TECHNICAL REPORT

Exploring Gender Responsive Agricultural Technology in Jumla and Bajura Districts of Nepal

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Published by
International Centre for
Integrated Mountain Development (ICIMOD)
GPO Box 3226, Kathmandu, Nepal

United Nations Development Programme
UN House, Pulchowk, Lalitpur
GPO Box 107, Kathmandu, Nepal

ISBN 978-92-9115-784-6 (electronic)

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Citation
Tiwari, S., Hamal, P., Bhatta, K., & Thapa Magar, S. (2026). *Exploring gender-responsive agricultural technology in Jumla and Bajura districts of Nepal* (Technical Report). International Centre for Integrated Mountain Development (ICIMOD) and United Nations Development Programme (UNDP). https://doi.org/10.53055/ICIMOD.1105

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Exploring Gender Responsive Agricultural Technology in Jumla and Bajura Districts of Nepal

Authors

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Acknowledgment

The report was commissioned by the Renewable Energy for Resilient Agri-Food Systems (RERAS) project, a joint initiative of the Government of Nepal and UNDP funded by the Royal Norwegian Embassy.

RERAS is working to increase food and nutrition security in 20 municipalities across Sudurpashchim, Karnali, Madesh and Bagmati provinces of Nepal. RERAS is contributing to SDG 2: Zero Hunger and SDG 7: Affordable and Clean Energy, in Nepal's most vulnerable regions.

The project aims to increase food and nutrition security by enhancing agricultural productivity by leveraging affordable energy solutions, empowering local farmers through modern technology, and partnering with government bodies and national organizations. The strength of RERAS lies in its diverse partnerships, bringing together expertise in climate resilient agriculture, off-grid renewable energy, home-grown school feeding and community empowerment.

On behalf of the Director General of ICIMOD and Resident Representative of UNDP we extend our sincere gratitude to the experts and organizations for their valuable intellectual contributions. Our special thanks are due to the authors, reviewers, and editors who made this report possible.

Foreword

Nepal's mountain communities have witnessed a profound feminisation of agricultural activities, driven significantly by the out-migration of men seeking overseas employment. This demographic shift has placed the dual burdens of farm and household management on women, intensifying their drudgery. The challenges are particularly acute in climate-vulnerable mountain districts like Jumla and Bajura, where declining productivity and rising food insecurity threaten community resilience. In this context, promoting improved access to gender-responsive agricultural technologies is not merely beneficial but crucial for alleviating women's workloads, increasing agricultural production and strengthening food security.

This report "Exploring Gender Responsive Agricultural Technology in Jumla and Bajura Districts of Nepal", delves into these pressing issues. It employs a robust methodology to conduct comprehensive gender analysis and investigate potential agricultural technologies and practices that address needs and constraints specific to women farmers in these districts. The study explores on the gender roles, responsibilities, and decision-making in the agricultural sector, critically examines the specific barriers women face in adopting technology, assesses existing agricultural technologies for their effectiveness and efficiency, prioritises technologies under gender-responsive criteria, and presents a technology action plan. By grounding its analysis in the unique context of Jumla and Bajura, the findings culminate in a set of practical and scalable recommendations for equitable, context-specific agricultural technologies and interventions aimed at promoting productivity, inclusivity and climate resilience.

The significance of this work lies in its detailed gender analysis and technology assessment, which establish a critical methodological foundation for the Renewable Energy for Resilient Agri-Food Systems (RERAS) project. The findings are designed to guide the prioritization and plan for RERAS's future interventions, ensuring investments are informed by a nuanced understanding of social contexts. This approach is vital for developing sustainable and equitable agricultural practices, empowering all farmers to build more productive and resilient livelihoods in Nepal's most vulnerable regions. The findings and recommendations in this report will serve as a valuable resource for policymakers, practitioners, and development partners in understanding the gender dynamics and advancing gender responsive agricultural technologies in Jumla and Bajura districts.

As we continue our journey towards a greener, more inclusive and resilient future, we hope this report will inspire deepened collaboration and concerted actions. We are grateful to the Government of Nepal, the Royal Norwegian Embassy in Kathmandu, the research team, local partners, and the communities of Jumla and Bajura for their essential knowledge, valuable contribution and participation.

Pema Gyamtsho, PhD
Director General
ICIMOD

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Contents

Executive summary

This study outlines the results of an exploration into the implementation of gender-responsive agricultural technologies in Jumla and Bajura districts of Nepal. It identifies gender disparities in the agrarian sector by evaluating the uptake of technologies and their potential effects on women's drudgery, productivity, and accessibility. The study also delves into the obstacles that prevent women from engaging fully in agricultural innovation and presents practical suggestions to foster a more enabling environment for inclusive agricultural advancement.

Key findings

Women are disproportionately burdened with unpaid domestic and caregiving duties, which restrict their engagement in labour-intensive agricultural practices and the adoption of new technologies. While women's participation in community initiatives is on the rise, this often results in an increased workload without a corresponding improvement in gender dynamics within the household.

In comparison to men, women experience low access to land, agricultural services, and technology. While there have been advancements in certain aspects, including the involvement of women in training and capacity-building initiatives, significant gender gaps continue to exist regarding access to essential resources such as land, financial services and mechanised technologies. Major household decision-making continues to be predominantly influenced by men, who primarily oversee financial matters, technology acquisitions, and significant agricultural choices.

Based on a technology needs assessment across multiple on-farm stages of agricultural production, several municipalities require varied technologies to enhance efficiency and output. For land preparation, mini tillers and improved spades are needed to reduce labour and strain, with adoption potential ranging from moderate to high. During production, plastic tunnels, high-tech and improved nurseries may boost yields and seedling quality, showing high to moderate adoption potential. Sowing technologies like jab planters and rice transplanters helps labour and time savings, though transplanters have low adoption potential. Irrigation systems including canal, lift, and drip are highly adoptable for reliable water supply and efficiency. Weeding, harvesting, and post-harvest stages require manual machines, improved sickles, shellers, pickers, and storage solutions like cold storage and solar dryers, mostly with high adoption potential. Value addition through processing machines and transportation via Krishi ambulances also show high potential to reduce losses and add value. However, the wider adoption of technologies such as drip irrigation, mini-tillers, and enhanced cookstoves faces challenges due to significant initial high costs, restricted access to credit, and insufficient gender-sensitive extension services. In addition, pre-existing socio-cultural norms, inadequate technical skills, financial constraints, and inadequate infrastructure restrict women's ability to fully leverage agricultural technologies.

Recommendations

Establishing local demonstration and Learning Centres: Local governments are encouraged to create community-based demonstration centres to enhance the usability and adoption of gender-responsive technologies. These centres may implement gender-responsive agricultural technologies, engage both male and female farmers in the evaluation and feedback process, and offer practical training that accommodates varying levels of literacy and skill.

Address socio-cultural barriers through community involvement: Authorities at the local level, non-governmental organizations, and community-based organizations may adopt inclusive strategies to tackle traditional gender norms. The strategies may incorporate campaigns aimed at raising awareness of gender equal opportunity, initiatives focusing on engaging men, and the incorporation of gender sensitivity into training for agricultural extension services.

Enhance financial accessibility for women farmers: To improve women's access to finance, stakeholders may create rotating funds and microcredit initiatives that impose minimal or no collateral demands. Simplified application procedures for subsidies, along with increased financial literacy initiatives might support and empower women to more effectively access and manage the necessary funds for adopting agricultural technology.

Implement practical and targeted capacity building initiatives: The study findings encourage municipalities and other local authorities to conduct gender-disaggregated skills evaluations to identify capacity gap and develop targeted training programmes. These programmes may concentrate on enhancing technical skills, leadership qualities, and decision-making capabilities to empower women and increase their involvement in agriculture.

The application of the suggested strategies may foster a more inclusive and sustainable agricultural practice that serves the interests of all community farmers, with particular emphasis on women.

List of abbreviations

AEPC	Alternative Energy Promotion Centre
AM	Ante-Meridiem
CBO	Community-Based Organization
CBS	Central Bureau of Statistics
CRA	Climate Resilient Agriculture
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
GDP	Gross Domestic Product
GIFT	Generating Income to Foster Transformation
GIZ	The Deutsche Gesellschaft für Internationale Zusammenarbeit
GoN	Government of Nepal
GRTs	Gender-Responsive Technologies
HH	Household
IFAD	International Fund for Agricultural Development
INGO	International Non-Governmental Organization
IPM	Integrated Pest Management
KII	Key Informant Interview
KIRDARC	Karnali Integrated Rural Development and Research Centre
LI-BIRD	Local Initiatives for Biodiversity, Research and Development
LRP	Local Resource Person
MoALD	Ministry of Agriculture and Livestock Development
NARC	Nepal Agricultural Research Council
NGO	Non-Governmental Organization
PMAMP	Prime Minister Agriculture Modernization Project
RM	Rural Municipality
SWOT	Strengths, Weaknesses, Opportunities, and Threats

CHAPTER I

Introduction

1.1 Background

1.1.1 Socio-economic significance of agriculture in Nepal

Agriculture is a major contributing sector to Nepal's national economy, employment, and food security. Approximately 66% of the country's population is engaged in agriculture, of which two-thirds rely on subsistence farming (CBS, 2021; Mishra, 2023). Notwithstanding its importance, agriculture accounts for merely 23.95% of Nepal's Gross Domestic Product (GDP) (Mishra, 2023), underscoring ongoing productivity issues. These issues are exacerbated by structural constraints, including fragmented landholdings, insufficient mechanisation, and restricted access to financial and technical resources.

1.1.2 Climate change and agricultural vulnerability

The agricultural sector in Nepal confronts escalating threats from climate variability, especially in mountainous areas, where unpredictable weather patterns, extended droughts, and atypical rainfall have resulted in diminishing yields and heightened livelihood insecurities (Chaudhary & Maharjan, 2023). The reliance on rain-fed agricultural systems intensifies vulnerabilities, as rural communities struggle to adjust to climate-induced disruptions. These challenges disproportionately affect disadvantaged groups, particularly women, who often have reduced adaptive capacity due to limited access to land, financial resources, and agricultural extension services (Bryan et al., 2024). The intersection of climate change and gender inequalities highlights the pressing need for targeted initiatives that strengthen agricultural resilience and promote equality and social justice.

1.1.3 The feminisation of agriculture – emerging trends and challenges

In the last few decades, Nepal has observed a notable rise in the feminisation of agricultural activities, largely influenced by the out-migration of men seeking employment opportunities overseas. The demographic shifts have resulted in women taking on increased roles in the management of farms as well as in making household decisions (Maharjan, 2010; Joshi Rajkarnikar, 2020). Regardless of their significant contributions, women continue to face difficulties regarding land ownership, access to credit, agricultural technologies and involvement in agricultural decision-making processes (Tamang, 2014; Rijal, 2017). Across the country, 34.4% of women own agricultural land, with considerable disparities among provinces, Gandaki province has the highest number of women landowners, while Karnali province has the lowest (CBS, 2021). In addition, the lack of gender-sensitive policies significantly limits women's capacity to embrace innovative agricultural technologies and enhance farm productivity (FAO, 2023). Agricultural technology in this study refers to the agriculture practices, climate resilient agriculture solutions, machineries and extension services.

The inadequate consideration of gender dynamics and tailored strategies to address gender needs in agricultural policies and institutional structures significantly hinders women's opportunity and capacity to embrace modern agricultural technologies, which have the potential to enhance productivity, reduce drudgery and alleviate labour demands. Their limited access to essential agricultural resources, including mechanisation, training, and technology, limits their ability to improve farm productivity and respond to climate change effectively. The persistent exclusion of women from agriculture, despite their crucial contributions, necessitates focused strategies that focus on women's needs for access to agricultural technologies, reduce gender inequalities, and address wider systemic challenges present in the sector.

1.1.4 Bridging the gender gap with agricultural innovations

Gender-responsive technologies are technologies based on needs and interest of both men and women farmers, technologies that reduce time and labour for women farmers, and technologies that are accessible and affordable to both men and women (Nelson & Huyer, 2016). Gender-responsive agricultural technologies help improve labour-intensive agriculture methods, enhance the efficiency of agricultural practices, and increase productivity. These technologies cater to the requirements of farmers of all genders and social groups, tackling specific challenges such as the unequal labour demands faced by women and the limited availability of climate-resilient agricultural practices. Nonetheless, various obstacles to the adoption of such technologies remain, such as high costs to operate them, socio-cultural practices, restricted access to training, and insufficient financial resources (Aduwo et al., 2017; Tufa et al., 2022).

Moreover, men's domination in agricultural decision making typically reduces women's opportunities to engage in and benefit from technological advancements (Gaya et al., 2017). Therefore, ensuring equitable access to agricultural technologies calls for technological developments and deliberate governmental actions to address the social and financial challenges faced by women working in the agricultural field. Furthermore, crucial steps to overcome these challenges help ensure that women fully benefit from agricultural developments and improve their skills through training and financial resource availability.

1.2 Rationale

The intersection of gender, climate change, and agriculture has received increasing attention in recent years, particularly within academic discourse and policy frameworks. Gender-responsive agricultural technologies are now recognised as essential for addressing the specific challenges faced by rural populations, especially women. The value of these technologies lies in their potential to overcome labour constraints, facilitate access to resources, and enhance agricultural productivity, while also addressing gender inequalities within the agricultural sector (Mann,

FIGURE 1 ELECTRIC MOTOR WATER PUMP THAT REDUCES FARMER'S WORKLOAD WHILE INCREASING ACCESS TO IRRIGATION

2010; Khatri-Chhetri et al., 2020; Huyer et al., 2021; and Thakur, 2023). In rural areas, women often make the largest contribution to food production: however, they face distinct barriers in adopting these technologies, including limited access to land ownership, credit, and training opportunities.

In Nepal, national policies like the Agricultural Mechanisation Promotion Policy (2014) aim to advance technologies that are responsive to gender issues, ease the burdens of women's labour, foster the involvement of youth and women in mechanised agriculture, and improve agricultural productivity (MoALD, 2014). Nevertheless, although these policies establish a comprehensive framework, their execution is often uneven, and the unique challenges faced in local contexts, particularly in the remote, high-altitude districts like Jumla and Bajura are not adequately addressed. In these districts, vulnerabilities stemming from climate change, inadequate infrastructure, and socio-economic limitations, including deeply rooted gender norms, significantly shape the agricultural landscape and affect the adoption of technology.

