helpers rather than farmers. Farm extension officers tended not to approach women as only men were considered de facto the "head of the family" and, therefore, "the producer" who receives the governmental support available to increase agricultural yields and income. Conversely, women did not approach farm offices because of social inhibitions and demands of time, which, in turn, affected the provision of services for women farmers. When women attempted to expand the farm or install pumps for irrigation, they could not access banking credit because bank credit was linked to land and asset ownership, and they could not provide any collateral security. The low incidence of land ownership, which I will discuss in the next section, becomes a major obstruction for women attempting to access credit or government schemes (Arun, 1999; Oxfam, 2016; Rao, 2016).

The constraints become especially significant if women farmers wish to produce for the market. This would require larger volumes of output, purchase of external inputs (whereas agroecological farming would require less of such inputs), interacting with buyers, who are generally men, travel to distant markets and negotiating with market officials. Women, therefore, face a range of obstacles related to access to land, extension and financial services, access to markets, and their ability to benefit from agricultural research (De Schutter, 2013;

MAKAAM, 2018). A UN Women (2012) report noted that despite 55 years of planned development in India, the shift from 'welfare' based to an 'empowerment approach' had remained more in the realm of rhetoric. It highlighted the underutilisation of funds allocated for social programs.

2.3.2. Effects of gender bias in land tenure

India is one of 15 countries globally, primarily located in South Asia, Latin America and sub-Saharan Africa, where patriarchal gender norms prohibit or make it difficult for women to acquire and retain land. In most of India, inheritance is traditionally patrilineal. Female-operated operational holdings amount to only 13.87% of all operational holdings (GOI, 2019b). Although over 70 per cent of rural women are engaged in farming, the majority don't formally own land, and as a consequence, they are not recognised as farmers. They are instead considered to be farm labourers. The current definition of a farmer linked to land ownership discriminates against landless labourers, women farmers, tenant farmers and pastoralists. Suicides of the majority of women farmers are not recorded or recognised as most of them did not own land and hence were not recognised as farmers.

In 2007, the National Policy for Farmers was adopted, and it defined a farmer as:

> '*a person actively engaged in the economic and/or livelihood activity of growing crops and producing other primary agricultural commodities and will include all agricultural operational holders, cultivators, agricultural labourers, sharecroppers, tenants, poultry and livestock rearers, fishers, beekeepers, gardeners, pastoralists, non-corporate planters and planting labourers as well as persons engaged in various farming related occupations such as sericulture, vermiculture and agro-forestry*' (Agricoop, 2007, p.4).

Tribal women engaged in the collection and sale of forest produce are also included. This definition would include much of the work by women who declare themselves as ''principally engaged in housework'. 61.6% of rural women aged 15 to 59 years report household work as their principal activity, of which 45% work on kitchen gardens, maintaining animal resources, collecting food and food processing activities. However, this definition of farmers is yet to be operationalised.

According to the Agricultural Census, 2015-16 (GOI, 2019b), the 13.87% female-operated amount to 20.02 million holdings, in contrast to male-operated 120.52 million holdings. However, the number of holdings has slightly increased from 11.70% in 2005-06. In terms of area, women-operated areas in 2015-16 stood at 11.57% of all operational area. Regarding average landholding size, women held 0.90 hectares, marginally smaller than men's average holding area of 1.10 hectares. The average size of holdings has been declining for both genders. Indian agriculture is thus dominated by small and marginal subsistence farmers[8].

While it is critical for women and men farmers to secure farmland tenure to ensure food security, women face an extra layer of risk. All farmers risk losing land from governments and corporation takeovers or due to economic shocks that may force them to sell their land. Women without independent property (land or house) ownership are highly vulnerable to poverty and destitution in case of desertion, divorce, or widowhood (Doss et al., 2018). Evidence demonstrates that where women own land, it critically impacts their welfare. It increases decision-making related to employment, access to healthcare, and greater control over earnings. It also enhances the ability to move outside the home independently. In addition to the apparent impact on individual welfare, it is particularly important for children's nutrition and health outcomes as women tend to spend more of their income on the children's needs than men (Swaminathan et al., 2012).

In 1979, the FAO Report of the World Conference on Agrarian Reform and Rural Development (WCARD) influenced the introduction in the 6th five-year-plan in India that the government would "endeavour' to give joint titles to spouses in programs involving redistribution of land and home sites. As a result, land reforms and redistribution took place through the 1980s and 1990s in Kerala and West Bengal. However, in most other states, large amounts of cultivable land were not distributed (Ghosh, 2007).

Agarwal (1994) criticised both government and non-government organisations for neglecting property rights issues, while academic research ignored the gender dimension of rural

[8] Small farmers are those with less than two hectares (5 acres) of land, and marginal farmers are those with less than one hectare (2.5 acres).

households and the effects of owning land. She argued that effective land rights were critical to establishing more equal gender relations and promoting well-being and empowerment. Land ownership enhances rural women's bargaining power in the household in ways that wage employment or a share in common property resources does not (Agarwal, 1997).

In 2005, the Hindu Succession (Amendment) Act that gave all Hindu women (married and unmarried) equal rights with men in the ownership and inheritance of property was passed. Despite the significant advances in inheritance laws for gender equality, substantial inequalities persist (Agarwal et al., 2021). Women often, for example, forgo their claim to ancestral property to maintain good social relations with their brothers: they may accept a lumpsum payment in lieu of property rights (De Schutter, 2013). Patriarchal norms may take precedence over legal norms and undermine effective control over the land. Research on upper caste 'Nair' women who usually inherit property in Kerala has shown that they have little control over managing the property because cultural norms dictate that men are the official heads of households. Ownership of land alone does not confer control of income from the land, its disposal or improved status within the household. The husband took charge of the land and farm responsibilities (Arun, 1999).

A Women Farmers' Entitlement Bill 2011, was first proposed by MS Swaminathan, a member of *Rajya Sabha* (the Upper House) at the time, to provide women for their gender-specific needs and protect their legal rights and entitlements to land, and services associated with credit, water, technology etc. is currently being redrafted by MAKAAM, a network of over 70 women farmers' organizations across the country, with support from UN Women and the National Commission for Women. This bill, if passed, would bring about the needed recognition and rights as farmers (Khadse, 2017).[9]

[9] MAKAAM (2018) suggests various measures for increasing secure land rights, such as prioritising landless women in various public land distribution initiatives by state governments. Women beneficiaries or assignees in public land distribution programmes need to be given clear, secure rights to lands assigned. In addition, state tenancy laws need to be reviewed and suitably amended to allow leasing of all unused, potentially

2.3.3. Notion of empowerment for women farmers

The notion of women's empowerment was articulated in the 1980s and 1990s as a radical approach to transforming power relations in favour of women's rights and engendering greater equity between women and men. The term 'empowerment', however, has been used in a variety of ways and assigned many attributes. Ibrahim and Alkire (2007) listed 32 definitions of 'empowerment' in current use, but these had several elements in common: an increase in agency, the capacity to make effective choices to improve our lives, and the capability to participate in and negotiate decisions that affect our lives.

These ideas are encapsulated in Kabeer's (2002) definition of empowerment, which many writers use as a reference point in the development context. She defined empowerment as a process that "*refers to the expansion in people's ability to make strategic life choices in a context where this ability was previously denied to them*" (ibid, p. 437). This ability to make choices encompasses three phases or dimensions:

1. Resources - defined as access to and future claims to material, human, and social resources. This dimension includes political institutions, such as voting rights or traditional norms.
2. Agency - "*the ability to define one's goals and act upon them. Agency is about more than observable action; it also encompasses the meaning, motivation and purpose which individuals bring to their activity, their sense of agency, or `the power within*" (Kabeer, 2002, p.438).
3. Achievements or well-being outcomes

These together form a rudimentary theory of change, which links access to resources to women's capacity to exercise strategic forms of agency to achieve well-being outcomes (Kabeer, 2018). Kabeer's notion of empowerment as a process of change through which a woman gains more agency to determine her own life is closely related to Amartya Sen's (1999)

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cultivable lands to landless women's groups while recognising such groups (SHGs, cooperative, other collectives) as a valid category of landowners.

capability approach. Sen saw poverty *"as a deprivation of basic capabilities rather than merely as low income"* (ibid, p. 20). He defined agency as people's ability to act on what they value and have reason to value. Similarly, Kabeer (2002) described agency as the ability to define one's goals and act upon them.

It is vital, however, to retain the meaning of empowerment as transforming power relations between individuals and groups since empowerment is more than just an expanded choice. The notion of shifts in social, economic and political power between individuals and groups is necessary to retain the meaning of empowerment as a transformative concept (Batliwala, 2007; Drydk, 2013; Cornwall, 2016). At the basis of this transformation lies a change in perspective. It involves consciousness raising in an unfolding process in how women perceive the world and their roles to become aware of inequalities and strive for justice.

Rowlands (1995) outlined four categories of power to clarify how empowerment is more than simply opening up access to decision-making. Bradley (2020) added the category – 'power for':

- 'Power over' refers to the power that people wield over others, such as by men over women and by dominant social, political, economic or cultural groups. Resisting the 'power over' entails an understanding of the dynamics of oppression, particularly internalised oppression.
- 'Power within' refers to self-respect and self-acceptance, where people see themselves as able and entitled to make choices.
- 'Power to' is a generative term that refers to creating new possibilities.
- 'Power with' refers to one's social ability to act in a group.
- 'Power for' refers to people's vision and values to create a world they want to live in.

The five categories are interlinked and complementary: 'power within' is essential and forms the basis of the other categories. In turn, an increase in one's capability to resist 'power over' or enhancement of abilities in the social domain would enhance the 'power within'. The categories have been used as a framework to map empowerment indicators for research purposes (Ibrahim and Alkire, 2007).

The importance of 'power within' or a woman's self-confidence and self-view is highlighted by Belenky et al. (1986). They argue that a woman's confidence in herself as a thinker and the

belief that she is capable of intelligent thought lies at the basis of her ability to make choices for her own well-being. They suggest a communication and teaching model based on Freire's critical pedagogy (Freire, 2017). Women can develop their own authentic voices in collaborative spaces if they and their first-hand experiences are respected. It is through speaking and listening that capacities to talk and think through issues are developed.

Another vital notion that underpins the empowerment discourse is that power relations function in multiple domains – domestic, social and political. In the domestic domain, gender often operates through the unquestioned acceptance of power. Women who accept their lesser claim on household resources or accept abuse at the hands of their husbands and relatives may do so because to behave otherwise would be considered beyond the realm of possibility (Kabeer, 2005). Gramsci's concept of cultural hegemony explains the unquestioning acceptance of power – how one group dominates or controls another. According to Gramsci (1971), power comes from consent and originates in subtle agreements with people who are being subjugated. This consent is won by people accepting cultural norms and rules as the way things are. People born into these cultures often view the normalised state of the world around them as something they must learn to accept. The set of cultural norms becomes a “common sense” by which they make sense of their place in society, which, in turn, reinforces the status quo.

Sen concurs with the concept of cultural hegemony concerning women. He noted that women in traditional societies such as India tend not to think in terms of their self-interest and personal well-being, "*There is much evidence in history that acute inequalities often survive precisely by making allies out of the deprived. As a result, the underdog comes to accept the legitimacy of the unequal order and becomes an implicit accomplice*." (Sen, 1990, p. 126). In contrast, Agarwal (1997) argues that women's overt compliance is not because of the lack of value they attach to themselves; rather, is it due to external constraints. Cultural norms are a strong force. For example, women may give a socially desirable and conforming response that is deferential, submissive, and non-resistant to maintain a favourable image for themselves and their families. Similarly, Khader (2011) argues that while women may accept certain aspects of their own deprivation, it does not mean they are not reflective agents capable of making meaningful decisions and caring deeply about certain things.

An approach which confers greater agency to women in decision-making within the patriarchal household is the bargaining approach (ibid, 2011). This contrasts with the standard economic theory about household decision-making, which rests on the assumption that the family is an undifferentiated unit governed primarily or solely by altruism. Through the lens of the bargaining approach, household interactions are seen as containing elements of both conflict and cooperation, where intra-household allocation is the outcome of a bargaining process. Household members tend to cooperate insofar as the outcomes benefit the negotiating parties relative to non-cooperation. In case there is an underlying conflict, as some outcomes are more favourable to members of the family than others – that is, a person may be at a loss while another person gains - which option is chosen will depend on the relative bargaining power of the household members (Agarwal, 1997).

How social and cultural norms exert power over women is illustrated in a study by Malhotra and Mather (1997), who examined the role played by employment and education in determining women's domestic power in Sri Lankan households. They found that the outcomes depended on multiple factors: the historical and economic context and a broad range of social, household and life course factors. These include class and ethnic differences, the composition of the household, a woman's life course stage and consequent status in the family, and the nature of productive work. While education and employment impacted women's input in financial decisions, these capabilities did not impact women's decision-making related to social and organisational matters. Instead, ethnic and class norms were the more significant determining factors than women's resources and achievements. Therefore, developing women's abilities or economic bargaining positions in the social domain may not be sufficient to affect change within the domestic domain.

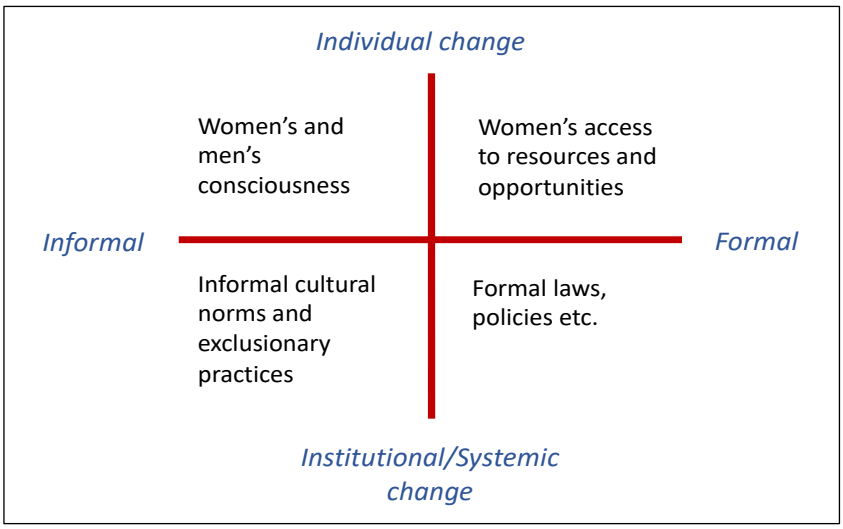
However, gendered structures of constraint can vary considerably across India and different parts of the world and can lead to different outcomes about the associations between paid work and women's empowerment (Kabeer, 2008). In India, women and men in tribal communities are more equal (Mohanty, 2001; Mitra, 2008). Pattnaik and Lahiri-Dutt, (2021) found that women in tribal and economically less developed regions are involved in decision-making. They participated in surveys without restrictions or inhibitions and were less class-conscious. Unquestioning acceptance of gender differences may, therefore, be based upon:

a) An acceptance of social norms and of one's role where the inferiority has been internalised, or

b) An awareness of injustices that exist but because of fear of conflict, lack of economic options or social support, women remain resigned to an unchanging social order.

Cornwall (2016) highlights that the fundamental notion of internalised oppression has implications for development projects. There is a reciprocal relationship between women's self-view, their capacity for self-expression, and their control over material resources. To address the deep structural basis of gender inequality calls for two vital levers. In addition to access to resources and enabling policies, women must first build critical consciousness. This process includes recognising and challenging beliefs that keep women in subordinate positions and restricted by social norms. Projects, therefore, must include methodologies to create spaces for building self-esteem and confidence in addition to providing assets or services.

Cornwall (2016) suggests that the framework (Figure 1) below by Rao and Kelleher (2005) effectively captures the different dimensions of change that are required. It includes transforming institutions and structures that reinforce existing power structures and the psychological dimension, which comprises the sense of one's value and entitlement. Next, I will discuss how these features reflect key tenets of an agroecological approach and can be instrumental in promoting the empowerment of women.



2.3.4. The role of women's groups and collectives in empowering women

This section will outline key literature on how women's groups and collectives advance women's agency and empowerment. Women working as a group or a collective is considered to offer various benefits for developing women's agency and empowerment - the 'power within', 'power with', 'power to', and 'power over' in terms of building up a resistance to diverse forms of oppression. However, it cannot be assumed that collectivisation alone will result in women's empowerment, e.g., where women take control over decision-making and additional incomes. The evidence from the literature suggests that the variations in the nature and degree of impact on women can be attributed to the change in the dimensions shown in Figure 1:

- Access to resources and opportunities
- Change in women's consciousness comprises a shift in values in the way one perceives oneself and the world. It involves investment in group formation and training.
- Supportive institutional structures and whether these reinforce the existing power relations
- The norms for collaboration and the type of group organisation, such as frequency of meetings

I will examine the literature relating to women's collectives with reference to these dimensions.

A predominant form of women's collectivisation approach to provide women with resources and opportunities began in Bangladesh in the 1970s. Mohammad Yunus, who was later

awarded the Nobel Peace Prize, pioneered the concepts of microfinance and microcredit and founded the Grameen Bank. Microfinance refers to providing small loans or 'microcredit' to poor women via neighbourhood groups for "self-help" and poverty alleviation. The Grameen Bank was the first lending institution to substitute material collateral with social collateral, that is, social pressure from group members. Each member is responsible to and for the collective, which is a strategy for ensuring high repayment rates. The approach was claimed to have the potential to promote women's empowerment and alleviate poverty by including women in finance and business. Micro-credit has since developed into a global business with over 211 million borrowers as of December 2013 – of whom women constitute over 74 % (State of the Microcredit Summit Campaign Report, 2015)

Research in the past decade has revealed that the endeavours of microcredit institutions to empower women have had mixed results and that microcredit and micro-savings reduced poverty in some circumstances for some of the clients at the time (Garikipati et al., 2017). Rehman (1999), in an anthropological study of 154 Grameen Bank members in Bangladesh, found that 60% of loans were being used by husbands. At the same time, 70% of the interviewed women reported an increase in violence and aggression in the household because of their involvement with the bank. The ideology of alleviating poverty and increasing women's welfare became diluted and was superseded by conflicting aims such as maintaining the financial success of the banks. This resulted in paradoxical consequences for the bank staff, borrowers and their families. Bank workers were pressured to increase loans and the recovery rate of loans in order to earn a profit. In turn, bank workers coerced women to accept different types of loans in order to maintain weekly repayments on previous loans, thus entrapping women into a spiralling debt cycle. The women who struggled to repay their loans, therefore, suffered considerable pressure and humiliation from bank staff and members of the peer group. Women also experienced inter-household fights and increased verbal and physical violence within the home. Bank staff and men within households exploited patriarchal norms and the vulnerabilities of women to advance their own interests. Bank employees found women easier to manipulate and preferred lending to them. Meanwhile, husbands often used the loans taken out in their wives' names for their own businesses or personal expenses.

The micro-credit approach was grounded in the political rationality of neoliberalism that seeks market-based solutions to a wide range of problem. Yunus sold the initiative as a win-win in

which both profits and poverty reduction could be achieved. In addition to its original ideological aims to alleviate poverty, microcredit could also be profitable for the organizations that promote it. The market was constructed as a universal remedy. The discourse focused on strategies for self-help rather than addressing state responsibility (Keating et al., 2010).

One of the key criticisms against microcredit is that its ideological goal to alleviate poverty is taking place in a context of wide inequalities fostered by a capitalist system where the accumulation of capital is engendered through dispossession. This takes many forms: forcible expulsion of peasant populations from their lands, deprivation of common land rights, suppression of traditional and alternate forms of production and consumption, proliferation of property rights, and appropriation of assets, including natural resources (Harvey, 2003). As discussed earlier, liberal feminists had bought into the neo-liberal paradigm to advocate that women should be better integrated into economic systems. Within these starkly unequal systems, marginalised people, such as poor women, are instrumentalised by global capitalism on greatly unequal terms. An institutional male bias persists at multiple scales. Indian women, for instance, receive 34% less than men's wages, although the wage gap has declined over time, falling from 48% in 1993–94 (ILO, 2018). They are further exploited through dispossession by financialisation, in which the credit system is used to extract wealth (Hartsock, 2006). Keating et al. (2010) argue that microcredit is a mechanism of accumulation by dispossession. It has co-opted feminist empowerment discourse, village-level collectivities, and civil society groups toward the goal of capitalist accumulation, often with contradictory effects on women. States often seek the assistance of CSOs to drive their agenda, and in doing so, CSOs too are co-opted as instruments of coercion[10].

In contrast, Agarwal (1997) contends that organisations that enhance credit and income-earning opportunities for women relative to men, such as the Grameen Bank in Bangladesh and

[10] In Andhra Pradesh, CSOs working in partnership with the state in its natural farming initiative use their social capital to persuade SHGs to apply for loans to buy cows, a questionable part of a natural farming practice being promoted by the state (Author observation).

the Self-Employment Women's Association (SEWA) in India, strengthen women's bargaining power within the household. However, while this may hold true for those who are economically advantaged, paid work for others can become a means of survival rather than an experience of empowerment. Paid work has a very different meaning for displaced peasants or for immigrants brought in as cheap labour at the bottom of the labour market. The hours of wage labour can occur in very unfavourable conditions and at the cost of their own businesses (Garikipati, 2008). Research from sub-Saharan Africa has shown that higher women's income lowers men's contribution to household expenditures and increases men's expenditure on personal consumption (Staveren and Ode Bode, 2007). Moreover, the compulsory nature of work and the tendency of that work to be demeaning - physically and mentally draining - means that many women experience the market as coercive. There is a danger that the economic burdens become so demanding so as to prevent women from becoming empowered. Economic work often keeps women in survival mode with no time to consider the political and broader economic implications of their roles and the needed changes (Chatrusheela, 2003; Batliwala and Dhanraj, 2004). Microfinance may be able to help some women improve their bargaining power within existing structures, but it does little to modify structures themselves.

Druscilla Barker (2005) observes that feminist studies grapple with two contradictions:

> *"First, there is a contradiction between valorizing work typically associated with women such as caring for children and other sorts of domestic labor, on the one hand, and changing the role that domestic labor plays in creating and maintaining women's subordinate status, on the other hand. Second, there is a contradiction between the emancipatory potential of gender equality in the workforce and the exploitation and inequality associated with the global feminization of labor."* (ibid, 2005, p. 2190)

In order to overcome these contradictions, De Schutter (2013) suggests that the emphasis should be on supporting women's choices, provided these choices are made freely and voluntarily between options that represent an improvement to the existing conditions and offer viable alternatives. The choices may be to work in family farming focused on satisfying the needs of the household and the local community or switching to producing for the markets. Women should also have the choice to work as waged workers in conditions that provide decent work with a guarantee of living wages equal to those of men.

Not all microcredit programs that emerged were led by commercial banks. Broadly, there are commercial microcredit programs tied to financial lending institutions as well as those by informal community savings groups. The latter involves groups pooling small amounts of money and rotating loans amongst group members at either very low or no interest. The formal microcredit programs can be further differentiated between commercial banks and cooperative banks or credit unions, which offer better terms and conditions than commercial banks (Keating et al., 2010).

In India, Self-help groups (SHGs) were first piloted by a CSO, MYRADA, in the mid-1980s to provide financial services to poor people (Sustainability Next, 2023). The pilot programme grew into a practice for social empowerment, particularly for rural poor women. SHGs have been promoted in India more comprehensively by the southern state governments. In 1992, India's National Bank for Agricultural and Rural Development (NABARD) introduced a bank-SHG linkage program to facilitate bank lending to rural groups at low interest. Since then, the SHG linkage program has grown into one of the world's largest microfinance networks. Various rural development programs have been targeted at these groups, such as the Integrated Rural Development Program (*Swarnjayanti Gram Swarojgar Yojana*) and, more recently, the National Rural Livelihoods Mission (NRLM) [11] and the *Mahila Kisan Sashaktikaran Pariyojana* (MKSP), for the empowerment of Women Farmers, launched n 2011, was a forward move in recognising the central role of women farmers. Agarwal (2020) identified three types of groups which have been successful:

1) SHGs as informal, small village organisations voluntarily formed with 10–20 members from a similar socio-economic background, who pooled savings and lending among members and support each other to achieve collective goals.
2) Community groups governing common resources, such as forests and water bodies. In 2001, India had 84,000 community forestry groups which resulted in improved outcomes in management of forests.

[11] National Rural Livelihoods Mission (NRLM) was launched by the government of India in June 2011. Aided in part through investment support by the World Bank, the Mission aims to increase household income through sustainable livelihood enhancements and improved access to financial services.

3) Groups for social programmes, such as for health and adult education initiated by a government programme – e.g., education for women's empowerment, Mahila Samakhya, an example of supportive institutional structures. This was a precursor for Telangana's group farms.

There is a danger, nonetheless, that the original logic of collectivisation – such as the political education of every member of the collective to participate in public life and assert her rights – is usurped by the logic of the SHG approach which treats micro-credit as an economic magic bullet. It allows governments to transfer poverty alleviation on to women and ignore structural inequalities which need state intervention and investment (Gurumurthy and Batliwala, 2012).

Brody et al. (2017) review of 23 quantitative and 11 qualitative studies from South Asia and Africa to assess the impact of SHGs on women's economic, social, psychological, and political empowerment present a mixed picture. They found positive effects on independence in financial decision-making and familiarity with handling money, solidarity social networks, and increased respect from community and household members. Women SHG members reported greater confidence in expressing opinions and in approaching authorities as a group to bring about positive changes in their communities. The review found few studies to determine the impact of SHGs on subjective well-being. Instead, there were instances where women reported adverse reactions and suspicion from their community members. The review also found low participation of the poorest of the poor in SHGs. In Tanzania, poorer women tended to perceive the SHG was a status symbol and were less likely to join an SHG. In India, caste and religion appeared to influence participation in SHGs. Women preferred to join groups with their own caste members.

2.3.5. How group farming can empower women

Agarwal (2018) argues that collectives which are small-sized, voluntary, socio-economically homogeneous and participatory in decision-making can improve well-being in ways that individual approaches usually cannot. These collectives can reduce the effects of state failure or market failure for the disadvantaged and, while they cannot overcome major disadvantages such as land ownership, they can alleviate and reduce disadvantages. As farms become more fragmented, a group approach can enable small and marginal farmers to pool resources and invest in tube wells, bullocks or rainwater harvesting structures. In addition, group farming can

familiarise women with a wider range of institutions (such as banks, agricultural extension agencies, input providers, and markets) than they are likely to encounter if engaged only in interventions for social change.

Agarwal's (2020) research on two state initiatives in India in the early 2000s in Telengana and Kerala examined whether group farming could empower women socially and politically. She found that group farming can enhance women farmers' ability to challenge structural inequalities and oppressive social norms, increase incomes and self-respect, and increase their bargaining power in markets, at home and with the state. The initiatives supported rural women in the collective cultivation of jointly leased land. Hence, this recognised women as farmers outside the domain of family farms with unpaid family work with little autonomy. Of the two states, initiatives in Kerala achieved greater success because of a variety of factors: support from local government institutions and *Kudumbashree*, a women's network, freedom to choose crops of their choice, bank linkages for credit and socio-economic heterogeneity in group composition which increased their network and allowed them to use their previous social capital and contacts to locate resources, e.g., land. The women reported experiencing a higher social status and respect in the family and in their villages. Enhanced incomes led to both economic and social benefits, improved knowledge of new cultivation practices, and widened their networks to include institutional officials and farmers from other states. Group farming created a sense of solidarity and, in particular, helped to lessen the burden of work during harvest and sowing times since the fields were cultivated collectively. In addition, it led to political empowerment for some who stood for and won *panchayat* (village council) elections.

The research by Agarwal (2020) did not focus on the processes of change experienced by women in the domestic and social domains. It raises several questions about whether, for some women, group participation raised household tensions, their workloads altered on a daily basis, or they managed their farming duties on household farms or whether the benefits were experienced by all group members. Did the processes of achieving a consensus within the group silence and marginalise some community members because of their caste or class? People who are not secure in their positions or concerned with social rejection tend to be more compliant (Ross and Mirkowsky, 1984). This is particularly important for marginalised women who may lack the sense of entitlement that more privileged women have and, therefore, hesitate to assert their rights in the public sphere. ANANDI (2015), a CSO working on gender issues in India,

uses Freirean-informed participative learning systems and demonstrates how participatory processes and consciousness-raising in groups help women gain strength and confidence.

It may be argued that being part of an organised group in itself can be socially empowering, even without economic cooperation. One of the positive effects of women's collectives is that the freedom of association allows group members to build solidarity through frequent meetings, which are not usually available to women. Exchanging experiences on numerous issues, subjects, and actions strengthens women and mitigates their isolation. A new perception of reality is constructed. It enables discussions about challenges and gains, allowing women to discover common ground by realising that their problems are similar to those experienced by other women. This builds women's social capital and normative influence in terms of altruistic collective actions such as stopping domestic violence or annulling underage marriages for individuals within the community. In addition, group participation provides legitimacy by the group's affiliation with CSOs or a government initiative. This legitimacy accords greater freedom for women to spend time away from the household or participate in collective actions in matters that may involve intervening in conflict situations (Sanyal, 2009).

This review demonstrates that women's group formation does not necessarily bring about changes in women's agency and empowerment on their own. Rather, it is the group formation strategies informed by an understanding of the causes of gender inequality and a commitment to bringing about social change that makes the difference. A crucial dimension of the process of empowerment is through the contesting of the social norms and beliefs that have been suffered by women. Development projects centred on economic activities must, therefore, include more than the activity and create spaces for facilitating an empowerment process (Rowlands, 1995; Cornwall, 2016).

In the next section, I will examine the literature on how the practice of agroecology offers positive collaborative spaces that mobilise women farmers, strengthen agency and enable innovative approaches.

2.4. Women farmers and agroecology

My thesis hopes to substantially contribute to bridging the gap between agroecology and gender scholarship. This topic is vital for ensuring the sustainability of agriculture in a socially

just way. In this section, I will first examine how agroecology can expand the realm of choices and support women farmers. Next, I will examine literature that demonstrates that an intentional focus on gender equity is needed if agroecology initiatives are to dismantle practices embedded within unequal power relations.

2.4.1. How agroecology can benefit women farmers

The agroecology paradigm has been seen to be facilitative of women farmers in several ways:

It promotes participatory learning and horizontal exchanges, contributing to greater gender equality and granting enhanced visibility to women. Agroecology is regarded as offering solutions for creating a level playing field among farmers, policymakers, and scientists. It enables smallholder farmers to be recognised as experts whose knowledge complements formal expertise. Participatory learning modes through collaborations between farmers and scientists can profoundly empower and foster transformation that dismantles patriarchal barriers and encourages new gender relations (De Schutter, 2011; Mpofu, 2016; VanGelder, 2017). Research by Bezner Kerr et al. (2019) in Malawi found that participatory praxis is central to mobilising agroecology and fostering food sovereignty. Collaborating as a team also inspires confidence and creativity, building collective strength for innovation. Action Aid Brazil (2011) implemented a process of experience systematisation as a strategy to challenge and reassess men's dominance over women. As women's experiences are examined, their issues, strengths, and achievements become apparent. Their project demonstrated that systematisation was a potent tool for empowerment, reinforcing efforts in agroecology.

It offers better nutrition and food security for families through pesticide-free food and diverse diets to overcome micronutrient deficiencies, which is a key emerging issue in India. For example, about 40% of adolescents in India are anaemic, many due to iron deficiency (UNICEF 2018). The diverse cropping systems needed for agroecology support women farmers, who do most of the work in family farming. Women have been found to be highly knowledgeable and skilful as managers of family nutrition, subsistence production, and risk reduction. They cultivate crops that meet a range of household requirements: a wide variety of food for the family to minimise the risk of crop failure, fodder for the livestock, and other needs like fibre and cash. Livestock has been especially beneficial for women as it adds to nutrition and provides additional income for women (Pionetti, 2005; De Schutter and Campeau, 2018).

More economic opportunities, more disposable income and decision-making because agroecology favours on-farm and locally produced inputs with livestock integration, which involves low start-up costs; small enterprises can be set up by women individually or in groups to provide services to the local or wider community. Agroecological produce, for example, also creates high-value end products for the market.

Participation for all family members: the diversity of agroecological farms, where a variety of plants, animals, and trees are included, presents opportunities for different family members to become involved. There may be crops managed by men, medicinal plants and animals by women; some animals may be managed by adolescents, while grandparents, including older women who are then valued for their traditional knowledge, may assist with seed saving, preserves, fruit trees, and pest management. It leads to a diversity of decision-making and income-generating roles, which dismantle patriarchal structures within the family (Rosset et al., 2011).

It provides a more significant role to women to conserve local seeds and maintain traditional knowledge: in addition to fulfilling household nutritional needs, women grow various plants, such as pulses and oilseeds, to maintain their culinary, cultural and religious traditions. Furthermore, they are knowledgeable about using herbs and non-cultivated plants for medicinal and nutritional value. These responsibilities, whichly a women's domain, promote and maintain biodiversity. Women are an intelligence bank for selecting and storing seeds and multi-cropping systems of grains, beans, tubers, vegetables and small animals. With the introduction of GR technologies and hybrid seed varieties, women farmers who practised their traditional knowledge were marginalised. Undermining women's roles in seed and crop management has severe implications for maintaining biodiversity, while the loss of food sovereignty deprives women of their decision-making roles. In contrast, agroecology makes resources available to women. It delinks farmers from corporate or external inputs, bringing self-reliance and autonomy (Pionetti, 2005; Khadse, 2015).

2.4.2. The need for a gender focus in agroecology transitions

The hypothesis explored here is that agroecology can create opportunities for rural women to become more autonomous by gaining knowledge, exercising greater control over raw materials, and participating in community organisations and commercial projects. However,

given the issues surrounding women's invisibility and subordination, a transition to agroecological farming alone may not be sufficient to overcome the barriers they encounter. While the principles and theoretical foundations of agroecology are aimed at promoting equity, its practice does not always reflect this intention. For instance, proponents of agroecology and food sovereignty often idealise family farming and the culture of rural and indigenous communities but neglect to scrutinise whether the position of women is equitable and allows for autonomy. Unequal gender relations that stem from cultural traditions associated with family farming or rural communities may indeed hinder women from realising the benefits of agroecology. If these issues are not addressed, there is a risk of establishing a patriarchal framework within food sovereignty and agroecology (Bezner Kerr, 2013; Montiel, M.S. et al., 2020).

When an intentional equity focus is missing in agroecology efforts, it runs the risk of increasing women's workloads or transferring decision-making or control from women to men. A study by Altenbuchner et al. (2017) in Odisha, India, explored the effects of an organic farming initiative on women's empowerment. It demonstrated that it did not lead to empowerment in every case or aspect, although it offered other opportunities for women. While organic farming had positive impacts on health and food security, there was an additional workload which women had to contend with. Women reported shifting tasks from men (purchasing and applying chemicals) to women (preparing and applying compost and bio-pesticides). Moreover, women were excluded from training in organic methods and decision-making.

In many other global agroecology movements that do not promote initiatives specifically for women, women are seen to be present but only as farmers' wives. This was evident in a study of the Zero Budget Natural Farming movement in Karnataka, India, led by a grassroots movement, the *Karnataka Rajya Raitha Sangha* (Khadse et al. 2017).

From a multi-level perspective, agroecology is at the niche level situated within the meso level of corporate food regime, which in turn sits in the landscape or macro level processes of patriarchy, capitalism, racism, and colonialism. To affect changes at the meso level, agroecology must work actively to challenge oppression and inequity by establishing models of equitable practice, community spaces, organisations, and just interrelationships. This may involve

confronting and dismantling unequal cultures and policies, which can be best achieved through collective action (Anderson et al., 2021).

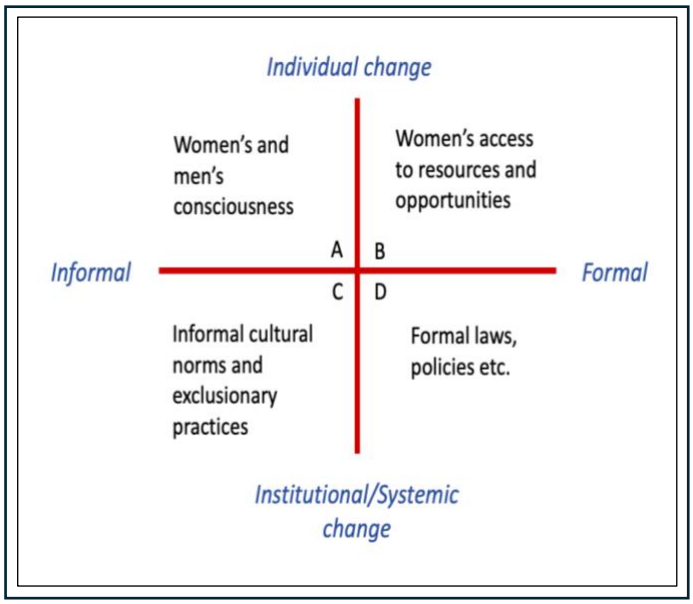
A synergistic relationship between agroecology and the feminist movement is essential for agroecology to be transformative (Schwendler and Thompson, 2017). The framework suggested by Rao and Kelleher (2005) captures the dimensions where explicit efforts are needed to empower women farmers.

A: Meeting spaces for women to discuss issues and for consciousness-raising for both men and women.

B: Women's access to learning, e.g., farmer field schools, access to public institutions, land and credit facilities.

C: Establishing structures that promote democracy within women's groups and sharing of responsibilities between genders

D: Establishing policies and supportive institutional structures that value women's work and consider the extra care burdens for women.



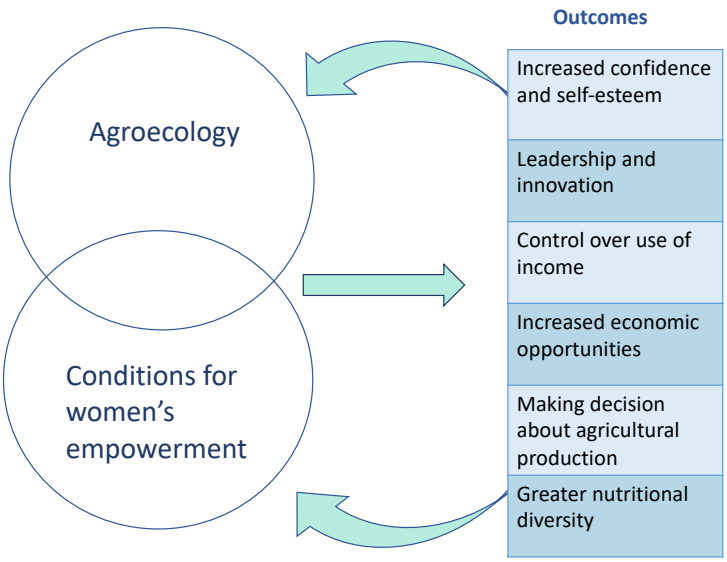


Figure 4: Author-constructed conceptual framework

The conceptual framework (Figure 4) represents the notion that combining agroecology with conditions of women's empowerment can set up an iterative process for women to become more autonomous through gaining knowledge, greater control over raw materials, and participation in community organisations and commercial projects. These, in turn, enhance the qualities that women bring to agroecology endeavours and set up a virtuous cycle.

Larrauri et al. (2016) surveyed studies demonstrating the success of gender relations transformation. These showed a process that begins with meetings, exchanging experiences, reflecting on their realities and work, and consciousness-raising. Where a more thorough approach of agroecology with a gender focus has been used, the results show greatly enhanced life outcomes and empowerment for women. A recent study of a project in Cuba[12] by Benitez et

[12] Cuba underwent an "agroecological revolution," in the early 1990's when the fall of the Soviet Bloc resulted in the loss of subsidised industrial farming. There was a transition to agroecological farming using a campesino-a-campesino (farmer-to-farmer) program of horizontal transmission.

al. (2020), which included workshops for both genders challenging deeply rooted patriarchal beliefs in rural households and communities, demonstrated increased employment opportunities and a doubling of incomes, marked changes in gender attitudes, greater sharing of household incomes and decision-making. The most striking findings were women's shifting attitudes about their skills, capacities and worth.

The Deccan Development Society's (DDS) work with low-caste Dalit women cultivating millets offers an exemplary model of addressing the most marginalised women's rights, agroecology and food autonomy as a holistic program. DDS began to address the nutrition and food needs of the most vulnerable families in Telangana's Medak district. They first targeted the women in the families and supported them to grow nutritious food agroecologically for the well-being of their communities. The women are organised into 'sangams' groups for savings and credit activities via interest-free loans. They farm on land leased collectively and run community grain and seed banks sold at subsidised rates to community members eligible for food support. The *sangams* have substantively impacted livelihoods with improvements in family diets, health care, children's education, marital relations and enhanced respect in the community (Khadse, 2017). These studies highlight the importance of prioritising gender equality in agroecology initiatives for social justice and women's crucial leadership in nurturing agroecology and using their knowledge and skills to enhance livelihoods.

So far, no studies have examined how the stages of agroecological transitions impact women and what benefits may arise from that. Additionally, there is a lack of understanding of how women navigate and control this process to maximise the benefits. This research aims to fill this gap.

3. Himachal Pradesh as the Context

3.1. Introduction

Himachal Pradesh is a mountainous state in the western Himalayas. It is one of the smaller states, 17th in size and 21st in population amongst the Indian states. The state has a population of 6.8 million people, of which 62 % are employed in agriculture and allied services. It is the only state in the country where 90 % of the population lives in rural areas (GOI, 2021). Approximately 80% of the total cultivated area in the state is rainfed. Only a little over 10% of the State's area is cultivated because of the mountainous terrain covering 50% of the State (GoHP, 2022).

Shortly after Indian independence from colonial rule in 1947, Himachal Pradesh was formed as a Chief Commissioner's province in 1948 by merging several princely states. Later, areas of Punjab were merged into Himachal Pradesh in 1966 as a result of a re-organization of Punjab state, and it attained statehood as Himachal Pradesh in January 1971. For administrative purposes, the state is divided into 12 districts consisting of 78 blocks (GoHP, 2024).

3.1.1. Religion and caste

Himachal Pradesh has the highest percentage of Hindu population in India: 95.17% of the population is Hindu, compared to a national average of 79.8%. Islam, the second most popular religion, forms 2.18 % of the population, while Sikhism and Buddhism form approximately 1.16 % each.

The scheduled castes (SC) in Himachal Pradesh constitute 25.19% of the total population (GOI, 2021). Other Backward Classes (OBC) form 13.52% and the Schedule Tribes (ST) form 5.71% of the population. The STs are concentrated in three districts: Kinnaur, Lahaul-Spiti and Chamba. These are situated in the north and north-east of Himachal Pradesh, forming a contiguous belt in remote high altitude and the most inaccessible areas. My research does not investigate women farmers in these areas. People from the SC, OBC and ST categories have historically faced discrimination from other castes in India.

3.1.2. Development indicators

Himachal Pradesh takes pride in the development indicators achieved relative to other states. It is amongst the richest states in India - its per capita income in 2013-14 was Rs. 54,494, as against the National Per Capita Income of Rs. 39,904 (NITI Aayog, 2021b). The main sources of income have emerged from developments in agriculture, tourism and hydropower. Initial focus and investment in basic infrastructure created a good network of roads, communication, schools and hospitals (Sharma, 2011).

The literacy rate places Himachal Pradesh amongst the top 4 states in India (NSSO, 2011). Rural women, however, had a lower literacy rate than men: 75% of rural females were literate compared to 82% of rural men. The gap narrowed for urban men and women, where 91% of the population was literate. Dreze (1999) noted that the literacy rate in Himachal Pradesh relative to the other Indian states was due to a "*spectacular transition towards universal elementary education*". The state government has been committed to promoting girls' education with special incentives. Women teachers have been appointed in most schools. With many villages having an active *mahila mandal* (women's group) in addition to the standard *gram panchayat (*village council*)*, public action at the village level has been less male-dominated. The *mahila mandals were* set up by government programmes before the self-help group movement of the 1990s (Sudarshan, 2011).

There is a high level of female labour-force participation: women's involvement in economic activities outside the household is much higher in Himachal Pradesh than elsewhere in north India. Additionally, the 7% gender gap in 2017-18 compared to other states in India was the lowest (Kumar et al., 2020).

3.1.3. Women's participation in MNREGA

In 2006, the Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA) was established in India. It guarantees 100 days of work in a year for each rural household. It was hoped that MNREGA would check distress migration and create village assets. The act is a safety net by providing a minimum income when no income is available. This was demonstrated during the COVID-19 2019 lockdown throughout India. Women's participation in MNREGA was initially low in Himachal Pradesh. In 2006/2007, only 13% of women participated in the scheme

as compared to other states: Tamil Nadu (82 %), Rajasthan (68 %) and Kerala (66 per cent). However, by 2009/10, 46% of women in Himachal Pradesh used the program (Sudarshan, 2011).

3.2. Land distribution initiatives

Upon the merging of hill states with a variety of feudatory land tenure practices, a uniform system of land tenure and tenancy was needed. Reforms in the 1960s and 1970s distributed land among the landless and reduced the hegemony of large farmers and more widespread land ownership (Kaushik, 1993; Sudarshan, 2011). A key reform, the Himachal Pradesh Ceiling on Land Holdings Act, 1972, bars land holdings beyond a permissible area for a family of a husband, wife and three minor children. The surplus area was distributed by the state government among landless agricultural labourers and to persons whose holding does not exceed 1 acre. The Ceiling Act was established later than other states, some of whom brought the Act into force in the 1950s, not long after Indian independence (Tripathi, 2018).

The Himachal Pradesh Nautor Land Rules, 1968, permitted the distribution of nautor or waste lands owned by the government up to 20 bighas (4 acres as shown in Table 4) to needy individuals. Additionally, Himachal Pradesh established the Grant of Nautor Land to Landless Persons and Other Eligible Persons Scheme, 1975, to speed up distribution under which nautor lands up to five bighas (1 acre) are granted to the landless and other eligible persons.

Furthermore, the Himachal Pradesh Tenancy and Land Reforms Act, 1972 imposes restrictions on land transfer in favour of those non-agriculturists who do not cultivate land personally in an estate situated in Himachal Pradesh. It allows only agriculturists to purchase land without permission from the state government. Leasing out land is banned except by people who fall into certain categories: disabled persons, members of the armed forces, single women, a minor or a student of a recognized institution. Negi (2021) found a decreasing trend in the degree of inequality from 1970-71 to 1980-81 due to an increase in land distribution. However, since then, the inequality in land distribution has been widening in the state.

Table 4: Land measures used in Himachal Pradesh

Hectare	Acre	Bigha
0.5	1.24	6
1	2.47	12
2	4.94	25
3	7.41	37
4	9.88	49
5	12.35	62
7.5	18.53	93
10	24.71	124

3.3. The impact of development on the environment

The Himalayan region is a fragile, new-fold, unstable mountain region and highly vulnerable to climate change. 49.62% of the state's total geographical area has undergone desertification and land degradation. Soil degradation problems are caused by water erosion, which includes loss of topsoil, flooding, acidity, and terrain deformations (TERI, 2015). Land use patterns have also changed significantly due to developmental modifications resulting in deforestation, urban expansion and habitat fragmentation. These have had an adverse impact on ecosystems and the livelihoods of indigenous people. The development of hydropower, cement factories and tourism has been achieved at the cost of environmental degradation, the depletion of its natural resources, and displacement of people. A considerable amount of arable land is used for developmental projects and industries. It leads to the erosion of local subcultures as well as women’s livelihoods based on traditional agriculture (Minocha, 2015; Negi, 2021).

Despite the adverse impacts on ecosystems, development projects continue unabated. The NITI Aayog 3-year plan (2021a) recommended that for diversified sources of revenue, the state should develop alternative industries such as timber plantations and fruit and floriculture. Further, approval for infrastructure projects involving the diversion of forest land should be expanded to an area of 10 ha from the present limit of 5 ha. Forests, however, play a critical role in shaping the state’s climatic conditions. They provide essential resources for local

communities, such as fodder, timber, food and medicinal plants. They ensure sufficient and timely rains and play a vital role in soil conservation.

Nonetheless, to develop tourism, the GoHP sought approval from the Supreme Court in 2021 to utilise 736 hectares of forest area protected under the Forest Rights Act 2006 (122 hectares) and the Forest Conservation Act 1980 (614 hectares) for projects. The approval was granted in January 2024. In February 2022, the GoHP permitted construction of 17 green belts that had been banned by the National Green Tribunal in 2000 (Mishra, 2024).

3.4. Agriculture in Himachal Pradesh

Himachal Pradesh is referred to as 'the apple state' of India - it is a major producer of fruits and vegetables. Due to variations in altitude across the state from lowlands to high mountainous areas, it has a range of climatic conditions, transitioning from subtropical climates to cold glacial deserts. The climate supports a wide range of crops, including cereals, fruits and vegetables. Currently, the main cereals cultivated are maize, wheat, rice and barley. The state has been divided into four agro-climatic zones on the basis of altitude and climate (Table 5). The districts often straddle more than one zone.

Table 5: Agroclimatic zones of Himachal Pradesh (Department of Agriculture, no date)

Zone	Climate	Altitude in metres	Districts included in the research (Figure 5)
Zone 1	Low hills, sub-mountain, sub-tropical	240 - 1000	Kangra
Zone 2	Mid hills, low humid, sub-tropical	1001-1500	Solan, Mandi
Zone 3	High hills, sub temperate wet	1501-3250	Shimla, Kulllu
Zone 4	High hills, sub-temperate dry	3251- 4250 and higher	

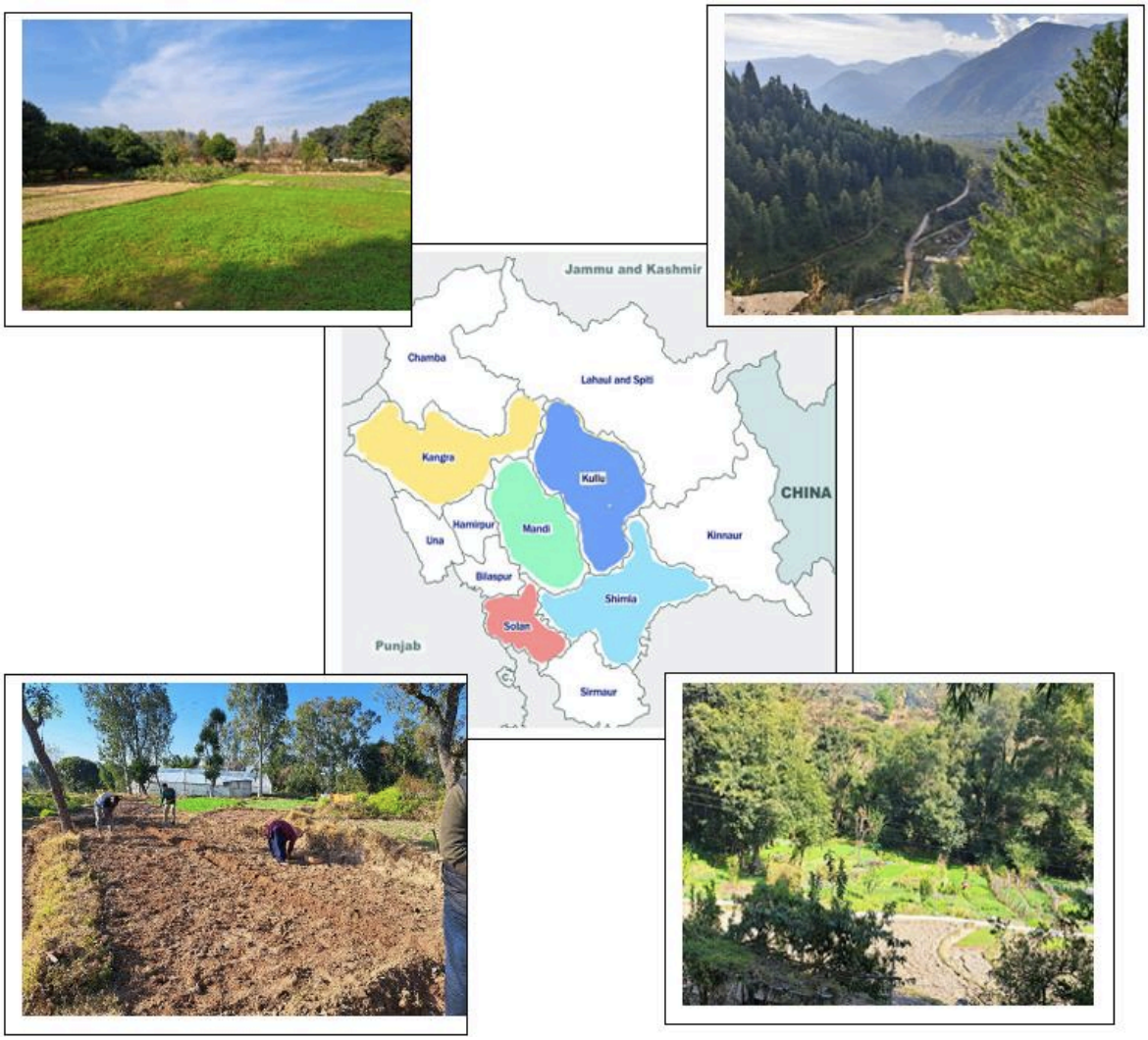


Figure 5: Map showing the five districts visited

According to the agricultural census of 2015/16, Himachal Pradesh has 997000 holdings comprising of 944000 hectares. 89% of all farms are marginal or small, with less than 2 ha. of land (Table 6). 71 % of these are marginal with an average size holding of 0.4 ha, equivalent to I acre, i.e., 5 bighas (GOI, 2019a). There is a countrywide pattern of women's contribution being greater amongst marginal and small farmers, particularly with subsistence farmers (Sahaas, 2015). This is particularly the case in rainfed regions where men migrate for employment (Rao and Raju, 2019). Compared to the national level, where irrigated land makes up 46% of the net sown area (NITI Aayog, 2021b), the irrigated area in Himachal Pradesh amounts to 20%.

Table 6: Size of holdings and their classifications

	Category		Classes (in ha)
I	Marginal	1. 2.	Below 0.5 ha. 0.5 < 1.0 ha.
II	Small	3.	1.0 < 2.0 ha.
III	Semi-medium	4. 5.	2.0 < 3.0 ha. 3.0 < 4.0 ha.
IV	Medium	6. 7. 8.	4.0 < 5.0 ha. 5.0 < 7.5 ha. 7.5 < 10.0 ha.
V	Large	9. 10.	10.0 < 20.0 ha. and above

There has been a gradual change in the agrarian structure, with marginal and small farmers increasing in number relative to the medium and large farmers, while the average size of land holdings decreases. The number of operational holdings increased by 63.71% between 1970 and 2016 (609000 operation holdings in 1970). The increase is due to the subdivision of land over time and partly to land allotted to the landless through distribution schemes to help them make it up to one acre (Negi, 2011). The holdings are owner-operated, with only 0.1 % being leased in. Population increase, industrialisation, and urbanisation have reduced the net sown area.

3.4.1. Agricultural policies and changes in cropping patterns

Agriculture in Himachal Pradesh is one of the major contributors to the total State domestic product. The State agricultural plans aim to increase farmer incomes by diversifying into the production of cash crops and boosting productivity, which includes better use of agrochemicals and hybrid seeds. At the same time, ecological sustainability is also cited as a goal (GoHP, 2022).

Cropping patterns have been changing across Himachal Pradesh. Commercial agriculture and diversification towards fruit and vegetable crops began to be promoted in the late sixties and

continue to be promoted. Vegetables have become the most significant high-value cash crops in the state. Vegetable production increased by 6.80% annually between 1992-93 and 2008-09 (Sharma, 2011). For example, Solan, Sirmaur and Kullu districts specialise in tomato production and account for 85% of the tomato production in the state. The state marketing board facilitates the marketing of high-value cash crops. Small and marginal farmers can sell their produce in marketing yards and established regulated markets. Since 2000, 73 marketing yards and 35 collection centres have been established.

Currently several programmes are underway to develop high-value fruits from imported rootstock further. In order to increase productivity, a new programme funded by the World Bank has introduced high-density planting using dwarf, spur-bearing, and high-yielding materials for apple growers. The project started in 2016 and was said to continue till 2023. Although the State is a leading producer of apples, the productivity level is below international standards. Nearly 40% of apple orchards have passed their optimal productivity life. Other factors related to irrigation, extension, and post-harvest losses due to inadequate storage were also included (Khanna, 2019). How high-density apple orchards will respond to NF practices remains to be seen by some apple farmers transitioning to NF.

A further project called 'Himachal Pradesh Subtropical Horticulture, Irrigation and Value Addition' (HPSHIVA) is underway for which a loan of 130 million dollars was agreed in June 2023 from the Asian Development Bank. The loan will be used to develop horticulture in the subtropical climate area of the state to diversify into other fruits, such as mangoes, kiwi and persimmon, to increase the income of farming households in 7 districts. The project aims to expand irrigation facilities to farmers and increase the cultivation of subtropical fruits for urban markets (Asian Development Bank (2023).

3.4.2. Analysis of trends towards commercial agriculture

The trends towards agricultural modernisation and promotion of commercial agriculture are based on the idea that traditional farming practices are backward and fail to benefit from science and technology advancements. This backwardness is believed to be a key reason why farmers, particularly small-scale farmers, remain poor. Van der Ploeg (2018) uses the term 'depeasantisation' to refer to how the modernist trend deprives farmers of their traditional or peasant character. Repeasantisation, on the other hand, is a process whereby farmers are

strengthened and recover their traditional way of being. Depeasantisation denudes farmers of autonomy and creates dependencies on purchased inputs and credit. At the same time, rural development programmes create opportunities for multinational input producers, promoting specialisation in monoculture crops and agrochemicals (Giraldo and Rosset, 2017). Van der Ploeg (2018) argues that although modernisation advancements may solve some problems, many more are being created, such as loss in soil fertility, farmer debt, and increased vulnerability to market fluctuations.

Problems caused by the structural changes in agriculture are evident in Himachal Pradesh. Sharma (2011) noted that cultivating high-value crops yields very high net returns and significantly improved income. However, several challenges were emerging. First, the cultivation of high-value crops, particularly horticultural crops, was proving to be unsustainable due to the depletion of soil fertility and essential micronutrients required for soil health, along with the increasing risk of crop diseases, pests, and insects. The high incidence of diseases has set up a cycle of increasing use of agrochemicals and a concomitant loss in yield. This has resulted in high production costs and adverse ecological impacts. Additionally, changes in weather and warming temperatures were inflicting significant losses for some farmers, such as apple growers. Prolonged dry spells and lack of snow are affecting apple production in particular. Further, there was competition from other areas of the country using new technologies, such as polyhouses, while more liberal international trade deals posed competition from cheaper imports. Nonetheless, these challenges are not considered significant enough to stall continued diversification into cash crops.

Moreover, the shift towards commercial agriculture is diminishing crop diversity. In the Kinnaur district, for instance, the cultivation of buckwheat (*Ogla*, *phafra*) has been replaced by more lucrative red kidney beans and apples. Additionally, in Kinnaur, pine nut and wild apricot forests are being sacrificed for hydropower projects or apple orchards (Gupta, 2022). Pine nut trees are not only ecologically significant but also serve as a valuable cash crop that enhances the socio-economic welfare of local communities.

Himachal Pradesh has the second-highest incidence of cancer in the country. This is attributed to the increasing use of fertilisers and pesticides in vegetable and fruit crops, which is

marginally higher than the national average. Research is underway to investigate whether pesticides pollute water sources (Prashar, 2024).

The key challenge is to increase farmers' incomes by diversifying into new crops without adversely affecting Indigenous crop diversity or harming people's health and the environment. The solution must involve reviving Indigenous crops. Himachal Pradesh boasts a rich agro-biodiversity of indigenous herbs, vegetables, and cereals, providing a variety of nutritious and climate-resilient species. The traditional diet included various cereals such as maize, finger millet, foxtail millet, buckwheat, chenopod, and amaranth. Local vegetables and grains are abundant in micronutrients, dietary fibre, antioxidants, and polyphenols (Dwivedi, 2024). There exists considerable potential for these to be revived and popularised among urban populations for their nutritional, medicinal, and therapeutic qualities, which has yet to be realised (Kanwar et al., 2018; Sharma and Sharma, 2020). For instance, the Himalayan grain, chenopod, belonging to the same family as quinoa, is highly nutritious and possesses promising potential for development (Partap and Kapoor, 1987). Instead, the focus has shifted to cultivating modern varieties favoured by urban populations as cash crops.

3.5. Introduction of Natural Farming

To overcome the ill effects of chemical-based farming, an organic farming policy was established in 2002. However, organic farming was found to be costly for farmers and productivity was low leading to financial losses. In its place, the agricultural department of Himachal Pradesh decided to implement a natural farming system as advocated by a farmer promoter Subhash Palekar called Subhash Palekar Natural Farming (SPNF)[13]. The main objectives are to reduce cost of cultivation, enhance farmer welfare particularly of small and marginal farmers, build climate resilience, improve soil fertility and its water holding capacity. Its vision was presented in line with the Food and Agriculture Organization's (FAO) concept of

sustainable food systems, which recommends holistic growth inclusive of gender, indigenous people, traditional cultures, health, and nutrition (FAO, 2018].

The scheme was launched in April 2016 with a four-day national workshop held by Palekar. Initial results were encouraging and in 2018 the State government launched a scheme, the *Prakritik Kheti Khushhal Kissan Yojna* (PK3Y) to promote SPNF. A dedicated 'State Project Implementing Unit' (SPIU) was established for its implementation.

The scheme offered various subsidies to offset transition costs:

- a 50 % subsidy up to maximum Rs 25,000 per farming family for purchase of one indigenous cow;
- Rs 8000 for lining a cement cowshed lining for urine collection;
- a 75% subsidy for purchasing of 3 plastic drums per family for the preparation of different NF microbial cultures and solutions;
- RS 10,000 was allocated to farmers to establish bio-resources centres (BRCs) known as *sansadhan bhandars* to prepare and sell various NF formulations.

The state had 961,000 farmers, of whom 150,000 farmers, i.e., 16%, were reported to be transitioning to NF by the end of 2022 and 170,000 farmers, i.e.,18%, were reported to be transitioning to NF at a state event in September 2024 (CSE, 2023; ET, 2024).

The PK3Y program collaborated with existing State extension institutions to deliver NF communication services. The state government allocated ATMA field staff, graduates, and post-graduates trained in agricultural sciences to the SPIU to implement the NF programme. They attended six-day training camps led by Subhash Palekar and were reorganised at improved salaries to work as communication agents for NF.

Top left: Intercropping vegetables with mulching.
Top right: Two female ATMA agents meeting women farmers in their home.
Bottom left: A training session on how to make bio-pesticides.
Bottom right: Spraying *jeevamrit* on a wheat crop.

PK3Y began to build a platform for certification and develop an efficient marketing system to achieve a fair price for NF produce in 2022. An online self-certification and evaluation system called the 'Certified Evaluation Tool for Agriculture Resource Analysis' for Natural Farming (CETARA NF) was established. It enables farmers to self-evaluate their practices based on NF principles. The self-evaluation is subsequently peer-reviewed by neighbouring farmers and verified by territory officials (Vashishat et al., 2024).

Next, Chapters 5 to 7 will present the research results and evaluate the mechanisms used by the State programme to engage with farmers and deliver communication services.

4. Methodology

4.1. Introduction

I begin this chapter by explaining the research approach on which the methodology is based. Next, I provide an outline of the study location and research design. I will discuss how the sampling strategy, research methods and tools were selected to expand and deepen my understanding of the conditions I encountered during the research process. In conducting the literature review and having initial conversations with women farmers, it became clear how their livelihoods, food security, and their choices are influenced by various social, economic, and environmental factors, which constitute the context. Decisions for data collection and lines of inquiry were developed iteratively based on emerging themes. Finally, I will discuss the strategies used to analyse the data in order to provide a nuanced understanding of farmers' lives, their decision-making process, and their responses to the mechanisms employed to transition farmers to NF.

4.2. Research approach

The theoretical perspective that informed my methodology is based on the epistemology of constructivism. It is the view that all meaningful reality is constructed by human beings as they engage with the world they interpret; it is developed and transmitted within a social context. Because meanings are constructed in this manner, objects cannot be adequately described in isolation from the conscious being experiencing them, nor can experiences be described accurately in isolation from their object (Crotty, 1998). There is an epistemological affinity between feminist inquiry, constructivist grounded theory and interpretivism. Interpretivism includes several different paradigms concerned with people's experiences and the meanings ascribed to them. It favours research in a natural setting and an inductive style of reasoning (Bryman, 2008). The feminist perspective allows for an intersectional approach that has the potential to uncover issues specific to the lives and experiences of marginalised women. Further, feminist inquiry and constructivist grounded theory share common epistemological features. They both value women's experiences as a legitimate source of knowledge, appreciate the influence of context in the production of

knowledge, and acknowledge the role of reflexivity in the research process (Charmaz, 2006; Wuest, 1995)

I selected a case study as a research approach to comprehend complex social phenomena and cultivate a holistic view of real-life events. A case study is an empirical inquiry that "i*nvestigates a contemporary phenomenon (the 'case') in depth within its real-world context, when the boundaries between phenomenon and context may not be clearly evident" (*Yin, 2014, p. 16). It has several advantages: it permits the use of various research methods; it is appropriate for a small sample size, which serves as an illustration; and it can yield rich and detailed data for the case being examined (Lindvall, 2007). The case facilitates the investigation of connections and patterns among social, economic, institutional, and environmental factors, which together constitute the context. To explore such complexity, numerous variables of interest might be present, and one may depend on multiple sources of evidence, with data converging in a triangulating manner.

The case study method is criticised for its limited generalisability due to small sample sizes, bias in choosing samples and lack of rigour. Flyvbjerg (2006) counters that generalisation is not always useful; rather, discovering and understanding an interesting and detailed problem may extend theories or disprove them. According to Yin (2014), a lack of rigour is less likely to be present when using methods that have more precise procedures to follow. For example, I included visual and participatory tools that engaged participants and showcased detailed responses on particular themes.

Similarly, Jacobsen (2002) argues that the detailed, contextual data with multiple variables lends these studies internal validity and makes them a valuable source of information. The ability to address the complexity and contextual conditions establishes case study methods as a viable alternative among the other methodological choices. Some researchers believe that a case study is appropriate for the exploratory phase of an investigation, but Yin (2014) illustrates how case studies can also be appropriate for the descriptive and explanatory phases. They are suitable for addressing "how" and "why" questions, which are central to this study. I will next outline the study location and research design.

4.3. Study location

Before selecting Himachal Pradesh as an example of a state programme to transition farmers to an agroecological approach, I conducted a scoping visit to Uttarakhand to investigate to what extent farmers had been practising conventional agriculture in recent years and whether a transition to agroecology had taken place with support from Grassroots, a local civil society organisation. I found farmers in Uttarakhand to be continuing their traditional agricultural practices. The CSO primarily focused on establishing a Farmer Producer Organisation (FPO) to market their produce, facilitating self-reliant local development in line with agroecology.

As my research focus was on examining agroecology transitions, I decided to concentrate on the state-led programme in Himachal Pradesh because of the key features that made it suitable for my study. The state agricultural department had implemented a natural farming system promoted by farmer advocate Subhash Palekar, known as Subhash Palekar Natural Farming (SPNF). The objectives included reducing cultivation costs, enhancing farmer welfare—particularly for small and marginal farmers—building climate resilience, and improving soil fertility and water retention capacity. The scheme was launched in April 2016, featuring a four-day national workshop conducted by Palekar. Initial results were promising, and in 2018, to further promote SPNF, the Himachal Pradesh government introduced a scheme called the *Prakritik Kheti Khushhal Kissan Yojna* (PK3Y). Their vision aligned with the FAO concept of sustainable food systems, which advocates for holistic growth that considers gender, indigenous peoples, traditional cultures, health, and nutrition (FAO, 2018). Although gender equity and women's empowerment were noted as goals, little information was provided on how to accomplish these objectives.

As a relatively recent example of an agroecology transition, Himachal Pradesh presented the opportunity to interview women farmers in the transition stage who would be able to recall changes that had occurred and challenges they had resolved or continued to face. Himachal Pradesh was a state where I was able to communicate directly with farmers in Hindi, an Indian language that I speak. This made it a preferred choice compared to a similar initiative in Andhra Pradesh, an Indian state notable for its engagement with rural women's self-help groups (Barucha et al., 2020).

4.4. Research design

An overview of the study research design is presented in Table 7 showing the selection of methods used for each objective. A mixed methods approach was used for primary data collection, including non-participant and participant observations, focus groups, open-ended questions, and narrative interviews to gather women's perceptions and personal stories. It included quantitative data gathered from institutional actors to showcase targets achieved

Table 7: Overview of study research design, data collection, phasing and methods

Objectives	Fieldwork	Methods	Tools
1) To investigate how processes or mechanisms support and empower women farmers during the transition to natural farming. 2) To examine the relationship between rural communication services and a culture of enquiry and innovation in farming. 3)To explore the role of state mechanisms in facilitating access to traditional seeds during the transition process.	Phase 1 4 weeks in November 2021	• Focus groups • Key informant interviews • Non-participant observations • Literature review	• Force field analysis • Audio recorder • Field diary
	Phase 2 3 visits 1) May / June 2022 2) Nov/Dec 2022 3) Nov 2023	• Semi-structured interviews • Narrative history interviews • Time use mapping • Key informant interviews • Ethnography • Literature review	• Timelines • Clock diagrams • Field diary • Audio-recorder • Questionnaire as aide memoire

4.5. Sampling strategy

The sampling strategy was based on an intersectional approach. First, categories such as gender, age, caste, and location were identified as being potentially relevant through the literature review. Later, other categories emerged during the investigation in Phase 1, such as types of households. It became clear that the women belonged to four types of farming households in relation to work burdens. These were:

(1) women-headed households (where a woman is single – widowed/divorced/ separated)
(2) women cultivators with male-out migration (men work in other towns or states and visit home periodically, e.g., every three to six months)
(3) women cultivators where husbands mostly live at home but hold non-farm jobs
(4) both women and men cultivate the land together

In the second phase, purposive sampling was adopted that took the four types of households into account, in addition to caste, length of time that NF was practised, i.e., for more than two years, and different agro-climatic zones to include different types of crops grown (Figure 6).

The sampling strategy included both purposive and theoretical sampling. Theoretical sampling, as defined in grounded theory, is an iterative process; it is "*the process of data collection for generating theory whereby the analyst jointly collects, codes, and analyses his data and decides which data to collect next and where to find them, in order to develop his theory as it emerges*" (Glaser, 1978, p.36). For example, I discovered new categories through focus group activities conducted in Phase 1, which led to further sampling in those dimensions. Coyne (1997) notes that theoretical sampling is a variation of purposive sampling; however, not all purposive sampling is theoretical.

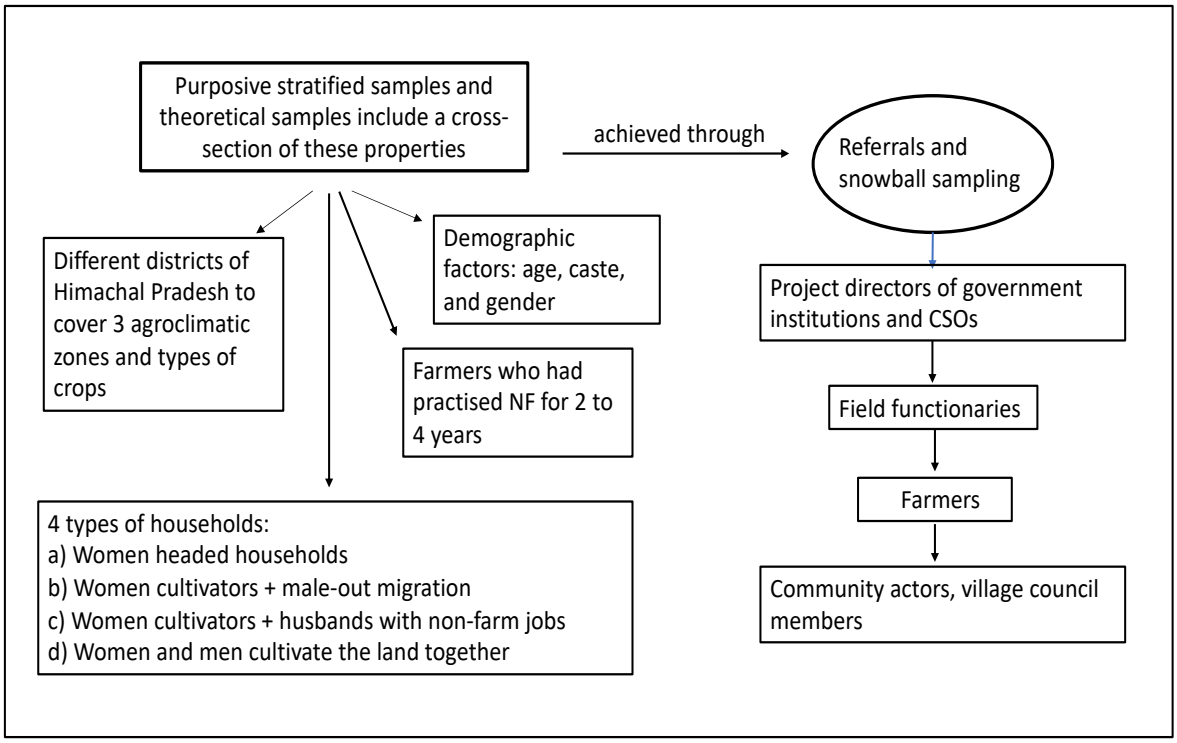


Figure 6: Sampling strategy

For Phase 1, qualitative data was gathered in November and December of 2021 during visits to Uttarakhand and Himachal Pradesh villages. The scoping visit to Uttarakhand lasted a week, during which I interviewed NGO staff and was introduced to women's groups in four villages. This was followed by a longer visit to Himachal Pradesh, where I met farmers in Shimla, Mandi and Solan districts. Focus groups, semi-structured interviews, and informal conversations were conducted with women farmers in nine villages selected by extension officers and based on the length of time the farmers had practised NF. These were combined with observations on the farms and trainings. The meetings were held outdoors with groups of ten women on average at one of their homes in the village. I was accompanied by Agricultural Technology Management Agency (ATMA) officers for most of the village visits, and they were able to provide details of the extension support that was being offered.

Phase 2 data collection comprised two six-week fieldwork visits to Himachal Pradesh in May and June of 2022 and in November and December of 2022. A brief and final fieldwork visit was conducted in November 2023 to observe a two-day farmer training since on the previous visit, which was during state elections, an observation of two-day training could not occur. For the

first visit in Phase 2, I selected two villages purposively through farmer contacts from Phase 1 and two villages through contacts with CSOs. These included two scheduled caste villages. I conducted repeat interviews with government officials from Phase 1, who facilitated contacts with ATMA agents in the high-altitude apple-growing district, Kullu. The ATMA staff arranged for me to meet individual women farmers who had been practising NF for at least two years and farmer groups in six villages. They organised homestays with four farmers, each lasting two to four days. Village and homestays, which occurred throughout Phase 2, facilitated casual interactions with village members and leaders, as well as with farmers who were not participating in the natural farming program. It also allowed for attendance at social gatherings and community events.

I returned to Kullu district for the second visit to investigate the phenomena observed during the previous visit. I also conducted repeat interviews with project directors. Next, I visited Kangra, a district where male outmigration is prevalent. The district project director in Kangra arranged for me to meet ATMA staff and visit a number of progressive farmers, including a few male farmers (Table 8). Again, I met with CSO staff and obtained farmer contacts from them. Overall, I visited thirty-five villages across five districts. A summary of the sequence of activities in the two phases is shown in Figure 7 below.

Table 8: Interviews and participants

	Number of participants
Women in groups	142
Individual women interviews	53 (Listed in Appendix J)
Families (14)	32
Male farmers	13
Total no of women farmers interviewed	190
Total number of farmers interviewed	210

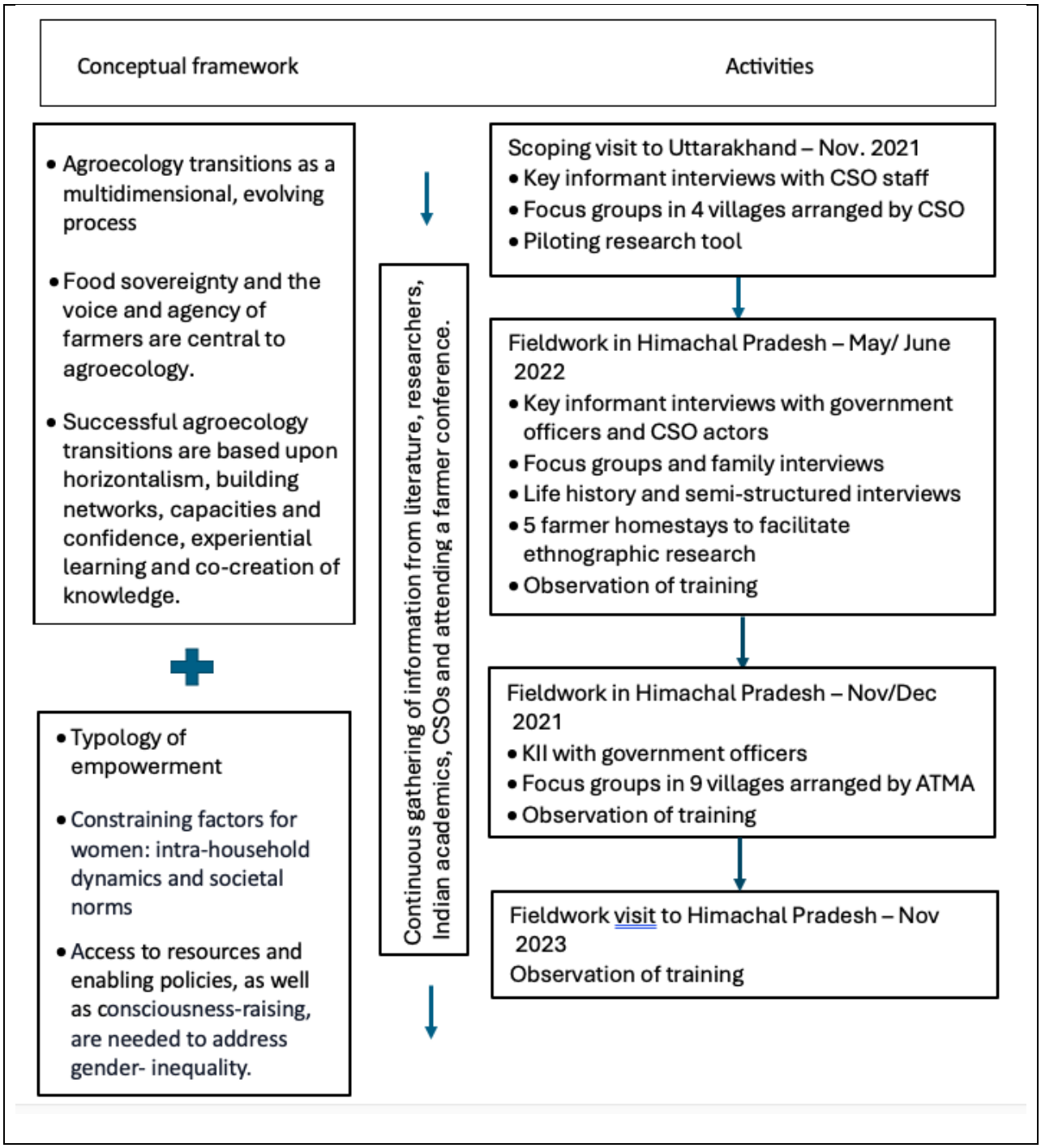


Figure 7: Summary of the sequence of activities during fieldwork

4.6. Data collection methods

4.6.1. Focus groups

In Phase 1 of the research, the emphasis was on using focus groups to better understand the context, the dynamics at the study locations, and women's viewpoints of the practical challenges in their day-to-day lives. Focus groups have been shown to disinhibit participants who may be uncomfortable with one-on-one interviews with a researcher from a different background; they are also more likely to use their own concepts and terms and elaborate on and challenge each other's accounts (Wilkinson, 2004) (Figure 8).

Figure 8: A focus group in a village.

4.6.2. Narrative interviews (NI)

Women farmers were identified as part of agroecological groups in different locations and invited to participate in narrative inquiry. Narrative interviews (NI) are qualitative interviews suitable for investigating personal perspectives of women farmers' experiences. NI is necessary for oral histories, reconstruction of events, and seeking insights into the interviewee's points of view. NI "emphasises the inner experience of individuals and its connections with changing events and phases throughout the life course" (Bryman, 2008, p.695). In keeping with

constructivist and interpretivist approaches, narrative research acknowledges people's "crucial interactive relationship between individuals' lives, their perceptions and experiences, and historical and social contexts and events" (Goodson and Sikes, 2001, p.2). The interviews included a life history narrative as I sought to develop an in-depth understanding of how a transition to agroecology affected their lives.

NI is strongly favoured as a data collection method in feminist and intersectional research. It provides opportunities for women to be listened to, for self-reflection, appraisal, catharsis, knowledge about a topic or advocacy, and to connect with a community with shared experiences and help someone later (Wolgemuth et al., 2015; Johnson and Thacker Darrow, 2023). In keeping with an intersectional approach, individuals can reflect upon how systems of power, privilege and intra-household dynamics impact their lives. Upon reflection, they may amend their narratives, as was mainly observed during home-stays when women added more information to their reports of certain experiences the next day. A woman farmer, for example, reflected on how being an older female child in a poor family meant she needed to shoulder more care responsibilities, which affected her educational opportunities. She later added that despite the extra burdens, she experienced a happy childhood with enough time for play.

Additionally, telling their own stories allows women to make themselves visible to counter the dehumanised representations often found in research reports. Participants are not treated like research objects but subjects whose own subjectivities and life stories constitute a central source of knowledge. As I spoke the local language, I conducted and recorded the interviews, which I later transcribed. NI, combined with other qualitative methods, focus groups, time-use mapping, semi-structured interviews and ethnography, provided more detailed and contextual insights into their lives, challenges, needs and preferences and how they were affected by larger power structures. The women interviewed were illustrative of the range of women involved in the NF projects.

4.6.3. Semi-structured interviews

Semi-structured interviews are in-depth interviews in which respondents are asked open-ended questions from an interview guide to optimize the use of interview time. The interview guide consisted of two sets of questions. One set aimed to discover the NF practices adopted, the mechanisms used, the challenges encountered, the crops grown, and the results achieved.

Another set of questions was posed to women farmers based on domain-specific indicators of empowerment (Rowlands, 1995). These included 1) leadership in the community, 2) control over decisions about agricultural production, 3) increased economic opportunities and control over income, and 4) effect on workloads. The questions utilised themes that are the foundation of a widely accepted standardized survey, the 'Women's Empowerment in Agriculture Index' (WEAI) (OPHI, 2012). The WEAI, however, has been criticized for ignoring sociocultural contexts, relational dynamics and collective agency (Addison et al., 2021). Semi-structured interviews were effective in examining these factors and the complexities of women's daily lives.

4.6.4. Participant observation

Participant observation is a central ethnography method. It involves the researcher either taking a full part in the situation being studied or being present as an observer (Thomas, 2017). Homestays with farmers offered many opportunities to observe farmers in their natural setting, working in their fields and interacting with households and the community. Participant observation was a key method for gaining insights into people's ways of life, social relations, power structures, experiences, values, and the significance they attributed to events. Knowledge of many aspects of their lives would not have been discovered without participant observation. For instance, the first homestay with a farmer revealed how arduous collecting fodder could be for women and related questions were subsequently included in the interview template (Appendix D). The interview questionnaire was developed iteratively as additional contextual issues were identified.