A significant deficiency in the existing literature and policy frameworks is the absence of assessments that specifically assess technology needs through a gender-responsive lens at the site level. Although policies at the national level offer broad frameworks, they do not adequately address the specific technological requirements for each region. This is particularly evident in high-altitude regions, where the distinct challenges of climate change, including unpredictable weather patterns and insufficient agricultural infrastructure, intensify pre-existing vulnerabilities. Furthermore, the socio-economic landscape at the regional level characterised by fragmented land ownership, patterns of out-migration, and restricted access to training and resources for women significantly limits women's capacity to interact with and gain advantages from agricultural technologies. The prevalence of these factors reduces the effectiveness of broad policy recommendations, underscoring the importance of conducting research that is tailored to specific local contexts.

Additionally, assessments at the national level have failed to consider gender-specific aspects of agricultural technology adoption within these districts. The absence of focused investigation indicates that regional policies and initiatives may not adequately address the unique requirements and possibilities for women farmers in regions like Jumla and Bajura, where women frequently oversee agricultural tasks yet encounter several obstacles in accessing and employing contemporary farming technologies. The lack of customised evaluations restricts the efficacy of national strategies at the community level, obstructing the development of genuinely inclusive agricultural frameworks.

This study seeks to address these gaps through a comprehensive assessment of the needs related to agricultural technologies in Jumla and Bajura, with a focus on gender responsiveness. This need assessment seeks to shed light on the unique challenges and opportunities encountered by women farmers in these regions, thereby informing the creation of more inclusive and context-specific policies and interventions. The results will contribute to the development of sustainable and gender-equitable agricultural practices, improve productivity, and bolster the resilience of rural communities against the effects of climate change.

1.3 Objectives

The overall objective of this study is to identify gender-responsive agricultural technologies and practices that address needs and constraints specific to women in Jumla and Bajura districts. The specific objectives are as follows:

1. To investigate the dynamics of gender roles and responsibilities in the agriculture sector by exploring the distribution of labour, availability of resources, and involvement in decision making in Jumla and Bajura;
2. To evaluate existing agricultural technologies and practices in Jumla and Bajura, emphasising their effectiveness and efficiency in addressing the technology needs of both female and male farmers; and
3. To evaluate and rank agricultural technologies that are responsive to gender issues by employing criteria that directly tackle gender-related challenges and suggest technologies tailored to the specific agricultural context of these districts.

CHAPTER II

Methods and Methodology

2.1 Study area

Both, Bajura district in Sudurpaschim Province and Jumla district in Karnali Province have complex geological formations and difficult mountainous terrain. As most people in both districts rely on subsistence farming, the unique topographical features play a crucial role in shaping agricultural methods. Although these areas are of great importance, they are particularly vulnerable to the adverse impacts of climate change, notably declining agricultural productivity and rising food insecurity (Regmi et al., 2023). Unpredictable extreme weather events, prolonged droughts, and erratic rainfall have increased the challenges associated with conventional farming methods and forced the districts to reduce the production and productivity as well as alter the agricultural practices.

Both provinces' unique agroecological attributes allow native crop types to flourish, which is necessary to preserve agro-biodiversity and guarantee local food security. Nevertheless, the consequences of climate change intensify already existing vulnerabilities; the lack of agricultural resources disproportionately impacts women, who bear the main obligations for both reproductive and productive labour in the agricultural context. The phenomenon of male outmigration has aggravated this issue by increasing the responsibilities of women in running farms, making decisions, and handling household chores.

These struggles underscore the urgent need for innovative, gender-responsive agricultural technologies capable of enhancing the current state of feminisation in agriculture by alleviating gendered labour, boosting output, and promoting sustainable farming practices.

2.1.1 Demographics and agricultural context

According to the Central Bureau of Statistics (CBS, 2021), Jumla covers an area of 2,531 square kilometres with a population of 118,349, of which 50.05% are male and 49.95% are female. Bajura, with an area of 2,188 square kilometres, has a population of 138,523, with 48.42% male and 51.58% female. The demographic shifts led by increasing male outmigration for better employment opportunities has added the responsibilities of women.

While Bajura has a significant presence of Biswokarma (Dalit) populations, the majority of inhabitants are Chhetri. Jumla has a noteworthy concentration of Chhetri as well as some Hill-Brahmin groups. Understanding access to agricultural resources and the dynamics of decision-making processes requires awareness of the ethnic makeup of the area and related socio-cultural practices. This is especially true as underprivileged populations usually face additional challenges related to land ownership, access to finance, and limited social capital.

The availability of agricultural land differs across the two districts. About 53% of the land in Jumla is suitable for agriculture, according to the United Nations Information Centre (UNIC, 2013), which indicates a significantly higher farming potential than in Bajura, where less than 10% of the land is farmed and only 20% receives annual irrigation (UNIC, 2013). This absence of appropriate infrastructure for an adequate irrigation system in Bajura leads to insufficient agricultural productivity, while the burden on women is greater as they are left having to manually irrigate fields and fetch water due to male out-migration.

FIGURE 2 **MAP OF BAJURA DISTRICT**

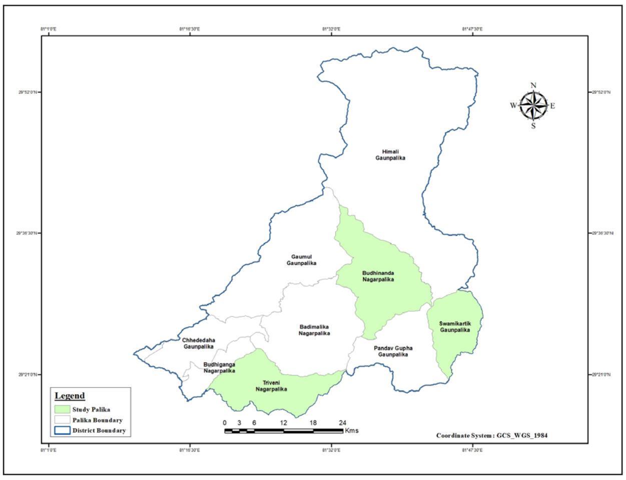
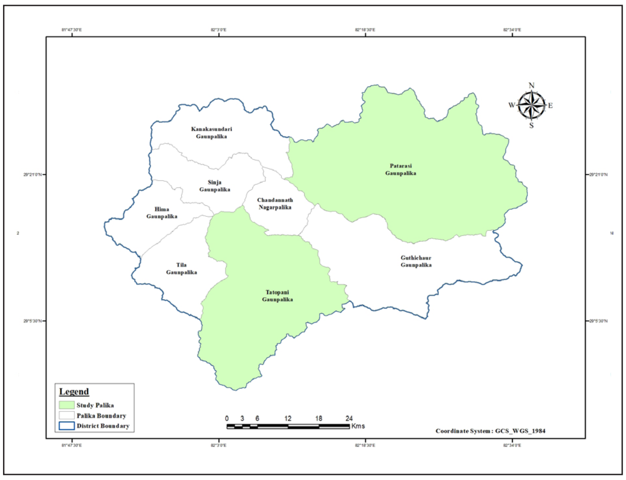


FIGURE 3 **MAP OF JUMLA DISTRICT**



Therefore, this study assesses five municipalities- three from Bajura (Budhinanda, Swamikartik, and Triveni) and two from Jumla (Tatopani and Patarasi) chosen based on their susceptibility to climate impacts, such as extreme weather patterns and droughts, which negatively impact agricultural productivity. Furthermore, these areas have high rates of outmigration of men, which has left women predominantly responsible for farming and household tasks. These factors make these municipalities ideal sites for assessing gender-responsive agricultural technologies that can address the specific needs of women farmers.

By focusing on these municipalities for an agricultural technology need assessment, this study will allow for the development of agricultural technology design that is context-specific and has the potential to improve climate resilience, gender disparities in agriculture, and sustainable food security. The result of this study is expected to contribute to gender-responsive agricultural interventions tailored to the unique agricultural contexts of Jumla and Bajura.

2.2 Methodological framework

The methodological framework of this study is grounded in a gender-responsive approach, in which each stage of the evaluation considers both gender-specific issues and the differing impacts of agricultural technologies on female and male farmers. Groot's (2018) *Guidance for a Gender-Responsive Technology Needs Assessment*, a recognised methodology offering detailed guidance on integrating gender analysis into technological assessments, is adopted within this methodological framework. It is meticulously designed to ensure a comprehensive understanding and effective consideration of gender dynamics in agriculture, including aspects such as the division of labour, access to resources, and decision-making processes.

Groot's (2018) methodological framework was specifically chosen for its comprehensive approach to assessing gender-specific needs in agricultural technologies. It allows for a systematic examination of the gendered dynamics within agricultural practices. This framework emphasises the need for inclusive processes during agricultural technology identification and prioritisation while centring users' (farmers') voices. The need to include gender issues in the evaluation process is emphasised, which fits well with the objective of this study that is to identify how technologies can be designed and utilised in a way that better address gender differences and needs.

To complement Groot's (2018) methodological framework, this study also follows the technology prioritisation technique of Joshi et al. (2016). This approach makes it easier to judge technologies based on gender-specific factors, such as how much manual labour they can replace, how much they cost, and how easy it is to access them. By looking at the specific problems of both male and female farmers, it is hoped that the technologies being implemented will meet the standards for effectiveness in promoting gender-responsiveness through the use of agricultural technology.

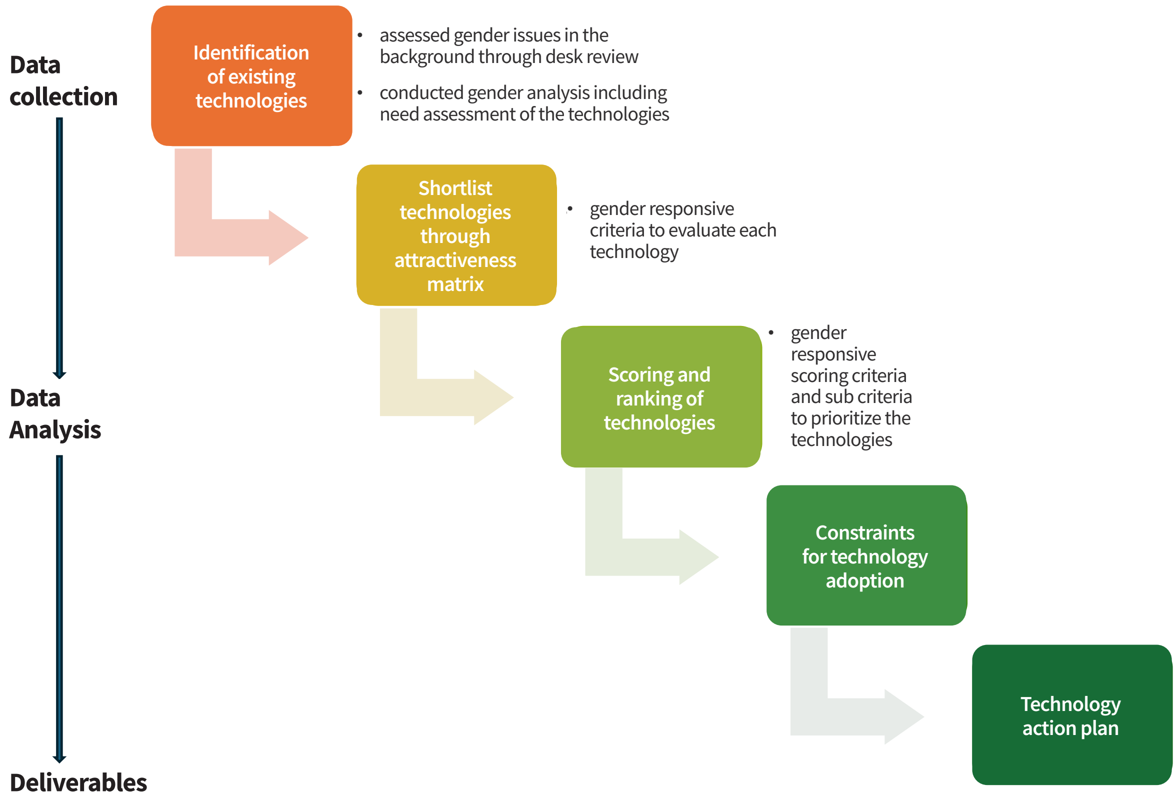
Merging these two models provides a robust methodological foundation to assess Jumla and Bajura districts' technological demands through a gender lense. The study starts with analysing gender dynamics in agriculture in these districts, focusing on the distribution of labour, availability of resources, and involvement in decision-making processes that differentiate the roles of male and female farmers. This will help reveal gender differences in farming methods that need attention through creative technologies.

The gender analysis utilises a multifaceted approach, integrating frameworks such as Moser's Gender Planning Framework (Moser, 1993) and Longwe's Women's Empowerment Framework, to examine the structural and relational obstacles affecting elements that influence women's access to agricultural resources, technologies, and decision-making power (Leder-Büttner, 2016). Moser's paradigm helps to highlight women's triple roles i.e. productive, reproductive, and community roles and to evaluate how development projects handle practical versus strategic gender requirements. In addition to this, Longwe's theory offers a hierarchical perspective which is vital for assessing women's empowerment progress. These approaches allow for an extensive examination of gender disparities in agriculture while tailoring technological interventions to meet the distinct needs of both male and female farmers.

The prioritisation of technologies is guided by the Attractiveness matrix and Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis, selected for their efficacy in assessing technologies with a focus on gender-responsive criteria and practical feasibility. The Attractiveness matrix assesses technologies based on two primary criteria: their ability to reduce the drudgery and their cost-effectiveness. The selection of these criteria is grounded in their significant relevance to tackling gender-specific challenges especially in labour-intensive agricultural activities, encountered by women farmers in the areas studied.

After the application of the Attractiveness matrix, the selected technologies are subjected to a scoring and ranking procedure employing a semi-quantitative scoring approach. This approach utilises weighted scores across five distinct criteria: reduction of drudgery, cost-effectiveness, practical utility, accessibility, and performance of technology. This assessment ensures that technologies most likely to assist female farmers are given top priority, providing an open and objective means of identifying gender-responsive technologies.

FIGURE 4 GENDER-RESPONSIVE MEASURES ADOPTED IN THE ASSESSMENT PROCESS



(Source: modified from Groot, 2018)

This approach depends on incorporating comments from stakeholders to ensure that the evaluation process stays inclusive and relevant to the local context. By involving local stakeholders, including government agencies, NGOs, community-based organisations, and farmers, the study ensures that the final recommendations reflect the real needs and challenges faced by both male and female farmers. Interacting with stakeholders is essential for validating technological needs, improving selection criteria, and identifying the most appropriate technologies for the areas being studied.

This report integrates awareness of gender differences with a comprehensive and varied approach to evaluating technological needs. The study combines Groot's (2018) framework on gender responsiveness with the prioritisation techniques proposed by Joshi et al. (2016), ensuring that gender equity and agricultural productivity are considered together throughout the assessment process. The methodological approach allows for an understanding of and adequate response to the pressing needs of farmers in Jumla and Bajura, while simultaneously creating a sustainable and gender-responsive framework for evaluating agricultural technology in other similar areas.

2.3 Data sources

The following section outlines the various sources used to collect data for this study, such as desk review, field observation, Key Informant Interviews (KII), and various stakeholder consultations. Each source is detailed below:

2.3.1 Secondary data collection

Secondary data was collected by reviewing several published and grey literature, official records of the municipalities, etc., to identify relevant stakeholders and agriculture technologies being used in Jumla and Bajura. The literature was also reviewed to identify gender disparities within the agriculture sector. Through these secondary data sources, key stakeholders were identified and mapped from different levels, such as local government, I/NGOs, research institutions, Community-Based Organisations (CBOs) and associations, women's groups, and private sector. In addition to this, existing agricultural technologies were listed to later be validated through stakeholder consultations. The gender gaps identified from the secondary data sources provided this study with a checklist to conduct a gender analysis of the agriculture sector.

2.3.2 Primary data collection

Primary data collection was a key source for this study. Three modes of primary data collection were undertaken: Key Informant Interviews (KII), stakeholder consultations, and field observation.

2.3.2.1 PARTICIPANT OBSERVATION

The study sites were visited to conduct participant observation. Hamal (2019) mentioned that it is essential to give voice to those engaged in agricultural activities using new technologies that can potentially improve their productivity. Therefore, in this study, overt participant observation (Hamal & Huijsmans, 2022) was used to get a first-hand and more profound understanding of the agricultural practices and technologies being implemented in Jumla and Bajura districts to list the existing successes and failures of agricultural technologies. The technologies were assessed based on their efficiency, impacts on productivity, and women's empowerment.

2.3.2.2 KEY INFORMANT INTERVIEWS

Using the purposive sampling method (Rai & Thapa, 2015), KIIs were conducted using a semi-structured questionnaire targeting individuals from diverse sectors engaged in gender-sensitive agricultural technologies such the heads of the agriculture department of each municipality, information officers of NGOs/INGOs/CBOs and indigenous groups who are working in the area, and representatives of local farmers, traders, retailers, and cooperatives. Altogether, 36 KIIs were conducted- 26 with farmers (12 Men and 14 Women) and 10 with other stakeholders to assess household (HH)-level gender roles, gender disparity in access to resources, household and agriculture decision making, climate change impacts and adaptation measures, technologies adopted on farming, and the perception of agricultural technologies adopted in terms of drudgery reduction, efficiency, affordability, accessibility, etc.

2.3.2.3 GROUP DISCUSSIONS

As part of the primary data collection using overt participant observation, a series of mixed-participant group discussions was conducted in each municipality. Altogether 23 group discussions were conducted- 4 each in Tatopani and Patarasi, and 5 each in Budhinanda, Swamikartik and Triveni. The main purpose of these discussions was to understand gender dynamics in the municipalities and generate scores and ranking of agricultural technologies based on

TABLE 1 DETAILS OF GROUP DISCUSSIONS

Municipality	Groups formed for discussion	No. of participants in groups	
		Female	Male
Tatopani	Group 1	3	5
	Group 2	3	5
	Group 3	2	4
	Group 4	4	6
Patarasi	Group 1	3	3
	Group 2	3	4
	Group 3	4	2
	Group 4	4	3
Budhinanda	Group 1	2	4
	Group 2	2	4
	Group 3	2	4
	Group 4	1	5
	Group 5	1	5
Swamikartik	Group 1	3	5
	Group 2	3	4
	Group 3	3	4
	Group 4	3	4
	Group 5	3	4
Triveni	Group 1	2	4
	Group 2	2	4
	Group 3	3	4
	Group 4	3	4
	Group 5	3	4

the main criteria and sub-criteria set for this needs assessment (see Annex 2-6 and Table 3). The study performed the following scientific calculations to conclude the score and allocate weightage to the agricultural technologies to identify needs:

Mean score calculation = ∑ (score)/number of entries

Mode score calculation = Most frequent score; and

Weighted Average Calculation = ∑ (score i *weight i)/∑ (weights)

2.3.2.4 STAKEHOLDER CONSULTATIONS

Stakeholder consultation is a key approach whereby the knowledge and expertise of relevant stakeholders provide valuable input for the identification and prioritisation of technologies, ensuring a participatory process (Groot, 2018). Five stakeholder consultations (see Table 1), with nearly 40% women participants, were conducted- one in each municipality to identify and validate existing agricultural technologies in the respective sites and prioritise them, taking into account gender issues, gender-specific needs, and constraints. Key stakeholders in the agricultural sector operating within the respective municipalities were identified through secondary data and KIIs. These workshops included representatives from government agencies, NGOs, and CBOs. The consultations also carried out a SWOT analysis of the prioritised technologies and discussed key actions required to enhance their adaptability and scalability within the municipalities.

TABLE 2 STAKEHOLDERS CONSULTED FOR PRIMARY DATA COLLECTION

Stakeholder consultation			
Municipality/districts	**Organisation**	**Type**	**No. of consultations**
Budhinanda	Budhinanda Municipality	Government	1
	LI-BIRD	NGO	
	GIZ	INGO	
	GIFT Nepal	CBO	
	Kalika Bahudeshiya Sahakari Sanstha Limited	CBO	
Swamikartik	LI-BIRD	NGO	1
	Swamikartik Municipality	Government	
	GIZ	INGO	
	LI-BIRD	NGO	
	LI-BIRD	NGO	
Triveni	Triveni Municipality	Government	1
	LI-BIRD	NGO	
	LI-BIRD	NGO	
Tatopani and Patarasi	Herd international	Private Company	1
	Sarbodaya Nepal	NGO	
	LI-BIRD	NGO	
	S4 Nepal	NGO	
	PACE Nepal	NGO	
Bajura	Agriculture Knowledge Center	Government	1
Bajura	PMAMP	Government	
Tatopani and Patarasi	HRS	Government	
Swamikartik	AEPC	Government	
Total			5

2.4 Data analysis

This section outlines the data analysis process undertaken for this study, which was carefully designed to assess and rank agricultural technologies based on inclusive criteria with particular emphasis on addressing the challenges unique to Jumla and Bajura. A comprehensive methodology was employed, integrating both qualitative and quantitative techniques. The approach incorporates gender analysis, the Attractiveness matrix, scoring and ranking, and SWOT analysis – each serving a distinct role in evaluating the suitability of technologies for addressing gender disparities and enhancing productivity. These tools ensure that the process is inclusive by engaging a diverse range of stakeholders, including farmers. The following sections discuss each tool in detail.

2.4.1 Gender analysis

Gender analysis is the backbone of gender-responsive technology needs assessments as it helps understanding context-specific gender issues and inequalities persisting in different sectors, including agriculture, and identifying appropriate technologies that benefit both men and women equally (Groot, 2018). There are several frameworks for gender analysis. However, considering the objective of this assessment, we adopted the hybrid method of Longwe's Women Empowerment Framework (Leder-Büttner, 2016) and Moser's Framework (Moser, 1993). This helped us to understand the gendered dynamics of the agricultural sector of both districts and identify gender issues and needs for gender-responsive technologies. The key areas for the analysis were gender roles, access to decision-making processes, and needs for agricultural technologies amongst others.

Several roles performed in the household, on the farmland, and in communities were categorised as triple gender roles, i.e. productive role, reproductive role, and community roles. Access was measured for land and HH resources, technologies, agricultural services, and capacity-building opportunities.

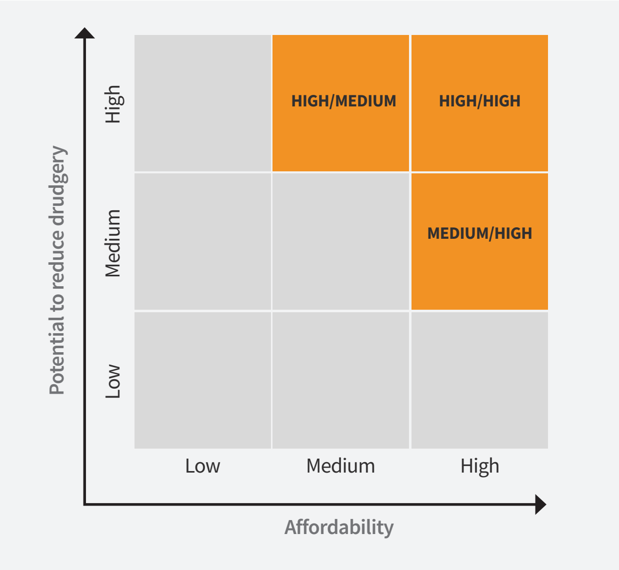
2.4.2 Prioritisation of agricultural technology

As suggested by Groot (2018), the prioritisation of agricultural technologies is a key deliverable of a technology needs assessment. To make the assessment gender-responsive, gender issues identified need to be considered for the prioritisation of technologies (Groot, 2018).

2.4.2.1 ATTRACTIVENESS MATRIX

An Attractiveness matrix is a strategic tool used to evaluate an intervention. It has been effectively used in the relative rating of value chains against two criteria (Joshi et al., 2016). This study adopted the matrix in an agricultural technology assessment process for the first time to shortlisting technologies that have been in use through stakeholder consultations. Agriculture related drudgery and lack of finance to afford the technologies are pronounced challenges for gender equality in the agriculture sector (Palikhey et al., 2017; Basnet, 2022). Therefore, the study used, first, "potential to reduce drudgery" associated with manual farming tasks that disproportionately affect female farmers and second, "*affordability*", to ensure the identified technologies are economically accessible to smallholder farmers especially female farmers, who have limited financial resources as the major gender-responsive selection criteria for the shortlisting of technologies. These criteria were also identified as key issues by the stakeholders during consultation. The technologies were evaluated based on their impact on given criteria (drudgery reduction and affordability), and those technologies listed as High/Medium, High/High, and Medium/High were shortlisted for the scoring and ranking method (see Figure 5).

FIGURE 5 **ATTRACTIVENESS MATRIX FOR EVALUATION OF TECHNOLOGIES.**
(ADAPTED FROM JOSHI AND GURUNG, 2009)



2.4.2.2 SCORING AND RANKING OF TECHNOLOGIES

Once the technologies were shortlisted using the Attractiveness matrix, they were further systematically scored and ranked using a semi-quantitative scoring method applying different values to the criteria (Kipper et al., 2014; Joshi et al., 2016). Five equally important criteria that have equal weightage (20%) were scored based on the sub-criteria provided. The major criteria, i.e., drudgery reduction, affordability, utility, accessibility, and technology performance, were set through desk and stakeholder consultations however, sub-criteria were determined through stakeholder consultations only (see Table 3). This scoring helped in identifying the best technologies and justifying their prioritisation to align with the objective of this study. If the criteria had been selected through focus group discussions involving a broader group of stakeholders the effectiveness and relevancy would have been enhanced.

2.4.2.3 STRENGTHS, WEAKNESSES, OPPORTUNITIES, AND THREATS (SWOT) ANALYSIS

SWOT analysis was conducted to complement the Attractiveness matrix and the scoring and ranking of technologies to identify the strengths, weaknesses, opportunities, and threats of prioritised agricultural technologies (Table 4). SWOT analysis is expected to give a deeper understanding of how each technology would fare.

2.4.3 Case study

Several case studies of successes and failures were collected during the field visit, aligning with the objective of this study. The cases were used as evidence to support the findings. The case studies were used to validate the findings from the Attractiveness matrix, scoring and ranking, and SWOT analysis, offering contextual insights into the gender dynamics of technology adoption. These lived experiences of different groups in different communities can be read in detail in sections 3.1.3., 3.1.4, and Annex 7 of this report.

TABLE 3 GENDER-RESPONSIVE SCORING CRITERIA FOR TECHNOLOGY PRIORITISATION

SN	Main criteria	Weight (wt %)	Sub-criteria	Weight (wt %)
1	Drudgery reduction	20	Reduction in manual labour required	10
			Reduction in time required to complete tasks	10
2	Affordability	20	Initial cost of technology	10
			Maintenance costs	5
			Total cost of ownership	5
3	Utility	20	Is technology easy to use?	10
			What level of training is required for users?	5
			Can the technology scale meet future needs?	5
4	Accessibility	20	Available in the market and easy to repair	10
			Availability of training and support resources	5
			Inclusivity (gender sensitive as well as socially inclusive)	5
5	Technology performance	20	Energy consumption	10
			Does technology perform the required functions effectively?	5
			Is technology environmentally sustainable?	5
	Total	100		100

TABLE 4 GENDER-RESPONSIVE PARAMETERS FOR SWOT ANALYSIS

Category	Description
Strengths	
Empowerment of women	Increased participation and reduced drudgery
Increased productivity	Higher yields and economic gains
Enhanced decision making	Better-informed agricultural practices
Economic growth	Boost women-led businesses and livelihoods
Weaknesses	
Affordability, accessibility and availability	High costs and restricted access to technology
Cultural barriers	Persistent traditional gender roles
Limited technical skills	Lack of technical literacy and training
Infrastructure issues	Inadequate electricity, internet, and transport
Opportunities	
Government and NGO support	Access to finance (subsidy, loans)
Market expansion	New markets for gender-responsive technologies
Collaborative networks	Strengthened knowledge sharing among women farmers
Research and innovation	Increased development of effective technologies
Threats	
Resistance to change	Community reluctance to adopt new technologies
Economic instability	Funding fluctuations impacting initiatives
Climate change	Environmental challenges affecting productivity
Policy gaps	Insufficient supportive policies for technology adoption

SECTION III

Findings and Results

3.1 Gender dynamics in Jumla and Bajura

3.1.1 Division of labour

The findings of this study reveal a complex landscape of gender roles, responsibilities, and the division of labour within the study sites. Gender roles vary across the study sites, depending on the social structure, cultural norms, and traditional division of labour. Many roles whether productive, reproductive, or community roles are generally collaborative and can be performed by both men and women depending on availability and need. Yet, the findings show that reproductive roles still primarily fall on women though all sites considered some of these roles, such as livestock rearing and care for the elderly, to be shared responsibilities. Some activities were predominantly women's responsibilities in some of the municipalities, such as fetching water (Tatopani and Patarasi), or childcare (Patarasi, Triveni). In other sites, however, there was a growing recognition of shared responsibility for these roles.