Where ethnography is conducted for short periods, it may lead to observer bias, that is, the tendency for researchers to perceive what they expect or desire to see rather than what is present (Hammersley and Atkinson, 2019). A way to minimise this bias is to observe the events through a dual perspective: the observer's perspective, which has been influenced by a literature review, on the one hand, and take note of the participant's perspective, on the other. Taking account of the participants' viewpoints and reporting these perspectives was essential to this research. For instance, some women farmers did not believe they required a source of income solely for themselves, in fairness to husbands who shared all the farm earnings. They questioned the validity of my inquiries, revealing an aspect of their thinking that had not been considered in the literature on women's empowerment.

An observer effect, also called social desirability bias (Bryman, 2008), occurs when people behave differently if they know they are being observed. A way to minimise the observer effect is by using other information sources to verify that the behaviour or reports are credible. Ethnography allowed for sufficient time and opportunities to check accounts with community members. Combining participant observation with interviews helped the data from each to illuminate the other (Hammersley and Atkinson, 2019). For example, I discovered that a farmer who had reported using NF on her entire farm was using CF on a fifth of her plot. She explained that she didn't have enough cow urine to extend NF to her entire plot. Other farmers later refuted her explanation and reported that they could obtain cow urine from their neighbours if there were a shortage. Upon further investigation, it became evident that the farmer's husband had decided to continue using CF on some cash crops.

4.6.5. Field diaries

A field diary or journal facilitates the research process by recording observations and the many informal discussions with farmers that are likely to occur. It was useful for noting thoughts and questions that emerged during the observation process. These facilitate reflective thinking about the research and planning the next steps. The field notes also objectively record the phenomena I observed, particularly trainings and interchanges between ATMA or CSO agents and farmers.

4.6.6. Key informant interviews

Key informant interviews (KII) are qualitative interviews to gather information about the context, new initiatives and outcomes, project progress, etc. The interviews may be structured or semi-structured to elicit as much information as possible on particular topics. The tone in these interviews is informal, resembling a conversation among acquaintances. The interviewer subtly probes informants and takes recordings or notes, which are transcribed or checked later (Kumar, 1989; Patton, 2002). I used purposive sampling to select key informants to learn about issues central to the purpose of my inquiry. I began the process by interviewing the highest-level government officials and policymakers at the headquarters in Shimla. Through their introductions, I worked outwardly, from program directors to extension agents. I interviewed PK3Y officials about the objectives and strategies being employed to scale out NF practices and

questioned extension agents about implementation methods and issues. I also consulted three CSOs who further provided farmer contacts. These were:

ENSS – *Ekal Nari Shakti Sangathan* - a prominent promoter of equal rights for single women.

RTDC—*Rural Technology and Development Centre*—a CSO that has partnered with PK3Y to deliver NF training to 100 villages it has worked in.

HimRRA— *Himachal Revitalising Rainfed Agriculture* – a network that collaborated with PK3Y in 2022 to train farmers in one village in each of ten panchayats (village councils) to grow millets, conserve seeds, and distribute seeds.

Developing a network of key informants was invaluable for checking policy changes, new developments, and implementation strategies employed by field staff. It also made triangulation possible.

4.7. Data collection tools

4.7.1. Forcefield analysis

This is a participative ranking of labels or drawings to denote the forces in play in a problem situation. In this instance, the focus was to think of the challenges or benefits of NF. Because the activity is based on visual depiction, force field analysis allows people to think of the forces or the enabling and disabling conditions that contribute to the posed question. The method is known to stimulate discussion and bring new points to light. I asked the women to note the advantages of NF above a horizontal line and the challenges below the line. They were then asked to rank the benefits and challenges from 1 to 5 by placing beans on the labels or drawings (Figure 9).

The activity served as an icebreaker and elicited responses from more group members who may have otherwise desisted from contributing. At the start of the activity, I shared the viewpoints of other farmers to exemplify that a range of responses were 'safe' to articulate so that the participants would feel emboldened to share their own views. Holstein and Gubrium (1995, p. 39) concur that the interviewer has an important role to play in that interviewers should ''*activate narrative production*'' by ''*indicating – even suggesting – narrative positions, resources, orientations, and precedents*''.

The visual analysis provides a framework for participants to express their views and organize their narratives. It encourages collaborative meaning creation and creative thinking within the group, fostering discussions for new interpretations, such as which challenge was the worst to deal with—animal raids or drought. I tried to involve the quiet observers by checking with them to see if they agreed with what was being said or by asking questions.

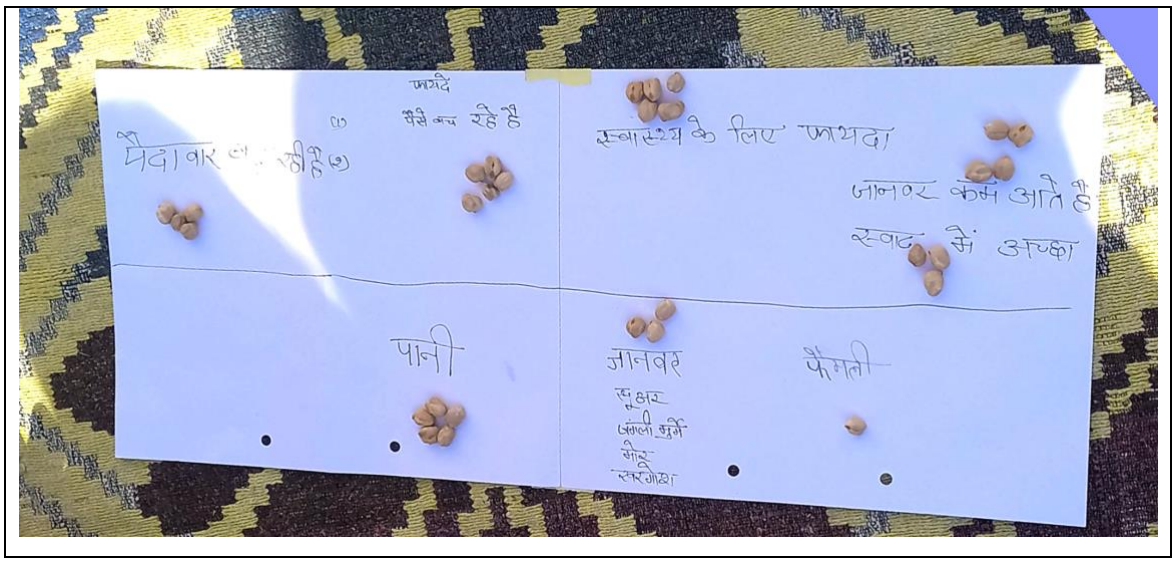


Figure 9: Photograph of a force field analysis sheet

4.7.2. Time use analysis

A daily time-use schedule formed a more structured and visual element of narrative inquiry. The participant was presented with two circles divided into half-hour intervals, with the inner circle representing am and the outer representing pm so that the entire day could be mapped. I asked a participant to report how they spent their time during a 24-hour period, along with some indication of the starting and stopping times of those actions (Appendix I). The participant was asked to suggest colours to represent certain activities, e.g., green for farming. I asked the participant to colour in the diagram when more interviewing time was available, such as during a homestay. The aim was to determine the impact of adopting natural farming on their lives in terms of time use and resulting work burdens. The visual depiction acted as an accessible medium that enriched communication and offered insights into various aspects of their everyday lives (Barbour, 2014). Valuable information was revealed about factors that impacted

their workload, e.g., the distance they needed to walk to collect fodder, the location of the farming plots in relation to their homes, or work shared by family members.

Timelines supplemented the in-depth interviews and observations conducted within the households. They assisted with understanding socio-economic, farm-related and ecological factors that had occurred in the last three years. Women were asked about changes or events in their lives in the last three years or since they began practising NF.

4.8. Fieldwork challenges

At the start of each fieldwork trip, state officers needed to be met to obtain contacts, updates, or interviews. However, the officers' availability in the state capital, Shimla, needed to be fitted into visits to other locations. In May 2022, the Executive Director of PK3Y accepted a new position as Vice-Chancellor of a state agricultural university, which made scheduling meetings more difficult.

During Phase 1, communication with the district project staff in Mandi was not sufficiently precise; thus, large groups of women were invited to meet me in the villages. These large gatherings were unsuitable for a forcefield activity, so I improvised by posing open-ended questions regarding their challenges and experiences with NF. Subsequently, I ensured that the field staff received clear requirements and that adequate time was also allocated for meetings with farmer groups.

At times, individual interviews with women farmers proved problematic due to the presence of relatives or neighbours who dropped in for visits. In those instances, I first conducted a short focus group to allow everyone to contribute, followed by individual interviews. Since farmers have a significant workload, their time for interviews was precious. I made sure to use their time effectively. When ATMA staff members accompanied me to villages, I requested time alone with the women for individual interviews.

4.8.1. Positionality

Regarding researcher positionality, I was an outsider because I was a non-farmer and belonged to a different class, even though I spoke Hindi. I was cognizant of local perceptions of village communities and considered them in my own ‘impression management’ to foster rapport and

create a safe space for the women farmers (Berreman, 2007). Certain factors facilitated privileged access, such as introductions from government officials. Nevertheless, this situation was both advantageous and problematic; the potential for farmers to view me as a government representative could hinder the free flow of information, while conversely, informants might embellish their responses to create a favourable impression. To mitigate potential bias, I made it clear to participants that I was an independent researcher, keen to find ways to support women farmers. Through further questioning, discrepancies emerged when field functionaries or farmers provided inaccurate information to impress.

Feminist scholars are particularly concerned with eliminating boundaries that privilege dominant forms of knowledge and epistemology. They are concerned with reducing the hierarchy between the researcher and the researched implicit in structured interviews, wherein interviewers lead and retain the right to ask questions, which implicitly places the interviewee in a subservient position (Ladner,1971; Oakley, 1974; Hesse-Biber, 2013). As recommended by Oakley (1981), Rheinharz (1983), and Smith (1999), I was respectful and shared experiences and my biography to increase rapport and reciprocity in the process and thus lessen the researcher's position of power. Establishing a relationship based on mutual trust was essential for the more in-depth interviewing to proceed. Homestays in villages were particularly useful for building rapport, repeat interviewing and developing an understanding of participants over time (Vincent, 2013).

4.8.2. Ethical considerations

My research is centred on a commitment to social justice. I aimed to be methodologically self-aware by respectfully involving those historically having less power and privilege. Using NI as the core methodology addresses issues of positionality in that it acknowledges the validity of women's perceptions of reality (Ginsberg and Mertens, 2009). However, "*all knowledge is affected by the social conditions under which it is produced and that it is grounded in both the social location and the social biography of the observer and the observed*" (Mann and Kelly, 1997, p.392). Feminist researchers have highlighted several factors that must be considered to ensure the interviewees' stories are being listened to. Harding (1993) urged researchers to use reflexivity to examine whether their own values, beliefs and attitudes contaminate the research process. For example, were the researcher's perspectives affecting the sampling strategy, the questions being asked and how the data is analysed and interpreted. Reflexivity would ensure

the interviewee is heard, understood and represented in the research process. Harding (ibid) introduced the concept of 'strong objectivity' and argued that reflexivity and consideration of their standpoint during all phases of research would deliver 'strong objectivity' for the researcher. As a researcher, I aimed to present women's realities meticulously.

Access to fieldwork and site visits was arranged in collaboration with the state government, local CSO, and community representatives. Following the University of Reading's ethical clearance (Appendices A, B and C) acquired for research, KIIs and farmers were offered anonymity at the start of fieldwork. Participant names will not be used in any published results from the study unless specifically allowed by the participants.

4.9. Analysis

The data analysis employed techniques consistent with constructive grounded theory (Charmaz, 2014). Data collection and analysis proceeded simultaneously and iteratively. Data was assigned codes or labels to a line, sentence or segment of data, which categorised or summarised the data. The initial codes were later subcategorised according to emerging meanings or themes. The analysis began to develop explanations that suggested further cases to sample. There was a progressive move from descriptive understanding to a more theoretical analysis. One arrives at a more abstract or analytic understanding towards the end of the project.

I used the coding software Nvivo to upload all interview transcripts and assign codes. To illustrate the process of assigning codes, one of the initial categories or codes used was "crops grown" Upon reviewing all the references, three subcodes were further assigned: 1) Indigenous crops, 2) cash crops, and 3) crops cultivated since the uptake of NF. It became evident that an additional classification for "cash crops cultivated with NF practices" was necessary, as many farmers were not utilising NF for all their crops. Women farmers also reported that cultivating tomatoes and cabbages demanded more effort due to their susceptibility to disease. This prompted the identification of a new area of interest requiring further investigation. In subsequent interviews, I included questions regarding which crops necessitated more effort when using NF. Thus, as the research progressed, the number of subcodes increased, reaching a

total of 114. Figure 10 illustrates the subcodes that emerged from investigating 2 of the 14 initial codes or categories.

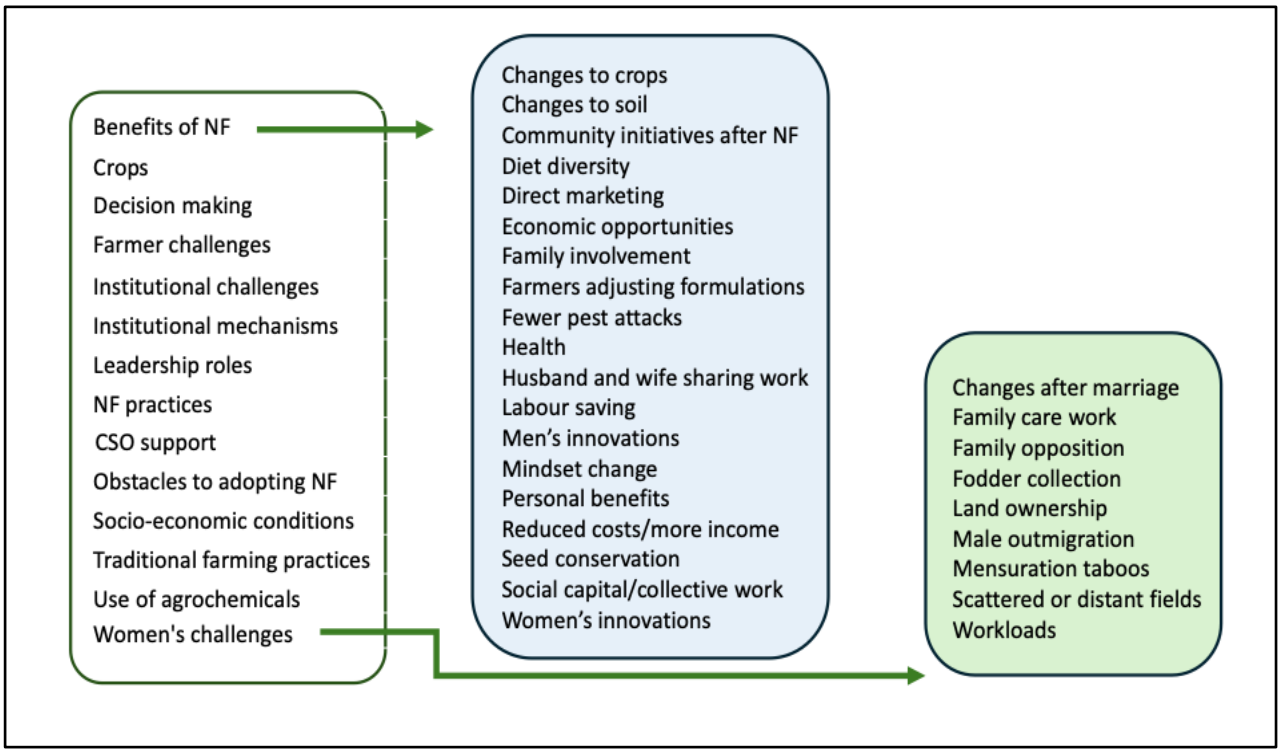


Figure 10: Examples of codes and sub-codes used

The initial codes were broad and avoided categorising phenomena in preconceived categories based on literature. For example, literature suggested that making NF formulations increased workloads for women on marginal farms. Beginning with a more general category, 'workloads' to gather all references in the transcripts revealed a nuanced picture. It became clear that the preparing NF formulations were offset by several factors which mitigated the workload: sharing tasks with family members or NF groups, saving time on purchasing inputs, and the convenience of making inputs at a suitable time of the day. Furthermore, it became evident that the person who made the formulations played a key decision-making role in experimenting and adapting formulations to local conditions.

Using the coding software Nvivo, I could generate different kinds of quantitative and qualitative data. For example, I could derive quantitative data, such as the percentage of respondents who found that agrochemicals harmed their health. I could also examine women's experiences and

interpretations of how NF benefited them personally. A woman's perspective on her journey to gaining confidence provided valuable insights into how transitioning to agroecology could empower women.

5. New Possibilities for Women's Empowerment through Agroecology in Himachal Pradesh, India

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Abstract

In 2018, the state of Himachal Pradesh in north India launched an initiative to convert all its farmers to natural farming (NF), an agroecological approach. The aim was to address multiple challenges related to rural livelihoods, high input costs, biodiversity loss, and environmental degradation. This paper is based on a qualitative case study of the state programme to transition farmers to NF. It seeks to understand how its mechanisms support and empower small and marginal women farmers. In addition to identifying mechanisms that facilitate the effective uptake of NF, the case study sought women's views on whether these mechanisms increased spaces for decision-making and developed capabilities and autonomy. Framed within the vision of reclaiming food sovereignty, various mechanisms such as training in villages, participating in NF groups and networks, visits to model farms, and adopting leadership roles offered new pathways for women farmers to gain confidence and capabilities. Women began to participate in spaces that had been culturally and structurally denied to them. This case study demonstrates how agroecology initiatives, with a particular emphasis on gender, can offer women various opportunities for decision-making, income generation, and creative expression. These initiatives also expand community agency and enable the acquisition of knowledge necessary for sustainable ecosystems.

5.1. Introduction

Natural farming (NF) is an agroecological approach that can potentially address multiple agricultural crises attributed to the industrial farming model (GOI, 2009; Kumar et al., 2020). The use of high-cost agrochemicals has not only placed farmers in debt but has polluted the environment, degraded the soil and affected people's health adversely. In India, NF is being adopted for its potential to regenerate the soil, increase farmer incomes, enhance food security, and enhance resilience to climate change. This paper uses a case study of a natural farming initiative by the north Indian state of Himachal Pradesh to explore how its mechanisms

support and benefit small-scale and marginal women farmers. In India, research on agroecology and gender has been limited to NGO reports (Khadse, 2017). Agarwal's (2020) significant research on how group farming empowers women did not examine farming practices. An emerging body of literature from Latin American countries bridges agroecological and gender scholarship, but relatively little has been published in English (Action Aid Brazil, 2011; Oliver, 2016; Benitez et al., 2020). There is a need for evidence-based research that explores the processes of change and the impact on women from their perspectives so that the complexities of their day-to-day lives are understood. This paper asks whether state mechanisms in India support women transitioning to NF, and whether these expand spaces for decision making and build capabilities to make effective choices to improve their lives.

The paper begins with a literature review that discusses key concepts in agroecology and women's empowerment. Exploring the different academic framings and shifts that have taken place within the literature will make evident how agroecology and gender studies share common ground related to justice and equity.

5.2. Literature Review

5.2.1. Agroecology as a sociopolitical movement

The first argument the paper makes from the literature is that the concept of agroecology has evolved from that of longstanding traditional practice and the science of sustainable farming into a discourse about whole food-system transformations and food sovereignty. Currently, multiple agroecology initiatives in India address the fallout from the Green Revolution (GR) technologies. The GR, an industrial model of agriculture comprising hybrid seeds, fertilisers, pesticides, irrigation, and mechanisation, was exported from the USA to India in the 1960s. It was resource-intensive, and, in India, it resulted in the marginalisation of small-scale farmers, soil degradation, water depletion, deteriorating human health, loss in biodiversity, and farmer indebtedness (Deb, 2009; State of Environment Report India, 2009; Patel, 2013). In 2018, the states of Andhra Pradesh and Himachal Pradesh began an ambitious plan to transition all their farmers from conventional chemical farming to NF. NF refers to low-cost regenerative agricultural practices based on ecological principles that do not rely on agrochemicals. A National Coalition of Natural Farming (NCNF), a network of 400 organisations, was established which defined NF as 'the direction and process of transition towards a more local, resilient, and

adaptive agroecology based farming' [NCNF, 2021]. The NCNF aims to empower small and marginal farmers with an emphasis on women farmers, which is of particular significance in India, where 63% of working women work in agriculture within oppressive patriarchal, caste, and cultural norms (NITI Aayog, 2017b).

Agroecology remains a contested term in its definition and scope. Altieri's well-known description of agroecology as an ecosystem approach that applies ecological concepts and principles to the design and management of sustainable agroecosystems has been expanded to include increasingly political spaces, using food sovereignty and food justice perspectives to transform food systems (Altieri and Nicholls, 2017; Sanderson Bellamy and Ioris, 2017). This sociopolitical dimension was facilitated by the emergence of agroecology as a sociopolitical movement. In opposition to high-input GR technologies and the "modernisation" agenda imposed on developing countries by the World Bank and International Monetary Fund, La Via Campesina, a transnational peasant organisation, proposed an alternative agriculture and rural development model framed as food sovereignty. This was adopted in 2007 by advocates from 80 countries (Martinez-Torres and Rosset, 2010; Alonso-Fradejas et al., 2015):

"Food sovereignty includes the right to food—the right of peoples to healthy and culturally appropriate food produced through socially just and ecologically sensitive methods. It entails peoples' right to participate in decision-making and define their own food, agriculture, livestock and fisheries systems. It defends the interests and inclusion of the next generation and supports new social relations free from oppression and inequality between men and women, peoples, racial groups and social classes" (Nyeleni, 2007).

Subsequently, the Declaration of the International Forum for Agroecology, held in Nyéléni in 2015, accepted agroecology as a key element in constructing food sovereignty. In asking for a transition to more sustainable food systems, this approach asks for a more just society that counters structural oppression, racial capitalism, and patriarchy (Anderson et al., 2021). Further, Schneider and McMichael (2010) argued that food sovereignty has a significant role as an environmental countermovement needed to resolve ecological crises. It achieves this by repairing the relationships between people and nature and restoring the "epistemic rift" caused by industrial agriculture, i.e., a rupture in the farmers' knowledge needed for sustainable ecosystems.

The question of how to scale agroecology up and out has become an increasingly important debate in global policy and funding spaces that address food systems, such as UN climate and biodiversity conferences and the UN Food Systems Summit (Mier y Terán Giménez Cacho et al., 2018; Anderson et al., 2019; Ferguson et al., 2019). Gliessman's five transition levels form a widely used framework to understand how farmers can transition from conventional farming (CF) to an agroecological system (Anderson et al., 2021). Gliessman borrowed the first three levels from Hill (1985), focusing on the technical aspects of transitions from CF to fully integrated agroecological systems at Level Three. He added two further levels to include a broader food system change and food sovereignty (Table 9).

Table 9. Transition stages to agroecology with examples

Source: adapted from Gliessman and Engles (2015), Gliessman et al. (2019), HLPE (2019, p.51).

	Gliessman's levels of transition		Examples
Transformational	Level 5 - Build a new global food system based on participation, localness, fairness and justice.	*Food system*	Dismantle seed laws that prevent farmers from selling or exchanging seeds. Restore and protect ecosystems based on equity and democracy.
	Level 4 - Reconnect consumers and producers through the development of alternative food networks.		Community supported agriculture (CSA), Participatory guarantee schemes (PGS), Direct marketing.
	Level 3 - Redesign the agroecosystem based on a new set of ecological processes and protect biodiversity.	Agroecosystem	Intercropping, permaculture, agro-sylvo pastoral farming, ZBNF, natural farming.
Incremental	Level 2 - Substitute conventional inputs and practices with agroecological alternatives.		Organic farming in monocultures.
	Level 1 - Increase efficiency of input use and reduce use of costly, scarce or environmentally damaging inputs.		Smart agriculture, precision farming, optimal crop spacing, drip irrigation.

Although Gliessman's transition levels appear to be a stepwise evolutionary process towards food systems transformation, several overlaps and entry points may exist. As was observed in Himachal Pradesh, NF is an example of a Level 3 systems redesign, also noted in Andhra Pradesh (Barucha et al., 2020), where some farmers, such as those with established fruit

orchards, begin with input substitution using the Palekar formulations. Success with these encourages further experimentation, and farmers transition to the next level. Anderson et al. (2021) argued that a Level 3 redesign would be challenging unless farmers are supported by broader structures and relationships such as food markets, reciprocity within the community and wider landscape changes found at Levels 4 and 5. In Himachal Pradesh, features of Level 4 wider community and food systems change were present: the transitions involved new relationships and forms of social organisation, participatory forms of learning, and communities sharing resources similar to those observed in Andhra Pradesh [Barucha et al., 2020; GIST, 2023).

In 2021, concerns that mainstreaming agroecology would deprive it of its political and social underpinnings, which distinguish it from other sustainable agricultural practices, led to the formation of the Agroecology Coalition (IDS and IPES-Food, 2022). To define agroecology more precisely, it adopted the 13 principles of agroecology suggested by the High-Level Panel of Experts (HLPE, 2019) of the Committee of World Food Security. These principles include the ten elements of agroecology from FAO (2018) and can be related to Gliessman's transition levels. The first seven principles—(1) recycling, (2) input reduction, (3) soil health, (4) animal health and welfare, (5) biodiversity, (6) synergy (managing ecological interactions), and (7) economic diversification—relate to Levels 1 to 3. The next six principles relate to whole food-systems changes: (8) co-creation of knowledge (embracing local knowledge and global science), (9) social values and diets, (10) fairness, (11) connectivity (between producers and consumers), (12) natural resource governance, and (13) participation.

5.2.2. The need for a gender focus in agroecology transitions

The second argument this paper derives from the literature is that transitioning to agroecological farming alone may not be enough to overcome the barriers women face due to their invisibility and subordination (Pattnaik et al., 2017). While agroecology's principles and theoretical underpinnings are based on promoting equity, its practice does not always reflect this (Bezner Kerr, 2013; Montiel et al., 2020). In agroecology movements that do not promote initiatives specifically for women, women are seen to be present, but only as farmers' wives. This was evident in a study of the ZBNF movement in Karnataka, India, despite being led by a grassroots movement (Khadse et al., 2019). For agroecology to be transformative, a synergistic

relationship between agroecology and the feminist movement is needed (Schwendler and Thompson, 2017). In instances where a gender focus has been included in agroecology approaches, the findings show enhanced life outcomes and empowerment for women (Larrauri et al., 2017).

Empowerment can be understood as gaining a sense of power to shape the lives we want to live ourselves and the lives of others (Cornwall, 2017). It is generally agreed that empowerment is a multi-dimensional concept, and it includes relational power as an essential aspect. It can be expressed through dominating others, resisting transformative change, or generating new possibilities through collaboration. Power relations function in multiple domains—domestic, social, and political. Additionally, what may be experienced as empowering for one woman may not be empowering for another. How interventions change women's lives depends on their circumstances, the possibilities open to them and what they value (Cornwall, 2016; Kabeer, 2002). The process, in essence, is one of self-determination. To understand how changes in power happen, it is helpful to distinguish between different types of power (Table 10).

Table 10: Distinguishing different types of power. Source: adapted from Bradley (2019) and Rowlands (1995)

Types of power	Meaning
Power over	The power that people wield over others, such as by men over women, and by dominant social, political, economic or cultural groups. Resisting 'power over' entails an understanding of the dynamics of oppression, particularly internalised oppression.
Power within	A sense of self-worth and self-respect, where people see themselves as able and entitled to make choices.
Power to	A generative term, which refers so the realm of creating new possibilities. It is one's power to act, speak out and make choices to shape one's own life.
Power with	One's social abilities to act in a group, where one can gain strength in working as a collective or in alliance with others.
Power for	People's vision and values to create a world in which they want to live. It inspires and motivates people to persist with their efforts towards that end.

The types of power are interlinked and complementary. For example, “power within” lies at the crux of empowerment and forms the basis of the other categories. In turn, an increase in one’s capability to resist “power over” or enhancement of abilities in the social domain, i.e., “power with”, strengthens the “power within”. The importance of “power within” or a woman’s self-confidence and self-view is highlighted by Belenky et al. (1986) who argued that a woman’s confidence in herself as a thinker and the belief that she is capable of intelligent thought lies at the basis of her ability to make choices for her well-being. These understandings reinforce the need for an intentional equity focus on agroecology efforts. Amartya Sen (1999, p. 125) noted, “the issue of gender inequality is ultimately one of disparate freedoms”. Gender equality and women’s empowerment are considered integral to each of the 17 Sustainable Development Goals (UN Women, no date).

Cornwall [36] emphasised the need for change at all levels—personal, social, and institutional as shown in the framework below (Figure 2) for gender equality and women’s empowerment to be achieved. She argued that providing women with resources, economic opportunities (Quadrant B) and supportive institutional policies (Quadrant D) were insufficient conditions for transformation. A process for a change in consciousness (Quadrant A) is also required in how women perceive the world and their roles so that they become aware of inequalities and limiting social norms (Batliwala, 1994; Cornwall, 2016). Quadrant C refers to deep cultural beliefs that exert ‘power over’ people’s actions and are often the most difficult to change.

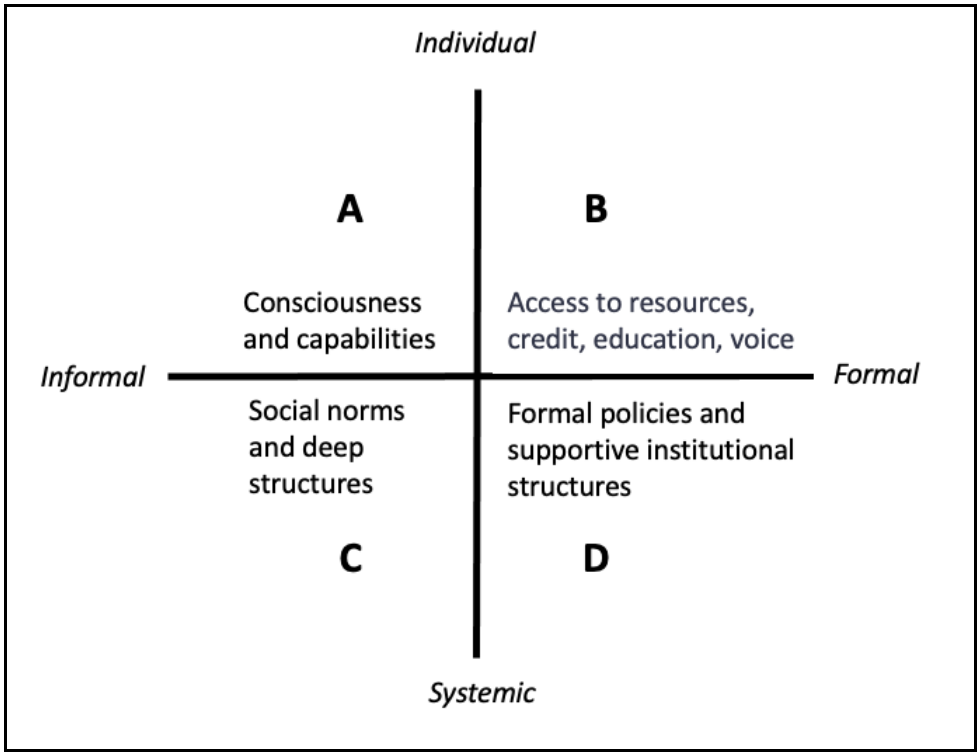

Figure 2: Gender at work analytical framework (Rao et al., 2016)

The right side of the framework refers to measurable and tangible efforts, while the left relates to changes that are hidden, invisible, or have fewer observable causes and effects. The x-axis represents informal and formal domains, while the y-axis refers to the individual and systemic domains. The framework will be used in the Discussion section to link ideas from agroecology and gender studies to analyse which combination of factors contributed to empowerment and where further change is needed.

5.3. Case study location and context

Himachal Pradesh, the case study location, is one of the northern states across the Himalayan mountains. Agriculture is the source of livelihood for 71% of the population, and 78% of the total cultivated area in the state is rainfed (NITI Aayog, 2021b). It is a major producer of fruits and vegetables and is called “the apple state” of India. However, intensive agriculture has increased susceptibility to insects, pests, diseases, falling yields, and soil degradation in recent years (GOI, 2009). About 90% of all farms are small, with less than 2 ha, or marginal, with less than 1 ha of land. The average size holding is 0.4 ha (GOI, 2019a). Land ownership amongst

farmers is widespread on account of land distribution reforms; all farming households interviewed owned land. A few farmers had increased their holdings by leasing additional land. Traditional practices based on manure persist on many marginal farms, where agrochemical use is limited to pesticides. However, farmers who specialise in apples and high-value vegetables use a range of agrochemicals. It was observed that a diverse variety of crops were grown on each farm, including cereals, beans/pulses, oilseeds, and between fifteen and twenty-five vegetables and fruits.

Himachal Pradesh has the highest percentage of Hindu population in India, with 95.17% being Hindu compared to a national average of 79.8% (GOI, 2019b). The Scheduled Castes (SC) constitute 25.22%, Other Backward Classes (OBC) form 13.52%, and Scheduled Tribes (ST) form 5.71% of the population. ST are concentrated in three northern high-altitude districts, which were not included in this research. Historically, these communities have suffered discrimination from other castes.

The state is proud of its development indicators and its relative progress compared to other states in India. With a per capita income higher than the national average, the state is one of the wealthiest in the country. Income sources have emerged from agriculture, tourism, and hydropower. Moreover, the state boasts a high literacy rate, which places it among the top four states in India (MOSPI, 2023). Dreze (1999) described the literacy rate relative to the other Indian states as spectacular. The state government has been committed to promoting girls' education with special incentives. With many villages having an active *mahila mandal* (women's group) in addition to the standard *gram panchayat* (village council), public action at the village level has been less male dominated (Sudarshan, 2011). There is a high level of female labour-force participation, and women's involvement in economic activities outside the household is much higher than elsewhere in north India. Additionally, the 7% gender wage gap in 2017–18 compared to other states in India was the lowest (Kumar et al., 2020). However, much of the arable land is being used for developmental projects and industries. It leads to the erosion of local subcultures and women's livelihoods based on traditional agriculture (Minocha, 2015).

Despite educational advances, patriarchal and patrilineal norms continue to take precedence over legal norms in land ownership. Although the Hindu Succession Amendment Act 2005 gives all Hindu women (married and unmarried) equal rights with men for the ownership and

inheritance of property, substantial inequalities persist (Agarwal et al., 2021). Women in Himachal Pradesh forgo their claim to ancestral property to maintain good relations with their brothers. Similarly, in their married homes, the land is inherited by their husbands, and should the husband die young, the father-in-law will not bequeath the son's portion to the daughter-in-law. Instead, the land will be inherited by other male members of the family. These ingrained beliefs and the norms for gender roles together form a profound cultural basis for gender inequality. No operational holdings in Himachal Pradesh are jointly owned. Women own 7.3% of operational holdings in comparison to a national average of 14% (GOI, 2019b)

5.4. Materials and Methods

5.4.1. Methodology

This paper is based on qualitative data gathered over three visits to Himachal Pradesh, India, between November 2021 and December 2022. The study employed a gender-specific approach to gather women's perspectives of how NF transitions had affected them personally, and whether they had increased spaces for decision-making, developed capabilities, and autonomy.

Data was collected in an iterative process that was split into two phases (Figure 12). Phase 1 consisted of focus groups in nine villages across three districts—Mandi, Shimla, and Solan—selected by extension officers based on the length of time the farmers had practised NF. The focus groups comprised women who engaged in a participatory force-field activity, ranking the challenges and benefits of adopting natural farming. The first phase provided insights into issues that required investigation, just as would be expected from a pilot study. It became clear that the women belonged to four types of farming households in relation to work burdens. These were (1) women-headed households (where a woman was single or widowed), (2) women cultivators with male-out migration (men worked in other towns or states and visited home periodically, e.g., every three to six months), (3) women cultivators where husbands mostly lived at home but held non-farm jobs, and (4) both women and men cultivated the land together.

In the second phase, purposive sampling was adopted that took the four types of households into account, in addition to caste, length of time that NF was practised, i.e., for more than two years; different agro-climatic zones, and types of crops grown. Districts and villages were selected to cover three out of four agroclimatic zones where farms predominantly grew either

cereals or vegetables and fruits as cash crops. Overall, thirty-five villages were visited across five districts—Shimla, Solan, Mandi, Kangra, and Kullu. Phase 2 included five homestays with farmers. Homestays were helpful in ethnographic research, helping understand women's work burdens, meeting their families, and generating rich accounts of their lives. Individual male farmers and farming couples were also interviewed to determine how decision-making and work burdens were shared. Furthermore, program officials (7), extension services staff (22), civil society organisations staff (5), and agricultural scientists (4) were interviewed to understand the context, challenges, objectives, and mechanisms being employed to engage with farmers and scale out NF practices. Each visit involved repeat interviews with program officials and meeting different field staff through snowball sampling. Meetings with farmers were organised by extension staff and three CSOs based on purposive sampling.

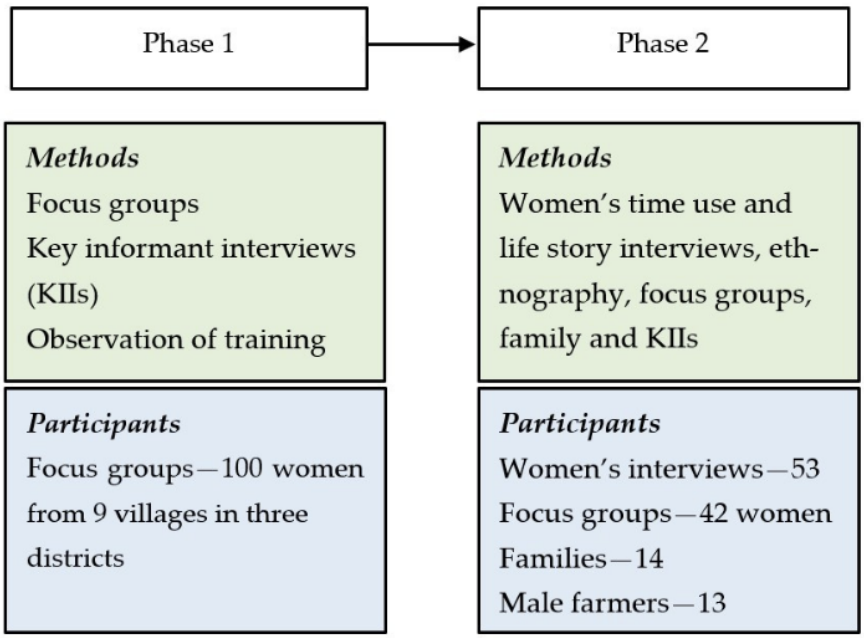

Figure 3: Phases of research and methods used

Phase 2 included life story interviews (20), time-use mapping (26), and semi-structured interviews with women farmers, individually or in small groups of up to five women. The semi-structured interviews comprised two sets of questions. One set aimed to discover the NF practices adopted, the mechanisms used, the challenges encountered, the crops grown, and the results achieved. Another set of questions asked farmers how the NF transition processes had affected their lives in specific domains. The themes of domain-specific indicators of empowerment were derived from the literature (Malhotra and Mather, 1997; Alkire et al.,

2013; Kabeer, 2020). These included leadership in the community, (2) control over decisions about agricultural production, (3) increased economic opportunities and control over income, and (4) effect on workloads. Within these domains, indicators for developing different powers—power within, power with, power to, and power for, or resisting power over—were noted. The interview template (Appendix D) was developed through an iterative process, where additional contextual issues were identified as the research progressed. For instance, the first homestay with a farmer revealed how arduous collecting fodder could be for women, and related questions were subsequently included.

The first author conducted the interviews in Hindi, a language spoken throughout Himachal Pradesh. The transcriptions were coded using Nvivo to organise, analyse, and highlight the trends and nuances in the results. A quantitative approach was not used to summarise the results related to women's experiences, as these would fail to capture the nuances of local contexts and intra-household dynamics (Addison et al., 2021). Instead, woman's accounts were used to describe their perceptions and the complex realities of their lives. Since introductions through extension staff could inhibit responses, it was clarified that the researcher was investigating improvements that were needed in the state scheme.

5.4.2. The natural farming programme in Himachal Pradesh

To overcome the difficulties of CF, an organic farming policy was established in Himachal Pradesh in 2002. However, organic farming with purchased inputs was costly for farmers, and lower yields led to financial losses. In its place, in 2018, a State Project Implementing Unit was set up to launch NF as a programme called *Prakritik Kheti Kisan Khushal Yojana* (PK3Y) (Figure 13) based on practices popularised by a farmer promoter, Subash Palekar. The main objectives were to reduce the cost of cultivation; increase farmer incomes, particularly for small and marginal farmers; grow healthy food; build climate resilience and improve soil fertility and water-holding capacity. Its vision was presented in line with the FAO (2018) concept of sustainable food systems, which recommends holistic growth inclusive of gender, indigenous people, traditional cultures, health, and nutrition. The state had 961,000 farmers, of whom 150,000 farmers, i.e., 16%, were reported to be transitioning to NF by the end of 2022. However, NF was practised only on 2.5% (CSE, 2023) of the net sown area, indicating farmers with very small plots of land featuring among NF farmers. Data on how many farmers were using NF on most of their holdings was in the process of being collected.

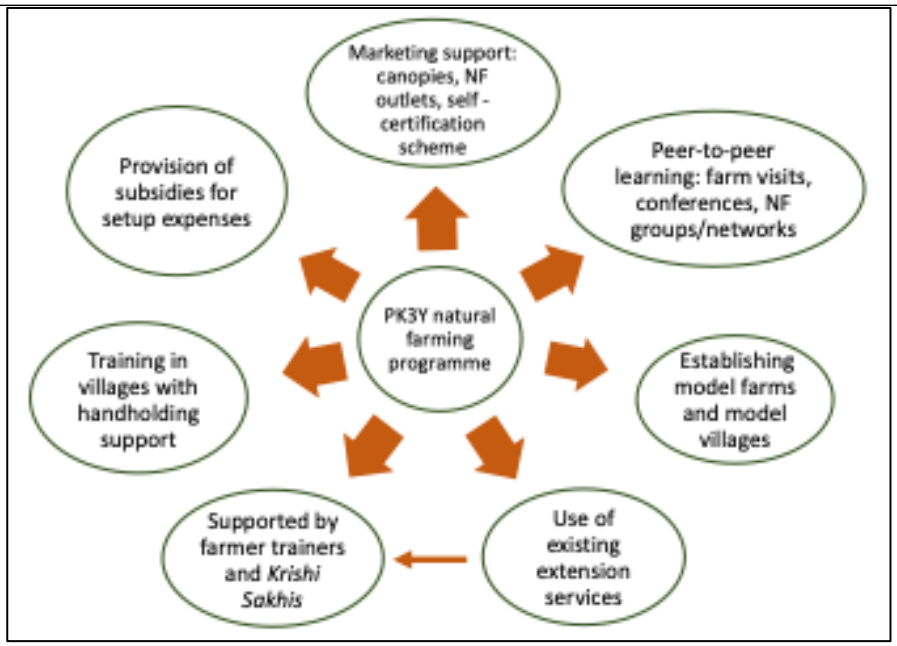

Figure 13: Key aspects of the PK3Y programme (author constructed)

Palekar's methods were based on four essential practices aimed at regenerating the soil microbiome, for which an indigenous cow was recommended:

1. *Beejamrit*, a seed coating of cow dung, cow urine, lime, and soil to protect seeds from fungal or soil-borne diseases.
2. *Jeevamrit*, a fermented mixture of cow dung and urine, pulse flour, jaggery, uncontaminated soil, and water, acts as a microbial culture to promote microbial activity in the soil and enhance fertility. The microbes make soil nutrients bio-available to plants. The microbial culture is also used in its solid form known as *ghanjeevamrit*.
3. *Aachhadan*, mulching to conserve soil moisture and stabilise soil temperatures.
4. *Whapasa*, the maintenance of aeration and moisture in the soil through humus and limited irrigation.

Other practices include multi-cropping, intercropping and line sowing. Various concoctions with botanical extracts, sour buttermilk, and cow urine control pests and fungal diseases. The state offered subsidies for drums (up to three drums per family), cement lining for cowsheds, 50% of the cost of an indigenous cow limited to Rs 25,000 with Rs 5000 for transportation, and Rs 10,000 for a bio-resource centre (BRC).

PK3Y used the existing extension system, the Agricultural Technology Management Agency (ATMA), which had previously offered training in organic and CF. ATMA field officers, 37% of whom were female, were known as Block Technology Managers (BTM) and Assistant Technology Managers (ATM), respectively. A BTM was required to have a master's degree, while an ATM was at least a graduate in agricultural sciences. In 2018 and 2019, the extension staff attended six-day training from Subhash Palekar and were reorganised at higher salaries to deliver the NF extension services. These training camps were also attended by progressive farmers. Each of the 80 blocks in 12 districts was assigned one BTM and two ATMs. Consequently, each BTM or ATM was responsible for extension to approximately one hundred villages. This number presented greater challenges in high-altitude districts relative to low-altitude districts. Additionally, the ATMA staff had the responsibility of informing and assisting farmers in accessing other government initiatives and schemes. The training was also cascaded to the farmers via other farmers nominated as Master Trainers (MT) and *Krishi Sakhis*, community resource persons funded by a central government scheme. The emphasis was on communicating the new techniques in a friendly and practical manner through demonstrations and working with the farmers in the fields. Although trained by Palekar, the extension staff were initially unsure whether the practices would work. Sometimes, they needed time to adjust recipes to local conditions to maintain yield. Essentially, they were learning together with farmers.

5.5. Results

This section begins with reporting the results related to the NF practices. Next, the processes or mechanisms used to support women's access to resources and learning opportunities will be explored to reveal how these opened pathways for women to build capabilities, skills, knowledge, and opportunities for collaborative work. Finally, results relating to changes in different domains of women's lives are recounted.

The following results refer to all farmers from Phase 1 and 2. All farmers who had practised NF for over a year reported that the soil texture had improved, and the population of earthworms had increased. The soil was crumblier or softer, and therefore, easier to till and weed. This concurs with findings in Andhra Pradesh (Duddigan et al (2023). Of the sample farmers, 60% of the farmers reported that the results in the first year had been poor for productivity and size of

vegetables, e.g., cauliflower heads were smaller. From the second year of transition, 80% of the farmers began to notice that the yield was at the same or higher levels than previously. The crops were more climate resilient; wheat and maize had stronger stalks and did not lodge in strong winds or heavy rains. All farmers in the second year of practising NF reported increased shelf life, improved taste and appearance, and prolonged fruiting periods for their produce. These factors contributed to increased income and diet diversity. Higher yields motivated farmers to plant more fruit trees and crops. Many farmers related stories about how their health had improved with NF. Women had reported experiencing skin rashes, headaches, body aches, and burning skin and eyes due to applying pesticides and chemical fertilisers. Three farmers, whose health had been adversely affected by CF to the point that they could no longer work, said they regained their health with NF.

5.5.1. State Mechanisms to facilitate uptake of natural farming

Face-to-face farmer training

The BTMs and ATMs delivered training in the villages themselves rather than setting up a camp in a block or agricultural institutions that villagers would have to travel to. This increased access to training, and women could participate with ease. In many villages, it was the first instance of agricultural training that they had ever attended. Women from a SC village said:

> *"People like us did not get trained or find out about training or attend any."*

The trainings were arranged either through existing women's self-help groups (SHGs) if these had been previously established by ATMA, or through a known farmer or through a *panchayat* (village council). Training dates were selected by consulting the farmers. Farmers were first encouraged to try NF on a part of their farms, particularly in kitchen gardens. In districts where male outmigration was prevalent, or men held local jobs, primarily women attended the training. Statewide, about 60% of the trained farmers were women. A village training lasted two days with lunch provided and comprised a mix of theory and practical demonstrations. It was delivered jointly by extension staff, a progressive farmer, or a farmer who had attended the Palekar training camps and was nominated as an MT. The involvement of a local farmer in trainings was believed to lend greater credibility to practices being promoted. The MTs were familiar with local crops and growing conditions and could communicate in local

dialects. It was observed that women listened to a woman MT with greater attention when she spoke in the local dialect.

At the outset, the person trained became both the advocate for and the expert in NF in the family. The trained farmer, whether a man or a woman, was the one who made the NF formulations and developed an understanding of what adaptations were required, what worked, and what did not. Adapting the formulations to local conditions requires creative thinking, intuition, and experimentation. Rather than merely indicating who bore the burden of extra work, the NF training engaged women in new endeavours and facilitated decision-making and problem-solving. It challenged cultural gender norms, as highlighted by a male farmer:

> *"According to the local culture, it is men who attend trainings and meetings, and the men also take the decisions."*

As NF methods offer a range of safe ingredients and equipment mostly available on the farm, they facilitate experimentation. In many villages visited, there was evidence that women were testing and adjusting the NF preparations to find the best combination to overcome challenges, such as pest attacks. In one village, a woman farmer first experimented with different quantities of *jeevamrit* to investigate its effect on the growth of young apple trees. She subsequently altered the recipes to suit her context. One farmer compared the effectiveness of different pest control substances, including chemical pesticides, cow urine, and NF concoctions, and invented combinations, such as tobacco leaves mixed with cow urine. In another village, a group of women altered the frequency of application and recipe of a mixture of sour buttermilk and *jeevamrit* to deter animal raids. They tested it further in areas where wild pig raids were occurring to check its efficacy and were encouraged by the BTM to share their innovations in training sessions. Through their agency and critical thinking, the women invented a practice to save their crops and increase their productivity by a third.

Establishing NF groups and networks

Along with the training, the extension officers formed an NF group of up to 25 members; therefore, a village of about 50 households would have two NF groups. Previously existing SHGs were used in some villages. They became the channel for communication from the extension

staff and the means for handholding—some extension staff made the solutions together with the women during their monthly meetings.

There were several benefits to forming NF groups. They comprised members from similar socioeconomic backgrounds and became a mutually supportive learning community through their regular meetings and the use of social media, usually WhatsApp. In some villages with no previous SHGs, the NF groups were the first to offer collaborative spaces for speaking and discussing common concerns. These developed capacities to talk, think through issues and find solutions to challenges. As a result, they became hubs for social, learning, and economic activities. In villages where farms were distanced from others, the NF group meetings offered opportunities to meet regularly. In one such village, the women turned the monthly meetings into celebratory events with music, singing, and eating together. As a government initiative, NF offered women greater freedom to spend time away from home for training or meetings.

Moreover, the SHGs acted as saving groups, where each woman contributed a small amount a month to a savings account that members could borrow from at a low-interest rate. The funds became a handy source of credit for women. They also used their savings to build community resources, such as purchasing mattresses and folding chairs for events and family gatherings. Working collaboratively generated income opportunities, such as selling homemade food products at community fairs and NF events. During the COVID lockdown, members of a group cooked sweets for Diwali to share and sell in a farmer's market.

Establishing NF groups strengthened the traditional culture of reciprocity and labour sharing in Himachal Pradesh, known as the *jowari* system. *Jowari* is an informal institution where village members contribute their labour and time in a free exchange system and for managing common village property resources (Padigala, 2014). Western sociologists refer to this as a dimension of social capital. Putnam (2001, p.19) defines "*social capital*" as "connections among individuals—social networks and the norms of trustworthiness and reciprocity that arise from them". Women in several villages reported working in groups to help each other with farming tasks during busy periods. When NF practices were introduced, women worked collectively to sow in rows, which is more labour intensive than broadcast sowing. Women groups made the NF preparations in the initial stages of implementing NF in all the villages visited, and some

groups continued to share the tasks. The labour-sharing culture helped mitigate the burdens in marginal farms where the men held non-farm jobs.

Collective work and reciprocity engendered through the NF groups reinforced social cohesion and social capital. Not all exchanges in villages were monetised, thus representing use value rather than exchange value. These involved sharing labour, seeds, crops, and resources for NF formulations. Giraldo and Rosset (2022) describe exchanges of use value as fundamental to transformative agroecologies, as these consolidate solidarity and cooperative economies. The farmers could access most materials within the village itself free of cost. Farmers who owned indigenous cows made the cow dung and urine available to others. However, transporting the materials to their farms was often laborious and viewed as an extra burden that some women preferred to avoid undertaking. Therefore, not owning a local breed of cow became an obstacle to adopting NF. The advice to farmers was altered later to increase the proportion of cow urine from non-indigenous cows in recipes so that farmers could use their own crossbred Jersey and Holstein cows.

The social networks became a pathway for informal and horizontal farmer knowledge exchange. Using a messaging app on smartphones became a vital tool for dialogues of knowledge and learning (ibid). Farmers posted pictures, appreciated each other's work, and raised questions on how to manage diseases. Moreover, two-way interchanges between farmers and extension staff took place: the extension officers informed members about techniques, success stories, which farmers had indigenous seeds to share, and forthcoming meetings, while the farmers contacted them with any queries regarding practices. A messaging app, therefore, became an essential tool for handholding. A BTM posted videos of farmers, often women, explaining various practices. These demonstrated to women that they were valued and promoted enthusiasm and motivation. In addition to the village NF groups, there were block- and district-level WhatsApp groups, which included extension staff and both male and women farmers. MTs became members of a state MT group. The wider groups enabled communications about farmer innovations and became an indigenous seed exchange mechanism. However, communications about farmer-led innovations did not seem to be communicated between districts; for example, extension staff in various districts were unaware of how the NF solutions were being used to deter animal raids by farmers in Solan district.

Visits to farms and conferences

Another mechanism critical for the horizontal transmission of knowledge used by PK3Y, in alignment with agroecology principle 8—co-creation of knowledge—was for farmers to visit progressive or model farms (HLPE, 2019). Extension staff organised visits to model farms established in each block or to those in other states. Additionally, there were state-level women's farmers meetings held on occasion. PK3Y arranged for 721 women farmers to attend a two-day conference in 2022 to mark International Women's Day. It is widely acknowledged that horizontal exchanges were vital to the success of the agroecology movement in Cuba, the most successful worldwide, which grew to over 100,000 smallholders in eight years. A study of the campesino-a-campesino (farmer-to-farmer) methodology revealed that training workshops were followed by farmer gatherings and conferences where one group of farmers visited another to see sustainable practices at work—tools, seeds, information, and knowledge passed hand to hand as an example of shared cultural praxis (Holt-Giménez, 2006; Rosset et al., 2011). In Himachal Pradesh, visiting other farms inspired farmers to try the practices. After seeing the crops grown by other farmers, women began to grow a wider range of crops, positively impacting their dietary diversity. For some women, the visits were a significant event in their lives and the first opportunity they had to travel out of their district or state (Vignette 1).

Vignette: 1

LK, a 35-year-old farmer practising NF for four years, suffered from PTSD because of traumatic events in her childhood. Her father died when she was six years old. Her mother worked hard to raise three children with no support from her community, as widows faced discrimination. Tragically, their home was washed away in a flood, after which they lived in a small wooden hut. LK married at age 21 and cared for her two children, their 0.8 ha of land, and two cows, mostly on her own since her husband had a job. She reported that whereas previously she used to get anxiety attacks, these had not occurred since she began practising NF. The practices kept her happy and busy. She enjoyed making the solutions and checking the crops for problems, which she resolved with support from the extension agent. The only break she had ever had from her 14-h-long workdays was when she participated in an out-of-state NF trip for three days.

Leadership in the community

Women who held leadership roles as MTs benefited greatly. An MT was responsible for delivering training to villages in three *panchayats* either with extension staff or on their own.

Seventeen MTs who were interviewed reported that the leadership roles had been beneficial in building their confidence, widening their social network, and earning respect from the community. They appreciated the support they received from extension staff to develop confidence in addressing groups. The role gave them freedom of movement, overcoming cultural restrictions on their mobility in public spaces. In the more populous districts, women felt safe travelling to villages independently. Three MTs commented on how it improved their learning as they aspired to become more knowledgeable. A 40-year-old farmer commented on how social interchanges affected her well-being:

> *"When you leave the home, meet people and socialise, it freshens your mind and brings about change. When the mind is at peace, the person is happy. Peace of mind also affects your body. If a woman is not healthy, how can she raise healthy children or a healthy family."*

Once they became known in the community, it created a domino effect for their involvement in community projects. One MT was selected as the secretary of an SHG federation comprising 150 members; another was chosen as the chairperson of a Farmer Producer Company facilitated by PK3Y. In an SC village, the MT and women from the NF group volunteered to run a state programme to teach basic literacy skills. They gave daily lessons for three months to women who had missed out on an education. For a few women, it became a catalyst to realise long-held personal goals; e.g., an MT chose to complete higher secondary school. Another farmer added an outside room to set up a shop in her house, which had been a long-held aspiration. The transformations in personal power triggered a shift in power relations within the home and the community. LK spoke about how her increasing confidence had resulted in altering intra-household relations:

> *"I used to feel that I had only studied till the 10th and I didn't know anything. I used to be afraid. Now, I have learned how to speak to people with confidence, and my knowledge has increased. My husband has noticed the change in me and looks to me to make decisions. It is because of NF that I am recognised; I have progressed and moved up in life."*

5.5.2. Autonomy in decisions about agricultural production

In areas where there was high male outmigration from marginal farms, such as in the Mandi and Kangra districts, women farmers had greater autonomy in decision-making with respect to agricultural production and farm incomes. This was particularly evident where farm incomes were supplementary to the main sources of income. Although all the women reported that they discussed major decisions with their husbands, this did not detract from their autonomy; rather, the decision-making was part of an ongoing cooperative household dynamic. When the women informed or consulted their husbands of their decision to use NF methods, the husbands were supportive.

In contrast, where men farmed full-time and grew cash crops, such as apple farmers in Kullu district, customary division of gender roles tended to persist, wherein men were the decision-makers. This hindered the transition efforts made by women. Women began to use NF in kitchen gardens, while men continued the use of CF in apple orchards. Some women negotiated with their husbands and in-laws to try out NF in plots other than kitchen gardens. Three women mentioned that they were only allowed to practise on small plots of degraded land that had been left fallow. While they trialled NF, they endured ridicule and criticism, often lasting longer than a year till a good harvest was achieved. Many women, therefore, were taking the lead in scaling out efforts, despite facing significant challenges and pressure. In a few instances where household relations were more equitable, women persuaded their husbands to adopt NF and share the decision making. A male apple farmer in Kullu reported:

> *"It was my wife who was trained first. She discussed it with me. I said I was aware of the issues with chemical farming and suggested she try out the alternative practices. Now we have expanded the area under NF; we discuss what needs to be done next and make joint decisions."*

5.5.3. Increased economic opportunities and control over income

About 25% of farmers interviewed were able to increase their income by selling NF produce directly to the public. This was often the case in Kangra, a populous district with many non-farming families. Some farmers developed a network of buyers who would place orders in advance and collect from the farmer. These sales secured between 10% to 20% more than the market rate on account of crop quality and their NF status. Marginal farmers with small

holdings benefitted from selling their crops through the outlets arranged by PK3Y. This comprised NF canopies managed by farmers and set up at central locations on particular days of the week. Some farmers used their own or group canopies to sell at community events or in their villages, as illustrated in Vignette: 2. Increased incomes through NF resulted in the women contributing more to household expenses, which altered their status within the home. Women proudly stated how their earnings contributed to the extension of their home or the everyday household expenses, or paying for their children's education.

Vignette: 2

RK, a 32-year-old farmer from the OBC caste category, lives with her two children, her husband (a schoolteacher), and his parents. She farms 0.75 acres of land (0.3 ha). Her in-laws opposed natural farming, particularly as the result in the first year was poor. However, RK persisted as she wanted to save costs, care for the soil, and eat healthy food. Despite family opposition, she borrowed Rs 80,000 from her SHG and travelled out of state alone to buy the highly prized *Sahiwal* cow for Rs 65,000. She received a subsidy for Rs 30,000 towards costs and paid back the loan through sales from her bio-resource centre and selling milk and ghee. The crop yield improved in the second year, and RK began to grow a wider variety of indigenous cereals and vegetables using seeds she sourced through her farmer networks. Her farm provided for all household foods and a diverse diet. RK sold vegetables in the village green about three times a week using the NF canopy given to her by PK3Y. Her income doubled within two years of starting NF, and she is now establishing a business to sell pickles jointly with her husband.

Farmers who had previously practised organic farming found that purchased biological inputs were expensive and did not increase yield. They reported that switching to NF significantly increased their income. For farmers transitioning from CF, savings on costs of chemical inputs depended on the types of crops grown. Savings for farmers growing disease-prone cash crops, such as capsicums and tomatoes, where chemical inputs cost around Rs. 100,000 per acre annually, were substantial. Costs were reduced by 90%, resulting in a 30% increase in annual profits. Additionally, for all farmers, several factors, such as farming the plots more intensively with a wider variety of crops, a higher yield, a more extended fruiting period, longer shelf-life, and better appearance, resulted in higher incomes. Encouraged by PK3Y staff, farmers began growing more indigenous cereals, such as red rice and millets, for consumption and higher selling prices. Many of these factors also contributed to their diet diversity. Most farmers were hopeful that being certified as NF farmers under the new Certified Evaluation Tool for

Agriculture Resource Analysis (CETARA) system established by PK3Y would secure higher prices for their produce (GoHP, 2022).

Establishing a bio-resource centre (BRC) was seen as a profitable opportunity for women farmers, as they reported earning between Rs 1000 and Rs 5000 per month, depending on the demand for NF formulations in their village. However, a woman farmer discovered that replacing her two Jersey cows with two *Sahiwal* cows (an indigenous breed) to set up a BRC resulted in a loss of income. The *Sahiwal* cows, purchased from a neighbouring state, did not adapt well to the colder climate in Himachal Pradesh, resulting in a loss from milk sales. Furthermore, the sales of cow urine and NF formulations were insufficient to compensate for the losses.

Most women interviewed had an independent source of income other than crops and the husband's earnings being shared with the wife for household expenses. Usually, this was derived from selling milk and food products or sewing and handicrafts. On farms where the husband sold farm produce in the *Mandi* (wholesale market), the cheque would be deposited in the husband's account to be shared later with the wife. In some households, cash payments from the *Mandi* would be transferred to the wife. Many women felt it was essential to have their own earnings allowing them to spend money without having to justify expenditure either to themselves or their husbands. This was especially relevant for a few women who had toiled hard over the years and had been denied their share of income from the farm. Where gender relations were mutually supportive, some women did not think they needed an income that was theirs alone.

5.5.4. Effect on workloads

A time-use survey with 26 women farmers revealed that the average workday comprising both care and productive work, excluding times for personal care and leisure, was fourteen hours long. It started early, often at 5.00 a.m., for women to first attend to their cows (or other livestock). All women farmers interviewed, except for two women, owned cattle, commonly one or two cows. Livestock care was time-consuming. Collecting fodder took two hours a day on average and could be excessively burdensome and risky. It involved women carrying 30 to 50 kg loads on their backs or heads over long distances or steep terrain in high-altitude districts. Many women also climbed trees to cut branches. On days when the women worked as waged

labourers for a Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) project, they started the day at 4 a.m. to allow for fodder collection. In Mandi and Kullu, the women spent several weeks in Autumn gathering stocks of dry grass and firewood two or three times daily to store for the snow-bound winter months. A round trip from the forest could take several hours. During this period, men also helped carry loads. Farming in the fields typically took three hours a day, with seasonal variations, to cultivate one acre (0.4 ha) of land.

Another arduous task related to livestock that women performed daily was carrying cow dung to the fields to add to a farmyard manure (FYM) heap. NF practices offered an alternative which eased this burden. If FYM was applied directly, 80 kg of cow dung was required for 40 fruit trees. NF offered the alternative of replacing FYM with one drum of *jeevamrit* that needed only 10 kg of cow dung. However, most farmers interviewed strongly felt that using FYM was a traditional practice they would not relinquish. In contrast, a woman from a mountainous district felt that NF had relieved her of the burden of carrying cow dung uphill daily to the field. Instead, she needed to carry 50 kg *ghanjeevamrit* for her 1-acre (0.4 ha) plot four times a year.

Women who made their own formulations reported that the tasks added two hours a week to their workload. They found that this was a fair trade-off for saving costs. When both the husband and wife had received training, the tasks were shared. Farmers said that the spraying schedule was equivalent to that of conventional farming. This varied, however, according to the crops grown and seeds used. Farmers growing tomatoes from hybrid seeds needed to spray pest-control or anti-fungal concoctions twice a week, which added to workloads considerably. The burdens were mitigated by sharing the spraying tasks with the family, including older teenage children who had previously not been allowed to spray chemical pesticides. Farmers with larger plots reported that line sowing, applying mulches, and weeding by hand added to workloads or labour costs.

5.5.5. Perceived constraints on the adoption of natural farming

The NF interventions were taking place in the context of constraints. Sen (1999) refers to these as “conversion factors” which can block or differentiate people’s ability to acquire capabilities and achieve goals. These contextual conversion factors may include family characteristics or physical and socio-economic constraints. They could impede the take-up of NF or its scaling out; for example, horizontal exchanges were constrained by the unavailability of smartphones

for some women—those women who started with better assets and capabilities captured more significant benefits than those who did not.

The most immediate challenges to farming were lack of rain and animal or stray cattle raids. Several rainfed villages had no rainwater harvesting structures or watershed development. In villages where animal raids were causing extensive crop damage, the women did not know any NF recipes to deter animals. Often, they were not aware of subsidised solar fencing schemes or the options available. Women felt it was pointless taking up NF, as drought and animal raids would hamper their efforts. Family opposition was another constraining factor. However, a few women adopted NF despite experiencing ridicule and hostility from older family members, often fathers-in-law, which continued till good results were achieved. All male farmers felt that being able to sell their NF produce at a higher price would accelerate out-scaling.

Some women rejected NF because it appeared complicated or because they felt it would increase their workloads to an intolerable level. These included mothers with young children, women farming on fragmented and distant fields, or those without help at home or with many animals. Lack of support in the home or from the community when the plots were larger or the fields were distant made for greater work burdens.

Inadequate planning and execution by a state department can hinder the adoption of NF. Even the most well-intentioned project can be negatively impacted by staff members who hold opposing views or lack personal engagement and skills. For instance, extension staff provided varying levels of handholding support, and exposure visits to model farms were infrequent. Additionally, a few extension officers failed to inform women about government schemes that could help mitigate challenges or offer appropriate support in acquiring subsidies. Although indigenous seeds were promoted, some officers with an industrial agriculture mindset distributed hybrid seeds to farmers. This raises the question of how managers and front-line workers can be empowered to act as agents of change.

Lack of land ownership is a further perceived constraint for women. A woman farmer reported how she failed to secure a bank loan to start a ghee-making enterprise because she did not own land. The lack of access to credit limits women’s freedom of action and choice and the means to improve their economic status and circumvents their creative and productive potential. In a domestic situation, economic abuse is recognised as preventing a cohabitant from acquiring

resources or assets or advancing their careers or restricting their ability to find employment. An individual uses this abuse to exert power and control over another. It may be argued that societal norms of denying land to women are an expression of patriarchal domination and economic abuse perpetrated collectively on women. In Himachal Pradesh, it is disguised as a cultural tradition that encourages good sibling relations.

Every woman interviewed who had siblings had agreed to gift their portion of land to their brother/s, or in one instance, to a sister who was caring for the parents. They had either made the decision when their father asked if they wished to inherit a portion of the land, or after his death at a meeting held by the land inheritance official. The officials often pressured the daughters to relinquish their share in favour of their brother/s (Minocha, 2015). A male farmer remarked that a woman's failure to gift the land to her brothers was considered lowly and dishonourable. A woman who had one sister and two brothers said:

> *"My father willed the land to the sons so that we would not need to attend a meeting with the tehsildar to give up our portions. This is an old tradition. In case there is a problem where the sister's marriage fails, the brother will give land to the sister for her to build a home. We trust the brother."*

However, SK, an MT and divorced single woman living with her parents and brother for twelve years since her divorce, had yet to receive land or the promise of land from her parents. SK actively supported single women to take up NF:

> *"For a single woman, it has had many benefits. There are some who were widowed early. Rather than thinking about issues at home and feeling depressed, they get out of the home, meet people and get busy with a project."*

Despite her leadership capabilities, she did not question the validity of the patrilineal norms and felt that asking for her portion of the land would reflect poorly on her.

5.6. Discussion

When implemented with adequate mechanisms for training and supporting women farmers, the NF initiative was seen to reap a range of benefits. The mechanisms described in the results above have been organised using the gender at work framework (introduced in Section 5.2.2) in Figure 14. How the individual and systemic changes impacted women will be discussed next.

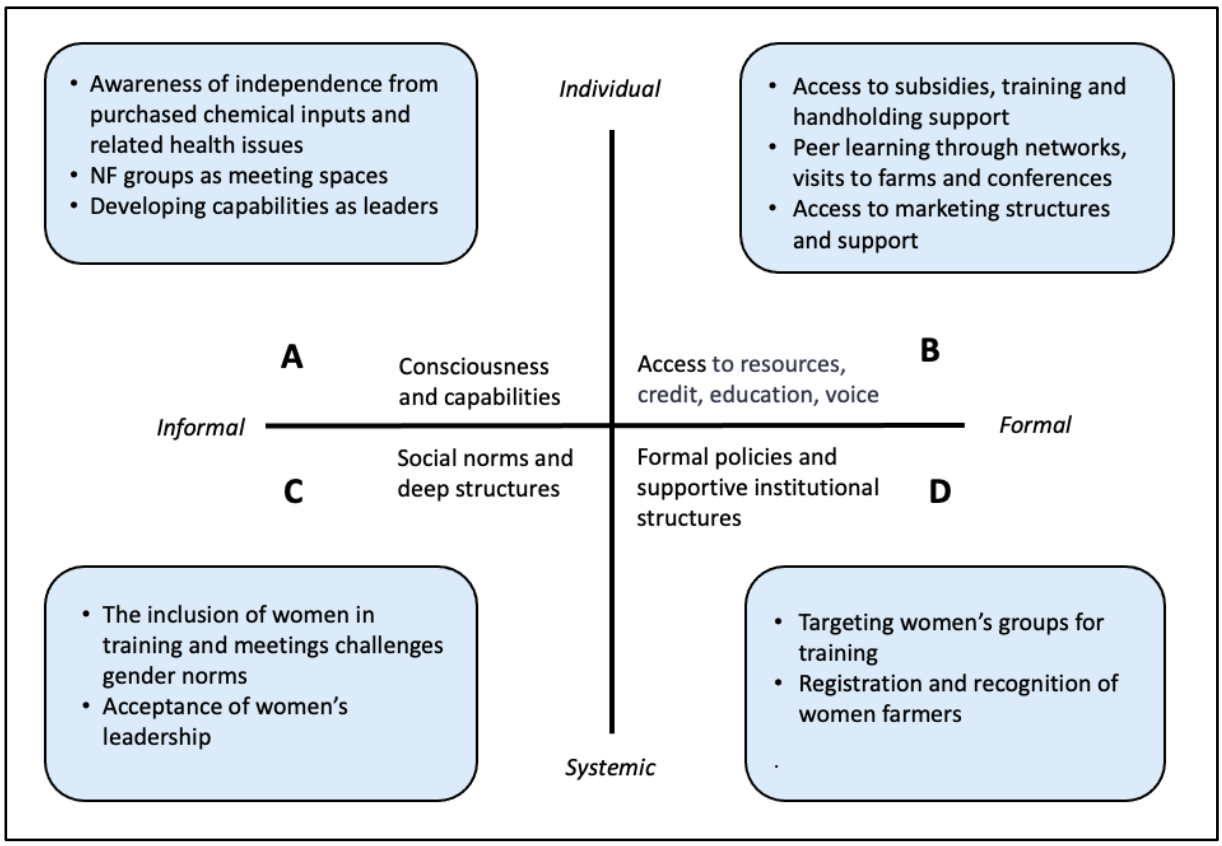

Figure 4: Gender at work framework with added summaries of state mechanisms and their effects

First and foremost, as a counter-movement to industrial agriculture, NF opened pathways to restore food sovereignty. A shift to industrial agriculture had alienated women from their traditional farming knowledge and marginalised their roles. In contrast, the NF programme raised women's awareness of their capacity to make decisions and become independent from corporate control (Quadrant A). Women recognised the independence, dignity, and control that NF gave them:

"I learnt that we have the ability and resources to make whatever we need. We do not have to depend on the market. Knowing that I can rely on myself makes me feel confident."

Further, a new vision of creating an ecologically friendly way of farming for the greater good inspired and motivated both women and men farmers to persist with their efforts. The NF vision of caring for "mother" earth, one's health, and protecting the land for future generations resonated with women's spiritual values. Women viewed NF as a worthy cause that made farming more meaningful. The fact that people may act for the good of others is a vital part of Sen's capability approach (Sen, 1999). It is broader than many concepts of agency because the agent is not self-centred:

"I feel good that the earth is safe, and we are not feeding poisons to people. I am establishing an example for future generations to follow."

Some women chose to pursue goals for the greater good despite opposition from their families. A SC woman wanted to revive millets for the benefit of the village farmers. She reported:

"*My husband tried to discourage me, but this made me even more intent on proceeding with the project. I argued that it would be beneficial for the women in the village and also to sell.*"

Establishing NF groups (Quadrant A), brought women together to share experiences, reflect, and build solidarity towards a common cause. These enabled women to discover common ground by realising that their problems were similar to those experienced by other women. A new perception of reality was constructed. A 38-year-old SC women farmer explained how joining a group developed confidence and agency:

"When we work the whole day, we do not even realise how hard we have worked. When we join a group, we get a good opportunity to express our thoughts and discuss our issues. When we attend a meeting, we get to learn new things. By joining a group, we acquire confidence and the capability to act."

In contrast to the industrial agriculture paradigm, which dispossessed farmers of their knowledge, a transition to agroecology is knowledge intensive. Maximising the ecological advantages of the local environment requires individual ingenuity, utilising traditional and new

knowledge, creativity, and innovation. The women appreciated how NF engaged their minds and expanded their knowledge:

"We find natural farming interesting, and it keeps our minds active. We want to learn more about how to control diseases."

It was evident that in addition to peer-to-peer knowledge exchanges, there was a need for structured learning options that advanced knowledge beyond basic practices. A farmer who had undergone the two-day training explained:

> *"I am hesitant to advise other farmers. What if it affects them adversely? I have not been trained properly; I am just following what I have been told by ATMA staff."*

While there may be a need in the early stages of transition to introduce recipe options that produce quick results, the full benefits of a transition, such as increased production, fewer pest attacks, and reduced need for inputs, can only be realised upon greater agroecological integration. These call for an understanding of how complex ecological processes interact. Given that many women do not have access to the internet through smartphones, the state needs to think about how access to learning networks and training could be assured for them. The requirement for farmers running model farms, *Krishi Sakhis*, farmer trainers, and extension staff to be well-versed in a range of NF practices and the vision of NF as a new food systems approach becomes even more critical.

When women were trained and demonstrated an interest in NF, it became the starting point of a widening social network where increased interactions with farmers, extension, and government officers developed the "power with". It built capacities to talk to government employees, raise questions, and share knowledge with their peers. RD, a 40-year-old SC farmer, received visitors and visited other farms; she spoke at a *panchayat* (village council) meeting and a video of her explaining practices was posted on YouTube by the BTM. She explained how social interactions and recognition built her sense of self-worth, identity, and purpose, which developed her civic capacities and citizenship power:

> *"When we started natural farming and got good results, we began to be known by other people. People asked us about the practices and wanted to visit our farms. It made us*

feel happy and that we were significant and had a place in the world…… We are learning more about government schemes by meeting people and attending panchayat meetings. We now support women by registering requests. We have gained the confidence to state our wants or speak about what is needed in the community."

Transition mechanisms aligned with the principles of agroecology listed in Quadrants B and D created new possibilities for empowerment for women. NF became instrumental in developing the existing dynamism in women, building confidence and capabilities, which, for some, resulted in a gradual change in the power relations in the home and society. The fact that women attended training and had direct access to subsidies strengthened their roles. The CETARA system established by PK3Y formalised the recognition of women as farmers. These measures challenged notions of gender identities and exemplified how the state could influence people's capacities to think differently and thereby construct a new "common sense" (Gramsci, 1971).

It was evident that despite women's developing capabilities and empowerment in the social domains, certain deep cultural norms that exerted "power over" women's choices remained unchallenged (Quadrant C). In particular contexts, empowerment in the social domain had yet to translate into increased autonomy in the domestic domain, and patriarchal norms impeded transition efforts. Changing deeply held norms is complex, and a variety of strategies are needed at the individual and policy levels to address gender disparities effectively (Rao, 2016). Transition mechanisms and policies must be scrutinised for their differential impact on women, and all data must be monitored by gender to understand the specific gender imbalances in different locations and contexts. For example, when male farmers were dependent on income from cash crops, they were more risk-averse and unwilling to relinquish control over farming decisions. The mechanisms needed for Kullu district, where men are the primary decision-makers, differed from those required in districts with male out-migration. In such contexts, it is important to introduce both men and women to NF and emphasise the benefits of joint decision-making. This could be facilitated by couples sharing their experiences of working collaboratively via videos, news channels or training.

Similarly, the state can take steps to change societal norms that prevent women from owning land. One way to encourage women's land ownership is to waive fees and offer incentives and

recognition to male farmers who add their wives to land titles or fathers who bequeath land to their daughters. The argument that daughters do not inherit land because it causes further fragmentation should apply equally to male siblings. In practice, many rural families cultivate land jointly, including land belonging to siblings who may have migrated for work.

5.7. Conclusion

This research paper investigated how a state-led transition to natural farming, an agroecological approach, empowered women farmers. What this study interestingly showcases is that it can offer spaces into previously unimagined women's empowerment through agroecology as a mechanism. A nuanced understanding of women's lives and choices exposed the power dynamics and how they manifested in the transition process. The positive collaborative spaces created by forming NF groups built the "power within" and "power with" and engendered a rich communication dynamic for learning and innovation. These new alliances for a common cause harnessed the "power for" and strengthened their resolve to traverse new territories and take greater risks to realise a vision, even when subjected to family censure. This was observed across castes. The increased capabilities developed through leadership roles, illustrative of the "power to", spurred the women to undertake further personal and community projects. At its most effective, the benefits derived from increased empowerment not only rippled out to the advantage of other women, communities, and initiatives but across generations, as in some instances, children of the women became involved with the NF work. In short, for many women, their growing sense of self-confidence and faith in their own developing capabilities contributed to "extending the horizons of possibility, of what people imagine themselves being able to be and do" (Cornwall and Edwards, 2010, p.3).

The state's success in promoting natural farming depended significantly on the active participation of women in facilitating the transition processes, despite their already substantial workloads. So that the state does not burden women to contribute even greater efforts, often in adverse circumstances, women's efforts must be fully supported. In contexts where gender dynamics play an obstructive role in agroecology transitions and in restoring food sovereignty, the state needs to establish policies that challenge oppressive norms and enable women to exercise their right to make decisions about agricultural production. Consulting women is

essential to understand their needs and preferences and to strengthen their capabilities and knowledge.

This case study illustrates how an agroecology transition with a deliberate gender equality perspective can significantly enhance life outcomes for women farmers owing to their increased sense of empowerment. Providing opportunities for decision-making and reclaiming their food sovereignty can mobilise women to harness their strengths, talents, and creativity to bring about transformative change in their lives and communities. Further research is needed to explore how more women farmers can overcome obstacles and participate as decision-makers and innovators in agroecology transformations.

6. Enabling participatory knowledge landscapes for agroecology: a case study from Himachal Pradesh

This article has been submitted to the 'Journal of Agricultural Education and Extension' for publication and is under review.

Abstract

In India, agricultural education and extension have been based on industrial agricultural practices delivered to farmers in a linear, top-down, and controlled manner. In contrast, the advent of agroecological farming approaches calls for participatory modes of learning and co-construction of knowledge through farmer and scientist partnerships. This article is based on a qualitative case study of the state programme in Himachal Pradesh to transition farmers to natural farming (NF), an agroecological approach. The article explores how the communication services and mechanisms of the NF programme promote critical thinking, innovation, and democratic and collaborative working between farmers, scientists, communication agents, and community organisations, together comprising the knowledge landscape. Using a communication services framework, the article presents evidence of the communication mechanisms utilised by the state initiative. It analyses how change was achieved and identifies areas where further work is needed to promote participatory and democratic processes for enhancing the transformative potential of agroecology

6.1. Introduction

This paper explores the significance of knowledge and learning in establishing a sustainable and equitable agri-food system. It specifically examines the knowledge and learning processes that align with the values and principles of agroecology from the perspective of the natural farming programme in Himachal Pradesh, India. Our primary question is: how do the mechanisms of the NF programme foster critical thinking, innovation, and collaborative and democratic practices among farmers, scientists, and communication services?

NF rose to prominence in 2018 when the practices recommended by a farmer promoter, Subhash Palekar, previously known as 'Zero Budget Natural Farming' (ZBNF) were adopted by

the states of Andhra Pradesh and Himachal Pradesh to transition all their farmers from conventional chemical farming to NF. Subsequently, a country-wide National Coalition of Natural Farming was established, comprising civil society organisations (CSOs), activists and farmers 'to accelerate the practice and policy related to agroecology-based farming in its multiple variants in India' (NCNF, 2021).

Agroecology has been defined as an ecosystem approach that applies ecological concepts and principles to the design and management of sustainable agroecosystems (Altieri, 2018). Some of the principles of agroecology are common to other ecological agriculture techniques, such as conservation, regenerative and organic agriculture. However, agroecology is distinct because it promotes sustainable farming practices based on the ecology of farms, democratic decision-making, the use of participatory, farmer-led knowledge, and the equitable distribution of power and resources. These aspects are often overlooked in other approaches to sustainable agriculture. It is underpinned by a rights-based approach, food sovereignty – 'the principle of ensuring that everyone has the right to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and the right to define their own food and agriculture systems' (Nyéléni, 2007). The voice, agency, and autonomy of food producers and their communities are central to agroecology. Anderson and Maughan (2021) stress that the framing of agroecology is a radical alternative to industrial agriculture.

This paper advocates for agroecology as a transformative vision and a holistic practice. Agroecology's transformative role begins with a change in farmers' perspectives or frames of reference to construct a revised interpretation of their experience (Mezirow, 1991; Coe and Coe, 2023). It involves raising consciousness where farmers begin to think critically about their relationship with nature and the damaging effects perpetrated by industrial agriculture and agri-businesses. This causes a shift in values. Consequently, they may place greater importance on their cultural heritage, traditional practices and foods or become aware of inequalities and strive for justice. The paper will examine the impact of the state's educational programs on farmers, particularly marginal women farmers, in terms of changing values and perspectives. It will begin with citing key arguments on the role of knowledge and learning in agroecology transitions.

Agroecology, which aims to achieve food sovereignty and transform agri-food systems, requires a particular approach to learning and pedagogy that differs from the dominant system. India's agricultural education system was primarily developed during the Green Revolution (GR) in the 1960s, which relied on an agrochemical-intensive form of agriculture with high input of fertilisers, pesticides, hybrid seeds, irrigation and machinery. GR practices led to adverse effects on health, declining water tables, environmental and soil degradation, increased farmer debt and loss in biodiversity (Deb, 2009; GOI, 2009; Patel, 2013). It marginalised farmer knowledge systems and replaced these with top-down knowledge and technology transfer (Kumar, 2019; Meek, 2018). Post-development scholars argued that the imposition of a Western model of agriculture without consideration of local knowledge amounted to cultural imperialism, enforcing Western norms and approaches over local ones (Escobar, 1992).

In contrast, agroecological approaches require integrating indigenous technical knowledge (ITK) and scientific knowledge (HLPE, 2019). Agroecology is knowledge-intensive. A transition to agroecological farming involves redesigning farming systems to promote "biological interactions and synergisms that can sponsor system services like regenerating soil fertility and providing pest management without resorting to external inputs" (Rosset et al., 2011, p. 163). It calls for the rebuilding of farmers' knowledge of how the farm works as an ecosystem and the need to manage interactions among the different components, such as timing plantings and rotations to disrupt the life cycles of pests. The approach involves strategies such as diversified rotations, multiple cropping, agroforestry, animal integration, and crop residues as mulch or animal feed. (HLPE, 2019). Participatory learning modes become crucial for developing the confidence and capacity to think critically, experiment and adapt to new conditions individually and collectively to maintain a sustainable food system through climate change (De Schutter, 2011; Pimbert, 2012).