Certain productive roles, such as farming and fetching timber, were shared between men and women but men dominated in formal employment in all the municipalities. Community roles were mostly attributed to both men and women with few indicating that it was exclusive to either men or women (see Figure 7). Although women's involvement in community roles has increased, this participation seems to come at the cost of additional time investment, rather than leading to greater equality in gender roles. Community roles appeared to have increased women's workload in the study sites of some of the municipalities. "*Men would rather spend their leisure time in teashops talking and playing games like carrom board. We women must complete our work at home no matter what,*" said a woman respondent from Tatopani municipality. She further added- "*If I have to go to any meeting or event outside the home, I wake up at 3 AM, complete all the morning tasks such as cleaning, fetching water, cooking, etc, and go to attend meetings so that my other family members can have their lunch on time.*"

This division substantially impacted agricultural outcomes, particularly technology adoption. For example, the intense contribution of women to household and care duties limits their time and capacity to engage in technology-intensive agricultural practices, such as using mechanised tools or attending trainings on new agricultural technologies.

3.1.2 Access and decision making

Access to resources and services was measured in terms of legal ownership, control, or physical availability of land, household resources, agricultural services, technologies, and training opportunities. The overall findings show that despite progress, gender disparity persists in access to resources and services for women in these communities.

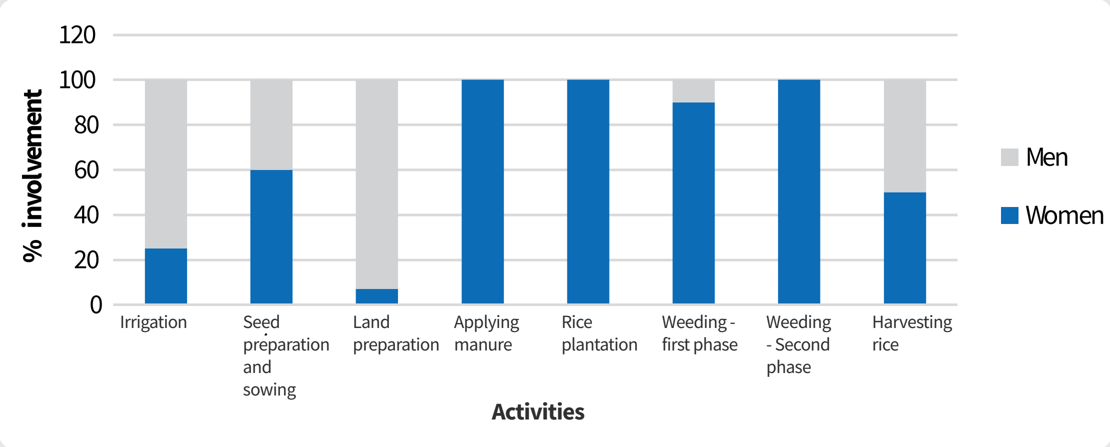
3.1.2.1 ACCESS TO LAND AND RESOURCES

The findings from the group discussion shows that men generally dominate access to both agricultural land and household land in the study sites. While a majority of groups claimed some level of shared access between men and women, the degree of access varied

Gender division of labour in Marsi rice cultivation in Jumla and Bajura districts

During the Training of Trainers (ToT) in Climate Resilient Agriculture (CRA) conducted with the participants from Jumla and Bajura districts, the assessment on gender roles in *Marsi* rice cultivation shows a gender divide in roles and responsibilities. Activities like seed preparation and sowing, plantation, weeding and applying manure are predominantly women's jobs, while land preparation and irrigation throughout the cycle are done by men. Tools and techniques are available for land preparation and irrigation but weeding remains largely manual and labour-intensive, particularly during the first phase.

FIGURE 6 **GENDER DIVIDE IN MARSI RICE CULTIVATION** (SOURCE: TOT IN CRA; 13 SEP 2024)



"We women pull out the weeds with our bare hands, while men collect the floating weeds using tools. As a result, this often leaves us with pain in our hands and under our nails." said a women respondent.

FIGURE 7 **GENDER DIVISION OF LABOUR ACROSS STUDY SITES**

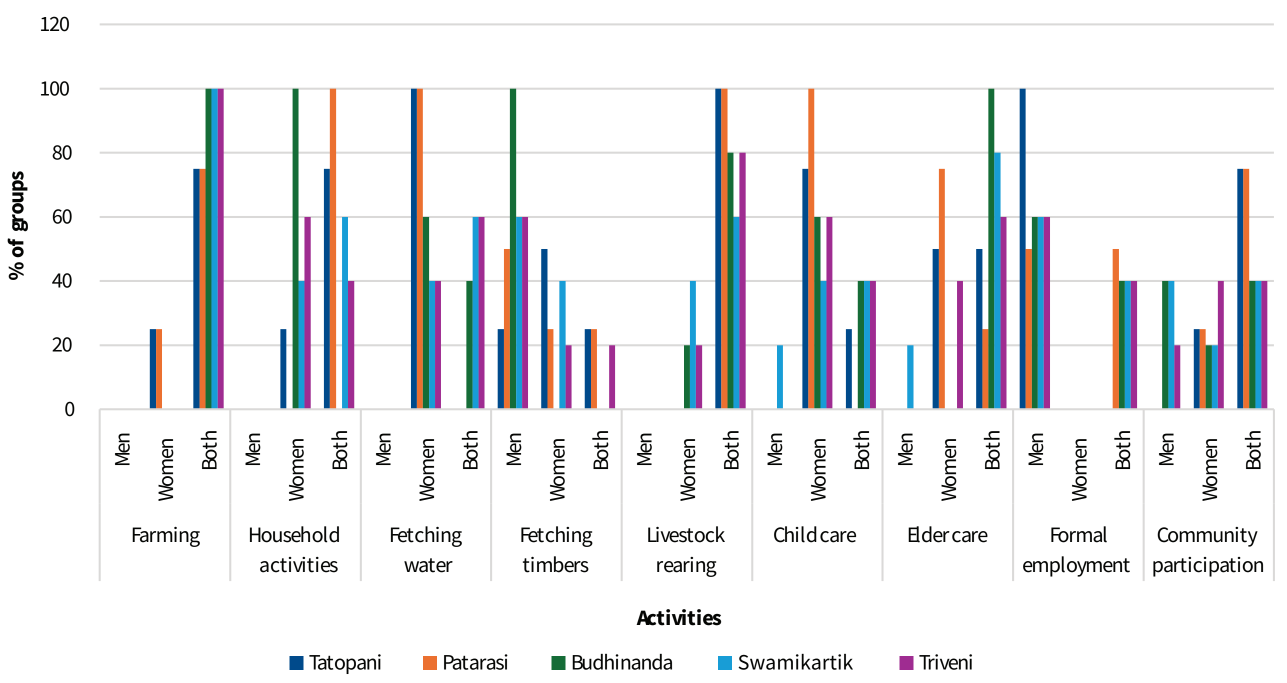
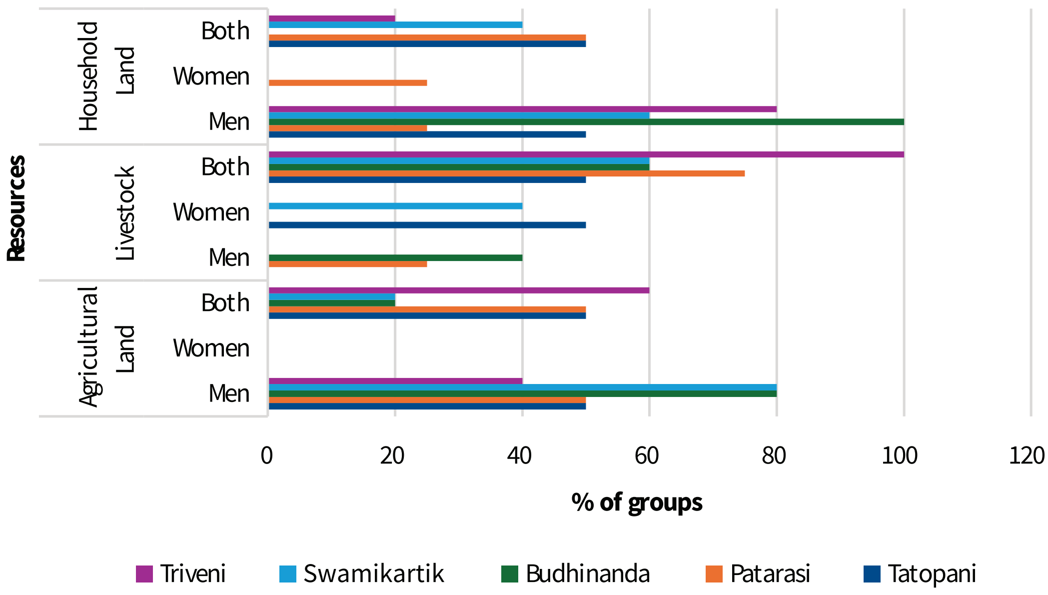


FIGURE 8 ACCESS TO LAND AND RESOURCES ACROSS STUDY SITES

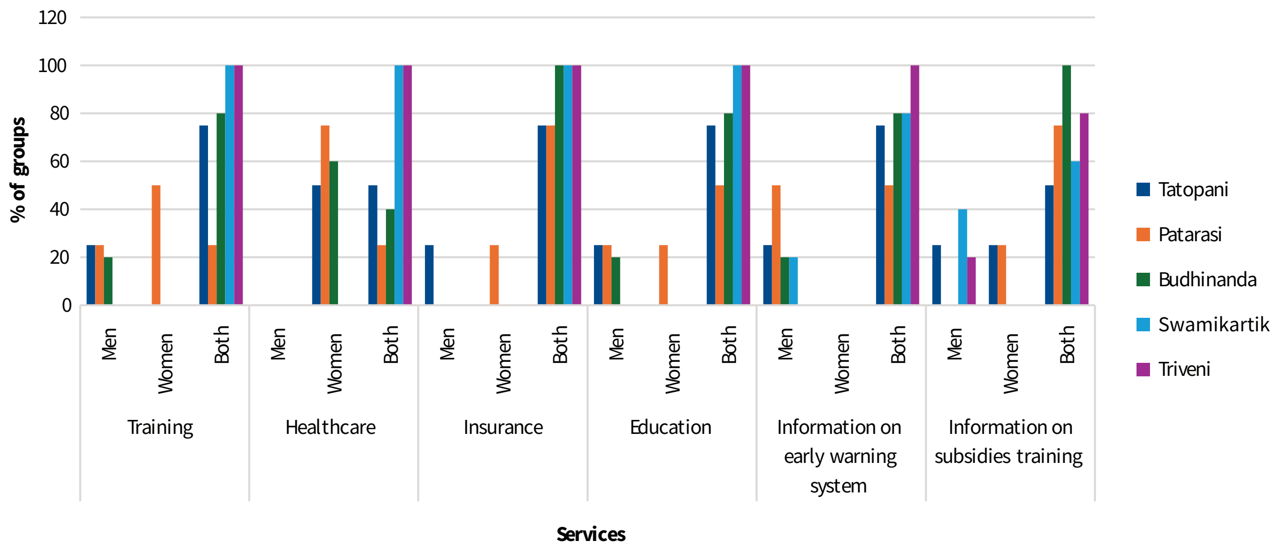


with men typically holding stronger control. Especially in Budhinanda and Tatopani, men were noticeably more likely to own agricultural and household lands. Across all study sites, women did not have independent access to these resources. In contrast, shared access to livestock was found to be more common than for land, except for study sites from Triveni, where livestock ownership is uniquely attributed solely to women (see Figure 8).

3.1.2.2 ACCESS TO AGRICULTURAL SERVICES

The study found that agricultural services are most frequently accessed by both genders, particularly in Triveni, where all groups reported shared access across all service types. However, women's independent access to essential services such as training, insurance, education, and information on early warning systems and subsidy-related programmes remained consistently low or absent across most study sites. This reflects systemic gaps and underscores the need for tailored efforts and interventions to enhance women's independent access to such critical services across municipalities (See Figure 9).

FIGURE 9 ACCESS TO AGRICULTURAL SERVICES ACROSS STUDY SITES



3.1.2.3 ACCESS TO AGRICULTURAL TECHNOLOGY

Group discussions revealed that generally, men and women share access to most agricultural technologies across the study sites. Independent access, however, is unevenly distributed. While women play a strong role in certain low-cost technologies such as plastic ponds, vermicompost, *jholmol*, and knapsack spray, men dominate access more technical and mechanised technologies such as drip irrigation, mini-tiller, corn sheller, and multi crop thresher across the study sites. These findings point to persistent gender disparities particularly regarding women's independent access to more technical or mechanised technologies highlighting the need for targeted efforts such as capacity building, subsidy, etc. to ensure equitable technology adoption (see Figure 10).

3.1.2.4 ACCESS TO AGRICULTURAL TRAININGS

The group discussions revealed that men have greater access to technical and mechanisation trainings on local crops awareness, seed production, and agricultural mechanisation across the sites. However, women's participation was higher in household-oriented trainings such as home garden management training. Women across the study sites also participated in specific trainings on climate smart agriculture, and Integrated Pest Management (IPM), which were intentionally targeted to women. Overall, the findings reflect progress in access to trainings for women. Yet, they also point to the need to further enhance women's participation in technical and mechanised agricultural domains to ensure equitable capacity building (see Figure 11).