Writers on the topic of how to scale up agroecology (Altieri, 2009; Giraldo and McCune, 2019; Holt-Giménez, 2001) argue that a grassroots social methodology driven by social movements is the most effective and sustainable way of outscaling. Rosset et al. (2011, p. 168) noted that in countries where the adoption of ecological practices is low, it is because "a methodology to create a social dynamic of widespread adoption is lacking". These comprise horizontal social learnings as seen in the Latin American 'campesino a campesino' (CAC) or farmer-to-farmer processes inspired by the Brazilian educator Paulo Freire. Upon the collapse of the industrial

farming system in Cuba following the loss of imports from the USSR, agroecology spread rapidly because of social processes and the dynamics of a farmer-led movement. A two-year study of the CAC movement showed that it fostered a culture of enquiry and experimentation: extension officers used simple, practical and innovative ways to illustrate abstract concepts; farm visits and conferences enabled smallholders to share experiences and listen to new ideas (Holt-Giminez, 2006). An underlying principle of CAC is that farmers are more inclined to believe and follow the example of another farmer who has successfully implemented a particular alternative on their own farm. This contrasts with relying on the advice of an agronomist who may not have first-hand experience in farming. Rosset et al. (2019) highlighted two key pedagogies underpinning CAC social learning to build knowledge – the pedagogy of experience and the pedagogy of example. In the pedagogy of example, the main activity is that the classes occur at an agroecological farm where the host families take responsibility for transmitting knowledge. In the pedagogy of experience, a peasant family visits another family who has successfully resolved a shared problem using an agroecological solution. The role of the communication staff changes to that of facilitators who support communication between farmers.

Freire believed that dialogue between teachers and students and reflective student participation that expanded their critical thinking capacity was key to developing critical consciousness and liberation, “Only dialogue, which requires critical thinking, is also capable of generating critical thinking” (Freire 2017, p. 9). He stressed the importance of the teacher as a facilitator respecting the autonomy and dignity of others, not as a mere courtesy but as an ethical imperative.

Freire's educational theories align well with Sen's capability approach. The capability approach asserts that the well-being of a person depends on the effective opportunities to live a life they have reason to value. Sen (1999, p. 153). argued that “Open discussion, debate, criticism and dissent are central to the processes of generating informed and reflected choices’ and that ‘these processes are crucial to the formation of values and priorities”. Further, democracy creates opportunities not only to enhance an individual's ability to choose a valuable life but also in the collective ability to influence government institutions so that greater freedom in making such choices is made possible. Conscientisation opens the doors to developing the capability, in Sen’s terms, to transform one’s reality (Glassman and Patton, 2014). A virtuous

cycle emerges in which the capability to participate in shared, informed decision-making leads to greater capabilities.

These considerations call for agricultural service-providing institutions to change to new forms of extension practices and services. The term extension was initially used in 19th-century Britain to refer to 'extending' useful information and knowledge from universities to the adult population at large (Garforth, 2010). This was a top-down, linear and prescriptive approach to extension that gradually shifted towards farmer participation and recognition of the importance of their involvement in agricultural service provision. Further, this shift in perspective gave rise to the notions of agricultural knowledge systems and communication to support innovation. Innovation refers to new practices, which may consist of technical innovations adapted to work in farmer fields. Simply put, 'it may be a new way of doing things' or even 'doing new things' in a manner that works in everyday practice (Leeuwis, 2004, p. 12). The term 'innovation' as used here is distinct from the concept of 'innovations' that focuses on market-led and technological changes driven by neo-liberal agendas. Anderson and Maugham (2021) warn that these may undermine the potential of agroecology as a radical alternative to industrial agriculture.

In Table 11 we have used Leeuwis's (2004) communication framework, which provides a systemic approach to understanding communication. This is particularly suitable for agroecology, which is also a systemic project. We have combined the suggested services and strategies with characteristics from the four pillars of transformative agroecology learning by Anderson et al. (2019): horizontalism; diálogo de saberes (dialogue among different knowledge systems); combining practical and political knowledge; and building social movement networks. These further emphasise the need for farmer participation in place-based efforts and their social and political context. The Results section will present evidence of how these services were demonstrated in Himachal Pradesh.

Table 10: Communication services framework for agroecology (adapted from Leeuwis, 2004, and Andersen et al., 2019)

	Service or Strategy	Goal
1	Raising awareness and consciousness	To foster transformation for food sovereignty and social justice
2	Practical training of new agroecological practices	To help realise policy objectives, such as, to reduce use of agro chemicals
3	Supporting horizontal knowledge exchanges	To stimulate knowledge through social learning via groups, networks, meetings and conferences
4	Advisory communication	To provide knowledge or process guidance to resolve local problems
5	Generating innovative practices through co-creation of knowledge	To resolve challenges by bringing together various stakeholder for experimentation and exploration
6	Conflict management	To deal with tension and conflict arising between different stakeholders
7	Supporting organization development and capacity building	To build and strengthen a particular group's capacity and community agency

6.2. Setting

Himachal Pradesh is one of the northern states located across the Himalayan mountains. Agriculture is the main source of livelihood for 62% of the population. Approximately 80% of the total cultivated area is rainfed (GoHP, 2022) It is known as the 'apple state' of India due to its significant production of fruits and vegetables. However, the promotion of cash crops and intensive agriculture has led to increased use of agrochemicals, and vulnerability to insects, pests and diseases, lower yields, and soil degradation in recent years (TERI, 2015). About 90% of farms fall within the small with less than 2 ha or marginal categories with less than 1 ha of land. The average size holding is 0.4 h (GOI, 2019b). Many small farms still rely on traditional manure-based practices and limit chemical use to pesticides. On the other hand, apple and high-value vegetable farmers use a range of agrochemicals. In addition to cash crops, farmers also cultivate cereals, beans/pulses, oil seeds, and a variety of fruits and vegetables. Despite the

state being amongst the richest in India with a high literacy rate, patriarchal and patrilineal norms persist and take precedence over legal norms in relation to land ownership.

To address the challenges of conventional agriculture, Himachal Pradesh implemented an organic farming policy in 2002. However, using purchased organic inputs locked small farmers into commercial value chains, which was costly for farmers and led to financial losses. In its place, in 2018, a programme called *Prakritik Kheti Kisan Khushal Yojana* (PK3Y) based on practices popularised by Palekar, referred to as Subhash Palekar Natural Farming (SPNF) was launched (Box: 1Box: 1). The main objectives were to reduce the cost of cultivation, increase incomes for small and marginal farmers, grow healthy food, build climate resilience, and improve soil fertility and water holding capacity. The state had 961000 farmers, of which 170000 farmers were reportedly trained in SPNF by the end of 2023 (CSE, 2023).

Box: 1 SPNF practices

SPNF was based on four essential practices aimed at regenerating the soil microbiome for which an indigenous cow was considered essential:

1. *Jeevamrit* – a fermented microbial culture as a key component of soil regeneration.
2. *Beejamrit* - treatment for seeds or planting material.
3. *Acchadan* - mulching comprises three types*:* soil mulch, straw mulch, and live mulch, which uses symbiotic ground cover intercrops and mixed crops.
4. *Whapasa* - maintaining a soil environment with air and water molecules by reducing irrigation.

Additional practices aimed at redesigning a system as a whole to regenerate the soil and promote integrated pest management included multi-cropping and intercropping, line sowing, trap crops, and several farm-made biopesticides. Palekar, however, has been criticised for being prescriptive in his approach and excluding practices that align with agroecology principles, such as using vermicompost (HLPE. 2019; Ramdas and Pimbert, 2024).

The PK3Y program collaborated with existing State extension institutions to deliver NF communication services. The public sector-funded agricultural extension system in India primarily serves the interests of conventional farming. It consists of the Indian Council of Agricultural Research (ICAR) and ICAR's field research units, Krishi Vigyan Kendra (KVKs). These conduct farmer extension programs and test new practices. In addition, the central government

established several hundred Agriculture Technology Management Agencies (ATMA) across the country to assist the states with agricultural extension. However, ATMA has faced challenges due to funding shortages, planning, limited capacity, training, and weak links to the research systems established by KVKs (IFPRI, 2011). The PK3Y program collaborated with ATMA for NF extension. ATMA field officers, 37% of whom were women, were known as Block Technology Managers (BTM) and Assistant Technology Managers (ATM), respectively. Each of the 80 blocks in 12 districts was assigned one BTM and two ATMs, an increase from the previous staffing of only one BTM and one ATM per block. A BTM was required to have a master's degree, while an ATM needed a first degree in agricultural sciences. Their degrees, however, were in conventional farming systems. At the inception of the NF programme, ATMA staff and progressive farmers attended six-day training camps held by Palekar. Many ATMA agents admitted to being sceptical about NF practices until they saw good results. In addition to ATMA agents, the NF extension system involved farmers who were nominated as Master Trainers (MT) and *Krishi Sakhis*, women community resource persons funded by a new central government scheme in 2021.

6.3. Materials and Methods

This research adopted qualitative research methods, with data gathered over four visits to Himachal Pradesh between November 2021 and December 2023. The methods included extended participant observation, in-depth interviews, and focus group discussions, constituting two phases in the research. Ethnography was used to understand farmers' perspectives and experiences and how NF impacted their lives. The 1st phase consisted mainly of focus group discussions with marginal women farmers using participatory activities in nine villages across three districts where male outmigration was prevalent. The 2nd phase comprised individual and small-group interviews of small and marginal natural farmers from different caste backgrounds and types of households. These included community resource persons, champion or progressive farmers, women's self-help groups (SHGs) members, and farmers not participating in the natural farming program. Observations of training and advisory meetings between farmers and ATMA officers occurred in both phases. The methods used are summarised in Table 12.

Table 12: Research methods

	Methods used	No. of participants	Districts/villages covered
Phase 1	Focus groups using participative activities; key informant interviews (KIIs); observations of training; ethnography	Focus groups: 100 women farmers Family interviews: 2	9 villages in 3 districts
Phase 2	Women's time-use and life-story interviews; observations of training; ethnography; focus groups; family and KIIs	Women's interviews: 53 Women focus groups: 42 Families: 13 Male farmers: 15	27 additional villages across 5 districts

PK3Y field staff and three CSOs organised meetings with farmers based on purposive sampling. The first author conducted all farmer interviews in Hindi.

6.4. Results

This section presents evidence of the communication processes employed by PK3Y. Table 13 outlines the broad themes of services detailed in Table 11, along with examples. Later in the Discussion, we will analyse how the transformative impact of the services could be enhanced by strengthening specific aspects of their processes or pedagogies.

Table 13: Types of services with examples of use

	Services	**Examples of use in Himachal Pradesh**
1	Raising awareness and consciousness	• Training by Palekar • Conferences and sensitisation days
2	Practical training of new agroecological practices	• Two-day introductory training • *Krishi Sakhi* training
3	Supporting horizontal knowledge exchanges	• NF groups and wider WhatsApp networks • Exposure visits to farms • NF conferences, meetings and community events • Use of farmer promoters/champions
4	Advisory communication	• Handholding support through early transitions • Collaborating with farmers to find solutions to local challenges and diseases
5	Generating innovative practices through co-creation of knowledge	University scientists conducting research on NF in collaboration with farmers
6	Conflict management	• Resolving intra-household conflicts • Caste based conflicts
7	Supporting organization development and capacity building	• Informing farmers of government schemes • Establishing farmer SHGs • Supporting seed groups • Supporting FPCs

6.4.1. Raising awareness and consciousness

In their study of key drivers in taking agroecology to scale, which included ZBNF led by Palekar in the state of Karnataka, Mier y Terán Giménez Cacho et al. (2018) found that in all cases, the process of teaching and learning was accompanied by a distinct ideological perspective and consciousness-raising. Raising awareness takes on a wider meaning aligned with Freire's (2017) notion of conscientisation, where individuals become aware of their true socio-cultural reality and recognise their ability to transform it. The use of champions of NF who have a commitment to the well-being of marginalised people was a key factor in this process. Many farmer promoters were committed to ecological farming transformation; they were both activists and knowledgeable about practices. Palekar, for example, critiqued exploitative corporations and

Western agricultural methods. Münster (2018, p.751) described Palekar's critique of modern agriculture based on a different ontology: 'sensing, inhabiting, and dwelling in new ways on the farm and cultivating modes of care'. Two male farmers who had attended Palekar's six-day training camp reported that it had been a transformative experience that altered their view of farming. A 27-year-old engineer who attended the training instead of his mother was inspired to become a farmer. Farmers found Palekar's story of his personal journey to NF and his use of metaphors to explain complex ideas, particularly engaging.

It was observed that many farmers gained critical awareness or consciousness of their capacity to make independent decisions and become autonomous from corporate control and input markets. Women appreciated that through adopting NF, they acquired independence, dignity, and control – qualities that underpin food sovereignty – whereas a move to industrial agriculture had led to the loss of traditional farming knowledge, as well as a decline in their roles. A 42-year-old woman who was a marginal farmer reflected on the significance of farming in her life:

"I now think that agriculture provides the best career. It gives you independence. You don't have to follow anybody's dictates but instead work according to your needs. The work is enjoyable because it is ours. You can find ways to earn more if you are short of income. You get many learning opportunities, and it keeps you busy. Compared to people living and working in congested cities, we are in a kind of heaven. We don't eat chemically grown foods and have enough for our needs. We are in control." (HP2-Kan-Kul)

In addition, farmers' views regarding industrial agriculture's ecological and health effects altered. Mobilising discourse by NF champions inspired the conviction and enthusiasm to adopt NF because it served the wider purpose of caring for one's health and nature and protecting Mother Earth as the source of life. Daily farming activities were attributed greater significance and meaning, acting as a motivational force (Coe and Coe, 2023).

"During the training, we found out that the chemicals were poisonous. With NF, we thought even if productivity was lower, we'd at least get safe food. What is the point of harming people for one's own profit? When we buy chemically produced food, we are buying diseases". (HP2-Mee-Shi)

However, increasing awareness of economic, social, political, and cultural crises is a gradual process that fosters confidence and capacity for collective action over time (Anderson, Maugham and Pimbert, 2019). Individuals may also prioritise personal goals and make choices to improve their well-being. Individuals who may have previously altered their desires and expectations to fit into an oppressive environment and conform to socially accepted norms, a process referred to by Sen (1999) as adapting preferences, can now be liberated to develop new values and make different choices.

There is a danger, nevertheless, that the state or other stronger voices can erroneously guide some farmers (Schiller et al., 2019). For example, some women farmers were motivated to exchange their cross-bred Jersey and Holstein cows for local Indigenous varieties and lost their income from milk sales as a consequence.

6.4.2. Practical training of new agroecological practices

This is the most common type of communication intervention where the object is to train farmers in specific practices, such as basic SPNF practices, during a two-day introductory training. Farmers were encouraged to trial NF on a small plot during the early transition phase, often 1 bigha (0.2 of an acre). Overall, the strategies observed four methodological principles used in CAC processes (Rosset et al., 2011):

1. Start on a small scale and proceed slowly;
2. Limit the introduction of new methods so as not to overwhelm farmers with many new practices;
3. First, introduce practices that will produce quick results so that farmers are motivated to continue participating;
4. Conduct small-scale trials on a portion of the land rather than risk the entire harvest.

The trainings took place in the villages, making participation easier for women. These were organised either through pre-established women SHGs, a known farmer, or the *panchayat* (village council). Statewide, about 60% of the trained farmers were women. In many villages, it was their first experience of agricultural training. It was delivered jointly by ATMA staff and an MT or a progressive farmer. Including a local farmer added credibility to the practices being promoted. Furthermore, in the absence of a sufficient number of ATMA agents, each of whom

was responsible for approximately one hundred villages, the strategy to involve local farmers extended the limited resources. ATMA staff also conducted a refresher training day in villages about a year after the initial 2-day training to review learning and address emerging issues.

Although women farmers had much greater access to training, the time spent at the training was limited. The day usually started at 11 am and ended around 3 to 4 pm allowing women to attend to animals and other care work. In the training observed, the first day was spent on theoretical information, while the second day was reserved for practical demonstrations for making basic NF concoctions. However, this format varied between districts, where some ATMA staff integrated the theory with the practical on both days. It was noticeable that the ATMA staff did not employ visual aids when discussing complex information related to microbial activity or intercropping. Nor were any participatory activities used to engage farmers or reinforce understanding. Women farmers listened passively and were reluctant to ask questions. There was some use of laptops and pico-projectors to show videos. The training director explained that transporting charts and boards to villages was often difficult.

The lack of visual aids limited the understanding of processes involved in soil regeneration. This gap in knowledge constrained the women farmers' ability to use NF, as was evident in Kullu. Kullu is a mountainous apple-growing district; the farms were managed by male farmers or, in a few cases, jointly by women and men. When women participated in the NF training, they found that their husbands were risk-averse and reluctant to try out NF practices. The husbands believed the NF practices would not work on long-established apple trees that were accustomed to chemicals. Some women, uncertain about the science of regenerating soil biology, deferred to their husbands' opinions. Consequently, their efforts to use NF were confined to their kitchen gardens. A few gradually extended the practices to small plots of land where they grew subsistence crops and experimented with planting young apple trees on these plots. Once their success with NF became evident, the husbands were persuaded to try a few NF practices, such as applying mulch in the apple orchards or using *jeevamrit* on a few trees.

6.4.3. Supporting horizontal knowledge exchanges

The PK3Y extension system employed key mechanisms for the horizontal transmission of knowledge that corresponded to CAC processes. Peer-to-peer learning is critical for agroecology transformations because it is self-driven, relevant to learners, and promotes autonomy and

independence (Anderson et al., 2020). First, progressive farmers or farmers who had attended Palekar's training camps were offered opportunities to become MTs. Farmer trainers or women community resource persons, such as *Krish Sakhi*s, were vital for increasing knowledge and outscaling. An MT was assigned to deliver training with extension staff or independently to villages in three *panchayats* (an area administered by a village council). The MTs were familiar with local crops, growing conditions, and dialects. When an MT spoke in the local dialect, it was observed that other women paid more attention to her. Second, the ATMA staff set up village NF groups of up to 25 members. The groups transformed into informal learning communities, providing mutual support and access to wider networks. ATMA staff established district and block-level WhatsApp groups for all farmers. Wider networks facilitated knowledge exchanges and served as an indigenous seed exchange mechanism. Women farmers explained how they benefitted from the networks:

> *"Through the WhatsApp group, I have come to know farmers across the district, when previously I didn't know anyone. We are learning more and becoming more confident. We post pictures of our work. Through the group, we can access phone numbers and contact people directly, such as when we need desi (indigenous) seeds. When we go out and meet other people, it builds confidence. We have visited many places." (HP3-Rhi-Kan)*

Furthermore, visits to model farms and meetings occurred at intervals, although the frequency of visits varied across districts. Observing other farmers enabled peer-to-peer learning and inspired farmers to try the practices. It also led to increased crop variety and improved dietary diversity.

> *"Women tend to stay at home, but when I stepped outside the home, I became known by others in the villages. I met and worked with an important farmer known for horticulture in this district. I appreciated the opportunities to learn from someone with more experience." (HP2- Kan-Kul)*

SK, a divorced OBC woman living with her parents, described how the hand-holding support that she offered in her role as an MT emboldened farmers to try NF and extend knowledge:

"I visit farmers in other villages and help them using my experiences. This support is necessary post-training. We must track and assist women farmers. When a male ATM visits them, they cannot speak freely. I sit with them on the floor and spend time in their fields. We discuss issues and decide what should be sown, where, and at the boundaries. They ask if they have used the right combination of mixed cropping or where coriander and turmeric should be sown. I assess their challenges, such as the water flows through the field and where they are likely to get monkey or stray cattle raids, and we find solutions accordingly." (HP3-Son-Kan)

However, SK could not afford to continue visiting farmers when the state-funded honorarium of Rs 4000 a month for MTs, introduced in 2021, was withdrawn. Thereafter, MTs were expected to volunteer their efforts to participate in training.

6.4.4. Advisory communication

Advisory communication refers to situations when farmers seek advice from communication workers on addressing a management problem. Farmers benefited from the knowledge of ATMA staff formally trained in agronomy. However, since ATMA staff had yet to develop agroecological expertise to resolve local challenges, many worked closely with farmers to find solutions through experimentation in the initial trial period. This set into motion a dialogue among diverse knowledge systems or *Diálogo de saberes* (Martinez-Torres and Rosset, 2014). If the trial was successful, the area under NF cultivation was increased. At times, farmers modified or replaced SPNF practices with ITK in discussions with ATMA staff. Many women farmers reported that ATMA staff encouraged them to adapt recipes to local conditions, which led them to devise innovative practices:

"We started with the kitchen garden. The BTM had first suggested spraying jeevamrit every three weeks, but we altered it to two weeks. We make bio-pesticides using bitter leaves that animals don't eat. When making agniastra, I add turmeric and fenugreek powder, as these are bitter. I have found that this works well." (HP2-Bha-Sol)

Some local challenges occurred because of the government's emphasis on yield and commercial practices in previous years, such as a move to grow high-value vegetables and fruit instead of cereals. These lacked a systems-oriented approach and undermined local dynamics.

NF practices, therefore, were first being deployed to substitute inputs in monocultures such as apple orchards before greater agroecological integration could be achieved. In the high-altitude district, Kullu, for example, NF farmers were experiencing difficulties eradicating a fungus, alternaria, which causes a leaf blotch in apple trees. Since deciduous plants needed for antifungal sprays in colder regions matured after the onset of the disease, they could not be utilized when needed. The BTM collaborated with farmers to test different methods for controlling alternaria, including using purchased organic antifungal agents for the short term. A farmer discovered that spraying apple trees with cow urine and sour buttermilk instead of *jeevamrit* in May, when the disease typically occurs, decreased the incidence of alternaria. This was communicated to other farmers by the BTM, along with advice based on ITK suggested by farmers to use ash and sour buttermilk instead of *jeevamrit* as foliar sprays in the harvesting season to support colour formation in apples. This example illustrates how agronomists and farmers co-produce and share knowledge through social learning. PK3Y had concurrently set up a farmer and researcher group to focus on practices for apples.

One of the detrimental effects of replacing cereals with high-value vegetables was a shortage of biomass. Two-thirds of farmers interviewed complained about not having enough biomass for both fodder and mulching. A farmer tried to grow yellow capsicums using NF practices but struggled to find biomass for mulching. Despite being aware of its damaging environmental impact, the farmer resorted to using plastic mulch (Zhang et al., 2022).

6.4.5. Conflict management

In some situations, conflicts management, which often has a social or cultural context, is called for. In Himachal Pradesh, cultural norms related to gender dynamics in the home restricted women's efforts to try NF. Women often faced opposition from the older generation or their husbands when they began practising NF. This caused household conflicts, where women farmers were ridiculed and criticised for their efforts, which could often last for more than a year or until a good harvest was achieved. In some cases, women had to negotiate with their husbands and in-laws for permission to try out NF. Four women mentioned that they were only allowed to practise on small plots of degraded land that had been left fallow. However, the women were proud of their achievements in making the land fertile and profitable.

Despite opposition from their families, many women led scaling efforts with support from ATMA staff. A woman found a way to resolve the conflict when a hailstorm damaged their vegetable cash crops, particularly tomatoes. She negotiated with her husband to let her use NF methods on half of their farm to compare the recovery with his half under conventional farming (CF). The husband agreed for her to try NF on the worst damaged crops. The woman received ongoing support from the BTM regarding which NF practices to apply. As it turned out, the tomato crop recovered equally well with both NF and CF practices. However, as the CF practices cost much more, the husband realised that NF was the better choice.

In some instances, conflicts based on class and caste occurred. The caste and class of the MTs and ATMA agents restricted their ability to build close relationships with farmers from another caste. In Kullu district, higher-caste women were hesitant to allow ATMA agents into their homes due to caste-based discrimination, preferring to meet them outside. The village's acceptance and view of the MT affected the adoption of NF. For instance, an MT considered an outsider due to her class, discovered her advice was unwelcome. On the other hand, leadership roles helped some women farmers overcome discriminatory norms. An MT who initially refused to eat meals in a scheduled caste village[14] later abandoned caste norms to work more effectively as a farmer promoter. ATMA staff in Kullu attempted to minimise caste-based conflicts by organising training groups comprised of people from the same caste.

6.4.6. Generating innovative practices through the co-creation of knowledge

Himachal Pradesh has two prominent universities whose research departments were researching NF practices for cereals/vegetables and horticulture. The objective was to determine how to control pests and maintain yield across various agro-ecological zones in the state. The scientists were conducting trials through KVKs – the research cum extension units linked to the universities. Experimental and demonstration plots were established in different

[14] The Scheduled Castes (SC) constitute 25.22% of the population of Himachal Pradesh, Other Backward Classes (OBC) form 13.52%, and Scheduled Tribes form 5.71%. Historically, these communities have suffered discrimination from other castes.

KVK or farmer fields. The researchers visited farmers to observe and replicate their practices on experimental plots. Attempts were made to find those natural farming practices which were more likely to be adopted by farmers; for example, since some farmers growing maize did not use intercropping, crop rotations with leguminous crops were suggested instead. Some farmers used vermicompost, and although it is not an SPNF practice, it was added to the list of practices being investigated. By working with farmers, the research departments expanded the range of agroecology practices beyond the constraints of SPNF. Similarly, advice to farmers on using indigenous cows was modified based on research on microbial populations in cow urine, allowing farmers to utilize their crossbred Jersey and Holstein cows.

The research staff reported that certain pests, such as fruit flies, fruit borers, and whiteflies, were difficult to control using NF bio-pesticides during the rainy season. Meanwhile, a group of women farmers in Solan district claimed to have found spraying regimens that controlled these diseases, of which the research departments were unaware. This demonstrated the requirement for a broader exchange of information.

In 2021, PK3Y began collaborating with local CSOs to deliver communication services. CSOs can be crucial in facilitating rural initiatives and innovation because they understand the socio-economic context, local agriculture and challenges. Rural Technology and Development Centre (RTDC), one of the predominant CSOs, became responsible for delivering NF services to 100 villages it had worked with in two districts since 1988. The social networks established by RTDC facilitated the delivery of communication services.

6.4.7. Supporting organisation development and capacity building

Innovations require the development of farmer and community organisations. PK3Y and ATMA agents facilitated change processes, built capacity, and strengthened groups and communities in several ways. Many ATMA staff informed farmers of government schemes they could use to overcome challenges, such as solar-powered fencing to prevent animal raids. The information enabled the women to improve their livelihoods and develop their capacity to assert their rights. This, however, depended on how familiar the ATMA agents were with the challenges being experienced by the farmers.

Establishing NF groups as community organisations had a range of benefits besides promoting CAC processes. Although the establishment of SHGs in the village and WhatsApp groups at the block and district levels was led by communication workers, the group activities were initiated by farmers. Some groups were set up by farmers themselves. The SHGs usually comprised women from similar socio-economic backgrounds who collaborated in social, learning, and economic activities. These spaces served a common purpose and allowed farmers with little power and voice in society to "gain confidence and skills, develop their arguments and gain from the solidarity and support that being part of a group can offer" (Cornwall, 2008, p. 275). The communication dynamic of everyday conversations appeared chaotic and diverse but was managed by participants and became a process of self-organisation (Leeuwis and Aarts, 2011). The group members worked collectively to generate income from selling farm produce and homemade food products. They experimented with NF practices and found solutions to challenges. The SHGs also acted as credit groups where members contributed a small monthly amount towards a savings account from which they could borrow at a low interest rate. A 32-year-old farmer borrowed money from her SHG to buy an indigenous cow to set up a bio-resource centre. She paid back the loan in full from the earnings and subsidies she received. When supporting farmers in selling their produce directly to the public or at shared outlets and local events, a few ATMA staff guided the women in managing accounts. Further, they supported farmer-led seed groups by purchasing seeds to supply to other farmers.

The increased social interactions through PK3Y built confidence in women and developed their civic capacities, community agency and citizenship power (Behl et al., 2024). Many women became more active in working to improve their own lives and those of their communities, in one instance, volunteering to implement a government educational scheme for adults. Establishing MT roles developed leadership capabilities. Seventeen MTs who were interviewed reported that the leadership role was empowering: it enhanced their self-esteem, expanded their social circle, and garnered the respect of their community. The support provided by the ATMA staff was crucial in boosting their confidence in speaking to groups. Vignette 3 demonstrates how participation in NF increased the confidence and capabilities of a woman farmer, resulting in both personal and community benefits.

Vignette: 3

KS, a 39-year-old farmer, was educated till lower secondary school but was prevented from joining the police force by her father. Married at 22, she found living in a large joint family difficult: the women farmed while the men held other jobs. With some difficulty, KS and her family acquired an independent home. KS was keen to learn and contribute to the greater good. She was feeling bored and depressed when the opportunity to attend a six-day training by Palekar occurred in 2019. An ATM subsequently supported her in running a farm school on her farm and becoming a Master Trainer. KS grew in confidence, and through the NF networks, she learnt of practices from prominent farmers. Despite increased responsibilities, caring for animals, a 1 ha farm and her two children, KS resumed studies to complete upper secondary school. She became known in her community for her determination and expertise in natural farming. The local federation of SHGs, comprising 150 members, chose her as their secretary, which increased her influence. KS has been reviving the use of indigenous crops and sharing seeds that she grows. Her work has been recognised in newspaper articles.

Alternative food networks and marketing support were developed by establishing designated outlets. This involved setting up specially designed NF canopies at central locations on specific days of the week, which farmers managed. Farmers could also use these canopies to sell at community events or in their villages. Further, the formation of NF Producer Companies (N-FPCs) was supported through a multi-stakeholder partnership involving a state university, Dr YS Parmar University of Horticulture and Forestry. Also, a self-certification system for NF produce, the Certified Evaluation Tool for Agriculture Resource Analysis (CETARA) was established. This would prevent certification companies from appropriating the value of products from small farmers. Mier y Teran Gimenez Cacho et al. (2018) observed that forming alliances through market mechanisms developed capacities and relationships with consumers and extended the influence of agroecology.

6.5. Discussion

Using a communication framework as an analytical tool, we demonstrated how the services provided by PK3Y contributed to a culture of experimentation, learning, participation, and innovation, while also identifying areas for improvement. The services used to fulfil different goals overlapped considerably. For example, the farmer training days also promoted horizontal exchanges between farmers. It was clear that to maximize the transformative potential of

agroecology, it was necessary to improve participatory and democratic processes that empower farmers. These are discussed below:

6.5.1. How training could be improved

The aims of building confidence and critical thinking have implications for the content and pedagogical approaches used in the introductory training. Due to the limited time for interactions with farmers over two days, careful planning with effective communication tools were needed to ensure that key information was imparted and understood. The degree to which participatory methods were used varied between blocks. In some blocks, the ATMA staff began the training day with a dialogue with the farmers about their context, cropping patterns, challenges and needs, but not in others. Involving the farmers in a dialogue raises their status in relation to the agent and puts them at ease. Conducting a dialogue among diverse knowledge systems, or *Diálogo de saberes*, with respect and sensitivity towards cultures and farmers is a necessary condition for co-creating knowledge (Gumucio-Dagron, 2004; Martínez-Torres and Rosset. 2014). Kerr et al., (2019) found that when farmers realise their knowledge is respected as real knowledge, they begin to share more of their knowledge of ecosystems. Farmer promoters and MTs should also receive training in participatory approaches to avoid imposing practices on farmers.

Clear communication and a step-by-step approach boost participants' confidence in asking questions, whereas a lack of clarity robs individuals of the ability or freedom to raise issues, effectively dehumanising them (Freire, 2017). Effective communication tools, such as visual aids, are necessary for understanding complex concepts like microbial activity, the benefits of mulches, line sowing, and intercropping. Communication agents should utilise portable visual aids, such as diagrams and images, to illustrate how soil biology functions, and have digital access to a repository of visual aids, animations, and digital storytelling materials to employ with pico-projectors. Moreover, visual resources like animations or videos could be made available online to reinforce learning and offer explanations for reference and sharing with families and communities. By utilising appropriate tools, one could integrate straightforward recipe options with an understanding of soil biology and principles of integrated pest management. Enhancing women's understanding of soil regeneration and fostering deeper insights into ecosystems would bolster their self-confidence and empower them to uphold and

advocate for their beliefs. Women farmers interviewed expressed a strong desire to expand their knowledge:

> *"I want to find out what is causing diseases in apples, such as leaf blotch. I try different solutions, and I experiment with bio-sprays to find out the most effective way to control diseases in cauliflowers."* *(HP2-Ush-Kul)*

Further, the internet expands possibilities for information sharing and participation, leading to increased cycles of consciousness-raising - praxis - capability being developed more equitably (Glassman and Patton 2014). Individuals who may have been overlooked can be provided with technology, such as financial assistance to purchase smartphones to access information and enable participation. However, while printed or audio-visual aids are needed to support communication, change hinges on experiential learning with farmer communities. The introductory training should ideally take place on a natural farm or include a visit to a model farm, as suggested by Rosset's pedagogy of experience. Forms of experiential training are a form of critical pedagogy and develop a culture of enquiry.

6.5.2. Use of participatory platforms

Communication platforms could be created to encourage more inclusive and participatory processes that involve a wider range of people. University researchers were not always aware of the innovative practices developed by farmers or their challenges. This was mainly due to channels of communication being limited by a hierarchical system that impeded the free flow of information. If a request was made to the university research department for assistance in addressing local challenges, the process involved was lengthy and linear:

Farmer -- extension agent -- district project director -- state research director -- university scientist

Each step presented a filter that could prevent the request from proceeding further. To establish more direct links, state departments must consider access to an online platform where communication staff and individual farmers can post requests and receive advice. Alternatively, an online forum allowing farmers to post their problems and challenges under different categories would enable horizontal interchanges between farmers, farmers and

Scientists. Such a forum or platform, with communication agents acting as facilitators, would provide opportunities for participants to express their views equally, irrespective of their social status or the scale of their farms. This aligns with Sen's (1999) notion of constructive democracy, which advocates for the use of public forums to generate and deliberate on new initiatives and policies that address the needs of the community. Input from farmers would foster face-to-face dialogues, crucial for cultivating partnerships and trust (Kerr et al., 2019). Moreover, the knowledge amassed by all participants from such a platform could be compiled and organised as a permanent resource for future reference. This compilation would enhance the understanding of alternative options, identifying efficiencies and common ground among traditional, organic, and NF practices. Above all, it would empower farmer-driven processes and ensure that the research agenda is shaped according to farmers' needs.

Better partnerships between CSOs and the government and consultations at the inception of rural development programmes are also needed. CSOs are a vital resource for advising the government on rural initiatives due to their experience and understanding of interdisciplinary issues, such as the socio-economic contexts, local agriculture, and challenges. It is essential to organise multi-stakeholder workshops at the planning stage. During these workshops, farmers, service providers, CSOs, researchers, and other communication intermediaries can come together to identify their strengths, expertise, shared interests, and training needs and explore ways to collaborate. CSOs can play a critical role in demonstrating pedagogical approaches and methods for working towards ideological objectives and building the skills and capabilities of communication agents MTs through mentoring and internship schemes. A successful model of collaboration between CSOs, the government, and academia throughout the planning and execution process is presented by the state Odisha Millets Mission, launched in 2017 to revive millets on farms (WFP India, 2022; Prasad and Dutta, 2021).

The evidence demonstrates how agricultural change and innovation often hinge on a collective process and transdisciplinary efforts involving farmers, farmer groups, and other key actors and institutions rather than an individual effort. This contradicts the instrumentalist assumption that new science-based policies can be effectively implemented in a top-down, linear, and controlled manner. Instead, the role of communication is to facilitate change or enhance the potential for change rather than to achieve an end goal (Leeuwis and Aarts, 2011). We have argued that there is potential that can be realised more effectively.

The success of state initiatives such as PK3Y depends not only on the extent of out-scaling but also on the effectiveness of their educational methods and the extent to which rural communities are empowered to bring about change. Empowered farmers and communities actively decide what kind of agriculture and food system they want and make effective choices to enhance their well-being. To build a strong coalition for change, communication agents must have the skills and relevant expertise to facilitate a knowledge landscape of shared learning and farmer-centred practices. For example, further resources are needed to support agents in participatory methods and build experiential learning via farm visits for all farmers. Communication platforms for horizontal and inclusive participatory processes must be developed to meet farmers' needs and expand capabilities for collective action. Furthermore, participatory planning in partnership with farmers and CSOs is needed.

7. Enabling access to traditional seeds in agroecology transitions: a case study from Himachal Pradesh.

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Abstract

This paper is based on a qualitative case study of an initiative by the state of Himachal Pradesh in North India to transition all its farmers to natural farming, an agroecological approach. The goal was to tackle multiple challenges related to rural livelihoods, high input costs, biodiversity loss, and environmental degradation. This paper explores the importance of traditional seeds or farmer varieties and asks how the state mechanisms enable access to traditional seeds and support farmer seed systems as part of the transition process. The study was conducted in thirty-five villages across five districts in Himachal Pradesh to understand the context, challenges, objectives, and mechanisms employed to engage with farmers and scale out practices, particularly amongst marginal women farmers. It examines farmers' practices and preferences related to traditional seeds and identifies areas needing further work to revitalise farmer seed systems. We argue that supporting farmers' traditional seed systems and access to seeds is a key enabling factor for agroecology: it is crucial to maintaining food sovereignty, enhancing health and nutrition, and building resilience to climate change.

7.1. Introduction

This paper explores the importance of traditional seed varieties (TVs) and mechanisms to facilitate access to and revive traditional seeds when transitioning to natural farming (NF), an agroecological approach, in Himachal Pradesh. In 2018, Himachal Pradesh began an ambitious plan to transition all their farmers from conventional chemical farming (CF) to natural farming; natural farming is a low-cost regenerative agricultural practice based on ecological principles that do not rely on agrochemicals.

Currently, multiple agroecology initiatives in India seek to address the fallout from the Green Revolution (GR) technologies. GR was resource-intensive, and in India, it resulted in the

marginalization of small-scale farmers, soil degradation, water depletion, deteriorating human health, loss in biodiversity, and farmer indebtedness (Patel, 2013; State of Environment Report India, 2009). Furthermore, industrial farming methods diminished the nutrient content of crops (Davis et al., 2004; Montgomery et al., 2022). Pivotal to the growth of industrial agriculture was the introduction of hybrid seeds (Box 1) in the United States, which established the basis for a global seed industry. Semi-dwarf wheat and rice varieties, characterised as high-yielding varieties (HYVs), were introduced in India as part of the GR technologies. These accelerated the loss of grain biodiversity at unprecedented rates. By 1990, 70% of rice and wheat cultivated in developing countries had been converted to HYVs (IFPRI, 2002).

Agroecology is an alternative paradigm that offers solutions to ecological crises and aspires to build sustainable food systems based on social justice and food sovereignty (Anderson et al., 2021; De Schutter, 2011). It emphasises the importance of local knowledge, placing the agency and power of small-scale farmers above powerful external actors. The inclusion of socio-political dimensions distinguishes it from other approaches to ecological farming.

In the early 1990s, a food sovereignty movement emerged to counter the current corporate food regime based on conventional GR technologies. Food sovereignty is “the principle of ensuring that everyone has the right to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and the right to define their own food and agriculture systems” (Nyeleni, 2007). It is an alternative food system and social movement that has evolved since its introduction by La Via Campesina at the World Food Summit in 1996. Agrarian and peasant movements embraced the concept of food sovereignty to protest against common threats. These included trade agreements destructive to local markets, diminishing state support for small farmers, the dominance of agri-businesses and seed companies being supported by states to legislate and enforce seed certification and Intellectual Property Rights (IPR) for agricultural genetic resources (Edelman et al. 2014; Martínez-Torres and Rosset 2010).

This research asks how the state mechanisms in Himachal Pradesh facilitated access to traditional seeds and supported farmer seed systems during the transition process. The paper is structured as follows: Section 2 reviews seed legislation to show how international regimes impact countries and restrict farmers' rights and access to seeds. This is followed by a summary of key reasons for the importance of agro biodiversity, where unrestricted access to and

support for FYs is essential for nutritional security, health, and adaptation to climate change. Next, seed conservation efforts in India are discussed briefly. Section 3 describes the research methods used and the context for the case study. The case study results are examined in section 4, illustrating the impact of NF practices on farmers, crops, and seed types, and the support provided by the NF program for using traditional seeds. Tensions emerging from the use of hybrid seeds for cash crops are discussed. The discussion in section 5 emphasises the need for coherent policies to support farmer seed systems.

Box: 2: Different types of seeds

Landraces – also known as traditional, indigenous, heirloom, local or farmers varieties – are open pollinated seeds developed and adapted over time to local climatic and geographical conditions. These typically display greater genetic diversity than types bred through formal breeding.

Open pollinated seeds result from a simple sharing of pollen between two like parent plants by natural means – insect, bird, wind or human hands. Before hybrids were introduced, all seeds were open-pollinated. The progeny (offspring) closely resembles its parents, has their characteristics, but may also have its own genetic diversity, by adapting and thereby developing resilience to changing conditions. The seeds can be saved and used by farmers. **Self-pollinating seeds such as** wheat, barley, oats, rice and tomatoes, can also be cross-pollinated.

Hybrid seeds are created by crossing two different varieties of the same plant. Crossing involves taking the pollen from the male flower of one plant and transferring it to the female flower parts of a different plant. First, pure lines of the parent plants are established, a process that can take several years, e.g., five years for wheat. Pure lines consist of plants which consistently self-pollinate to produce desired traits. After horticulturists establish two pure lines and cross-pollinate them, the female plants will bear F1 (First generation) hybrid seeds. Hybrid seeds are expensive and need to be purchased each year because seeds saved will not produce plants that are true to the parent type.

7.2. Literature review

7.2.1. Seed Laws and Legal Commitments

Seed legislation in India

The Seed Act of 1966 was India's first seed legislation. Its purpose was to ensure a supply of quality seeds for farmers and establish rules for registration and certification. It did not address farmers' rights to TVs, also called landraces, indigenous seeds, or heirloom varieties. TVs are not within the purview of the Seed Act and, therefore, the formal seed system. However, TVs represent the collaborative efforts of farmers who developed seeds by observing variations, selective breeding, and seed multiplication.

UPOV

The International Union for the Protection of New Varieties of Plants (UPOV) convention was the first international treaty on intellectual property in agriculture. Drafted in 1961 by industrialized governments in Europe, it sought to protect plant breeders in both their own and overseas markets. It fostered a regulatory environment, continuously contracting spaces and modes available for informal seed exchange in favour of seed corporations (Kloppenburg, 2010; ACT Alliance EU 2022). The requirements of the seeds to fulfill the criteria of uniformity, distinctiveness, and stability (DUS), as part of the registration process, favour seed corporations. These IPR regimes exert pressure to decrease diversity, limiting the effectiveness and adaptability of future seed supply and extracting more from the collective pool of knowledge than the IPRs contribute (Halpert and Chappell, 2017).

Europe and the WTO

The European seed market is highly regulated by the WTO and UPOV. They implement IPRs and restrict TVs, arguably in the interests of innovation and economic growth. Until the late 1980s, plant genetic resources were characterized as the 'common heritage of mankind' or as global public goods that farmers and plant breeders could access. However, this permitted the international IPR regime to treat any products derived therefrom as private property. Developing countries view this pattern as doubly inequitable (Kloppenburg and Kleinman, 1987). What was once a part of the commons is transformed into an exclusive, commodified form.

Since the 1994 Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), all WTO members must provide Intellectual Property protection for plant varieties, which developing countries believe should not be treated as private property on moral or cultural grounds. The requirements of TRIPS conflict with overlapping treaties in international regimes outside of the WTO: the Convention on Biological Diversity (CBD) and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) (Helfer, 2009; Kloppenburg, 2010; GRAIN, 2015)[15]. CBD, which came into force in 1993, explicitly recognises that 'states have sovereign rights over their own biological resources' and characterises plant genetic resources as a sovereign national property. WTO allows its members who wish not to assign breeding rights and patents under the UPOV Convention to opt for a 'sui generis' (meaning 'of its own kind') protection suited to their circumstances. India enacted the Plant Varieties and Farmers Rights (PVPFR) Act in 2001, which combines plant breeders' rights with elements of CBD and ITPGRFA, permitting farmers to save, use, exchange, and sell new plant varieties. A separate chapter on farmers' rights was included because of campaigning by civil society groups and farmers' unions. However, the Indian government continues to be pressured to join UPOV in bilateral trade deals with the US and the EU (GRAIN, 2020).

The CBD was signed by 150 countries in 1992. This required countries to follow up with a review of their domestic legislation. In India, the Biological Diversity Act (BDA) was enacted in 2002, and a National Biodiversity Authority was set up in 2003 to implement the work of the BDA[16]. Subsequently, State Biodiversity Boards were established to fulfil the objectives of the BDA. One task was the establishment of the People's Biodiversity Register (PBR), a repository of local flora and fauna species and traditional knowledge of medicinal herbs and plants. This

[15]In 2004, the International Seed Treaty (International Treaty on Plant Genetic Resources for Food and Agriculture—ITPGRFA) came into force and developed a greater public awareness of the threat of genetic erosion and the central role of farmers as custodians of these resources.

database is supposed to safeguard biodiversity and protect IPRs. However, efforts to maintain PBRs have been inadequate due to insufficient funding and a lack of expertise (Shekhar, 2024).

In 2018, a further UN resolution, the UN Declaration on Peasants' Rights and Other People Working in Rural Areas (UNDROP) required states to respect and fulfil peasants' rights to seeds. As a UN Declaration, it is above any national legislation drafted in line with the UPOV convention and is intended to guide any international agreements related to seed issues (ACT Alliance EU, 2022).

7.2.2. Why crop biodiversity is important

The world's food supply depends on approximately 120 out of 7,000 edible plant species. However, 90% of the total calories consumed are provided by just 12 plant species (Coupe and Lewins, 2007). Four plant species - rice, potatoes, wheat and maize – that account for 50% of dietary intake globally are increasingly limited to a few varieties.[17] The utilization of fewer and fewer plant varieties accelerates the decline in crop genetic diversity. The Food and Agriculture Organization of the United Nations (FAO) estimated that 75% of the agrobiodiversity worldwide was lost during the 20th century (FAO, 2010). Although estimates vary, it is estimated that over 100,000 different rice varieties in India were reduced to 7,000 due to the introduction of hybrid varieties as part of the GR technologies (WEF, 2019).

Loss of diversity within a species results in the loss of genes that help resist pests and diseases, adapt to climate change, provide nutrition, or have medicinal use. Landraces have a wealth of genetic variation and resilience accumulated over thousands of years of adapting to harsh conditions (Fowler and Mooney, 1990; Deb, 2009).

Relation to indigenous technical knowledge (ITK) and cultural heritage

Indigenous knowledge, developed in harmony with nature and climate fluctuations, is rooted in the principles of coexistence and community (Negi et al., 2023). A shift to CF caused an 'epistemic rift' or rupture in farmers' knowledge, resulting in a loss in agroecological

[17] The Latin American coffee industry is founded upon a single coffee plant from Ethiopia, while the Asian palm oil industry is based on four Nigerian palms (Fowler and Mooney, 1990).

knowledge, practices and skills (Schneider and McMichael 2010). This rift can also be seen as a process of alienation, described as a disorienting sense of exclusion and separation. Marx (1977) used the concept of 'alienation' to describe how capitalist modes of production alienated workers from the product of their labour while reducing the labour to meaningless tasks and tedium in which work does not freely engage the farmer's mental capacity. Furthermore, GR technologies, particularly hybrid seeds, deprived women of decision-making roles in selecting and storing seeds and multi-cropping systems of grains, pulses, beans, tubers, and vegetables. In contrast, using indigenous seeds can provide a more significant role for women in conserving local seeds and maintaining traditional knowledge. Crops often hold deep socio-cultural significance beyond their culinary use (Negi and Maikhuri, 2013; Kuruganti and Ramachandrudu, 2022). Therefore, in addition to meeting household nutritional needs, women cultivate a range of plants to preserve their cultural and religious traditions.

Resilience to climate change

Biodiversity loss weakens ecosystems' capacity to serve as natural shields against extreme weather events that threaten food security (FAO, 2023). FEED (2024) found that 40.9% of Indian marginal farmers surveyed had experienced drought, while 32.6% had faced excessive rains. The vast array of TVs provides an invaluable resource for adapting crops to new pressures and needs. For example, Debal Deb (Vidal, 2014) reintroduced six salt-tolerant rice varieties into Bangladesh, the only ones to survive Cyclone Aila in May 2009. Variable environmental conditions over several generations have led to greater genetic heterogeneity in seeds and an ability to adapt to climatic changes (Schneider et al., 2024). Farmer-managed seed systems of locally adapted, traditional varieties are more resilient to environmental stresses. In contrast, when confronted with unfavourable conditions, hybrid seeds can be vulnerable and fragile (Ficiciyan et al., 2018).

Importance for nutrition, diverse diets and medicinal properties

Studies have revealed the superior nutritional content of indigenous varieties. This is of particular significance in India, where food security and nutrition among under-five children is of significant concern: about one-third of children (32%) under five years old are stunted (low height for age), reflecting chronic undernutrition (FAO, 2022). Furthermore, 17% of the total population is undernourished, while 53% of women suffer from anaemia. The first quantitative

study comparing B vitamins in about 300 indica rice landraces to 3 modern rice cultivars revealed that many rice landraces were nutritionally superior to modern cultivars. Therefore, these landraces hold great potential in ensuring nutritional security for low-income people (Ali and Bhattacharjee, 2023). Similarly, higher nutrient content has been found in farmer's wheat cultivars (Parvez et al., 2019). The consumption of millet, a traditional staple food, declined when modern wheat and rice cultivars were promoted by the GR. Millets are rich in dietary fibre, nutrients, phytochemicals and antioxidants. Each type of millet has a unique nutritional profile. They are an ideal food for regulating diabetes and offer both health and therapeutic benefits (Jacob et al., 2024).

On the other hand, research findings on modern cultivars introduced during the GR demonstrate decreased mineral density in wheat grains (Fan et al., 2106). A recent study revealed that hybrid cereals exhibit reduced mineral density and elevated levels of toxic metals in plants (Debnath et al., 2023). Essential minerals, such as zinc and iron, in rice grains decreased by 33% and 27.0% respectively, while for wheat these decreased by 30% and 19.0% over the past 50 years. The loss in nutrient density of hybrid rice and wheat cultivars adversely impacts diet quality and human health. Indeed, hybrid cultivars may contribute to anaemia among women as these grains form the basis of the Public Distribution System, India's food subsidy program, which provides nearly 800 million people with subsidised grains (World Bank, 2019). Of equal concern is the increase in the absorption of toxic minerals (Arsenic, Aluminium, Barium, Chromium, Strontium) from the soil, particularly in rice cultivars. This is attributed to plants losing their natural evolutionary defence mechanisms against toxicants due to genetic tampering in modern breeding programs.

Furthermore, biodiversity performs a critical medicinal function. According to the WHO, 65% to 80% of the populations in developing countries currently use medicinal plants for prevention or remedies (WHO, 2011). India has a rich tradition of medicinal plants, but many of these plants are at risk of extinction. In the Indian state of Maharashtra, the Medicinal Plants Conservation Centre, run by local civil society organisations, supports the preservation of 1600 medicinal plants by women farmers.

Disease resistance

Fowler and Mooney (1990) argued that loss of agro biodiversity could lead to unimaginable hunger worldwide, and it could occur unexpectedly. A decrease in local varieties and lower in-field diversity leads to declining ecosystem services, such as biological pest and disease control. Crop failures are caused by plant diseases spreading more easily in monocultures as pathogens encounter less resistance. The FAO estimates that, currently, the world loses between 20% and 40% of its annual harvest due to pests and diseases (FAO, no date).

7.2.3. Seed conservation efforts

The conservation of TVs has primarily been the purview of farmers and CSOs working specifically on seed conservation. They remain outside the purview of the formal seed system, which follows India's seed legislation, beginning with the Seed Act of 1966. CSOs are working with state agricultural institutions to find a way to mainstream TVs and be recognised within the formal seed system (WASSAN, 2023).

Seed conservationists grow each variety yearly so the seeds stay viable and evolve with changing climatic conditions. To accomplish the complex task of preserving over 1,000 rice varieties while maintaining the purity of each variety, Debal Deb in Odisha and Syed Ghani Khan in Karnataka devised planting plans to prevent cross-pollination so that varieties are planted adjacent to cultivars based on asynchronous flowering. Deb (2005) argues that the purity of distinctive landraces must be maintained through seed conservation and selection, as the loss of the genetic purity of landraces erodes crop genetic diversity. Due to cross-pollination between different landraces, distinctive characteristics, such as drought tolerance or pest resistance, can be lost. Selection occurs at each stage of sowing, transplanting, and flowering. Plant quality is maintained through 'roguing', which involves the routine removal of 'rogue' plants with undesirable traits or off-type characteristics. For example, rice grains are identified by their morphological characteristics, such as plant size, leaf length and width, flag leaf angle, panicle shape, and panicle size. The final selection involves picking out the panicles showing the most desirable characteristics, such as size, aroma, or ripening time. Selection requires skills and ITK, which farmers who use purchased seeds may have lost.

Indigenous societies are known to preserve an astonishing genetic diversity of crops through continued seed exchange (Pratap and Rawal, 2022). Indian states have promoted landraces in

some cases. The state of Odisha implemented the Odisha Millets Mission program in collaboration with CSOs to preserve and promote millets in tribal areas in 2012 (Chaudhury et al., 2022). In 2016, the Department of Agriculture in Odisha introduced *Kalachampa*, a high-yielding local variety of paddy, to the formal seed supply system (Kuruganti and Ramachandrudu, 2022). In 2022, the West Bengal Biodiversity Board began large-scale cultivation of 25 indigenous rice varieties to revive their use. These include varieties with high nutritional content, climate resilience, and aroma. These exemplary cases showcase practices for other states to emulate. Following a request from the Indian government, the FAO declared 2023 the International Year of Millets as a measure to revive the tradition of millet consumption.

7.3. Methods and Materials

This paper is based on qualitative data gathered during four visits to Himachal Pradesh between November 2021 and December 2023. The data was collected in an iterative process split into two phases (Table 14). Phase 1 consisted of focus groups in nine villages across three districts—Mandi, Shimla, and Solan—that highlighted issues requiring further investigation. The focus groups used a participatory force-field activity to rank the challenges and benefits of adopting natural farming.

Table 11: Details of methods and samples

	Methods used	No. of participants	Districts and villages
Phase 1	Focus groups using participative activities; key informant interviews (KIIs); observations of training; ethnography	Focus groups: 100 women farmers Family interviews: 2	9 villages in 3 districts
Phase 2	Women's time-use and life-story interviews; observations of training; ethnography; focus groups; family and KIIs	Women's interviews: 53 Women in focus groups: 42 Families: 13 Male farmers: 15	27 additional villages across 5 districts

In the second phase, purposive sampling was used to consider different household types, caste, duration of NF practice, various agro-climatic zones, and crop types. Districts and villages were selected to represent three different agroclimatic zones, each specialising in cultivating cereals or vegetables and fruits as cash crops. Thirty-five villages were visited across five districts—Shimla, Solan, Mandi, Kangra, and Kullu. Semi-structured interviews comprised two sets of questions. One set aimed to discover the NF practices adopted, the mechanisms used, the challenges encountered, the crops grown, the types of seeds used, and the results achieved. Another set of questions asked farmers how the NF transition processes had affected their lives in specific domains (Behl et al., 2023).

7.3.1. Context

Himachal Pradesh is a mountainous state in the western Himalayas. It is a major producer of fruits and vegetables and is known as India's 'apple state'. Agriculture is the source of livelihood for 69% of the population, and 78% of the total cultivated area in the state is rainfed. Land holdings in the Himalayan states tend to be small, scattered and fragmented. The average land holdings are less than one hectare, while in the rest of the country, they are less than two hectares (GOI, 2019b). In recent years, conventional agriculture has increased susceptibility to insects, pests, diseases, falling yields, and soil degradation (TERI, 2015). Marginal farmers cultivate cereals, beans and pulses, oil seeds, fruits, and vegetables and still rely on traditional manure-based practices with limited chemical use of pesticides. In contrast, apple and high-value vegetable farmers use a range of agrochemicals. Since the mid-1990s, farmers have been encouraged to shift from growing cereals to more profitable vegetables raised from hybrid seeds, leading to an increased use of agrochemicals in the area.

To address the challenges of conventional agriculture, Himachal Pradesh implemented an organic farming policy in 2002. However, using purchased organic inputs was costly for farmers and led to financial losses. In its place, a State Project Implementing Unit was set up in 2018 to launch a program called *Prakritik Kheti Kisan Khushal Yojana* (PK3Y) based on practices popularised by a farmer promoter, Palekar, referred to as Subhash Palekar Natural Farming (

Box). The main objectives were to reduce the cost of cultivation, increase incomes for small and marginal farmers, grow healthy food, build climate resilience, and improve soil fertility and

water holding capacity. PK3Y used an existing extension system, the Agricultural Technology Management Agency (ATMA), which had previously offered training in organic and CF. The state had 961,000 farmers, of which 170,000 were reportedly trained in SPNF by the end of 2023 (CSE, 2023).

Box 3: Subhash Palekar Natural Farming (SPNF) techniques

SPNF adopted by PK3Y was based on four practices that aimed to rejuvenate the soil microbiome, with indigenous cows being considered essential:

1. *Jeevamrit* – a fermented microbial culture as a key component of soil regeneration.
2. *Beejamrit* - treatment for seeds comprising local cow dung, cow urine, lime, and soil.
3. *Acchadan* - mulching comprising soil, straw, and live mulch, using the symbiotic ground cover of intercrops and mixed crops.
4. *Whapasa* - reducing the water requirement by improving the soil's water-holding capacity.

Additional practices aimed at redesigning a system as a whole to regenerate the soil and promote integrated pest management included multi-cropping and intercropping, line sowing, trap crops, several farm-made biopesticides, and agro-forestry.

7.4. Results

The question this paper is asking is what mechanisms were being used by the state program PK3Y to enable access to and revive traditional TVs. The section will first present data showing which crops were cultivated and which TVs and hybrid seeds were used by three marginal and small farmers to illustrate these patterns. The selected farmers are from different districts and agro-climatic zones: Kullu, Solan, and Kangra. These farmers had been practising NF for three to four years and specialised in different commercial crops. Their stories exemplify the diverse richness of crops grown in Himachal Pradesh. These comprise a combination of crops grown for personal use, referred to as subsistence crops, and cash crops grown primarily for income. The farmers faced challenges transitioning to NF due to previous state policies encouraging them to grow cash crops.

The first characterization is from Kullu, a high-altitude zone specializing in horticulture, particularly apples. Figure 15 depicts vegetables and cereals cultivated by Usha, a 28-year-old farmer, during a standard calendar year. Usha's family owned 2.4 acres (approx. 1 ha) of land, of which one acre was dedicated to growing fruits —apples, pears, plums, and persimmons - as cash crops. She farmed the land with help from her in-laws and her husband, who held another job.

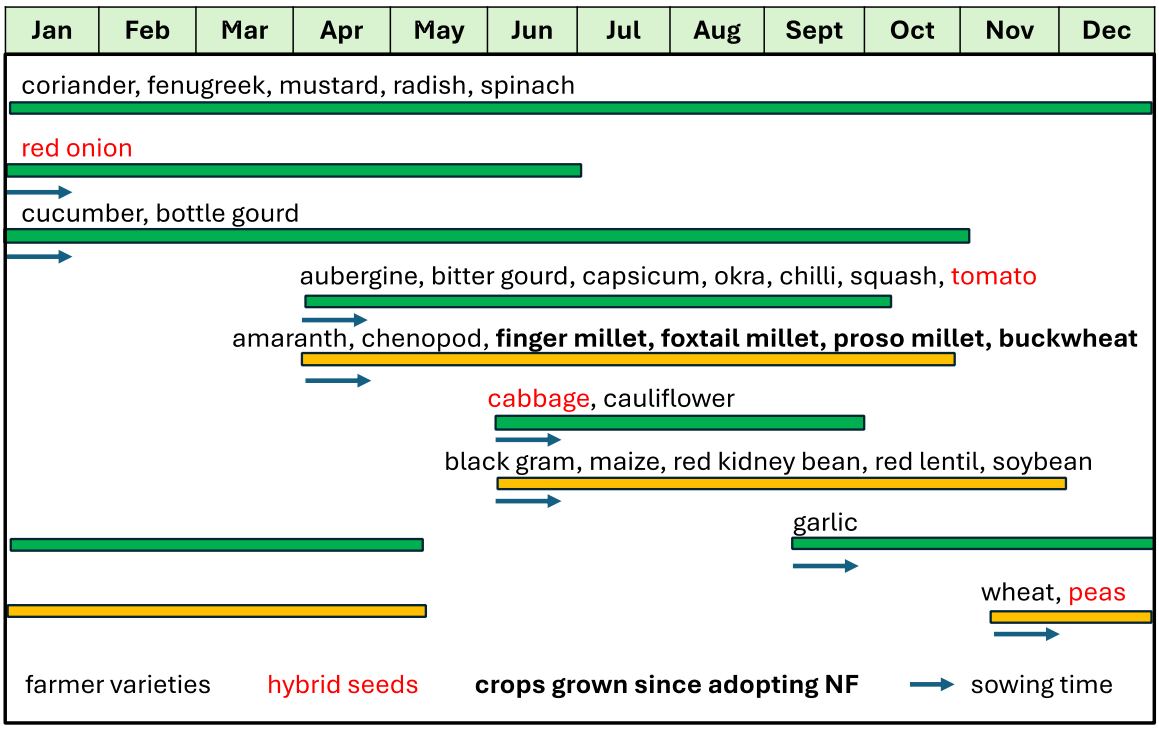

Figure 5: Crops cultivated by Usha, a marginal women farmer in Kullu district

Usha cultivated 31 vegetables, legumes and cereals in addition to growing fruits. Other than wheat, cultivated entirely as a subsistence crop, most crops fulfilled subsistence requirements and were also sold to a greater or lesser degree. A few vegetables, such as tomatoes, red onions, and cabbages, were grown primarily for income. Usha reported that many farmers wished for indigenous seeds, and ATMA staff occasionally provided these if they had been sourced from other farmers. Usha made attempts to find TVs to replace the hybrid varieties of vegetables she grew. She reported that TVs required less work as they were more disease resistant. She was successful in finding a TV of cauliflower from a local nursery. In NF trainings, Usha was informed that the old grains were disappearing from farmers' fields. She learned

about their superior nutrition and climate resilience. Thereupon, Usha resolved to revive these grains.

> *"We have lost our old cereals and we are trying to revive them. I have started growing millets and buckwheat. ATMA staff motivated us and stressed that it is essential to grow old grains."*

She sourced millets and buckwheat from other farmers and began to grow these for the benefit of the community and also to sell. Although ATMA staff offered support by purchasing some millet seeds from her to distribute to other farmers, the market for millets was limited and she could not sell her entire crop.

Usha noted that the crops began demonstrating greater climate resilience from the 2nd year of using NF practices. For example, maize stayed upright and did not flatten with the weight of the corn heads in strong winds and heavy rain. It also stayed green during a drought compared to the maize crops of other farmers practising CF. Usha enjoyed practising NF not only for the practical benefits it provided but also for how it reinstated her right to be in control and increased her decision-making over how to produce food.

The second characterisation comes from the Solan district, which lies in a low hill zone and specialises in vegetable cash crops (Figure 16). Solan accounts for a third of tomatoes produced in Himachal Pradesh. Radha, a 40-year-old woman, farms 1 acre of land with her husband, who also has a part-time job. Radha cultivates 30 crops, consisting of both TVs and cash crops produced from hybrid seeds or rootstock. She farmed the 1-acre plot intensively, where vegetables were grown amongst fruit trees. The primary sources of her income were tomatoes, capsicum, and cucumber. However, growing tomatoes was a gamble as the price fluctuated widely each year. It was often too low to cover costs, i.e., Rs 200 for a crate of tomatoes, interspersed with fewer years when it was highly profitable. Radha reported that farmers continue to cultivate tomatoes, hoping for good profits and to offset losses incurred in previous years due to the high cost of chemicals

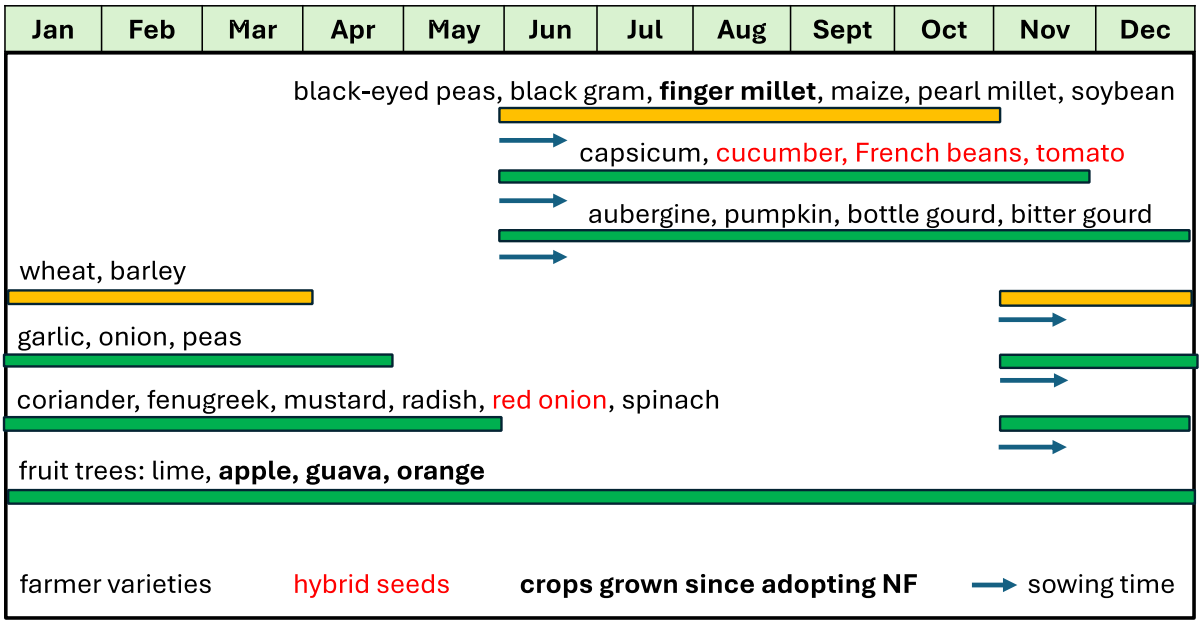

Figure 6: Crops cultivated by Radha, a marginal woman farmer in Solan

Radha stated that hybrid seeds were more disease-prone than TVs. She found that the seedlings were prone to fungal infections during transplanting, which was not true with TVs. Radha used to grow hybrid capsicum but replaced this with a TV purchased from a local farmer. The yield was comparable to the previously used hybrid variety. Radha appreciated having seeds of TVs as it saved money. In contrast, hybrid seeds were expensive and needed to be purchased annually. ATMA staff occasionally distributed TV seeds, and Radha received seeds for radishes, peas, fenugreek, coriander, and black gram. When Radha learned about the nutritional properties of millets in ATMA meetings, she began to grow finger millet and cook with pearl millet, which had been grown for fodder. All vegetables responded well to NF practices, particularly legumes.

> *"Normally, the tomatoes would be 4 to 4 ½ feet tall. With NF, the tomatoes grew taller and, therefore, had more flowers and fruit. But we must spray them with NF anti-fungal and pesticide preparations right from the start. They need to be sprayed every 3 or 4 days."*

Tomatoes also achieved a higher yield because they weren't sprayed with pesticides that damaged the plant. Radha reported that chemical pesticides would cause the flowers to drop once the tomato plant began flowering, affecting the yield. Furthermore, using CF had resulted

in decreasing yield over the years. In contrast, with NF, the yield stabilised after an initial drop in the first one or two years. Previously, the TV wheat was treated with chemical fertilisers, which made it susceptible to yellow rust. With NF, the wheat had become disease-free.

The third characterization is from the Kangra district. Kangra lies in a low hill zone where the farmers specialize in growing cereals, including paddy (Figure 17). Yudhbir Singh, age 55, and his wife Meenaji farmed a 4.5-acre plot. Yudhbir retired from the police force in 2016 and began farming full-time with Meenaji. Meenaji had so far managed the farm on her own using conventional methods. Yudhbir participated in a Palekar 6-day training camp in 2018 when NF was introduced in Himachal, and they began to practise NF. The farm comprised two plots: 2.5 acres close to the house and 2 acres about 1.5 km away. They found it difficult to transport *jeevamrit* to the more distant plot, nor was it possible to make *jeevamrit* in situ as the containers would get stolen. Consequently, they continued to use conventional farming on the distant plot where hybrid seeds were used, while the closer plot was fully converted to NF.

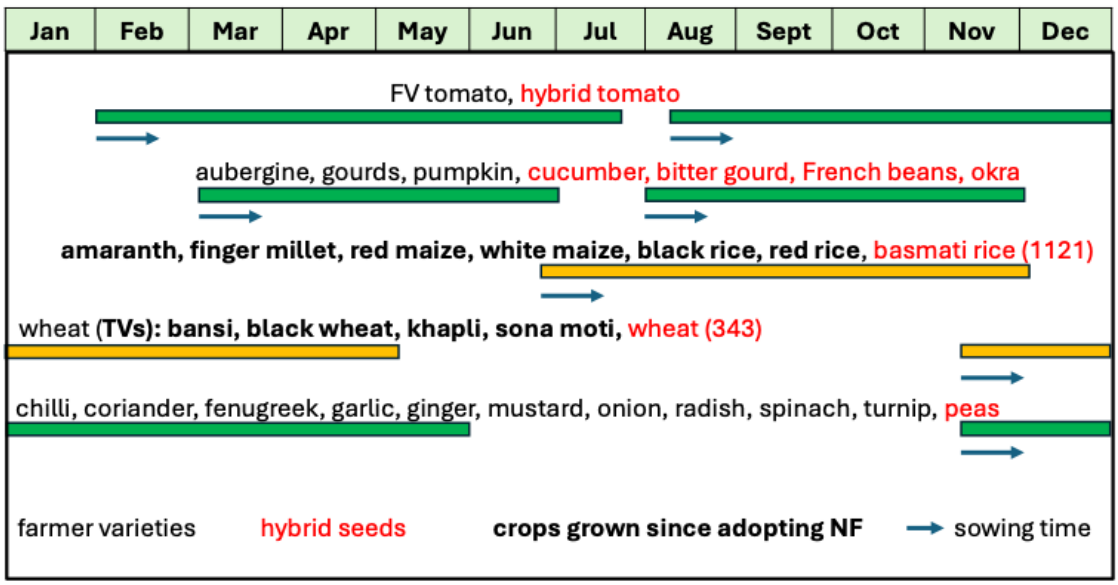

Figure 7: Crops cultivated by Meenaji and Yudhbir Singh, farmers in Kangra district

Meenaji and Yudhbir were interested in filling a gap in the market for TVs. They began growing a range of cereal TVs for their nutritional value and to be sold as seeds. These were especially sought after by individuals with medical conditions like diabetes. Meenaji and Yudhbir believed

that TVs needed to be publicised and promoted for their nutritional and medicinal uses. Also, people needed to be informed about the benefits of naturally farmed produce.

> *"If people were made aware of the nutritional benefits of indigenous wheat and rice varieties, we could cultivate and sell more of those crops. At present, there is not enough demand."*

ATMA agents in Kangra had provided farmers with open-pollinated red rice seeds developed by the Department of Agriculture. They did not purchase the seeds from farmers, such as Yudhbir and Meenaji, for distribution to other farmers but made the seed availability known on WhatsApp groups and other networks. Meenaji undertook the role of storing the seeds and dealing with farmer requests.

Meenaji and Yudhbir found that NF reduced yield in hybrid grain varieties. They grew wheat 343, a hybrid variety, to sell, but the yield was reduced by about 10% when grown with NF. They began cultivating a hybrid 1121 basmati rice, renowned for its long grain, aroma, and yield (Singh et al., 2018) 3 years ago, but they found it to be highly disease-prone. Yudhbir experimented with salvaging the best rice seeds to grow the next crop. He found that the second crop exhibited better disease resistance. They preferred using their own seeds as they knew how the crop would respond to local conditions, which wasn't the case when growing newly purchased hybrid varieties. They further reported that hybrids were not drought resistant. The hybrid crops could not survive without water for ten successive days, whereas the TV would.

Meenaji and Yudhbir cultivated hybrid and local tomato varieties because both sold well in the market. The local variety was known for its tangy taste and was used in traditional dishes for special events like weddings. On the other hand, the hybrid tomatoes, which were taller and had a higher yield, were primarily sold for salads. Both tomato crops required extra spraying with bio-pesticides to keep diseases at bay.

As shown in the characterisations above, marginal farmers cultivated a rich diversity of crops: they grew between 15 to 35 vegetables, grains, legumes, and oilseeds in addition to fruits. The majority were raised from indigenous seeds (Table 15).

Table 15: Crops commonly grown from indigenous seeds

Cereals	maize, wheat, rice, barley, buckwheat, millets, sorghum, chenopod, amaranth
Vegetables	garlic, mustard, spinach, fenugreek, radish, cucumber, red and green chillies, okra, aubergines, bitter gourd, bottle gourd, sponge gourd, pumpkin, beetroot, coriander, turmeric, onions
Legumes	black gram, red-kidney beans, black eyes peas, soya bean, chickpeas, red lentils, peas

Farmers cultivating a diverse diet for their own consumption and selling to local markets had, in previous years, been encouraged by the state to grow cash crops raised from hybrid seeds, such as tomatoes, capsicum, cabbages, cauliflower, seedless cucumber, and French beans, to increase their incomes. A number of farmers reverted to indigenous crops due to concerns about soil damage caused by the chemicals needed for hybrid varieties. All the farmers indicated that they used to cultivate millets and ancient grains in the past, and many had begun cultivating these again after being introduced to NF. The fact that their cropping patterns were partially dictated by what would sell in the market led to tensions when adopting NF.

7.4.1. The impact of natural farming on hybrid plants

Most farmers reported increased shelf life, improved appearance, and prolonged fruiting periods for their vegetables and fruits from the second year of practising NF. In many instances, these results were achieved for crops raised from both TVs and hybrid seeds, contributing to increased income and diet diversity. The quotes below show how some hybrid fruits and vegetables responded to NF practices.

> *"The capsicums (hybrid) last longer and continue to stay green because of jeevamrit applications. The fruiting time was also prolonged." [H2-Me-Kul]*

> *"The growth of apple trees is better. 3-year-old trees have the growth that you would expect from a 4-year-old tree." [H2-An-Kul)*

"The French beans are continuing to fruit longer than we expected. But now, we must pull out the plants to make space for the next crop." [H1-Sha-Sim]

In contrast, farmers who grew hybrid cereals, such as wheat and maize, reported a drop in yield when these were grown with NF. How different hybrid crops react to NF practices under different conditions remains an area for further research. A key factor may be the length of time NF has been practised and the extent of agroecological integration. A farmer in their fourth year of NF reported that the diseases had decreased. Tomatoes, for example, were no longer being attacked by nematodes.

Table 12 showcases illustrative quotes from farmers as evidence that they associated hybrid seeds with poor climate resilience, cultural and practical unsuitability, and a high reliance on agrochemicals. Older farmers recalled how cash crops had resulted in the use of agrochemicals and impacted their diets.

Table 12: Farmer Perceptions of Hybrid Seeds and TVs

Characteristics of hybrid seeds	Illustrative farmer quotes
Cultural and practical (Socio-ecological) unsuitability	*Before the year 2000, we used to eat a different cereal every day of the week – maize, barley, millets, etc. Now people mainly eat rice and wheat. These changes to the diet occurred when cash crops began to be promoted. There is also less hay for animals. The cereals we grew earlier provided enough hay.* [H3-Go-Kul] – a 53-year-old apple farmer.
	I tried hybrid maize but the stalks were too thick for my cows to eat so last year I went back to the local seeds. [H2-Ka-Kul]- a 39-year-old marginal woman farmer in the 4th year NF.
	Local tomatoes have a thinner skin and are much better to cook with. Hybrids have a thicker skin and don't cook easily. [H3-Ra-Kul] – a 40-year-old woman farmer in the 4th year of NF.
	New varieties of plants are weak plants. They need to be supported if they grow tall. The older plants were stronger and did not get diseases.

	In the interests of improving plants, they have been ruined. [H2-Sa-Kul] – a 48-year-old male apple farmer in the 4th year of NF.
	Chuirri, a red tall wheat that was resilient in rain and hailstorms is no longer available. The grains would not fall down unlike hybrid varieties where grains are shed if it rains. [H2- Ka-Kul] - a 38-year-old marginal woman farmer.
Link to diseases and chemical use	*We cultivated cabbages with chemicals for about 4 years and then dropped them when we found out that chemicals harmed our health and the soil. [H2-Me-Mas]- a* 47-year-old woman farmer farming 4 acres with her family since 2018.
	We have adopted vegetables that are not traditional to this area. Cabbages and tomatoes are the most disease prone. With local seeds that is not the case. [H2-Me-Mas] - a 50-year-old small holding male farmer from Shimla district.
	The seeds for wheat and maize are local; we keep them at home. They don't get any diseases. [H2- Ra-Sol] – a 40-year-old marginal woman farmer from Solan district.
	Growing indigenous seeds with natural farming is fine, but if you are growing hybrid seeds which need chemicals, a lot of effort and changes are needed. Instead of using 50 litres of jeevamrit, you would need 400 litres. [H2-Sh-Sol] – a 40-year-old commercial farmer.
	Hybrid seeds are for businesses not for farmers. We grow crops primarily for our health [H3-Ra-Kul]- a 44-year-old woman apple farmer in the 4th year of NF.
	We have an old rice variety from our grandparent's time called Kasturi basmati. If we added urea to it the entire crop would flatten and die. [H3-So-Kan]- a 40-year-old woman farmer in 4th of NF.

Sixty-two farmers were asked about their views on hybrid seeds, and 100% of respondents associated these with the use of agrochemicals and stated a preference for TVs. The use of agrochemicals implied high costs, difficulties in controlling plant diseases, and a negative impact on their health. Women reported experiencing body aches, headaches, and allergic reactions such as skin rashes, burning skin, and eye irritation due to the application of pesticides and

chemical fertilisers. Three farmers reported that chemical fertilisers had adversely affected their health to the extent that they could no longer work. Of the respondents, 39% spontaneously reported practical, cultural, and ecological drawbacks of hybrid seeds compared to TVs, and felt the latter showed greater climate resilience.

7.4.2. Difficulties with controlling diseases in hybrid plants

Scientists researching NF at the agricultural university in Himachal Pradesh reported that certain pests that attacked tomato crops, such as fruit flies, fruit borers, and whiteflies, were difficult to control during the rainy season using NF bio-pesticides. Whiteflies and fruit borers had also become resistant to chemical pesticides.

It was evident that using NF practices on hybrid crops increased workloads significantly due to the increased spraying required to control diseases. Out of a sample of 49 farmers, 94% or 46 respondents felt that greater effort was needed. However, this varied according to the crops grown and the agroecological context. Farmers agreed that cabbages and tomatoes were the most disease-prone. Tomatoes, in particular, need to be sprayed twice a week. Two apple farmers reported that their spraying schedule had doubled. A male farmer growing yellow capsicums in polyhouses had developed a spraying regimen through trial and error that was four times as intensive as that required by CF. Nevertheless, he was pleased with the crops' high yield and good condition.

The need for additional spraying often discouraged farmers from adopting NF, as they believed it would increase their workload to an intolerable level. Increased workloads were particularly relevant for women farmers. A time-use survey of 26 female farmers found that women already bore a substantial workload - the average workday lasted 14 hours, comprising both care and productive work.

7.4.3. Efforts to Promote Traditional Seeds

Although ATMA staff encouraged farmers to use and revive TVs, efforts to supply farmers with seeds were perceived by farmers to be inadequate. The demand for indigenous seeds far exceeded supply. There was a lack of coordination within the PK3Y program, and practices varied among districts. In some districts, ATMA staff purchased TVs from farmers to distribute to other farmers within that district. In other districts, only certified open-pollinated seeds

supplied by the agricultural department were distributed to farmers as and when available. Farmers tried to source seeds using the WhatsApp groups established by ATMA. ATMA staff also shared information within these networks regarding which farmers could provide seeds. ATMA staff, however, continued distributing hybrid seeds to farmers when FYs or open-pollinated seeds were unavailable. In one training session, ATMA agents supplied farmers with hybrid maize to start a Farm School[18] even though the farmers grew a local variety of maize. This raises the question of whether supplying farmers with free seeds as a motivational ploy should be dispensed with.

PK3Y had initially attempted to establish seed groups with Rs 25000 for set-up costs to multiply indigenous seeds for distribution to farmers, but very few were successful. An extension agent reported that they did not receive training on how to set up a seed group. Given that the agricultural degrees focused on conventional agriculture, skills and knowledge related to traditional techniques were not covered. Their agricultural course at the state universities had not addressed core knowledge about seed multiplication, selection, and storage. In 2022, PK3Y collaborated with a CSO, HimRRA, to train farmers in growing millets, conserving and distributing seeds, and cooking with millets. However, this initiative was limited to 10 *panchayats* (village councils). In 2023, the Year of Millets, PK3Y also distributed millet seed kits and organised community events to publicise the nutritional qualities of millets and showcase foods cooked from millets.

7.5. Discussion

This research supports the notion that introducing hybrid seeds, an integral part of the industrial agriculture paradigm, can lead to the erosion of food sovereignty. Literature suggests that hybrid seeds are high-yielding, disease-resistant, and climate-tolerant. However, most farmers in the case study associated hybrid crops with high costs, damaging chemicals, diseases that were difficult to control, and poor climate resilience.

[18] A Farm School involved working with five farmers in a village during a crop season. ATMA staff would conduct six field visits, two visits at each stage of growth, to discuss techniques and progress and share solutions to challenges.

Additionally, recent research by Debnath et al. (2023) highlighted the poor nutritional quality of hybrid plants and called for urgent nutrient profiling before releasing a cultivar of staples like rice and wheat. This must apply to all hybrid plants that farmers use for cash crops. The crux of the problem lies in the focus on maximising yields and monetary value. The drive to grow cash crops undermines the HLPE's agroecology principle of Synergy, which is to enhance positive ecological interaction, synergy, integration and complementarity among the elements of agroecosystems (animals, crops, trees, soil, and water) (HLPE, 2019). For example, moving away from cultivating diverse cereals in favour of cash crops affected nutrition adversely and caused a shortage in biomass.

Farmers attempting a transition to NF were caught between two conflicting paradigms. On the one hand, farmers were encouraged to grow hybrid cultivars as part of the industrial agriculture paradigm. These cultivars promised high yields but required the use of expensive agrochemicals. This approach seemed destined to repeat the mistakes of the GR, leading to increased debt, continued loss of biodiversity, and the poisoning of people, soil, and water. In opposition to this, farmers were being asked to adopt an agroecological approach to counteract the adverse effects of the industrial project.

It is unclear whether PK3Y aimed to achieve food sovereignty for marginal farmers in Himachal Pradesh. Their vision of NF described a more sustainable farming system that raised farmer incomes by reducing dependence on external inputs, regenerating the soil, producing healthy foods, and enhancing 'biodiversity by encouraging the production of traditional crops to ensure food security' (GoHP 2022). However, hybrid seeds were not mentioned, nor was their relation to biodiversity loss highlighted. Without a clear policy and plan for promoting indigenous seed varieties, PK3Y ground staff lacked clarity on the role of hybrid seeds. Some continued to distribute hybrid seeds, which gave mixed messages to farmers and undermined the NF project.