FIGURE 10 ACCESS TO AGRICULTURAL TECHNOLOGIES ACROSS STUDY SITES

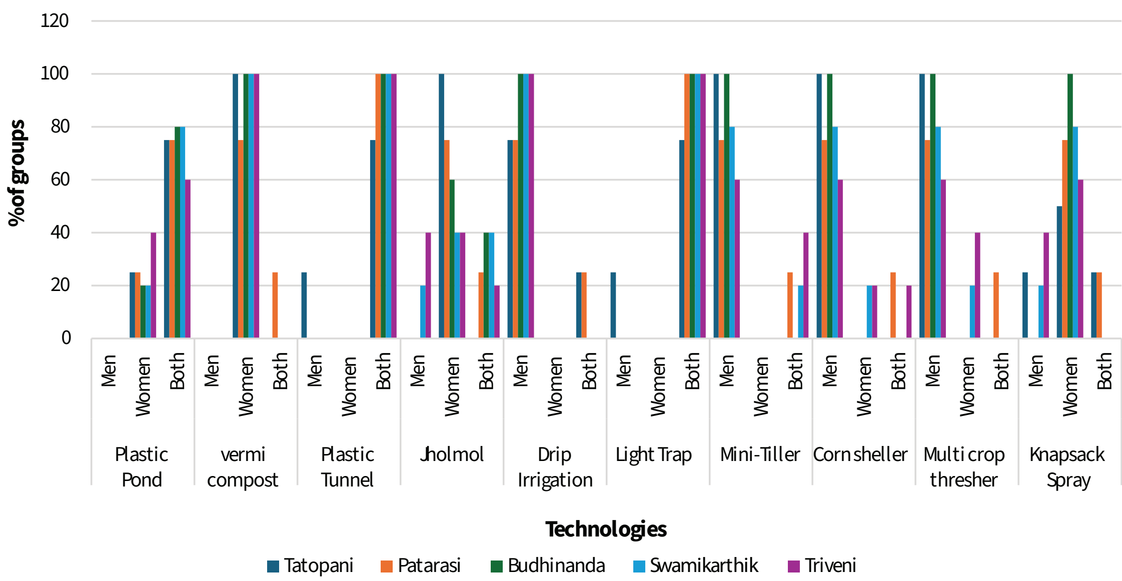


FIGURE 11 PARTICIPATION IN AGRICULTURAL TRAININGS ACROSS STUDY SITES

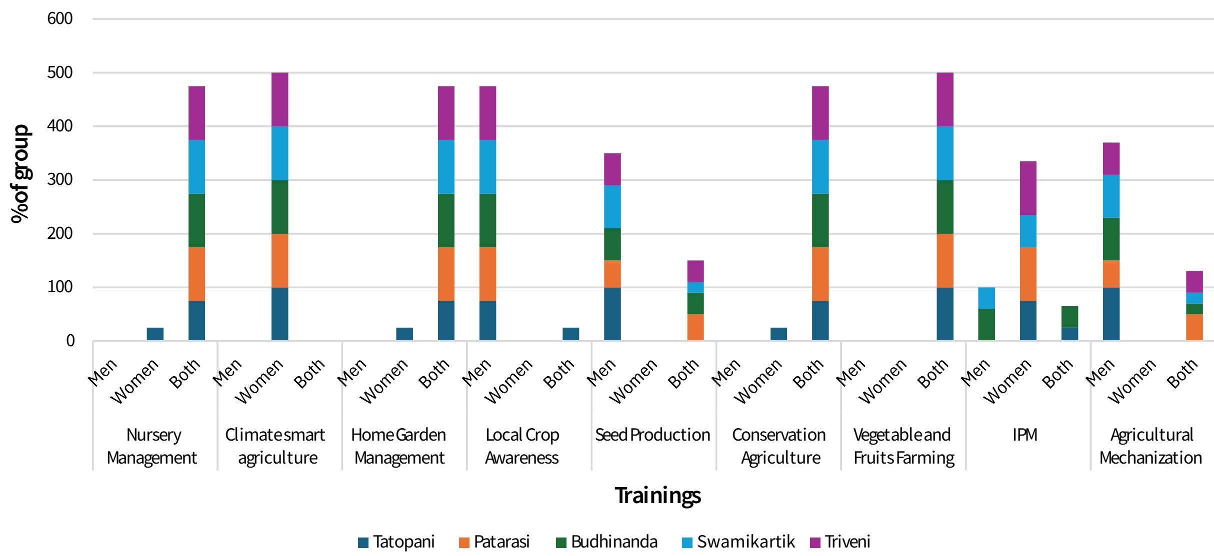
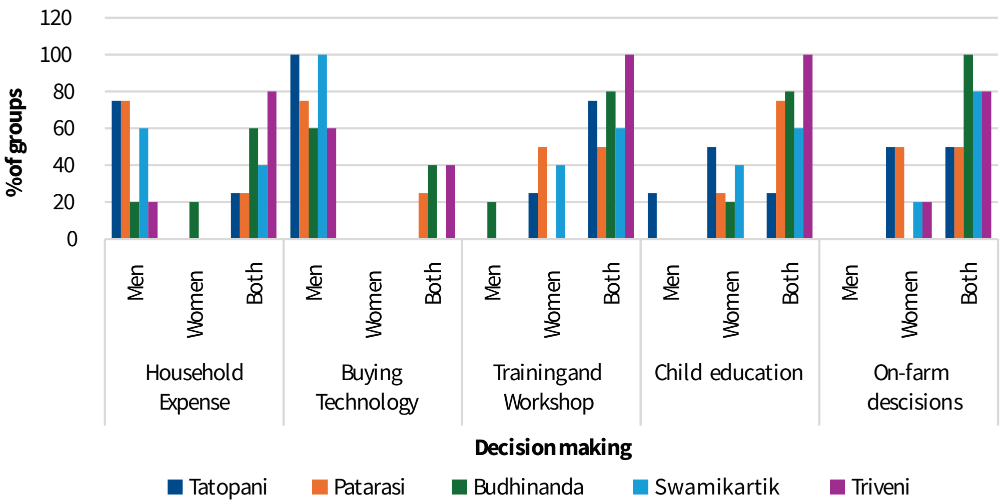


FIGURE 12 HOUSEHOLD DECISION MAKING ACROSS STUDY SITES



3.1.2.5 HOUSEHOLD DECISION MAKING

The findings reveal that while some progress toward shared decision making is evident across all the activities, significant gender gaps remain, particularly for decision making on finances. In most of the study sites, men dominate decisions on household expenses and purchasing technology, with women having little (study sites of Budhinanda) to no say (study sites of Tatopani, Patarasi, Swamikartik and Triveni) (see Figure 12). This suggests the need for targeted interventions to empower women in economic and technical domains for more equitable household and agricultural decision making.

3.1.3 Needs assessment of technologies

Several on-farm activities, from land preparation to harvest, are carried out across the study sites of Tatopani, Patarasi, Budhinanda, Swamikartik, and Triveni. These tasks are often labour-intensive and rely on traditional tools. In addition, challenges such as long droughts, lack of irrigation, and pest infestations are affecting agricultural productivity. The needs assessment conducted during consultation meetings demonstrates the necessity of technologies across various agricultural stages to ease these tasks (see Table 5). The technologies were also evaluated from the perspective of gender friendliness. The technologies are considered gender friendly when both men and women can handle and operate them. In addition, the gendered division of labour and its impact on technology access can be better understood through real-life case studies. For instance, the experience of Tika Oli Giri, a Local Resource Person (LPR) in Tatopani, highlights the success of disseminating climate-resilient agricultural

Smart agriculture to empower communities, led by a female Local Resource Person (LRP) in Tatopani

Tika Oli Giri, a well-known name in Tatopani, leads the spread of climate-house agriculture innovations that include tunnel houses, biopesticides, vermicompost, and rainwater collection. She has not only increased her own crop output, allowing off-season production and better plant development, but also initiated efforts to empower fellow women farmers from her municipality. She has now become a LRP, whose work has greatly influenced her fellow community members. She has shared her skills and encouraged a community-centred strategy that allows the advantages of this technology to spread beyond her own farming operations. Although these technologies show enormous promise, their acceptance calls for ongoing education and assistance to fully realise their potential and widespread adoption. This shows that LRPs can play a crucial role in enhancing sustainable farming methods and providing support for women-led projects (for details, see Annex 7).

Producing potato chips to promote women's empowerment in Patarasi Municipality

Durga Devi Bahudeshiya Sahakari Sanstha – a women-led cooperative of three hundred households in Patarasi Municipality are effectively operating new machines and generating sustainable income stream through potato chips manufacture. Encouraged by the Department of Agriculture Development Office (DADO) and other local NGOs, they make locally grown potatoes a popular snack for both local and larger markets. The use of machine has greatly reduced the physical work required, improving production efficiency and enabling women to participate in other family-oriented and productive activities. However, due to the lack of local access to spare parts and qualified experts in the municipality, maintaining machines is a common challenge for cooperative. To ensure viability and sustainability of this women-led project, these gaps need to be filled by encouraging community involvement, and building local markets for machine components (for details, see Annex 7) technologies such as tunnel houses and biopesticides. Her attempts to empower women in her community by using these technologies demonstrate how local leaders can help promote acceptance of labour-saving technologies. Similarly, Durga Devi Bahudeshiya Sahakari Sanstha, a women's cooperative in Patarasi, has effectively used technology in potato chips making, greatly increasing output and economic returns for local women. These examples underline the transformative potential of combining technology with community-driven support systems to boost agricultural productivity and foster gender equality.

3.1.3.1 LAND PREPARATION

Tilling the soil by hand is tiring and time-consuming. Traditional tools, like spades, are not very efficient, especially for larger areas. Mini tillers can save time and reduce physical effort by making the process faster and easier. While mini tillers work well on flat land, they may not be as useful on very steep terrain. Conversely, better spades are more efficient and durable than conventional spades, hence they could be the choice for any kind of terrain. These tools are useful in saving time and require less physical effort. For mountainous regions with steep fields, mini tillers are not suitable, therefore their potential of adoption is assessed as moderate (see Table 5); nonetheless, upgraded spades perform effectively on any type of terrain.

3.1.3.2 PRODUCTION

Some farming areas need protection from bad weather, and better-quality seedlings are required for successful crops. Technologies like plastic tunnel houses and nurseries can help. A plastic tunnel is like a small greenhouse that protects plants from extreme weather, helping them grow better and even produce crops out of season. High-tech and improved nurseries help improve the quality and growth of seedlings in a controlled environment. However, plastic tunnels seem to have great potential in high-altitude climates with unpredictable weather. Similarly, improved[1] nurseries also have great potential for adoption as they can be adapted to local weather conditions with available resources. High-tech nurseries are less likely to be adopted by farmers as they require a high initial investment and technical skills, as shown in Table 5 below.

3.1.3.3 SOWING

The manual seeding process is time-consuming and labour-intensive, which requires more efficient tools. Jab planters[2] help save time and labour while ensuring uniformity in planting, which is essential for crop success. Rice transplanters reduce labour requirements and improve plant spacing, which is crucial for rice cultivation. The jab planter, although preferable in uneven terrain, has a moderate chance of adoption (see Table 5) as it is particularly effective for large-scale plantation, while the rice transplanter has low potential as it is most suited for terraced fields, limiting its application scope. The terraces in the study sites are narrow, making it difficult to operate mechanised transplanters effectively. Moreover, additional barriers such as limited technical know-how, high cost, and the relatively heavy weight of the machine are key challenges for the adoption and wider use in these sites.

3.1.3.4 IRRIGATION

Limited water availability in some regions and reliance on rainfall necessitates dependable irrigation solutions. Canal irrigation helps increase crop yield by ensuring viability during dry seasons. Lift irrigation facilitates water access from lower elevation sources, expanding cultivable areas. Drip irrigation promotes efficient water use by reducing excess water use. All irrigation technologies have a high potential for adoption in study sites as they are suitable for irrigating fields and cultivating high-value crops in tunnel houses (see Table 5).

3.1.3.5 WEEDING

Weeding is often a labourious task that requires substantial time and effort. The manual weeding machine reduces labour inputs and improves crop health by effectively removing unwanted plants without damaging the crops. The potential of its adoption in studied municipalities is high due to its ability to reduce reliance on herbicides, making it a valuable tool for maintaining healthy crops.

3.1.3.6 HARVESTING

Traditional harvesting tools are often inefficient in reducing loss during harvests and are physically taxing, emphasising the need for improved options.

[1] Improved nurseries refers to those nurseries that are cheaper, affordable and can be operated with medium technical knowledge and have some improvement over traditional type of nursery. As for instance, the gummose nursery, hot bed nursery, poly house nursery, elevated nursery.
[2] A manually operated machine that penetrates the soil cover by jabbing action, opens a seeding slot and places the seed into that slot

Improved sickles enhance efficiency and decrease physical strain during harvesting. The corn sheller greatly simplifies the labour-intensive task of shelling corn. The apple picker reduces the labour involved in manually picking apples and minimises fruit damage. Combined threshers save time and labour by combining harvesting and threshing into one process.

3.1.3.7 POST-HARVESTING AND PROCESSING

Post-harvest losses due to inadequate storage facilities and the need for food processing highlight the need for technological solutions. Solar cold storage not only reduces spoilage and prolongs the marketability of produce like apples but also reduces carbon emissions.

The needs for different agricultural technologies are summarised in the following table:

TABLE 5 **TECHNOLOGY NEEDS ASSESSMENT**

S. N	Stage	Municipalities	Technologies needed	Benefits	Potential of adoption
1	Land preparation	Budhinanda, Triveni, Swamikartik	Mini tiller	Reduces labour, time, and physical strain on farmers	Moderate
		All municipalities	Improved spade	Increased efficiency and durability	High
2	Production	Swamikartik, Triveni	Plastic tunnel house	Increased crop yield, off-season production	High
		Budhinanda, Tatopani, Patarasi	High-tech nursery	Enhanced seedling quality and growth	Moderate
		Triveni	Improved nursery	Improved growth conditions and seedling survival	High
3	Sowing	Budhinanda	Jab planter	Saves time and labour, ensures uniform planting	Moderate
		All municipalities	Rice transplanter	Reduces labour and time, improves plant spacing	Low
4	Irrigation	All municipalities	Canal irrigation	Reliable water supply, increases crop yield	High
			Lift irrigation	Access to water from lower elevations, increases area under cultivation	High
			Drip irrigation	Efficient water use, reduces water wastage	High
	Weeding	Budhinanda	Manual weeding machine	Reduces labour, improves crop health	High
6	Harvesting	All municipalities	Improved sickle	Increases efficiency, reduces physical strain	High
			Corn sheller	Reduces labour	High
			Apple picker	Reduces labour, minimises fruit damage	High
			Combine harvester[3]	Combines harvesting and threshing in one step, saving time and labour	High
7	Post-harvesting and processing		Cold storage	Reduces spoilage, prolongs marketability of produce	High
			Solar dryer	Provides a sustainable drying method, adds value	High
			Combined rice mill	Increases milling efficiency, reduces time and labour	Moderate
			Oil mill	Adds value to oilseeds, provides income diversification	Moderate
			Cellar store	Reduces spoilage, ensures year-round availability	High
8	Value addition	All municipalities	Apple slicing machine	Creates new product opportunities, reduces waste	High
			Jam/jelly machine	Adds value, diversifies income sources	High
			Wine machine	Adds value, introduces new product to market	Moderate
			Sauce machine	Adds value, reduces post-harvest loss	Moderate
9	Transportation	All municipalities	Krishi ambulance	Reduces post-harvest loss and workload carrying goods	High

[3] A self-propelled machine designed to perform reaping, threshing, and winnowing crops like rice and wheat in a single operation

3.1.4 Barriers to technology adoption

There exist several barriers that affect agricultural practices and resource accessibility across the study sites. All the sites experience several specific challenges. First, cultural and social barriers due to traditional norms and practices have often limited the participation of women and marginalised groups in agriculture decision making in all the study sites, which has restricted their access to resources, capacity-building opportunities, and leadership roles. For example, the situation of Hari Devi Budha, a young mother operating her farm by herself while her husband is abroad, points to the challenges that many women in rural areas face. Due to agricultural and family responsibilities, Hari Devi struggles with time management, often leading to her exclusion from community support systems. This, along with cultural and societal barriers further restrict her access to agricultural technologies and information. Her predicament is a prime example of how these constraints inhibit women, especially those living in remote areas, from fully enjoying the resources at hand.