Many seed activists and CSOs argue that local seed varieties should be integrated into formal seed systems and policies, as well as evolving related operational strategies (ACT Alliance EU, 2020; Kuruganti and Ramachandrudu, 2022; Rao, 2019; WASSAN, 2022). These strategies are also relevant to sustainable agriculture practices in other countries. They ask that the focus shift from creating new HYVs to discovering and cultivating more resilient, productive, and nutritious farmers' varieties and maintaining their ITK.

Table 13 combines the broad strategies collated from the literature review and those suggested by farmers and activists interviewed for this case study.

Table 13: Strategies to Support Farmers' Seed Systems

National level	• Prevent farmers' seed rights from being eroded in any way as defined by UNDROP. • Undertake the digital documentation and cataloguing of shared farmers' varieties to establish a national People's Biodiversity Register, as mandated by the Biological Diversity Act, which should be exempt from IPR registration. • Develop institutional and financial capacities of State Biodiversity Boards to maintain People's Biodiversity Registers. • Establish mandatory nutritional analysis for new cultivars.
State level	• Establish biodiversity blocks for mapping and identifying the existing diversity in crops with farmer participation. • Conserve local seed stocks with attention to purity. • Include popular landraces in the government seed delivery system. • Publicise nutritional benefits of traditional varieties based on nutritional profiling.
Farm level	• Build capacity of farmers and agriculturists in seed selection, seed multiplication, and storage. • Create seed catalogues to facilitate free seed exchange among farmers. • Form farmer producer organisations (FPOs) for multiplying and selling seeds.

7.6. Conclusion

Several conclusions can be drawn, ranging from the immediate experiences of farmers in the research field to broader implications that may inform ongoing debates and further work at both national and international levels.

The importance of farmer experiences in Himachal Pradesh

In relation to hybrid seeds, farmer experiences in Himachal Pradesh challenge the narrative that hybrid seeds are more disease-resistant than indigenous seeds or TVs. Instead, the results reinforce the benefits of indigenous seeds. The accumulated know-how and experiences demonstrate that indigenous seeds have cultural and practical advantages for farmers. They are essential to adapting to climate change and maintaining food security.

Wider issue of integrating agroecological practices

The findings highlight a wider issue about whether using hybrid seeds as a component of the industrial agricultural paradigm conflicts with natural farming. This article has addressed this issue, with proposals to be further explored and pursued. Initiatives seeking to transition agricultural systems to agroecological practices must include coherent policies to support farmer seed systems, identify local traditional seeds, and design a plan for ensuring access to those seeds.

Rethinking the approach of International Frameworks

At both national and international levels, it is imperative that instead of a focus on granting new powers and privileges to corporations, significant action is taken to uphold the rights of farmers and access to seeds, as outlined in the UNDROP. It is essential that at the international level, a higher priority is given to protecting local communities' rights to seeds that maintain local biodiversity, as well as providing financial support. This process should involve relevant international institutions and international regimes.

Support for farmers' seed systems that allow unrestricted access to local seed varieties will be pivotal for future food security and nutrition, spreading the risk and enhancing the resilience of family farmers to climate shocks and crises. For example, a UN fund should be established to help countries identify, characterise, and register local indigenous seeds and integrate them into formal seed distribution systems. Finally, this paper finds that supporting farmers' traditional seed systems and access to seeds is a key enabling factor for agroecology. Implementing the principles of agroecology will be crucial to maintaining food security and sovereignty, enhancing health and nutrition, and building resilience to climate change.

8. Discussion

8.1. Introduction

This chapter draws together the key intersecting themes that emerge from the findings in Chapters 5 to 7. This thesis explores the methods and mechanisms used to support women transitioning to natural farming as an agroecological approach and the resulting benefits. The following themes re-engage with the debates presented in Chapter 2 to deepen understanding of how the NF programme in Himachal Pradesh empowered women farmers and how the emancipatory potential can be further realised.

The themes are discussed in the following subsections: 1) The importance of consciousness-raising in agroecology transitions; 2) Communication capacity building and pedagogical conflicts; 3) Women's empowerment requires a holistic approach; 4) Conflicting state agricultural programmes undermine agroecology.

8.2. The importance of consciousness-raising in agroecology transitions

The study of motivations for adopting NF practices, especially among women farmers, reveals that a key factor in transitioning to NF is altering perspectives and redefining their roles as decision-makers in agriculture. (Coe and Coe, 2023; Mezirow, 1991). The transition process began with raising awareness so that farmers started to think critically about their relationship with nature and the impacts of industrial agriculture. In Himachal Pradesh, it was observed that a shift in values is a significant driver for many individuals to engage in NF. However, the agroecology principles developed to date do not address the changes in values, beliefs, or attitudes which serve as a motivational force (HLPE, 2019; FAO, 2018b).

The Industrial agriculture regime dispossessed farmers of their knowledge, telling them what to grow, how to grow it and the seeds they needed to purchase. Historically, industrialisation caused people to move off the land to towns and factories, causing a 'metabolic rift' that Marx (1977) attributed to the decline in the recycling of human organic waste. Schneider and McMichael (2010) argue that the metabolic rift was accompanied by a rupture in knowledge and the means to build knowledge about the soil and farming as people "also took culturally,

historically, and geographically specific knowledges about farming practices and local ecosystems" with them (Ibid, 2010, p. 477). Thus, the metabolic rift had ecological consequences and also caused an epistemological break or epistemic rift. Traditional knowledge about farming was not passed down to the next generation and was lost. This situation represented a crisis for humanity when agricultural workers with valuable agroecological knowledge were relegated to mundane tasks in factories and other manual labour jobs, and "the production and reproduction of embodied knowledge of local ecosystems and potentially sustainable agricultural practices" was lost (Ibid, 2010, p. 477). Likewise, an epistemic rift also occurs when industrial farming replaces traditional practices and knowledge.

The capitalist modes of production had another consequence. Nature, humanity, labour, knowledge, and institutions started to be primarily evaluated for their monetary worth - a process of commodification (Marx, 1977). Similarly, when agriculture is considered mainly for its financial benefits, concerns about ecological integrity and nature-human relations are excluded. Writers have suggested that the agroecology movement underpinned by food sovereignty can repair the epistemic rift, restoring the nature-human connection (Munster, 2016; Schneider and McMichael, 2010; Wittman, 2009; Tyagi and Kumar, 2020). This connection is one of reciprocity and evokes the ideas of dependence, participation and care (Palsson, 2003).

Restoring the epistemic rift and building the nature-human connection has broadly twofold effects. First, it builds an ecological mindset and a sense of place, which are motivational forces for agroecology. Coe and Coe (2023, p.7) argue that the sets of agroecology principles delineated so far need to include an additional principle to "build ecological mindsets that bring understanding of and empathy for the natural world into the design and management of food and agricultural systems". This research demonstrated in Chapter 5 how farmers became committed to NF because of a changed or enhanced ecological mindset. Women invested their efforts to resolve challenges, upheld their beliefs in the face of family opposition, worked to persuade other members of their community, and took steps to conserve biodiversity. Farmers who had attended the training by Palekar were particularly inspired:

"When I heard Palekar, I realised that we need to protect Mother Earth and not feed it poisons. When I returned home, I decided to follow his practices. I thought that if I don't make Rs 6 lakhs, I would at least make Rs 2 lakhs to cover expenses" (HP2-Sur-Sol).

Second, raising awareness takes on a broader meaning in line with Freire's (2007) concept of conscientisation, wherein individuals become aware of different socio-economic perspectives and how the current system affects people. These include raising awareness of industrial agriculture's economic and political implications. The NF programme in Himachal Pradesh increased the awareness of women farmers about their ability to make decisions regarding agricultural practices and their right to food sovereignty. They realised that NF enabled them to gain independence from corporate control (see Chapter 5, Section 5.5 and Chapter 6, Section 6.2.1). Women farmers expressed how this boosted their confidence and empowered them to take charge of agricultural decisions, as well as their learning and knowledge acquisition.

"I feel very good practising NF. It has given us our right to be in control, to increase our knowledge and our right to earn money"

"I learned we have the ability and resources to make whatever we need; we do not have to depend on the market. That I can rely on myself makes me feel confident" (A 45-year-old apple farmer).

Consciousness-raising is crucial for cultivating independent, self-sustaining motivation among farmers to uphold their practices and innovations. This can endure even when confronted with changes in project management or financial constraints that hinder its plans.

8.3. Communication capacity building and pedagogical challenges

In Himachal Pradesh, the ATMA communication and extension services were trained in conventional agriculture, and extension services had previously been delivered in a top-down, didactic manner. These communication methods are inconsistent with agroecology, which aims to honour and restore their right to knowledge and strengthen their capacity for generating knowledge and innovation (Pimbert, 2017; Titonell et al., 2020; Maughan and Anderson, 2023). Freire (1999) criticised the top-down teaching approach as authoritarian. Instead, he promoted a critical and liberating pedagogy that encouraged critical reflection and a culture of inquiry.

Agroecology requires participatory methods and diverse communication strategies that encourage dialogue and co-creation of knowledge. Such an approach is underpinned by epistemic justice. The term ‘epistemic justice’ was coined by Fricker (2007). According to Fricker (Ibid, p.5), "epistemic injustice wrongs someone in their capacity as a subject of knowledge, and thus in a capacity essential to human value". Epistemic injustice denies people's right to participate in knowledge production and dehumanises them. Visvanathan (2011) introduced a similar term, ‘cognitive justice’, which acknowledges the right of various forms of knowledge to coexist. It recognises that different knowledges are linked to specific cultures and ways of life. Both cognitive and epistemic justice emphasise that disregarding local and gender-specific knowledge would be unfair. Instead, the observations and reflections of each farmer should be respected and valued.

The transition to NF required the ATMA staff to acquire expertise in various knowledge and skill areas. They needed to comprehend the rationale of farmer-centred approaches, develop skills and tools to facilitate the co-creation of knowledge and promote critical thinking. Observations of training sessions revealed gaps in skills related to participatory tools, farmer-centered approaches, and effective communication techniques regarding NF practices (Chapter 6). This implies that communication staff need to develop a wider range of skills than previously required in conventional agriculture

To deepen knowledge of NF techniques and agroecological integration, engaging in process-oriented learning is essential. This develops capacities through problem-solving and collaboration with farmers. ATMA staff learned about NF practices alongside farmers because the training in NF techniques had been limited to attending Palekar camps. A BTM reported that it took him two years to establish the optimal strength and frequency of application of *jeevamrit* for local conditions. Often, when farmers consulted ATMA staff to resolve problems, it led to the co-creation of knowledge, which was subsequently shared with other farmers. In this respect, the communication staff being at the start of their learning curve about NF practices contributed to collaborative learning.

Advocates of agroecology have often been critical of using recipes in NF. However, according to the CAC pedagogy, farmers should begin a transition by carrying out small-scale experiments with a few methods taught by farmer promoters (Rosset et al., 2011). Examining emblematic

cases of transitions to agroecology also revealed that simple recipes and practices that showed quick results were used at the introductory stage. Initially, they were easy to apply and experiment with, while more complex knowledge of integrated agroecological management was introduced gradually. Moreover, these early trials capitalise on the knowledge farmers have and build the capacities of farmers while they learn from their experience (Machín Sosa et al., 2013; Mier y Terán Giménez Cacho et al., 2018; FAO, 2024). In other words, several methods and strategies are needed. Learning how to create an inoculum or a bio-pesticide increases knowledge of the range of methods to regenerate the soil or control diseases and experimenting with a few options encourages creative thinking. Therefore, using recipes can be one of the methods used in a participatory, farmer-centred approach. The defining pedagogy for agroecology is a farmer-centred approach rather than the use a particular method.

It was observed that not all communication staff were skilled at consciousness-raising. Some only highlighted the benefits of NF in terms of saving costs and safeguarding one's health. Notably, as the program was a state initiative, the political aspects of the state's previous promotion of environmentally damaging practices were not mentioned. However, farmers who attended Palekar's training camps at the start of the program had a different experience from those who were subsequently trained by communication staff. Palekar denounces the injustices of the global food regime and industrial methods, although this is set alongside Hindu nationalist rhetoric (Munster, 2018). The farmers trained by communication staff developed critical thinking as an evolving process through the informal learning spaces embedded in NF groups and networks. Through visiting farms and attending meetings and conferences, they gained an understanding of the ecological, economic, and political impacts of industrial agriculture and rediscovered their roles as knowledgeable decision-makers. To what extent the mechanisms employed by PK3Y successfully raised awareness depended on the opportunities to attend meetings, visit farms, and listen to farmer promoters. Often, champions of NF emerged from the grassroots and had a catalysing influence in motivating others.

8.4. Women's empowerment requires a holistic approach combining many factors

Women's empowerment arises from a combination of processes and mechanisms, all of which are necessary for its potential to be realised. Women's empowerment is not only a rights-based issue, or, as Freire (1999) would describe, a necessary ethical condition, it is also necessary for

agroecology. Agroecology can only be successful as a transformed food system if farmers, including women farmers, are empowered to bring about change. Given the current climate crisis, along with environmental degradation, biodiversity loss, and conflicting agricultural policies, farmers' knowledge, active participation in problem-solving, and innovation are needed now more than ever.

The literature review discussed the multidimensional nature of empowerment and the necessary conditions for women's empowerment to occur (Chapter 2; Chapter 5, section 5.2.2). Cornwall (2017) emphasised the need for change at all levels—personal, social, and institutional—to begin the process of achieving gender equality and women's empowerment. These comprise resources, training, economic opportunities, supportive institutional policies, and a process of change in consciousness (Chapter 2, Section 2.4.2). In the context of a transition to agroecology, all the mechanisms must aim to engage women farmers and simultaneously build and strengthen individual confidence, capacity, and community agency to foster a culture of experimentation and innovation. Agroecology, as a holistic, transformative approach, must be based upon a holistic transformation in women's power.

First, as discussed in the previous section, restoring the epistemic rift repairs the nature/human connection. PK3Y staff began the process of raising consciousness in this respect. They stressed the importance of generating healthy soils, protecting "Mother Earth," and using NF practices to safeguard people's health. Women were motivated by a strong sense of purpose and commitment, ready to use their "power for" to create a new farming system.

Second, discovering traditional knowledge and learning new techniques to make decisions and exercise food sovereignty builds accomplishment and dignity. For example, younger farmers accustomed to working with GR technologies were unaware of legumes' nitrogen-fixing role. Older farmers, on the other hand, recalled intercropping wheat with indigenous peas before monocultures were introduced (Chapter 6, section 6.1). Establishing and expanding ITK encourages independence, creativity, and resourcefulness. Recognising their own specialised expertise reshapes power dynamics (Timmermann and Félix, 2015).

Agroecology also engenders epistemic justice in another way. Local conditions and climatic changes require new solutions that engage cognitive capacities and expand knowledge. Maximising the ecological advantages of the local environment requires individual ingenuity,

utilising traditional and new knowledge, creativity, and innovation. Epistemic justice involves not only respecting the knowledge and contributions of farmers but also ensuring that they are not deprived of the opportunity to develop their knowledge and creativity further.

However, the potential for empowerment lies in effective mechanisms used to develop knowledge about NF practices and accomplish practical tasks, including preparing and resolving challenges as they occur. Enhancing women's understanding of soil regeneration, pest management, and ecosystems is necessary to boost their self-confidence and empower them to uphold their beliefs. This impacts their role as decision-makers in their families and communities. The research showed that ATMA staff's training approaches were inconsistent and lacked participatory techniques and clear explanations using communication tools (Chapter 6). These were, nonetheless, offset partly by the roles played by women communication workers or promoters/Master Trainers. They communicated in local languages and created safe and convivial dialogic spaces for learning.

There was a further need to provide both informal and formal learning opportunities at later stages. Although women farmers had opportunities for peer learning and experimentation via their WhatsApp networks and farm visits, these were often restricted if exposure visits were infrequent or the women did not own smartphones. There was a digital divide where some women farmers were less likely than men to own a smartphone and have digital skills to access the internet. The state should ensure that all women can access learning networks and alternative digital channels to expand peer-to-peer learning opportunities.

It was apparent that where male outmigration was prevalent, women played a greater role in decision-making and led NF transitions. In contrast, when couples farmed together, women who had received training and wanted to use NF on their farms had to either defer to or negotiate with the men. In these situations, it is important to ensure that men also receive training and that the benefits of joint decision-making are highlighted.

8.5. How conflicting State programmes undermine agroecology

Reinstating food sovereignty so that farmers exercise "their right to design their own food and agriculture systems" (Nyéléni, 2007) is implicit in transitioning to an agroecological farming approach. However, the government's pursuit of conflicting agricultural policies driven by

productivist objectives compromises the goal of empowering farmers to manage ecosystems sustainably.

When agriculture is only considered for its economic and financial gains, it excludes concerns about ecological integrity and nature-human relations. This endangers food and nutrition security, autonomy, and strong and mutually supportive local communities. It undermines the value of a poison-free and diverse diet. It neglects the importance of a strong bio-diverse soil structure, which is crucial for retaining moisture, supporting plant life and preventing erosion. The epistemic injustice deprives small family farmers of the learning opportunities essential for managing ecosystems susceptible to climate change.

This argument suggests that agricultural programmes must support ecological conditions and biodiversity, which Himachal Pradesh has yet to achieve. Inconsistent policy positions and competing interests within the State and between departments make it hard for farmers to navigate between increasing crop yields on the one hand and preventing environmental damage on the other. Encouraging the cultivation of cash crops can have detrimental ecological consequences due to increased agrochemical use (Chapter 3, section 3.4). Furthermore, biodiversity and dietary diversity are reduced as land shifts from subsistence to cash crops. Farmers are tempted to grow cash crops, such as tomatoes, which promise high returns, only to find that prices fluctuate widely due to oversupply in the market. This study supports wider literature that finds that more farmers are being caught in a cycle of debt on account of synthetic inputs that degrade their soil and long-term productivity while receiving diminishing returns for their produce. The debt drives them to persist in the cycle and take another risk the following year, hoping for improved returns. This approach appears destined to repeat the errors of the GR, resulting in increased debt, ongoing loss of biodiversity, soil and water pollution and harm to people's health.

The challenge is to increase farmer incomes by diversifying into new crops without losing biodiversity and causing negative ecological impacts. The answer lies in the revival of indigenous crops. Himachal Pradesh has a rich agro-biodiversity in indigenous herbs, vegetables, and cereals, providing a diverse range of nutritious and climate-resilient species. There is significant potential for these to be marketed and popularised among

urban populations due to their nutritional, medicinal, and therapeutic qualities, which have yet to be realised (Chapter 3, section 3.4).

Many of the practices being followed by marginal farmers in Himachal Pradesh were conducive to a transition to natural farming. They were growing diverse crops from indigenous seeds and used farmyard manure. However, many farmers who had started growing cash crops with chemical inputs encountered significant challenges when trying to transition to NF. These challenges included increased workloads and persistent plant diseases that were hard to eliminate. As a result, the expansion of natural farming was impeded, and these difficulties deterred others from adopting NF practices.

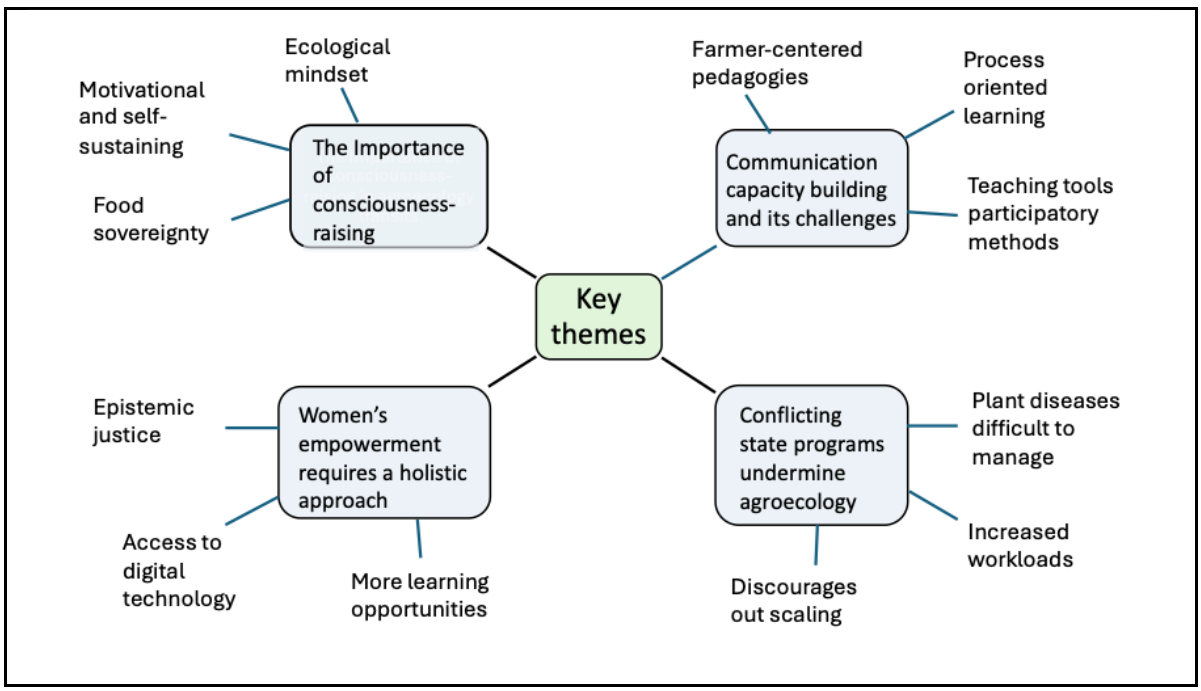

Figure 8: Key themes and related issues

Figure 8 summarises the four themes and related issues. The theme of 'The importance of consciousness-raising' can foster an ecological mindset and promote food sovereignty, which serves as a motivational force for transitioning to sustainable practices. 'Communication capacity building and its challenges' pertains to developing skills and knowledge through process-oriented learning utilising farmer-centred approaches, participatory methods and teaching tools. Analysing the gaps in women's empowerment revealed shortcomings in access

to digital technology and learning opportunities. Addressing these gaps would enhance the potential for change and deliver epistemic justice. In the final chapter, the issues highlighted in this section will be linked to the main findings of this research.

9. Conclusion

9.1. Introduction

This research study set out to examine the methods and mechanisms used to support women in transitioning to NF and how these empowered and benefitted marginal women farmers. This addresses the gap in understanding how transitions to agroecology affect women farmers. The findings make a novel contribution to an emerging area of research that is currently underexplored but essential to delivering agroecology-based empowerment pathways in agriculture for small and marginal women farmers.

The research approach was based on feminist and constructivist principles and a case study of a State initiative to convert its farmers to an agroecological approach. Qualitative methods were employed to explore women's perspectives on the advantages and challenges of transitioning to NF. The use of life story interviews, semi-structured interviews and ethnography enabled a nuanced understanding of their lives, constraints and the power dynamics at home and in the community. The data was collected during fieldwork spanning two years, from November 2021 to December 2023.

This final chapter provides concluding findings on the main research objectives and questions. It highlights the contribution these make to debates and knowledge on how agroecology can empower women farmers and the challenges that the state can encounter when attempting to transition farmers to agroecological farming in an empowering way. It offers reflections on the implications for policy and practice, as well as future research opportunities.

9.2. Main findings

The following three subsections focus on the key findings from Chapters 5 to 7. The first subsection focuses on how the State programme's mechanisms supported women farmers, leading to their empowerment. This is followed by considering whether the communication services engendered a culture of enquiry and innovation. Lastly, the support offered for farmer seed systems and access to traditional seeds is summarised.

9.2.1. What processes or mechanisms did the state employ to support and empower women farmers?

The transition mechanisms used by the PK3Y, a State programme in Himachal Pradesh, were investigated in relation to key empowerment indicators: women farmers' autonomy and decision-making about agricultural production, their leadership roles and economic opportunities (Chapter 5)**.** The transition process began with accessible training for women in villages and the establishment of NF groups and wider networks. Women farmers reported how participation in NF built their confidence and empowered them to take charge of agricultural decisions and their learning and knowledge acquisition. Several factors contributed to women making agricultural decisions. At the outset, women receiving training in NF practices challenged cultural gender norms, which dictate that men attend training and make decisions. Furthermore, making NF formulations and adapting practices to local conditions required creative thinking and experimentation. This process engaged women farmers in new endeavours and facilitated decision-making and problem-solving.

Being part of NF groups allowed women to build "power with". It increased their confidence and enabled them to share experiences, reflect on their lives and work, engage in peer learning, and raise consciousness. It fostered solidarity for a shared cause and strengthened relationships of mutual interdependence and the existing social capital in the villages of Himachal Pradesh.

Opportunities for peer learning were facilitated through membership in wider networks, model farm visits, and attending conferences. These also raised awareness of ecological and health issues and the nature-human connection. This appealed to many women farmers' values and strengthened their resolve to traverse new territories and take greater risks to pursue their choices.

It became apparent that in areas with high male outmigration, women farmers had more autonomy in decision-making regarding agricultural production and farm incomes. This was especially noticeable in cases where farm incomes were supplementary to the primary sources of income. Although the women reported discussing major decisions with their husbands, this did not diminish their autonomy but was part of a cooperative household dynamic. This evidence is contrary to the literature reviewed in Chapter 2, section 2.3 and presents novel findings.

In contrast, at the other end of the spectrum, when men were fully engaged in farming and grew cash crops, traditional gender roles persisted, with men being the primary decision-makers. This limited women to using NF in kitchen gardens, while men continued using CF for cash crops. Some women negotiated with their husbands and in-laws to extend the use of NF on the farm despite facing significant opposition. They endured ridicule and criticism or were only allowed to use NF on degraded land. The ATMA staff played a vital role in ongoing support for trialling NF on farms.

Women who had the opportunity to adopt leadership roles benefited greatly. They could volunteer or be selected as NF group treasurers, secretaries or leaders or become master trainers (MTs). The MTs found that leadership roles built their confidence, widened their social network, expanded their knowledge, and garnered respect from the community. They appreciated the support they received from ATMA staff in developing confidence. Additionally, the MT roles gave them freedom of movement in public spaces as they travelled to other villages to deliver training on their own or in groups. Often, they played a decisive role as champions of NF and in motivating others. The social interactions and recognition nurtured their sense of identity and bolstered their civic capacities and citizenship power. They led the NF groups to undertake community projects or worked collectively to generate income from selling farm produce and homemade food products. The NF groups also acted as saving groups, where the funds became a valuable source of credit for women for personal or community resources.

Economic opportunities increased from the second year of practising NF due to the increased shelf life of vegetables and fruits, improved appearance, and a prolonged fruiting period. PK3Y arranged for sale outlets for marginal farmers. This comprised NF canopies (pop-up stalls) managed by farmers and set up at central locations on particular days of the week. Some farmers used their own or group canopies to sell at community events or in their villages. The outlets and canopies began to be used successfully in populous districts to sell small quantities of crops. They were not used by farmers in districts specialising in cash crops such as apples and tomatoes as these were sold in larger quantities in the *mandis* (wholesale markets).

9.2.2. Did the rural communication services promote a culture of enquiry and innovation?

A culture of enquiry and innovation is crucial to adapting agroecological practices to local conditions and the vagaries of climate change. Participatory and farmer-centred learning modes are essential for developing capacities to think critically, creatively, and experiment (Pimbert 2012; Rosset et al. 2011). A key element of a culture or enquiry and innovation is the co-creation of knowledge, stated as principle 8 of the agroecology principles (HLPE, 2019, p.41): "Enhance co-creation and horizontal sharing of knowledge including local and scientific innovation, especially through farmer-to-farmer exchange".

Although women farmers had greater access to the introductory two-day training, the communication agents' capacities to engage the women through dialogue and participatory approaches were often inadequate (Chapter 6, section 6.5.1). The ATMA staff's training approaches were inconsistent and lacked participatory techniques and clear explanations using communication tools. The lack of visual aids limited understanding and constrained the women farmers' ability to use NF and defend their beliefs in the face of family opposition.

On the other hand, newly trained farmers received hand-holding support from the ATMA staff or the MT, which emboldened them to try NF and deepened their knowledge. Furthermore, the positive collaborative spaces created by forming NF groups engendered a rich communication dynamic for learning and innovation. Additionally, women farmers had peer learning and experimentation opportunities via their WhatsApp networks and farm visits. However, these were often limited if exposure visits were infrequent or the women did not own smartphones.

Further resources and training were needed to build communication agents' capacities in participatory methods and foster experiential learning via farm visits for all farmers. Communication platforms were required to facilitate peer learning and knowledge co-creation.

9.2.3. What mechanisms did the state use to promote the use of and facilitate access to traditional seeds?

Three characterisations of marginal farmers were used to illustrate the rich diversity of crops cultivated. Small and marginal farmers grew between 15 to 35 vegetables, grains, legumes, oilseeds, and fruits. The majority were raised from indigenous seeds. Hybrid seeds were used for cash crops, such as tomatoes and capsicums, and were the primary income source in some

districts. Although ATMA staff encouraged farmers to use and revive TVs for millets and old grains, the seeds were often unavailable, and efforts to supply farmers with seeds were inadequate. The demand for indigenous seeds far exceeded the supply. There was a lack of coordination, and practices varied among districts. In some districts, ATMA staff purchased TVs from farmers to distribute to farmers within that district. In other districts, only certified open-pollinated seeds supplied by the agricultural department were distributed to farmers as and when available. Some ATMA staff, however, continued distributing hybrid seeds to farmers when FYs or open-pollinated seeds were unavailable.

PK3Y had initially attempted to establish seed groups, but few were successful as ATMA staff lacked experience and training in this area. In 2023, the Year of Millets, ATMA distributed millet seed kits and organised community events to publicise the nutritional qualities of millets and showcase foods cooked from millets.

Making NF formulations added approximately two hours per week to women's average 14-hour daily workload. They had several reasons for not seeing this as a burden. They thought it was a fair trade-off for saving costs, and the tasks could be performed at convenient times. The tasks were shared if both the husband and wife had received training. Farmers reported that the spraying schedule was similar to CF, but this varied significantly depending on the cultivated crops. Farmers cultivating cash crops from hybrid seeds or rootstock found that they needed to spray NF pest-control or anti-fungal concoctions more frequently than required by CF, which added to workloads considerably.

The benefits of longer shelf life, enhanced appearance, and extended fruiting periods for vegetables and fruits grown with NF were realized for crops cultivated from both TVs and hybrid seeds. This led to increased incomes. In contrast, cereals grown from hybrid seeds dipped in yield with NF. Most farmers associated hybrid seeds with poor climate resilience, cultural and practical unsuitability, and high use of agrochemicals. They reported that using agrichemicals adversely impacted their health.

Farmers attempting a transition to NF were caught between two conflicting paradigms. On the one hand, the state was encouraging farmers to grow cash crops from hybrid cultivars as part of the industrial agriculture paradigm. These cultivars promised high yields but required expensive agrochemicals and caused environmental damage. In opposition to this, farmers

were being asked to adopt an agroecological approach to counteract the adverse effects of the industrial project.

9.3. Implications for understanding how the transformative potential of agroecology can be realised for women farmers

The case study investigated whether the transition mechanisms supported and empowered women farmers. It sought women's views on whether it increased spaces for decision-making and developed capabilities and autonomy. Few empirical studies from India show how change happens, what benefits are derived, and the critical role of enabling factors in agroecology transitions. This research contributes significantly to the topic and is the first to incorporate the gender dimension.

This research enhances understanding of the synergistic relationship between agroecology and gender equity. This implies that agroecology can only be successful as a transformed food system if farmers, including women farmers, are empowered to bring about change. An empowerment focus includes enabling conditions for agroecology, such as participatory and democratic knowledge landscapes, epistemic justice and seed sovereignty.

The NF initiative was being implemented within a context where agricultural policies were being driven by a productivist agenda that undermined other values detailed in the 13 principles of agroecology (HLPE, 2019). Farmers had been encouraged to grow crops from hybrid seeds. The findings show that farmer experiences in Himachal Pradesh challenge the narrative that hybrid seeds are more disease-resistant than indigenous seeds. The results reinforce the benefits of indigenous seeds; they have cultural and practical advantages and are essential to adapting to climate change and maintaining food security.

Agroecology comprises a set of practices and a social movement aspect, as discussed in Chapter 2. This research offers new insights into the importance of addressing social and epistemic justice for the success of agroecology. It highlights that farmers' ability to adapt practices to local conditions, knowledge, creativity, and innovation is crucial for agroecological success. Therefore, evaluating the effectiveness of state programs should go beyond merely counting the number of farmers trained or supported; it should also assess how well these programs empower farmers to enact change in food systems. The study illustrates that it is indeed

possible to evaluate a state mechanism based on its empowerment of farmers, including women farmers.

The findings provide empirical evidence of how a State programme can promote collaborative learning and knowledge co-creation, involving partnerships between farmers, communication workers, and scientists. Since complex systems require transdisciplinary efforts involving multiple stakeholders and different knowledge systems, collaboration becomes crucial. Analysing results using a communication services framework highlighted essential services, resources, attitudes, and skills needed to strengthen farmer agency and innovation. It highlights specific methodological and organisational processes required to support inclusive and transformative learning. The learning encompasses not only agroecological practices but also raises awareness of ecological imperatives, independence from corporate control and the value of local foods and knowledge.

9.4. Implications for policy and practice

This section summarises the implications of the research findings for policy and practice in India and the worldwide agroecology movement. The State government was following contradictory policies, where work by government departments and agricultural research universities opposed agroecological approaches. For example, agroecology refers to a set of principles rather than prescribing particular practices, as these must be adapted to local conditions. However, the Indian government promotes Subhash Palekar's practices for its nationalistic affiliations. SPNF has been criticised for being restrictive as it is based on indigenous cow dung and urine formulations, which would be difficult to use in regions where indigenous cows are unavailable. Conflicting policies pose tensions that undermine agroecology and disempower farmers. The suggestions listed below would help to mitigate these tensions and provide greater autonomy to farmers.

Agroecology is a complex, multidisciplinary endeavour. Accordingly, multi-stakeholder, transdisciplinary partnerships between CSOs, women's groups, community leaders, technical experts, communication services, the government and academia are needed at the planning stage of any transition program. Workshops should be held to identify strengths, expertise, and training needs and develop a comprehensive plan, implementation procedures and

collaborations. This has been exemplified by the Odisha Millets Mission, launched in 2017 to revive millets in farms (WFP India, 2022; Prasad and Dutta, 2021).

Gender-aware policies must be integrated at all levels of institutional work to change attitudes that perpetuate inequalities. This asks for continued monitoring of activities according to gender; however, from an intersectionality perspective, gender cannot be reduced to a single category, and policy analysis must consider women's needs and experiences, which may be determined by their caste, education, location, and marital and socioeconomic status. There must be a proportionate inclusion of a cross-section of women farmers in consultations, state meetings and exposure visits. Consulting women is essential to understanding their challenges and preferences and strengthening their capabilities and knowledge, particularly in households where gender dynamics play an obstructive role or for single women—for example, consulting single women to understand how they are being marginalised by their communities and the state or how access to training and digital resources can be improved.

Emphasis needs to be paid to single women farmers (unmarried, widowed or divorced) who don't own land or women whose holdings are too small to afford a living. Various options must be considered: single women are prioritised for land distribution; groups farming with leased land with financial and technical support from the state and village councils. The Kudumbashree Mission in Kerala provides a successful group farming model for landless women (Chapter 2, section 2.3.5).

Greater planning should be devoted to training processes. Continuous informal and formal learning programs should be made available to deepen and expand knowledge of integrated agroecological systems. This should include conferences and farm visits supported by online access to knowledge forums, resources, animations, and digital stories based on different crops and issues.

It is paramount that access to biodiversity remains freely available to farmers rather than allowing corporations to enclose and commodify it. Community-led seed systems should be central to climate and biodiversity policies. Reviving seed diversity is not just a matter of autonomy; it is about nutrition security, ecological farm management, and adaptability to diverse growing conditions. It ensures that farmers have the knowledge and timely access to diverse seeds to allow for innovation as required. Public seed research and development must

be redirected to support farmer seed systems. Steps in this direction have been taken by two states – Odisha and West Bengal (Chapter 7).

9.5. Further research

As the research was conducted in a limited time frame, it was not possible to investigate long-term changes for women who had adopted NF enthusiastically and who felt that the approach provided an empowering change in their lives. The questions that need asking are – what the long-term effects were on:

1) Intra-household dynamics;

2) Citizenship roles in the community—did the empowerment enhance farmers' collective ability to influence local government institutions or decisions?

3) Could a community become self-supportive and continue with NF if support from government institutions were to be withdrawn?

Not all women were sufficiently empowered by adopting the NF approach, in order that their lives changed significantly. Analysis of this phenomenon must form part of any future NF initiative. In the case of Himachal Pradesh, inadequacies in training, lack of access to digital technology and related skills, gaps in experiential and peer learning, or intra-household dynamics contributed to this phenomenon. Further research focusing on a particular village would reveal tensions, viewpoints, and challenges within a particular community that constrain or encourage them from adopting NF and the changes that ensue.

One of the constraining factors for outscaling NF was that many farmers had fragmented and distant fields. The extent to which they practised NF on distant plots varied from farmer to farmer and depended on several factors. Further research is needed to investigate farmers' approaches for extending NF to distant plots, their challenges, and potential solutions.

A final word

This case study illustrates how an agroecology transition with a deliberate focus on gender can significantly enhance life outcomes for women farmers. At their most effective, the NF mechanisms produced a positive feedback loop initiated by the work and actions of the women

farmers, which further strengthened their sense of empowerment. A shift to industrial agriculture had alienated women from their traditional farming knowledge and marginalised their roles. As a countermovement, NF restored their right to participate in decision-making, which, coupled with transition mechanisms aligned with agroecology principles, created new possibilities for empowerment.

This research supports the notion that agroecology can only succeed in transforming food systems if farmers, including women farmers, are empowered to drive change. The notion of living in harmony with nature was seen as inspiring farmers with a strong sense of purpose to pursue a sustainable agricultural system. It requires them to reflect upon ideas of well-being and what is valuable, which, in turn, has the potential to drive self-sustaining change.

Transitions from conventional farming to an agroecological approach involve a complex learning process involving policies and procedures that must be continuously evaluated and amended. This study argues that a holistic approach to women's empowerment, including participatory learning pathways and seed sovereignty, is necessary. Finally, consulting women when designing and implementing agroecological transitions is essential for achieving the epistemic and social justice agroecology aims to achieve.

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Appendix A: Ethical Clearance 1

ETHICAL CLEARANCE

School of Agriculture, Policy and Development GRANTED

Form 2. MSc PhD Staff Ethical Clearance Submission Form

PLEASE allow a minimum of 3 weeks for this process.

You must not begin your research until you have obtained consent as evidenced by this form returned from the APD student Office signed and dated. Ethical Clearance cannot be granted retrospectively.

This form can only be used if the application :

- Does not involve participants who are patients or clients of the health or social services
- Does not involve participants whose capacity to give free and informed consent may be impaired within the meaning of the Mental Capacity Act 2005
- Does not involve patients who are 'vulnerable'
- Does not involve any element of risk to the researchers or participants
- Does not involve any participants who have a special relationship to the researchers/investigators

If any of the above apply, please refer to the APD Ethics Chair to decide whether an application can be made through the APD review process or whether the application needs to be referred to the full University Committee.

It is the applicant's responsibility to check for any particular requirements of a funder regarding ethical review. Some funders may require that the application is reviewed by full University Committee and not the devolved School committee.

Full details of the University Research Ethics procedures are available at

http://www.reading.ac.uk/internal/res/ResearchEthics/reas-REethicshomepage.aspx and you are encouraged to access these pages for a fuller understanding. Some helpful advice is available on this link

http://www.reading.ac.uk/internal/res/ResearchEthics/reas-REwhatdoIneedtodo.aspx and the FAQs are particularly relevant.

ALL QUESTIONS MUST BE COMPLETED.

APD Ethical Clearance Application Reference Number : 001691

1. APPLICANT DETAILS:

Main applicant name: Punam Behl

Name of academic supervisor/project investigator: Prof Henny Osbahr

Email Address (decision will be emailed here): p.behl@pgr.reading.ac.uk

MSc Student ☐

PhD Student ☒

Staff Member ☐

Other (please specify) Click here to enter text.

2. PROJECT DETAILS:

Title of project: To assess how agroecology benefits small scale women farmers in India

Please provide a lay summary of the project, including what is being investigated and why:

This research will examine efforts being made by Himachal Pradesh, an Indian state, to transition all farmers to an agroecological farming approach called Zero Budget Natural Farming (ZBNF). ZBNF is a low-cost regenerative agricultural practice based on ecological principles and does not rely on the use of agrochemicals. Agroecology is one of the most promising pathways for pursuing equity within agriculture and food systems especially for marginalised groups such as women. There is a current debate about whether its adoption has the potential to enhance the livelihood resilience of women farmers to climate change, while meeting the goals of conservation of the environment, nutrition and food security. My research will investigate whether the transitions to agroecology result in a strengthening of women farmers' agency and enhance their rights to resources and influence over decision making.

Procedure. Please outline the project's research protocol (what procedures, research methods and analysis methods are being used) :

The research design is grounded in the constructionist paradigm that mostly begins with an open-ended inquiry through research questions. Constructionism accepts the notion that reality is constructed in numerous ways based on social context and that each person has a unique and equally valid interpretation of the world around them. A mixed methods approach will be used, which will include quantitative data from institutional actors, while non-participant observations, focus groups and narrative inquiry will be used to generate accounts of women's perceptions and personal stories.

It is expected that around 40 institutional representatives from NGOs and government will be purposively selected via networking and interviewed using a guided interview tool, while around 60 women farmers will be identified as part of agroecological groups and invited to participate in focus groups. From these a few women farmers will be selected for follow up interviews. These women will be illustrative of the range of women involved in the local projects. A plan of the focus group guided discussion and tools is provided. Informal conversations and observation will also be useful and recorded in a note book. The rich and detailed qualitative data will be analysed using narrative and content analysis through transcribing and qualitative coding, as well as organisation of any quantitative reporting from institutional representatives. As I speak the local language, I will be able to conduct the interviews personally and be able to transcribe or take notes personally. If the interviews or group activities are recorded, permission will be sought by all beforehand. Notes will be taken to support group exercises.

Period over which the data collection is to be undertaken (note: data collection CANNOT commence until ethical approval has been granted as evidenced by this form signed and returned).

Proposed Start Date: 01/11/2021

Proposed End Date: 15 /12/2021

3. THE RESEARCH:

a) **Nature and number of participants** who are expected to take part in your survey/focus group. Please estimate if uncertain. As ethical clearance involving minors is more complex because of safeguarding and consent issues, please consider carefully whether you need to involve minors under the age of 16 in your research.

Participants	Number participating
Minors under 16 years of age	0
Students	0
Other members of the University	0
Members of the general public	0
Businesses	20 members of NGOs
Government officials	20
Other If other please specify:	60 farmers

b) **Funding.** Is the research supported by funding from a research council or other external sources for example a charity or business?

Yes ☒ If yes, please specify funder : UoR PhD studentship No ☐

If yes, it is the responsibility of the applicant to check for any particular requirements of the funder regarding ethical review. Some funders may require that the application is reviewed by full University Committee and not the devolved School committee.

c) **Recruitment.** Please describe recruitment procedures. How have participants been selected? Are there any inclusion/exclusion criteria? Participants must be told on the Participant Information Sheet how and why they have been selected. You should attach ay recruitment materials to this application.

NGO and government representative officials will be pusposively recruited as explained on the information sheet, using networking to identify relevant organisations and leads. This process of networking and seeking of advice through current contacts has already started but during my visit, personal meetings to network will be easier. The recruitment and protocol has been discussed in detail with my supervisors.

Individual farmers will be identified through these networks using the NGO and government officials to introduce me to communities. These communities will be locations where the NGOs and Agricultural Extension support women's self-help group promoting agroecological practices

and there is already an established relationship between the farmers, facilitating an entry point for my data collection. I will be aware of any potential for bias in the selection of communities during this process and will visit a selection before I decide. At this stage of the research, the initial recruitment will be for small focus groups to better understand the dynamics at the potential study locations. Recruitment will include around 5-8 members per group, with effort made to ensure different types of women farmers are representative and given voice (e.g. age, caste, wealth, activities, etc). Non-participants of the ZBNF projects will also be approached for informal interview. I am expecting there to also be lists of members of SHG available via extension and NGO workers, allowing for stratified sampling of women farmers for the interviews, again reflecting different types of farmers (this will be informed by the outcome of the focus group meetings). Engagement with women during recruitment will adhere to University of Reading ethical protocols.

d) **Exceptions.** Does the research involve minors, medical patients, individuals with learning difficulties, vulnerable adults, participants recruited through social service departments, or anyone in a special relationship with yourself/data collectors? E.g. Supervisor; lecturer to a group of students; or person in a position of responsibility for participants.

Yes ☐

No ☒

If yes, this may result in referral to the University Research Ethics Committee (please note their deadlines). Please provide extra detail here: Click here to enter text.

e) **Where is the data collection to be undertaken?** Specify country(ies) and specific location(s)

Data to be collected through email, phone and in person interviews. This approach allows remote data collection and follow ups as well as the development of the in-person activities. These will take place predominantly during the fieldwork visit to the state of Himachal Pradesh, India, from November to December 2021. The location, India, has no restrictions to entries from the UK and for travel to and within state of Himachal Pradesh. As I am fully vaccinated, I will need to observe the following rules upon arrival to the UK, which are currently that I must: 1) Book and pay for a day 2 covid 19 test to be taken after arrival in England, 2) Complete a passenger locator form – anytime in the 48 hours before I arrive in England, 3) Take a Covid-19 test on or

before day 2 after I arrive in England. I will follow FCO guidance, be supported by local contacts in India and maintain contact with my supervisors. I will also complete a risk assessment approval prior to departure. As previously mentioned, I speak the local language and this will also facilitate my awareness of any changes to covid rules, as well as more general aspects of safety and social norms. In addition, all UoR risk and travel paperwork has been completed and comprehensive insurance will be taken. I will maintain in communication with my supervisors during the fieldwork to update them.

f) What forms of data collection does the research involve?

Group discussion/ workshop ☒
Personal interviews ☒
Telephone interviews ☒
Questionnaire/paper survey ☐
Postal survey ☐
Email/ online survey ☐
Which software tool will be used, if any? Click here to enter text.
Other *(specify)*: Click here to enter text.

g) Who will undertake the collection and/or analysis of data?

Myself ☒
Other MSc students ☐
Other Higher degree students ☐
Other contract research and/or academic staff ☐
Individuals outside University ☐
External organisations ☐

If individuals outside the University and/or external organisations are involved in the collection or analysis of data, give brief details below. Indicate how the ethical procedures and standards of the University will be satisfied: Not for this fieldwork visit.

h) Does the research require participants to consume any food products?

No ☒ Yes ☐

If yes, please provide full details and indicate measures in place to ensure excellent food hygiene standards and ensure participant safety. Click here to enter text.

i) Do you consider there are any potential ethical issues in this project? Does the research require collection of information that might be considered sensitive in terms of confidentiality, potential to cause personal upset, etc.?

No ☒ Yes ☐

If yes, please provide full details and indicate how these issues will be addressed, how researchers will manage participant reaction. Support and de-brief sheets should be attached if relevant. Click here to enter text.

j) **Will the research involve any element of intentional deception at any stage**? (i.e. providing false or misleading information about the study, or omitting information)?

No ☒ Yes ☐

If yes, this must be justified here. You should also consider including debriefing materials for participants which outline the nature and justification of the deception used. Click here to enter text.

k) Are participants offered a guarantee of anonymity and/or that the information they supply will remain confidential?

Yes ☒. No ☐

If yes, give brief details of the procedures to be used to ensure this and particularly if the data has 'linked' or 'keyed' anonymity (e.g. where published results are anonymous but participant details are recorded and held separately to the responses but keyed with reference number) : Interviewees from NGO and Extension will be offered anonymity, and their role recorded and a unique code given. Farmers will be given unique codes. All names and contacts will be linked by this unique keyed reference number and stored securely and separately. The participant details will not be used in any published results from the study. Before any data collection, I will explain verbally these details via an information sheet and share the information sheet.

l) **Will participants be required to complete a separate consent form?** Many APD applications do not require participants to complete a separate consent form. Please see the templates provided.

☐ Yes. Names, addresses and copies of completed forms will be given to APD student office

☒ No. The data collection is anonymous and a combined information/consent sheet supplied

☐ Neither of the above, or the research involves participants under the age of 16

If 'neither of the above' selected, or the research involves participants under the age of 16, please outline the specific circumstances. Click here to enter text.

m) Will participants be offered any form of incentive for undertaking the research?

No ☒ Yes ☐

If yes, give brief details, including what will happen to the incentive should the participant later withdraw their input or decide not to proceed : Click here to enter text.

4. DATA PROTECTION

Data Storage, data protection and confidentiality. Please make sure you are familiar with the University of Reading's guidelines for data protection and information security. http://www.reading.ac.uk/internal/imps/

Please outline plans for the handling of data to ensure data protection and confidentiality. Covering the following issues: Will any personal information be stored? How and where will the data be stored? Who will have access to the data? When will it be deleted?

Data will be stored securely on my password locked computer and backed up onto the University servers. All e-recordings will be stored together. Notebooks and exercises will be typed and originals stored in a locked cupboard. All data will be securely destroyed one year after the submission of my thesis in 2024. The data will be only available to myself and where appropriate my supervisors for their guidance with analysis.

Applicants: Please now scroll to Section 7 to input your :

- Information Sheet(s) for Participants (mandatory)
- Data Collection Tools, for example: recruitment materials, interview/focus group protocols (how you are conducting the process), interview/focus group questions, questionnaires, online survey questions, debriefing and fact sheets
- Consent Forms (optional, may not be necessary if consent assumed in Information Sheet)

If the text boxes do not allow input in the desired format, please append documents separately to the email when sending this form.

Please then email your completed form (and any separate supporting documents) to your supervisor/project investigator. Project investigators or independent academics may return form directly to sapdethics@reading.ac.uk

A decision on whether ethical clearance has been granted will be emailed to you via the APD Student Office along with your authorised form.

You may NOT proceed with your data collection until ethical approval has been granted as evidenced by return of this approved form.

Note: The process of obtaining ethical approval does not include an assessment of the scientific merit of the questionnaire. That is the separate responsibility of your supervisor/project investigator in discussion with yourself.

5. Supervisor/project investigator review. Section to be completed by supervisor/PI where relevant.

Participant information sheet(s), data collection tools and any other supporting information may be pasted in section 7 below. Alternatively, they may be attached to this email. Please review these documents and then complete the checklist below.

Checklist. Does this application and supporting documents adequately address the following ?

- ☒ The safety of the researcher(s) and those collecting data, the safety of the participant(s)
- ☒ Is the language /grammar/content appropriate (i.e. University standards and reputation upheld)
- ☒ There are no questions that might reasonably be considered impertinent or likely to cause distress to the participants
- ☒ The researcher has provided the participant information sheet (mandatory)
- ☒ The researcher has provided the questionnaire or survey/ workshop, focus group or interview questions
- ☒ The Participant Information Sheet gives sufficient information for the participants to give their INFORMED consent
- ☐ A separate consent form has been included (optional)

☒ Data will be handled, stored and deleted appropriately according to University guidelines, and the participants have been adequately informed about this in the Participant Information Sheet

☒ The Participant Information Sheet contains all relevant sections

☒ I am satisfied that this application meets the minimum standards for APD Ethical Clearance to be granted

6. APD ethics committee review. Section to be completed by APD Ethics Committee member.

Decision

Clearance refused ☐ Resubmission required

Clearance granted as presented ☐

Clearance granted subject to revisions suggested ☒ No need to resubmit once amended

Referred to APD Research Ethics Chair ☐ May require further information

Ethics Committee Member please enter comments, reasons for rejection, summary of revisions required before proceeding (if applicable):

This is a very thorough REC application. I have a few things for the applicant to take account of, but there is no need to resubmit:

1. Please specify in the Farmer PIS why/how the particular woman farmer was selected to be interviewed. Does this include a reference to the length of time they have been involved in ZBNF?
2. Don't say that you will destroy all your data in 2024 – why would you do that? Yes, it needs to be stored according to the UoR Data Management protocols, but you may be drawing on this data for some years after that, for your publishing, ec.
3. Consider providing a local mobile number (Indian simcard) in the PIS with your contacts, so that you are more accessible to the participants.
4. You should specify a little more clearly how the data will be used: in your thesis, but also in other documents, reports?

5. Do you plan to take photographs? If yes, you need to get separate, individual permission for that.

Committee Member Name: A.Ainslie Date Reviewed : 10/12/2021

APD Ethics Committee member electronic signature (For signature, save document as pdf, then open pdf and use 'sign' option. Alternatively check here if no electronic signature used ☒)

Appendix B: Ethical Clearance 2

School of Agriculture, Policy and Developm

University of Reading

Form 2. MSc PhD Stat

PLEASE allow a minimum of 3 weeks for this process.
You must not begin your research until you have obtained consent as evidenced by this form returned from the APD student Office signed and dated. Ethical Clearance cannot be granted retrospectively.

This form can only be used if the application :

- Does not involve participants who are patients or clients of the health or social services
- Does not involve participants whose capacity to give free and informed consent may be impaired within the meaning of the Mental Capacity Act 2005
- Does not involve patients who are 'vulnerable'
- Does not involve any element of risk to the researchers or participants
- Does not involve any participants who have a special relationship to the researchers/investigators

If any of the above apply, please refer to the APD Ethics Chair to decide whether an application can be made through the APD review process or whether the application needs to be referred to the full University Committee.

It is the applicant's responsibility to check for any particular requirements of a funder regarding ethical review. Some funders may require that the application is reviewed by full University Committee and not the devolved School committee.

Full details of the University Research Ethics procedures are available at http://www.reading.ac.uk/internal/res/ResearchEthics/reas-REethicshomepage.aspx and you are encouraged to access these pages for a fuller understanding. Some helpful advice is available on this link http://www.reading.ac.uk/internal/res/ResearchEthics/reas-REwhatdoIneedtodo.aspx and the FAQs are particularly relevant.

ALL QUESTIONS MUST BE COMPLETED.

APD Ethical Clearance Application Reference Number : 001841

1. **APPLICANT DETAILS:**

Main applicant name:	Punam Behl
Name of academic supervisor/project investigator:	Prof Henny Osbahr
Email Address (decision will be emailed here):	p.behl@pgr.reading.ac.uk
MSc Student	☐
PhD Student	☒
Staff Member	☐
Other (please specify)	Click here to enter text.

1. PROJECT DETAILS:

Title of project: To assess how agroecology benefits small scale women farmers in India

Please provide a lay summary of the project, including what is being investigated and why:

This research will examine efforts being made by Himachal Pradesh, an Indian state, to transition all farmers to an agroecological farming approach called Zero Budget Natural Farming

(ZBNF). ZBNF is a low-cost regenerative agricultural practice based on ecological principles and does not rely on the use of agrochemicals. Agroecology is one of the most promising pathways for pursuing equity within agriculture and food systems especially for marginalised groups such as women. There is a current debate about whether its adoption has the potential to enhance the livelihood resilience of women farmers to climate change, while meeting the goals of conservation of the environment, nutrition and food security. My research will investigate whether the transitions to agroecology result in a strengthening of women farmers' agency and enhance their rights to resources and influence over decision making. My fieldwork began in November 2021 and the first phase was covered by a separate ethical clearance. This will be the 2nd visit to the research location and the activities in this phase relate to this ethical clearance application.

Procedure. Please outline the project's research protocol (what procedures, research methods and analysis methods are being used) :

The research design is grounded in the constructionist paradigm that mostly begins with an open-ended inquiry through research questions. Constructionism accepts the notion that reality is constructed in numerous ways based on social context and that each person has a unique and equally valid interpretation of the world around them. A mixed methods approach will be used, which will include quantitative data from institutional actors, while non-participant observations, focus groups and narrative inquiry will be used to generate accounts of women's perceptions and personal stories.

It is expected that around 20 institutional representatives from NGOs and government will be purposively selected via networking and interviewed using a guided interview tool, while around 30 women farmers will be identified as part of agroecological groups and invited to participate in narrative inquiry. As some farmers may not provide sufficient detail, the ethical clearance application includes up to another 20 farmers. Narrative inquiry is a type of qualitative interviewing suitable for investigating personal perspectives of women's farmers' experiences of how transitions to agroecology have had an impact on their lives. A timeuse mapping activity will also be included. Telling their own stories will enable the women to claim ownership of their narratives and is in harmony with and is integral to research with an empowerment focus. These women will be illustrative of the range of women involved in the

local projects. A plan of the guided discussion and tools is provided. Informal conversations and observation will also be useful and recorded in a note book. The detailed qualitative data will be analysed using narrative and content analysis through transcribing and qualitative coding, as well as organisation of any quantitative reporting from institutional representatives. As I speak the local language, I will be able to conduct the interviews personally and be able to transcribe or take notes personally. If the interviews or group activities are recorded, permission will be sought by all beforehand.

Period over which the data collection is to be undertaken (note: data collection CANNOT commence until ethical approval has been granted as evidenced by this form signed and returned).

Proposed Start Date: 04/05/2022

Proposed End Date: 30/08/2022

3. THE RESEARCH:

a) **Nature and number of participants** who are expected to take part in your survey/focus group. Please estimate if uncertain. As ethical clearance involving minors is more complex because of safeguarding and consent issues, please consider carefully whether you need to involve minors under the age of 16 in your research.

Participants	Number participating
Minors under 16 years of age	0
Students	0
Other members of the University	0
Members of the general public	0
Businesses	10 members of NGOs
Government officials	10
Other If other please specify:	50 farmers

b) **Funding.** Is the research supported by funding from a research council or other external sources for example a charity or business?

Yes ☒ If yes, please specify funder : UoR PhD studentship

No ☐

If yes, it is the responsibility of the applicant to check for any particular requirements of the funder regarding ethical review. Some funders may require that the application is reviewed by full University Committee and not the devolved School committee.

c) **Recruitment.** Please describe recruitment procedures. How have participants been selected? Are there any inclusion/exclusion criteria? Participants must be told on the Participant Information Sheet how and why they have been selected. You should attach ay recruitment materials to this application. NGO and government representative officials will be pusposively consulted as explained on the information sheet, using networks established during the 1st fieldwork visit. Individual women farmers who have been practising ZBNF for at least two years will be identified from each of the categories listed below.

a) Women headed households (where a woman in single or widowed)
b) Women cultivators with male-out migration.
c) Women cultivators where husbands live at home but hold non-farm jobs.
d) Both women and men cultivate the land together.

A sampling strategy to include women farmers from all four categories for in-depth interviews would help to better understand women's challenges, their work burdens and how these are related to farm sizes plus male outmigration. Efforts will be made to ensure different types of women farmers are represented and given voice (e.g. age, caste, wealth, activities, etc). Non-participants of the NF projects will also be approached for informal interviews. Engagement with women during recruitment will adhere to University of Reading ethical protocols.

d) **Exceptions.** Does the research involve minors, medical patients, individuals with learning difficulties, vulnerable adults, participants recruited through social service departments, or anyone in a special relationship with yourself/data collectors? E.g. Supervisor; lecturer to a group of students; or person in a position of responsibility for participants.

Yes ☐

No ☒

If yes, this may result in referral to the University Research Ethics Committee (please note their deadlines). Please provide extra detail here: Click here to enter text.

e) **Where is the data collection to be undertaken?** Specify country(ies) and specific location(s) Data to be collected through email, phone and in person interviews. These will take place during the fieldwork visit to the state of Himachal Pradesh, India, from May to August 2022. The location, India, has no restrictions to entries from the UK and for travel to and within state of Himachal Pradesh. As I am fully vaccinated, I will need to observe the following rules upon arrival to the UK, which are currently that I must: 1) Book and pay for a day 2 covid 19 PCR test to be taken after arrival in England, 2) Complete a passenger locator form – anytime in the 48 hours before I arrive in England. I will follow FCO guidance, be supported by local contacts in India and maintain contact with my supervisors. I will also complete a risk assessment approval prior to departure. As previously mentioned, I speak the local language and this will also facilitate my awareness of any changes to covid rules, as well as more general aspects of safety and social norms.

f) What forms of data collection does the research involve?

Group discussion/ workshop	☐
Personal interviews	☒
Telephone interviews	☒
Questionnaire/paper survey	☐
Postal survey	☐
Email/ online survey	☐

Which software tool will be used, if any? Click here to enter text.

Other *(specify)*: Click here to enter text.

g) Who will undertake the collection and/or analysis of data?

Myself	☒
Other MSc students	☐
Other Higher degree students	☐
Other contract research and/or academic staff	☐
Individuals outside University	☐
External organisations	☐

If individuals outside the University and/or external organisations are involved in the collection or analysis of data, give brief details below. Indicate how the ethical procedures and standards of the University will be satisfied: Not for this fieldwork visit.

h) Does the research require participants to consume any food products?

No ☒ Yes ☐

If yes, please provide full details and indicate measures in place to ensure excellent food hygiene standards and ensure participant safety. Click here to enter text.

i) Do you consider there are any potential ethical issues in this project? Does the research require collection of information that might be considered sensitive in terms of confidentiality, potential to cause personal upset, etc.?

No ☒ Yes ☐

If yes, please provide full details and indicate how these issues will be addressed, how researchers will manage participant reaction. Support and de-brief sheets should be attached if relevant. Click here to enter text.

j) **Will the research involve any element of intentional deception at any stage**? (i.e. providing false or misleading information about the study, or omitting information)?

No ☒ Yes ☐

If yes, this must be justified here. You should also consider including debriefing materials for participants which outline the nature and justification of the deception used. Click here to enter text.

k) Are participants offered a guarantee of anonymity and/or that the information they supply will remain confidential?

Yes ☒ No ☐

If yes, give brief details of the procedures to be used to ensure this and particularly if the data has 'linked' or 'keyed' anonymity (eg. where published results are anonymous but participant details are recorded and held separately to the responses but keyed with reference number) : Interviewees from NGO and Extension will be offered anonymity, and their role recorded and a unique code given. Farmers will be given unique codes. All names and contacts will be linked by this unique keyed reference number and stored securely and separately. The participant details will not be used in any published results from the study. Before any data collection, I will explain verbally in the local language these details via an information sheet and share the information sheet.

l) **Will participants be required to complete a separate consent form?** Many APD applications do not require participants to complete a separate consent form. Please see the templates provided.

☐ Yes. Names, addresses and copies of completed forms will be given to APD student office

☒ No. The data collection is anonymous and a combined information/consent sheet supplied

☐ Neither of the above, or the research involves participants under the age of 16

If 'neither of the above' selected, or the research involves participants under the age of 16, please outline the specific circumstances. Click here to enter text.

m) Will participants be offered any form of incentive for undertaking the research?

No ☒ Yes ☐

If yes, give brief details, including what will happen to the incentive should the participant later withdraw their input or decide not to proceed : Click here to enter text.

4. DATA PROTECTION

Data Storage, data protection and confidentiality. Please make sure you are familiar with the University of

Reading's guidelines for data protection and information security. http://www.reading.ac.uk/internal/imps/

Please outline plans for the handling of data to ensure data protection and confidentiality.

Covering the following issues: Will any personal information be stored? How and where will the data be stored? Who will have access to the data? When will it be deleted?

Data will be stored securely on my password locked computer and backed up onto the University servers. All e-recordings will be stored together and transcribed. After transcription the e-recordings will be deleted. Notebooks and exercises will be typed and originals stored in a locked cupboard. The data will be only available to myself and where appropriate my supervisors for their guidance with analysis. It will not be possible to identify individuals with names from the keyed sheet as codes will be used and these will be used in presenting the data in the thesis. The data will be used for my PhD thesis and publication of research papers and will be securely destroyed after completion of these, by September 2024.

Applicants: Please now scroll to Section 7 to input your :

- Information Sheet(s) for Participants (mandatory)

- Data Collection Tools, for example: recruitment materials, interview/focus group protocols (how you are conducting the process), interview/focus group questions, questionnaires, online survey questions, debriefing and fact sheets
- Consent Forms (optional, may not be necessary if consent assumed in Information Sheet)

If the text boxes do not allow input in the desired format, please append documents separately to the email when sending this form.

Please then email your completed form (and any separate supporting documents) to your supervisor/project investigator.

Project investigators or independent academics may return form directly to sapdethics@reading.ac.uk

A decision on whether ethical clearance has been granted will be emailed to you via the APD Student Office along with your authorised form.

You may NOT proceed with your data collection until ethical approval has been granted as evidenced by return of this approved form.

Note: The process of obtaining ethical approval does not include an assessment of the scientific merit of the questionnaire. That is the separate responsibility of your supervisor/project investigator in discussion with yourself.

5. Supervisor/project investigator review. Section to be completed by supervisor/PI where relevant.

Participant information sheet(s), data collection tools and any other supporting information may be pasted in section 7 below. Alternatively, they may be attached to this email. Please review these documents and then complete the checklist below.

Checklist. Does this application and supporting documents adequately address the following ?

☒ The safety of the researcher(s) and those collecting data, the safety of the participant(s)
☒ Is the language /grammar/content appropriate (i.e. University standards and reputation up
☒ here are no questions that might reasonably be considered impertinent or likely to cause istress to the participants

☒ The researcher has provided the participant information sheet (mandatory)

☒ The researcher has provided the questionnaire or survey/ workshop, focus group or inter
questions

mandatory)

☒ The Participant Information Sheet gives sufficient information for the participants to give th
NFORMED consent

☐ separate consent form has been included (optional)

☒ ata will be handled, stored and deleted appropriately according to University guidelines, ar
The participants have been adequately informed about this in the Participant Information S

☒ The Participant Information Sheet contains all relevant sections

☒ am satisfied that this application meets the minimum standards for APD Ethical Clearance t

granted

6. APD ethics committee review. Section to be completed by APD Ethics Committee member.

Decision

Clearance refused ☐ Resubmission required

Clearance granted as presented ☐

Clearance granted subject to revisions suggested ☒ No need to resubmit once amended

Referred to APD Research Ethics Chair ☐ May require further information

Ethics Committee Member please enter comments, reasons for rejection, summary of revisions required before proceeding (if applicable):

This is a carefully considered REC application. I do have a few pointers that I would like you to address:

1. If your data is securely stored in password-protected files, then it is not required that you destroy it soon after you have completed your doctoral studies. In fact, you might want to revisit it in future, once your doctoral thesis is completed. If you change this point here, then please ensure that the correct information is reflected in the Participant Information Sheets x3.

2. Also, with regard to data management, I think it would be useful to contact Dr. Robert Darby the Research Data Manager at the University, who will have advice about the (a) longer-term storage and (b) accessibility

(or so-called 'Open Access' nature) of your data. His email address is: r.m.darby@reading.ac.uk

3. I would like to see included in the Participant Information Sheets for men and women farmers information on

(a) how/why they in particular were selected and (b) how long the interview will take – I think it could take

60mins + given all the issues you wish to find out about (c) that they can withdraw from the interview until a particular date after which this will not be possible because the data will be aggregated and analysed.

Committee Member Name: A.Ainslie Date Reviewed : 17/05/2022

APD Ethics Committee member electronic signature (For signature, save document as pdf, then open pdf and use 'sign' option. Alternatively check here if no electronic signature used ☒)

Appendix C: Ethical Clearance 3

Appendix to the APD Ethical Clearance Application Reference Number: 001841

I plan to visit India on October 27th to conduct further fieldwork in Himachal Pradesh. This will require more samples to be added to the approved ethical clearance since I was not able to fulfil all the requirements of my sampling strategy during the fieldwork visit in May/June 2022. In addition, other unanticipated factors came to light that require an increase in sample size. I have listed these circumstances below.

1) I had aimed to include farmers from four categories listed below but did not meet women from category (b) and, therefore, my next field trip will target districts where male outmigration is prevalent.

a) Women-headed households (where a woman is single or widowed).

b) Women cultivators with male-out migration.

c) Women cultivators where husbands live at home but hold non-farm jobs.

d) Both women and men cultivate the land together.

2) At the very end of the last field trip, I discovered that the state extension officers in Kullu district were specifically training the husbands of previously trained women farmers to advance the scaling out of natural farming. I now plan to visit the villages involved to interview a sample of both men and women farmers to investigate how this strategy has affected decisions to transition to natural farming

3) I will also visit cereal growing farmers in district Una who have experienced greater success in natural farming than vegetable and fruit growers in other districts. This has an impact on women's workloads.

4) I hope to attend a recently announced farmers' convention on sustainable agriculture during the field trip. This will provide opportunities to speak to several NGOs, officials, and farmers who could provide further information on a few issues related to the state program in natural farming.

5) As part of my research is ethnographic in nature, I find that during my stay in villages I come across community leaders who exercise considerable influence on farmers' uptake of natural farming. I will, therefore, aim to speak to these particular farmers in the villages I visit. I have listed community leaders as a separate category rather than including them in the 'farmer' category. The questions I will ask were included in the questions sheets previously presented.

In the previous two field trips, I received ethical clearance for interviewing 30 NGOs, 30 KIIs, and 110 farmers. Because of the factors listed above, I anticipate that I will need a sample size for an additional 100 farmers for the fieldwork during Nov/Dec 2022. As this will be my final field trip, the number indicates a top estimate to cover emerging information and opportunities to investigate issues in-depth.

I am now requesting for the addition of the following sample sizes:

Farmers – 100
KIIs – 30
NGOs - 20
Village community leaders – 20

Comment from Andrew Ainslie, REC application reviewer:

I am satisfied that what is outlined above will not materially change the very thorough REC application that was submitted earlier by this applicant in relation to this doctoral research. I therefore approve of this appendix and ask the applicant to continue with the same systematic and considered attention to detail.

Signed: A.Ainslie 31 Oct 2022

Appendix D: Question guide for interviewing women farmers

General

1. What is your name?
2. How old are you?
3. How much have you studied?
4. How old were you when you got married?
5. How much land do you own? How much of this land is used for farming?
6. How far are your fields from your house?
7. How many cows do you have?
8. Which kind of cows are these?

Support in the household

9. Who lives in your household?
10. Do you have any children? How old are they? Which year of schooling?
11. Are they able to help with farming?
12. Who else helps with farming or looking after the housework?
13. What does your husband do?
14. If your husband has a job, does he live at home?
15. If he lives away how often does he come home?

Challenges

16. Do you have any problems with either wild animals or stray cows?
17. Do you have irrigation? What kind?
18. How long does it take every day to collect fodder for the cows?
19. Do you have enough biomass for mulching?
20. Are any of the fields scattered in different places or are they all together?

Natural farming

21. When did you start NF?
22. Who did you get training from?

23. What did you like about NF?
24. How did you start using NF and on how much land?
25. What did you husband or other family members think of it?
26. Did anyone else in the family attend NF training?
27. What did you grow and what was the result in the first year?
28. How much of your farm do you use NF on?

Group membership

29. When you started NF, did you join a natural farming group?
30. Did a self-help group already exist in your village? Who set it up?
31. How does the group help you in NF?
32. What is your role in the group?
33. Have you been a member of other groups previously or had leadership roles?
34. Have you visited any other good farmers or met other farmers practising NF?
35. Are you a member of a WhatsApp group? If so, how does it help you?
36. Do all the ladies in your village have smartphones? If not, how many do you think don't have smartphones?

Crops

37. Which crops do you grow for selling?
38. Which are the crops to grow only for your own use?
39. Which crops are cultivated using hybrid seeds?
40. Do you use more pesticides for crops raised from hybrid seeds?
41. Which crops are you growing with NF?
42. Are you able to control crop diseases through NF?
43. Have you started growing any new crops since you started NF?
44. Have you had any problems with NF? Has your workload increased?
45. If your fields are far away, how do you take jeevamrit or ghanjeevamrit to the fields?
46. What crops do you grow on the more distant fields?
47. Do you still use FYM and jeevamrit or have you stopped using FYM?
48. Why do you like NF? How has it helped you in your life so far?
49. What changes would you like to see that would help with NF?

Income and decision-making

50. Do you have any income from selling milk, MNREGA, or other economic activities?
51. Where do you sell your crops?
52. Who gets the income from the sale of the crops?
53. Do you ever go to the *mandi* to sell crops or to collect money?
54. Who makes the decisions about what to grow or sell?
55. Who makes decisions about everyday expenses? Or bigger decisions such as buying a piece of furniture?

Appendix E: Interview guide on seeds

Support for farmer seeds

1) How can government departments support farmers in using indigenous seeds?
2) What is being done to support farmer seed systems in Himachal Pradesh?
3) Which OP vegetable seeds are available for cash crops, e.g., tomatoes, capsicums, cauliflowers, cabbages, French beans and peas?
4) Are efforts being made to find indigenous varieties of cash crops where possible?
5) Is there a central institution which keeps abreast of developments in seed research and information on suppliers of indigenous seeds?
6) What are the main challenges or difficulties that farmers face when they aim to multiply seeds for distribution?
7) Are there any difficulties that need to be overcome if farmers grow indigenous seeds from other parts of the country?

Use of hybrid and open-pollinated seeds

8) How do certified seeds differ from indigenous and open-pollinated (OP) seeds in terms of productivity, resilience and nutrition?
9) What are the advantages of indigenous seeds over hybrid or certified seeds?
10) Are state agricultural departments required to adhere to the Seed Act? What does that entail?
11) Why do farmers change the OP seeds they use after a particular period, such as four years?

Questions for the research director and agricultural university scientist

1) When did the HP agricultural department begin trials on SPNF?

2) Please describe what is being tested and the results.

3) Which kinds of seeds are being used in these trials?

4) Are any attempts being made to compare crops from indigenous seeds to those from hybrid seeds in the NF trials?

5) Are Subhash Palekar's methods being followed as suggested, or have any changes been made?

6) Are farmers involved in the trials? If so, how?

7) What measures are being taken to keep abreast with farmer innovations and challenges?

8) How are researchers working with farmers to resolve challenges?

Appendix F: Focus group activity plan

Forcefield Analysis

A force field analysis will be used as a focus group activity to facilitate participatory discussion. The method is known to stimulate discussion and bring new points to light. It uses a visual framework, allowing the group to reflect on and discuss the forces or the enabling and disabling conditions contributing to the question being posed. The strength of each force is also represented visually, which makes it easier for participants to think about the advantages and disadvantages of each contributing force and voice their opinions. Using objects, such as beans, which are physically positioned on each force depicted, makes the activity interactive and stimulates talk.

Process

1) Introduce myself and explain the purpose of the exercise.

2) Explain the posed question, e.g., "What is helping you to practice natural farming and what is not, i.e., which conditions/forces are making it difficult?"

3) Use a large sheet of paper with a line drawn horizontally across the centre of the sheet.

4) Provide pencils and erasers. Ask the participants to note down enabling forces above the line while disabling forces are stated below the line.

5) Next, ask them to assign weights, such as a number of beans, on each force to depict the strength of each force. Use 1 to 5 beans to show the strength, with 1 bean representing the weakest force. 5 beans above the line would be the most favourable force, while 5 beans below the one would depict the most obstructive force.

7) Check with all the participants to see whether they are satisfied with the forces depicted and their relative strength and whether they would like to make any modifications.

8) Once they are satisfied with the diagram, ask them what changes they would like to see. How could the positive forces be reinforced and disabling forces diminished?

9) Take photographs of the diagram and thank the participants for their time.

Appendix G: Transcription of a Life Story Interview

Appendix H: Summary of focus groups in Phase 1

Date	Village	Practising NF since	No of women met	Audio	Video	Pic	Context	Challenges	Benefits	Quotes/noteworthy
22.11.21	Bxxxx	3 years	14	3	1		S. Transition from Chem to NF, earn extra income from small industries, men work elsewhere. Only one desi cow in village. NF effortful.	Lack of irrigation, wild animals	Group support, health, better yield, lower costs	Collective work with sowing in rows. Selling home-made produce at farmer market. Women not fully transitioning
23.1.21	Mxxxx	2 years	15	1	1	1	C - Transition from Chem to NF, (10 bighas) farms at a distance from one another, men work at home	Stray animal attacks	Group benefits, have few desi seeds	Problems with arranging for solar fencing, irrigation available from stream, Chemicals used only for fodder crops
24.1.21	Kxxxx	Less than 1 year	10	1			S+C Transition from CF to NF, a few men work at home, some hold non-farm jobs.	Stray animal attacks	Still to be seen	Huge problem with stray cattle - abandoned.
24.1.21	B xxxxxx		10			1	Brief visit - Village spread in a valley with stream. Male outmigration. Discussion without activity	Only part of village had access to water from stream		3 women had set up a seedling's nursery Women were decision makers on farms.
25.1.21	B Gxxx	2 yrs	6	1	1	3	S – Rainfed, men hold non-farm jobs	Wild animals, drought	better health, lower costs, higher yields	Nir – trainer – followed NF despite family opposition. Some women resisting transition because of work burdens
26.1.21	Bxxxx	1 yr	10	3	1	1	S+C – Rain fed,	Drought Pest attacks	Yet to be seen	

S – subsistence C - commercial

Date	Village	Practising NF since	No of women met	Audio	Video	Pic	Context	Challenges	Benefits	Quotes/noteworthy
19.11.21	Nxxxx	2 yrs	8	2		2	S – Remote, traditional farming, Men hold non-farm jobs at distance.	Wild animals	Higher yields	strong tradition of working collectively and mutual support, even at waged labour.
20.11.21	Bxxx	3 yrs	10	1	4	1	C – 2 women trained by SP 3 years ago, headed by single woman, men work on farms. Use of poly tunnels, bore wells.	Selling at a fair price for NF produce	Several: higher yields, lower costs	Shk, a leader in her community, is a trainer farmer, experiments, posts videos in her WhatsApp group, holds meetings to plan for a transition to NF.
30.11.21	Koti, Solan	3 yrs	7	1		5	C – grow tomatoes and sweet peppers as cash crops, men farm with women, also work at MNREGA jobs for 3 months/yr	Finding farmer seeds	taste, appearance, healthy food, no animal attacks	An, a trainer farmer, has found a way to deter animal raids through experimenting with her group. Several women trainers.
			Total 100							

Appendix I: Example of time use clock

This was completed by a woman farmer.

Appendix J: Characteristics of Women Participants

Characteristics of 53 women participants interviewed individually

The table shown below includes the following characteristics:

Types of households

1 = women-headed households (where a woman was divorced/separated or widowed) - 8
2 = women cultivators with male-out migration - 8
3 = women cultivators whose husbands mostly lived at home but held non-farm jobs - 25
4 = both women and men cultivate the land together - 12

Caste

Gen = General – 27
SC = Scheduled Castes - recognised in the Constitution as being among the most disadvantaged in the country - 14
OBC = Other Backward Classes – this refers to socially, economically and educationally disadvantaged classes – 12

The scheduled castes (SC) in Himachal Pradesh constitute 25.19% of the total population, and Other Backward Classes (OBC) form 13.52%.

Education

10 = Secondary,
10 + 2 = Upper Secondary

	Name	Age	Caste	Education Year of school/ degree	Household type/ marital status	Children s – son d - daughter	Cows	Land 5 bigha = 1 acre 8 kanal = 1 acre	NF since
District – Kullu									
1	Kan	38	Gen	10 +2	3	1s (10), 1d (12)	2	6 bigha	2019
2	Bee	45	Gen	3	4	2s (24, 26)	2	6 bigha	2019
3	Ush	30	SC	10 +2	3	1d (8), 1s (5)	1	12 bigha	2019
4	Bin	28	SC	MA	3	1s (3), 1d (1)	0	5 bigha	2019
5	Vee	50	SC	4	3	1d (32), 2s (30, 28)	2	5 bigha	2019
6	Mee	36	SC	10	3	5 d	2	4 bigha	2019
7	Ani	46	Gen	10 +2	4	2d (21,27), 1s (25)	2	50 bigha	2018
8	Bim	50	Gen	10	4	2s (28. 30)	2	30 bigha	1 year
9	Gan	54	Gen	8	1 (Wid)	2d (23, 29)	0	garden	2019
10	Ros	43	Gen	10	3	1d (9), 1s (16)	1	3 bigha	2019
11	Ayo	42	Gen	10	4	1d, 1s	2	5 bigha	2020
12	Pro	40	Gen	10	4	1d (15), 1s (17)	4	38 bigha	2019
13	Aru	42	Gen	10	3	2 ds (15, 17)	4	5 bigha	2018
14	Vim	42	Gen	10	3	1d (17), 1s (21)	1	5 bigha	2019
15	Rad	44	Gen	8	3	1d, 1s	5	6 bigha	2019
16	Ash	45	Gen	10	1 (Wid)	!s (18) 2d (15, 22)	1	5 bigha	2020
District – Mandi									
17	Tar	40	Gen	BA	3	1d (21), 1s (19)	0	25 bigha	2018
18	Lal	43	Gen	10	3	2s (12, 14)	2	4 bigha	2018
19	Kus	36	SC	10	3	1d (10), 1s (13)	1	4 bigha	2019
20	Dra	38	SC	10 +2	3	1d (13), 1s (15)	1	3 bigha	2018
21	Pad	60	SC	5	3	3 ch - adults	2	4 bigha	2018
District – Shimla									
22	Sha	52	Gen	8	1 (Wid)	2 s – adults	2	15 bigha	2019
23	Ree	39	Gen	5	3	1d, 1s	1	5 bigha	N/A
24	Mee	43	Gen	8	4	2 s (25, 27)	6 + 2 bulls	20 bigha	2019
25	Khi	40	Gen	10	3	2 s (21, 24)	1	5 bigha	2019
26	Gee	45	Gen	10	3	2d , 1s	2 + 2 bulls	11 bigha	2020
District – Solan									
27	Ush	46	Gen	10	4	2	5	25 bigha	Apr 2021
28	Rad	40	SC	10+2	3	1d (14), 1s (12)	1	6 bigha	2019
29	Bha	42	SC	10	3	2s (17, 19)	1	12 bigha	2019
30	Res	52	SC	5	3	1s (30)	2	4 bigha	3018
31	Ani	45	SC	10	3	1d, 1s	2 buff	5 bigha	2018
32	Kan	44	SC	10	1 (Wid)	2 s (21, 24)	1	5 bigha	2020
33	Shi	56	Gen	5	1 (Wid)		2	5 bigha	N/A

34	Van	65	Gen	5	1 (Wid)	3d, 2s	2	60 bigha	N/A
35	Nee	36	SC	BA	1 (separated, living with parents)			0	2019
District – Kangra									
36	Por	45	OBC	10	2	1d (20), 1s (22)	1	7 kanal	2019
37	Vee	59	Gen	10	4	2 married ds	2	15 kanal	2018
38	Ris	34	OBC	10 + 2	3	1d, 1s	2	6 kanal	2019
39	Sar	40	Gen	10	2	1 son (17)	2	6 kanal	2018
44	Cha	34	OBC	10 +2	2	1 d (14), 1s (12)	2	10 kanal	2019
41	Nee	37	Gen	10	4	!s (10), 1d (12)	4	42 kanal	2020
42	Kam	47	OBC	10	2	2s (25, 28)	1	7 kanal	2021
43	Mad	47	OBC	LLB	2	1 d (21)	2	6 kanal	2020
44	Bab	43	OBC	10 +2	3	1d, 2s (17, 23)	2	5 kanal	2019
45	Man	35	OBC	10	2	1d (12), 1s (15)	1	6 kanal	2019
46	Son	40	OBC	10	1 (divorced, living with parents)			0	2019
47	Bab	30	OBC	BA	2	1s (3) + 1d (9)	1	16 kanal	2021
48	Sas	40	SC	10	3	1d, 1s	2	10 kanal	2019
49	Sar	45	Gen	10	4	1s (25), 2d (20)	2 + 2 buff	6 kanal	2021
50	See	47	OBC	5	3	0	2	8 Kanal	2021
51	Shr	43	OBC	10	2	2d (20, 22), 1s (18)	2	8 kanal	2019
52	Mee	49	Gen	10	4	1d (24)	3	37 Kanal	2019
53	Mee	64	OBC	8	4	1d (34), 1s (39)	1	6 kanal	2019