Secondly, challenges in utilising technologies due to the lack of technical skills are prominent in all study sites. Overcoming this requires efforts in technical capacity building of farmers, particularly women, to ensure that all farmers can effectively use the technologies and benefit from them.

Third, financial constraints prevent smallholder farmers, particularly women, from adopting modern technologies due to high upfront costs and limited access to credit. These constraints can be addressed through the expansion of agricultural credit programmes and microfinance and cooperative lending for smallholder farmers, especially women, to assist marginalised farming communities with technology subsidies and improve the financial access of women. This can be well-demonstrated through the failure of a solar and wind energy project in Dangibadha, Tatopani, reflecting the nature of this issue. The initial installation improved livelihoods but it later failed due to insufficient funds for repair and the lack of technical capacity. The collapse of these systems explains the need for long-term financial sustainability and community-based upkeep in general. Especially for women, who typically stay excluded from technical professions, it shows that even promising technologies can become obsolete without accessible replacement parts, maintenance, and inclusive technical training. This story emphasises the importance of combined financial and technical support systems for scaling gender-responsive technologies.

Fourth, market access and infrastructure barriers are recorded in all study sites where challenges related to market access and inadequate infrastructures have affected the ability of farmers, particularly women, to distribute and sell their products efficiently, leading to post-harvest and financial loss.

In addition to all the above-mentioned barriers, land ownership and tenure insecurity are identified as an issue specific to study sites in Triveni Municipality, while other study sites reported that access to land is not linked to technology adoption. Further, the lack of access to timely information and resources required for effective farming and technology adoption is a challenge in study sites of Swamikartik and Budhinanda municipalities. In Swamikartik, institutional barriers, i.e. inadequate policies and lack of an enabling institutional environment have also been highlighted as challenges.

The hardships of women farmer

A young mother-of-two, Hari Devi Budha, manages her farm and house alone while her husband works overseas. She went back to the fields barely two months after giving birth, despite the heavy workload. Her isolation from community networks exacerbates her difficulties, restricting access to agricultural technologies and information. Her case illustrates the challenges single women in agriculture face when limited time, money, and support networks significantly prevent access to information, technology, and opportunities. Targeting outreach initiatives that support isolated women, promote inclusive community behaviours, and create childcare options can help women like Hari Devi feel empowered. Empowerment programmes and inclusive support systems are two solutions that primarily help women in agriculture meet their requirements and thereby enhance their quality of life (for details, see Annex 7).

Difficulties using renewable energy in Dangibadha, Tatopani

The first solar and wind power installations in Dangibadha, Tatopani, effectively improved the standard of living for people there. But when the project ran required high repair costs, it faced major difficulties, and the systems were abandoned. This experience emphasises the need for sustainable maintenance techniques for gender-responsive technology. The inability of renewable energy sources emphasises the need for local capacity building, particularly in training women as technicians to maintain and troubleshoot such devices. Additionally, financial barriers, such as high repair costs and the lack of accessible funding, emphasise the need for financial models like microcredit or subsidies to support the long-term sustainability of GRTs. This case study illustrates the need for comprehensive planning, which includes financial strategies, technical training, and community involvement, to prevent setbacks and ensure the success and sustainability of renewable energy projects in rural areas (for details, see Annex 7).

3.2 Identification and prioritisation of agricultural technologies

3.2.1 Existing agricultural technologies

The extensive list of technologies implemented by various donor agencies and organisations in Jumla and Bajura was compiled through a literature review and verified during consultation meetings conducted on the respective sites. Multiple organisations and stakeholders, including LI-BIRD, NARC, AKC, GIZ Nepal, and AEPC, in collaboration with local governments, are actively implementing agricultural projects in the area and supporting farmers in the adoption of climate-resilient technologies. Most of the technologies, such as biopesticides, IPM traps, foot sprayers, knapsack sprayers, mini tillers, plastic ponds, soil cement ponds, mulching, etc., are common in all the municipalities studied, which can be attributed to the donor-driven projects' common goal of improving agricultural productivity. In total, 24 technologies in study sites in Tatopani, 22 in Patarasi, 24 in Budhinanda, 21 in Swamikartik, and 20 in Triveni were listed in the long-list (see Figures 13 and 14, and Annex 1). The maps also provide valuable insights for stakeholders looking to introduce new technology in the area and provide researchers with a foundation for analysing the scalability of these technologies.

3.2.2 Shortlisting of technologies using gender-responsive criteria

We shortlisted effective and affordable agricultural technologies from the above list of existing technologies. A total of six technologies in Bhudhinanda Municipality (mini tiller, drip irrigation, vermicompost, plastic tunnel, knapsack sprayer, and soil cement tank), five in Swamikartik (mini tiller, solar dryer, vermicompost, plastic tunnel, and solar store), seven in Triveni (mini tiller, drip irrigation, plastic tunnel, knapsack sprayer, multi-crop thresher, vermicompost, and improved cowshed), seven in Tatopani (irrigation canal, improved cookstove, power tiller, thresher, combined rice mill, biomass mulching, jam/jelly training), and eight in Patarasi (drip irrigation, plastic tunnel, biopesticide, plastic mulching, irrigation canal, rainwater harvest, biomass mulching, and apple picker stair) were shortlisted based on the criteria provided. The findings indicate that these technologies not only

FIGURE 13 MAP OF BAJURA DISTRICT SHOWING EXISTING TECHNOLOGIES AND STAKEHOLDERS

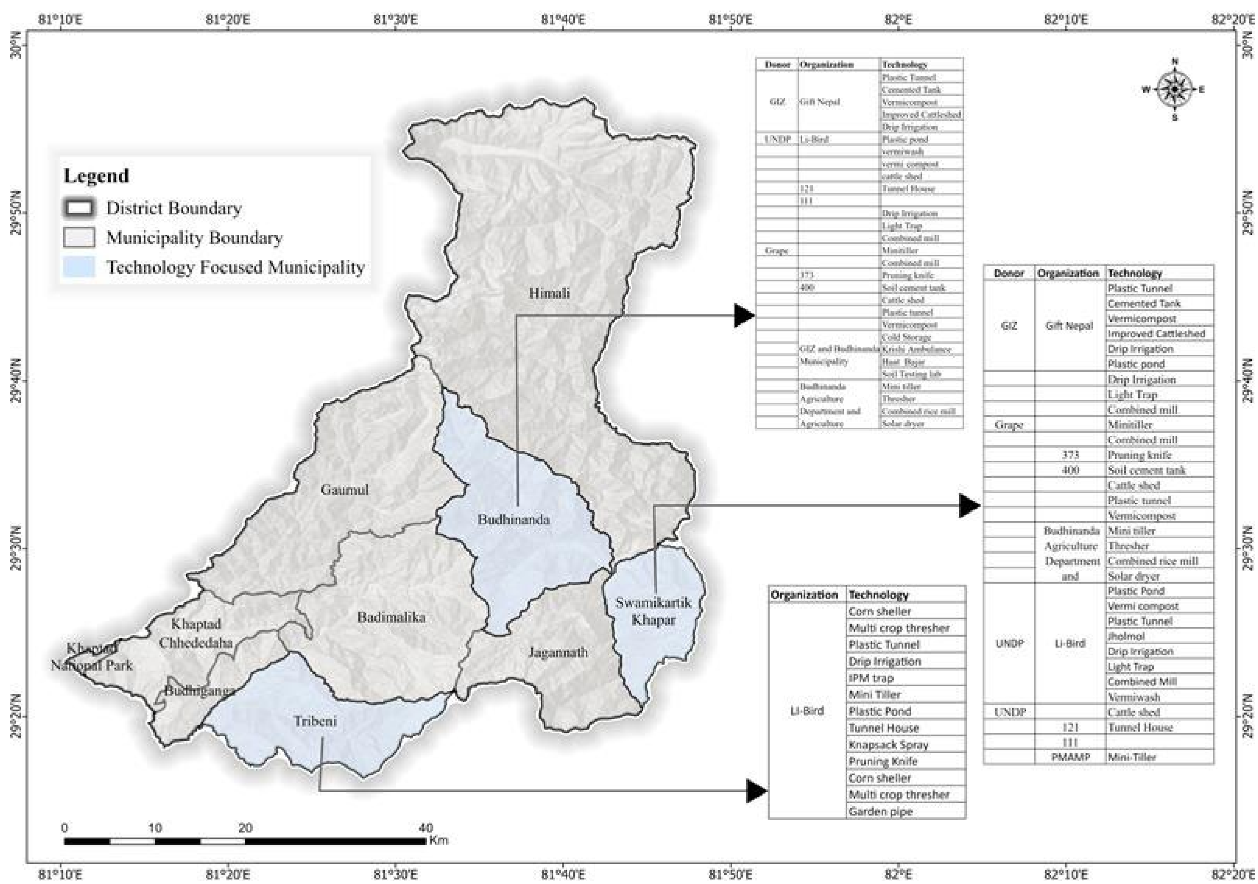
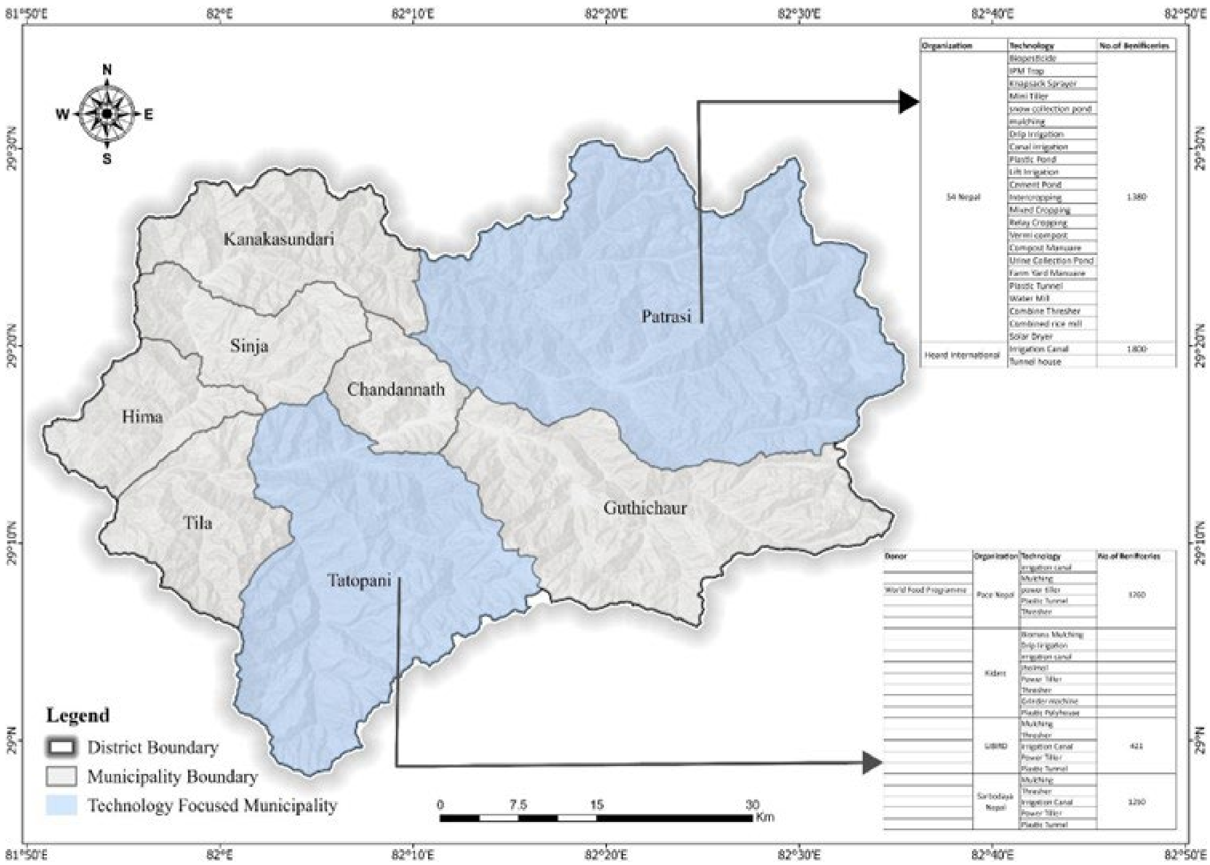


FIGURE 14 MAP OF JUMLA DISTRICT SHOWING EXISTING TECHNOLOGIES AND STAKEHOLDERS



significantly alleviate women's workloads but are also affordable for independent installation, even without subsidies or external support from the government or organisations. This underscores their viability and potential for empowering women in agriculture within the municipalities studied.

3.2.2.1 DRUDGERY REDUCTION

Figure 15 highlights the potential of shortlisted technologies to reduce drudgery in on-farm activities in the study sites. The significant reduction in time spent by both men and women on farming activities demonstrates the importance of technologies in easing the agricultural workload while ensuring efficiency. Farmers have experienced that the use of technologies in farming can save nearly 50% of their time spent on on-farm activities such as land preparation, irrigation, weeding, harvesting, and selling farm products. "*Agricultural technologies and machineries also contribute to timesaving in household activities, particularly in pre-farming and post-harvest management,*" shared a participant from Patarasi during a group discussion.

3.2.2.2 AFFORDABILITY

A clear correlation between the proximity of technologies and associated costs influences the farmers' decisions on technology adoption. The table below (see Table 6) shows the affordability and accessibility of shortlisted technologies. In Budhinanda, Swamikartik, and Triveni municipalities, technologies such as drip irrigation, plastic tunnels, and vermicompost were preferred for their easy access to the nearby market, which minimises travel-related and maintenance expenses. Whereas Dhangadhi-based technologies such as the mini tillers and multi-crop threshers require a lot of travel, which increases total expenses despite their functional advantages being significant. In Khalanga and surrounding markets, innovations such as the irrigation canal, plastic tunnel, and improved cookstove, which are reasonably priced in Tatopani and Patarasi municipalities, have low logistical expenses and are hence efficient in their use. On the other hand, agricultural technology imported from farther distances like the combined rice mill from Kathmandu and the power tiller and thresher from Nepalgunj demands intense logistical preparation and transport, affecting total expenses. Locally available technologies like biomass mulching provide more sustainable solutions and opportunities for economic diversification.

FIGURE 15 EFFICIENCY OF AGRICULTURAL TECHNOLOGIES IN SAVING TIME SPENT ON ON-FARM ACTIVITIES ACROSS STUDY SITES

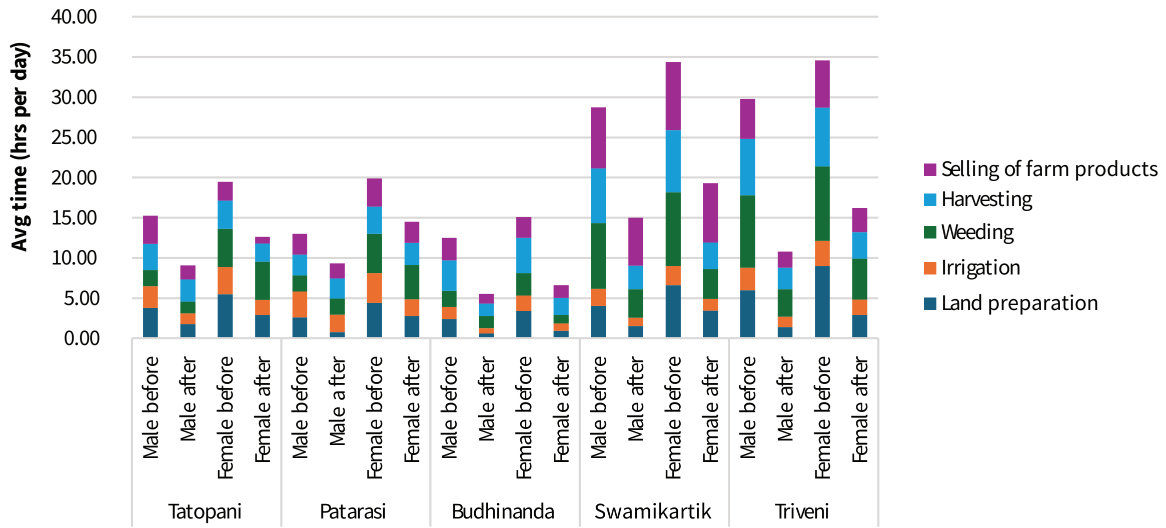


TABLE 6 AFFORDABILITY OF AGRICULTURAL TECHNOLOGIES ACROSS STUDY SITES

Municipalities	Shortlisted technologies	Market centre	Distance to market (km)	Workshop location	Cost of installation (NPR)	Cost of maintenance (NPR)
Budhinanda	Mini tiller	Dhangadhi	300	Kolti	70000-75000	15000
	Drip irrigation	Dhangadhi	300	Kolti	5000-7000	2500
	Vermi-compost	Nepalgunj	400	Kolti	3000-5000	1000-1500
	Plastic tunnel	Kolti	10	Kolti	40000-50000	15000
	Knapsack aprayer	Kolti	10	Kolti	4000-5000	1000
	Soil-cement pond	Kolti	10	Kolti	20000-25000	3000-5000
Swamikartik	Mini tiller	Dhangadhi	300	Kolti	70000-75000	15000
	Solar dryer	Dhangadhi	300	Kolti	5000-7000	2000
	Vermi-compost	Nepalgunj	400	Kolti	3000-5000	1000-1500
	Plastic tunnel	Kolti	10	Kolti	40000-50000	15000
	Cellar store	Kolti	10	Kolti	100000-125000	
Triveni	Mini tiller	Dhangadhi	300	Bamka	70000-75000	15000
	Drip irrigation	Bamka	10	Bamka	15000-17000	2000
	Plastic tunnel	Bamka	10	Bamka	7000-10000	5000
	Sprayer	Bamka	10	Bamka	3500-4000	1000
	Multi crop thresher	Dhangadhi	300	Bamka	70000-80000	10000
	Vermicompost	Bamka	10	Bamka	5000-6000	1000-1500
	Improved cowshed	Bamka	10	Bamka	15000-20000	4000
Tatopani	Irrigation canal	Khalanga	20	Khalanga	2000000	500000
	Improved cookstove	Khalanga	20	Khalanga	10000	2000
	Power tiller	Nepalgunj	400	Khalanga	80000	15000
	Thresher	Nepalgunj	400	Khalanga	100000	15000
	Combined rice mill	Kathmandu	950	Khalanga	60000	10000
	Biomass mulching	Locally available	10	Khalanga		
Patarasi	Drip irrigation	Jumla bazar	10	Jumla bazar	20000	5000
	Plastic tunnel	Jumla bazar	10	Jumla bazar	150000	20000
	Biopesticide	Jumla bazar	10	Jumla bazar	5000	1000
	Plastic mulching	Lassi bazar	3	Lassi bazar	15000	1000
	Irrigation canal	Jumla bazar	10	Jumla bazar	200000	100000
	Rainwater harvest	Jumla bazar	10	Jumla bazar	30000	15000
	Biomass mulching	Lassi gaun	2	Lassi Gau	3000	500
	Apple picker ladder	Jumla bazar	10	Jumla bazar	25000	4000

3.2.3 Scoring and ranking of gender-responsive technologies

The scoring and ranking methods prioritised agricultural technologies from a gender perspective in each of the study site. The scoring criteria uses the criteria of drudgery reduction, affordability, utility, accessibility, and technology performance, to systematically prioritise shortlisted technologies. The top five technologies based on scoring were prioritised in each study site (see Table 7).

The implementation of drip irrigation and bio-pesticides in municipalities like Triveni and Budhinanda reveals considerable promise in reducing labour-intensive responsibilities historically borne by women, including manual watering and pest management. The implementation of these technologies has the potential to enhance time management for women by significantly reducing the time spent on manual irrigation and crop maintenance. The time that has been saved can be effectively used to participate in activities focused on skill enhancement, capacity building, and leadership development. Conversely, moderate scores for mini tillers indicate that, while this equipment has the potential to reduce physical labour, challenges related to accessibility and ergonomic design may still be present, which could restrict its use among women. Technologies tailored to infrastructure in Tatopani, like enhanced cooking stoves, carry significant gender-related consequences. These efficient stoves can lessen the duration women dedicate to cooking and gathering fuel, thereby positively influencing health and allowing time for additional productive endeavours. Innovations such as vermicomposting in Swamikartik, recognised

TABLE 7 TOP FIVE TECHNOLOGIES BASED ON SCORES ACROSS STUDY SITES

Municipalities	Ranking	Technology	Score
Budhinanda	1	Drip irrigation	4.15
	2	Biopesticide	4.08
	3	Knapsack sprayer	3.77
	4	Tunnel house	3.64
	5	Mini tiller	3.36
Swamikartik	1	Vermicompost	3.95
	2	Tunnel house	3.81
	3	Mini Tiller	3.6
	4	Combined rice mill	3.5
	5	Multicrop thresher	3.3
Triveni	1	Biopesticide	4.02
	2	Drip irrigation	3.88
	3	Plastic pond	3.78
	4	Tunnel house	3.67
	5	Mini tiller	3.25
Tatopani	1	Biomass mulching	3.75
	2	Improved cookstove	3.58
	3	Irrigation canal	3.58
	4	Advanced nursery	3.48
	5	Drip irrigation	3.43
Patarasi	1	Biomass mulching	3.78
	2	Biopesticide	3.7
	3	Drip irrigation	3.63
	4	Plastic pond	3.51
	5	Plastic tunnel	3.35

for their role in improving soil health, can be crucial for women who usually oversee household farms and gain direct advantages from enhanced crop yields. The findings indicate that although specific agricultural technologies are acknowledged for their ability to empower women through labour reduction and productivity enhancement, there are still obstacles concerning accessibility, design appropriateness, and market penetration that require attention. Focusing on these areas can effectively address gender disparities in technology adoption, enabling women in agriculture to fully leverage these advancements.

3.2.4 SWOT analysis

A SWOT analysis offers a comprehensive view of the deployment and prospects of gender-responsive technologies within each municipality, highlighting the strengths, weaknesses, opportunities, and threats linked to these technologies. Generally, technologies listed for the study sites support women farmers in tackling agricultural challenges brought about by climate change, including limited access to irrigation water and pest and disease outbreaks, while also alleviating their workload. These technologies are gender-friendly and both men and women can operate and benefit from them. However, socio-cultural barriers and gaps in technical skills may threaten equality and inclusivity in agricultural technologies. Management of financial resources for the adoption of technologies and actions to improve the capacity and leadership of women are crucial in each municipality. This analysis can guide targeted technological interventions to maximise the impact of gender-responsive technologies on women's empowerment and agricultural productivity.

3.2.5 Technology action plan

Table 8 below presents a systematic overview of strategic interventions and actions aimed at the adoption of essential agricultural technologies in the study areas, emphasising the resolution of challenges and the utilisation of opportunities. For mini tillers, obtaining microfinancing is essential to alleviate substantial upfront expenses and enhance adoption rates. Power tillers necessitate modifications for use on steep terrains, which can be accomplished through collaborations with engineering institutions. Offering subsidies and microfinance solutions to address financial limitations can facilitate the quicker adoption of tunnel houses, ultimately improving the protection of crop yields. Integrated rice milling facilities, crucial for enhancing milling efficiency and minimising losses, can be effectively promoted via on-site demonstrations. Training initiatives have the potential to enhance the uptake of vermicomposting by tackling the existing gaps in knowledge and expertise, thus facilitating a transition to organic agriculture. Lift irrigation plays a vital role in high-altitude regions, and it is essential to utilise governmental assistance for infrastructure development while providing training for maintenance to ensure a dependable water supply. Cold storage solutions are essential for minimising post-harvest losses and enhancing market access, relying on the facilitation of investment capital via grants and loans. The targeted technological interventions aim to improve efficiency, sustainability, and productivity in farming communities.

TABLE 8 TECHNOLOGY ACTION PLAN

Technologies	Location	Constraints (Challenges)	Opportunities (Leverage points)	Proposed interventions	Activities	Expected outcomes
Mini tillers	Patarasi, Swamikartik Triveni, Patarasi, Budhinanda	High initial cost of technology	Availability of microfinancing option	Facilitate access to microfinancing	Partner with microfinance institutions	Increased technology adoption rates
Power tillers	Triveni Swamikartik	Steep terrain makes it inefficient in some areas	Existing small-scale tillers can be adapted to the terrain	Promote the development of terrain-suitable models	Partner with engineering institutions to modify machinery	Improved functionality of machinery in hilly landscapes
Tunnel houses	Swamikartik, Budhinanda	Lack of capital to set up large tunnel houses	Government and NGOs promoting tunnel farming	Provide access to subsidies and microfinance options	Partner with microfinance to raise awareness about subsidies	Increased adoption of tunnel houses and improved productivity
Combined rice mills	Triveni Swamikartik	Limited availability of modern milling facilities	Introduction of modern rice mills in some areas	Promote the adoption of combined mills through demonstrations	Partner with mill suppliers for on-site demos and training	Increased milling efficiency, reduced post-harvest losses
Vermi composting	Tatopani	Lack of awareness and technical skills in vermiculture	Growing interest in organic farming practices	Conduct training programmes and provide vermicomposting units	Collaborate with NGOs and agri-extension workers for workshops	Increased adoption of organic farming, improved soil fertility
Lift irrigation	Swamikartik	High altitude, high maintenance costs, low water source	Government support for water infrastructure projects	Increase access to subsidies and technical support	Collaborate with local engineers for installation and maintenance training	Reliable water supply, improved irrigation efficiency
Cold storage	Patarasi, Swamikartik, Triveni, Patarasi, Budhinanda	Large initial investment, limited access to financing	Government and NGOs promoting storage technologies	Facilitate access to investment capital through grants/loans	Partner with banks and the government for cold storage financing options	Reduced post-harvest losses, improved market access

SECTION IV

Conclusions and recommendations

4.1 Conclusions

This study demonstrates how gendered agricultural labour and access to agricultural technologies is across the hill and highland areas of Jumla and Bajura districts of Nepal, where deeply entrenched social conventions continue to shape unequal divisions of labour, restricted access to resources, and limited participation of women in agricultural decision making and technology adoption. While donor interventions have improved women's access to training and community roles in agriculture, unpaid care work and unequal access to land, finance, and institutional support continue to hinder their full participation in agricultural innovation.

Technology assessments that consider gender are vital for highlighting how suitable technologies, like drip irrigation and improved harvesting methods, can improve farming. These technologies can reduce strenuous labour especially for women, increase farm productivity, and create fairer farming systems for everyone.

However, the widespread adoption of these technologies faces obstacles. Strong cultural norms can prevent farmers from accepting new practices. Farmers, particularly women, may lack the skills to use and maintain the technology. Limited financial control and access to credit make it hard to invest in technologies. Limited land ownership, especially for women, discourages long-term investments. Poor infrastructure, such as unreliable transportation and electricity, further limits the usefulness of these technologies.

These ongoing problems reduce the overall effectiveness of technology in agriculture. More importantly, they reinforce existing inequalities in how agricultural benefits are distributed between men and women. This prevents technology from driving positive change and fair growth in farming communities. Targeted efforts are needed to overcome these challenges.

Dealing with these problems calls for both inclusive grassroots activity and fundamental policy-level reform. Important actions include legally safeguarding women's land rights, including gender-responsive planning into agricultural extension services, and increasing access to reasonably priced finance and subsidies for women farmers. Concurrently, supporting community-based systems including inclusive farmer cooperatives, women-led technology user groups, and local maintenance hubs helps to ensure fair access, increase local capacity, and sustain innovation uptake.

This study's rigorous, data-driven approach (using scoring, SWOT, and affordability analyses) offers a replicable framework for local governments and development organisations to prioritise technology. It highlights that equitable agricultural development depends on usability, control, and institutional support, not just access. Scaling gender-responsive technology in Nepal's highlands requires coordinated, multi-stakeholder efforts to dismantle institutional barriers and empower women as equal drivers of agricultural transformation and climate resilience.

4.2 Recommendations

Based on research examining gender roles, resource access, and technology adoption in Jumla and Bajura, the subsequent recommendations aim to facilitate equitable adoption and ensure sustainability of gender-responsive agricultural technologies. The key recommendations based on this study's findings are:

1. Establish local demonstration and learning centres for gender-responsive agricultural technologies.

Supported by development partners and agricultural research institutes, municipal governments may set up community-based demonstration and learning centres in every municipality to improve the use, acceptance, and contextual relevance of agricultural technologies. These centres may:

- **Use participatory approaches** that actively engage both men and women farmers in piloting and testing high-potential, gender-responsive technologies (e.g., drip irrigation, vermicompost, plastic tunnels);
- **Incorporate visual tools and experiential learning**, offering hands-on training tailored to different literacy and learning abilities;
- **Establish peer-learning hubs** to facilitate farmer-to-farmer knowledge exchange and create continuous feedback loops to support the adoption of agricultural technologies;
- **Document and disseminate pilot result**s to inform policy development and guide future scaling strategies.

These efforts directly fill knowledge voids, foster local ownership, and increase women's confidence in handling farming implements.

2. Address socio-cultural barriers through structured, community-led engagement.

Discriminatory norms and gendered social conventions continue to restrict women's participation in farming and related decision-making processes. Local governments, NGOs, and community groups may help dismantle these barriers through multi-level community-driven engagement strategies, including:

- **Gender awareness campaigns**, using culturally appropriate platforms such as village dialogues, street theatre, and community radio to spark conversations and challenge norms;
- **Male engagement programmes**, encouraging local men to act as advocates for women's leadership in agriculture and for the equitable sharing of household responsibilities;
- **Integration of gender modules into agricultural extension training**, ensuring frontline staff members are equipped to recognise and address gender dynamics in their work;
- **Collaborate with religious and community leaders** to foster alliances that challenge exclusionary practices and promote inclusive community norms and policies.

These initiatives may be integrated into municipal development strategies to guarantee long-term social transformation and sustained behavioral change.

3. Improve and organise financial services for women farmers.

Women's access to agricultural technologies is significantly constrained by their limited access to financial resources. To address this challenge, collaboration between municipal governments, cooperatives, and microfinance institutions is essential. The following measures are recommended:

- Establish collateral-free microcredit programmes targeted at women farmers, including revolving funds to improve financial access and resilience.
- Provide technology-specific subsidies, such as for irrigation systems or mini tillers, with affirmative action mechanisms (e.g. quotas) and streamlined application procedures accessible to women with limited literacy.
- Enhance women's financial autonomy by supporting training in digital banking courses and financial literacy, enabling women to manage finances confidently and take independent decisions.
- Develop gender-sensitive tracking systems that use gender-disaggregated data to monitor resource use and inform future programme design and policy formulation.

These measures may enhance women's economic agency and ensure their broader participation in agricultural modernisation.

4. Conduct gender-responsive skills mapping and deliver targeted capacity development.

Each municipality may conduct a gender disaggregated skills assessment to identify technical and leadership gaps, ensuring equitable adoption of agricultural technologies. Based on the findings, the following actions are recommended:

- Develop and implement modular training programmes covering technology operation and maintenance, organic farming, market access, and leadership skills.
- Launch mobile training initiatives and utilise community learning centres to reach women in remote and inaccessible areas.
- Encourage greater participation of women in cooperatives, user groups, and agricultural governance bodies through targeted courses on leadership, negotiation, and decision making.
- Co-design all trainings with local women's groups to ensure relevance, ownership, and alignment with national agricultural extension strategies.

Building women's skills not only facilities wider technology uptake but also empowers them as leaders in agricultural innovation and resilience.

These recommendations are grounded in the lived experiences of farmers from Jumla and Bajura and are designed to operationalise gender-equitable agricultural development. By combining institutional reform, community engagement, financial inclusion, and capacity building, stakeholders may ensure that gender-responsive technologies do not merely exist but thrive as instruments of empowerment, productivity, and resilience.

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Annexes

Annex 1: Longlist of the agricultural technologies across the study sites

S.N.	Budhinanda	Swamikartik	Triveni	Tatopani	Patarasi
1	Biopesticide	Biopesticide	Biopesticide	Biopesticide	Biopesticide
2	IPM Trap	IPM Trap	IPM Trap	IPM Trap	IPM Trap
3	Foot sprayer	Foot sprayer	Foot sprayer	Knapsack Sprayer	Knapsack Sprayer
4	Knapsack Sprayer	Knapsack Sprayer	Knapsack Sprayer	Mini Tiller	Mini Tiller
5	Mini Tiller	Mini Tiller	Mini Tiller	Spade	Drip Irrigation
6	Spade	Spade	Spade	Drip Irrigation	Canal irrigation
7	Drip Irrigation	Drip Irrigation	Drip Irrigation	Canal irrigation	Plastic Pond
8	Canal irrigation	Canal irrigation	Canal irrigation	Plastic Pond	Cement Pond
9	Plastic Pond	Plastic Pond	Plastic Pond	Cement Pond	Intercropping
10	Soil Cement Pond	Soil Cement Pond	Soil Cement Pond	Intercropping	Lift Irrigation
11	Mulching	Intercropping	Intercropping	Lift Irrigation	Water Mill
12	Vermicompost	Mulching	Mulching	Snow Collection Pond	Mulching
13	Compost Manure	Vermicompost	Vermicompost	Mulching	Vermicompost
14	Farmyard Manure	Compost Manure	Compost Manure	Vermicompost	Farmyard Manure
15	Plastic Tunnel	Farmyard Manure	Farmyard Manure	Farmyard Manure	Plastic Tunnel
16	Water Mill	Plastic Tunnel	Plastic Tunnel	Plastic Tunnel	Relay Cropping
17	Solar Dryer	Water Mill	Water Mill	Water Mill	Combine Thresher
18	Combine Thresher	Cold store	Corn Sheller	Relay Cropping	Mixed Cropping
19	Combined rice mill	Combined rice mill	Combine Thresher	Combine Thresher	Combined rice mill
20	Jab planter	Seed Bank	Lift Irrigation	Mixed Cropping	Improved Cowshed
21	Mixed Cropping	Cellar Store	-	Combined rice mill	Solar Dryer
22	Improved Cowshed	-	-	Improved Cowshed	Compost Manure
23	Intercropping	-	-	Solar Dryer	-
24	-	-	-	Compost Manure	-

Annex 2: Scoring of agricultural technology in Budhinanda Municipality

SN	Main criteria	Weight (%)	Sub-criteria	Weight (%)	Tunnel house		Knapsack sprayer		Biopesticide		Mini tiller		Drip irrigation	
					Score	Weight score	Score	Weight score	Score	Weight score	Score	Weight score	Score	Weight score
1	Drudgery reduction	20	Reduction in manual labour required	10	3.00	0.30	4.00	0.40	4.00	0.40	4.25	0.43	4.00	0.40
			Reduction in time required to complete tasks	10	2.75	0.28	4.33	0.43	3.60	0.36	4.50	0.45	5.00	0.50
2	Affordability	20	Initial cost of technology	10	3.00	0.30	2.67	0.27	4.00	0.40	2.50	0.25	2.67	0.27
			Maintenance costs	5	3.75	0.19	2.67	0.13	4.00	0.20	2.25	0.11	3.33	0.17
			Total cost of ownership	5	3.25	0.16	2.67	0.13	3.80	0.19	2.50	0.13	2.67	0.13
3	Utility	20	User-friendliness: Is the technology easy to use?	10	4.25	0.43	4.33	0.43	4.40	0.44	3.50	0.35	5.00	0.50
			Training requirements: What level of training is required for users?	5	3.50	0.18	4.00	0.20	3.60	0.18	2.50	0.13	3.67	0.18
			Scalability: Can the technology scale to meet future needs?	5	4.25	0.21	4.67	0.23	4.00	0.20	3.75	0.19	4.67	0.23
4	Accessibility	20	Available in market and easy to repair	10	3.75	0.38	4.33	0.43	4.60	0.46	3.00	0.30	4.67	0.47
			Availability of training and support resources	5	3.50	0.18	3.00	0.15	3.60	0.18	2.50	0.13	3.33	0.17
			Inclusivity (gender responsive as well socially inclusive)	5	4.00	0.20	4.00	0.20	4.60	0.23	3.75	0.19	4.67	0.23
5	Technology performance	20	Energy consumption	10	4.00	0.40	3.33	0.33	4.60	0.46	3.50	0.35	4.67	0.47
			Functionality: Does the technology perform the required functions effectively?	5	4.50	0.23	4.00	0.20	3.80	0.19	4.25	0.21	4.33	0.22
			Sustainability: Is the technology environmentally sustainable?	5	4.50	0.23	4.33	0.22	3.80	0.19	3.25	0.16	4.33	0.22
	Total max score :					3.64		3.77		4.08		3.36		4.15

Annex 3: Scoring of agriculture technology in Swamikartik rural municipality

SN	Main criteria	Weight (%)	Sub-criteria	Weight (%)	Tunnel house		Mini tiller		Multicrop thresher		Vermicompost		Combined rice mill	
					Score	Weight score	Score	Weight score	Score	Weight score	Score	Weight score	Score	Weight score
1	Drudgery reduction	20	Reduction in manual labour required	10	4	0.4	5	0.5	5	0.5	4.33	0.43	5	0.5
			Reduction in time required to complete tasks	10	3.6	0.36	5	0.5	4.6	0.46	3.33	0.33	4.25	0.425
2	Affordability	20	Initial cost of technology	10	3	0.3	2.8	0.28	2.2	0.22	3	0.3	2.75	0.275
			Maintenance costs	5	4.4	0.22	3	0.15	3	0.15	4.33	0.22	3	0.15
			Total cost of ownership	5	3.4	0.17	3.2	0.16	2.4	0.12	3.33	0.17	2.75	0.1375
3	Utility	20	User-friendliness: Is the technology easy to use?	10	4.4	0.44	3.4	0.34	2.8	0.28	4.67	0.47	3.75	0.375
			Training requirements: What level of training is required for users?	5	3.6	0.18	3.6	0.18	3.8	0.19	4	0.2	3	0.15
			Scalability: Can the technology scale to meet future needs?	5	4.2	0.21	4.4	0.22	4.2	0.21	4	0.2	3.75	0.1875
4	Accessibility	20	Available in market and easy to repair	10	3.6	0.36	2.8	0.28	2.4	0.24	3.33	0.33	3	0.3
			Availability of training and support resources	5	3.6	0.18	2.8	0.14	2.6	0.13	3.33	0.17	3.25	0.1625
			Inclusivity (gender responsive as well socially inclusive)	5	4	0.2	2.8	0.14	3.4	0.17	4.67	0.23	3.5	0.175
5	Technology performance	20	Energy consumption	10	3.8	0.38	3.2	0.32	2.8	0.28	4.67	0.47	3.25	0.325
			Functionality: Does the technology perform the required functions effectively?	5	4.4	0.22	4.6	0.23	4.2	0.21	4	0.2	3.5	0.175
			Sustainability: Is the technology environmentally sustainable?	5	3.8	0.19	3.2	0.16	2.8	0.14	4.67	0.23	3.25	0.1625
	Total max score:					3.81		3.6		3.3		3.95		3.5

Annex 4: Scoring of agricultural technology in Triveni Municipality

SN	Main criteria	Weight (%)	Sub-criteria	Weight (%)	Tunnel house		Rainwater harvest/Plastic Pond		Biopesticide		Mini tiller		Drip irrigation	
					Score	Weight score	Score	Weight score	Score	Weight score	Score	Weight score	Score	Weight score
1	Drudgery reduction	0.2	Reduction in manual labour required	10	4	0.4	4.00	0.40	4	0.4	4.8	0.48	4	0.4
			Reduction in time required to complete tasks	10	4	0.4	3.67	0.37	4	0.4	4	0.4	4.4	0.44
2	Affordability	0.2	Initial cost of technology	10	2.6	0.26	3.00	0.30	3.75	0.375	2.4	0.24	3.2	0.32
			Maintenance costs	5	3.2	0.16	4.33	0.22	4.5	0.225	2.6	0.13	3.6	0.18
			Total cost of ownership	5	3	0.15	3.00	0.15	4	0.2	3	0.15	3.4	0.17
3	Utility	0.2	User-friendliness: Is the technology easy to use?	10	4	0.4	4.33	0.43	3.75	0.375	2.4	0.24	4.2	0.42
			Training requirements: What level of training is required for users?	5	3.2	0.16	3.67	0.18	3.75	0.1875	3	0.15	3.6	0.18
			Scalability: Can the technology scale to meet future needs?	5	4	0.2	4.00	0.20	3.5	0.175	3.6	0.18	3.4	0.17
4	Accessibility	0.2	Available in market and easy to repair	10	4	0.4	3.67	0.37	4.25	0.425	3.6	0.36	3.6	0.36
			Availability of training and support resources	5	3.4	0.17	3.00	0.15	3.75	0.1875	3.2	0.16	3.6	0.18
			Inclusivity (gender responsive as well socially inclusive)	5	4.2	0.21	4.00	0.20	4.5	0.225	2.4	0.12	4	0.2
5	Technology performance	0.2	Energy consumption	10	3.6	0.36	4.67	0.47	4.75	0.475	3.2	0.32	4.8	0.48
			Functionality: Does the technology perform the required functions effectively?	5	4.2	0.21	4.00	0.20	3.5	0.175	3	0.15	3.6	0.18
			Sustainability: Is the technology environmentally sustainable?	5	3.8	0.19	3.00	0.15	4	0.2	3.4	0.17	4	0.2
	Total max score					3.67		3.78		4.025		3.25		3.88

Annex 5: Scoring of agricultural technology in Tatopani Rural Municipality

SN	Main criteria	Weight (%)	Sub-criteria	Weight (%)	Irrigation canal		Improved cookstove		Advanced nursery		Mulching		Drip irrigation	
					Score	Weight score	Score	Weight score	Score	Weight score	Score	Weight score	Score	Weight score
1	Drudgery reduction	20	Reduction in manual labour required	10	4	0.4	4.67	0.467	4	0.4	3.33	0.33	4.67	0.47
			Reduction in time required to complete tasks	10	4	0.4	3.33	0.33	3.67	0.37	3	0.3	4	0.4
2	Affordability	20	Initial cost of technology	10	3	0.3	3	0.3	3	0.3	5	0.5	3	0.3
			Maintenance costs	5	2	0.1	2.67	0.13	4	0.2	3.33	0.17	4	0.2
			Total cost of ownership	5	3.33	0.17	3.67	0.18	3.33	0.17	4	0.2	3.33	0.17
3	Utility	20	User-friendliness: Is the technology easy to use?	10	4.33	0.43	4.67	0.47	3.67	0.37	4.67	0.47	3	0.3
			Training requirements: What level of training is required for users?	5	3	0.15	2	0.1	3.33	0.17	3.33	0.17	3.67	0.18
			Scalability: Can the technology scale to meet future needs?	5	3.67	0.18	3	0.15	4	0.2	4	0.2	4.33	0.22
4	Accessibility	20	Available in market and easy to repair	10	4.33	0.43	3.33	0.33	3.67	0.37	4.67	0.47	3	0.3
			Availability of training and support resources	5	3.33	0.17	2.67	0.13	3.33	0.17	3.33	0.17	2.67	0.13
			Inclusivity (gender responsive as well socially inclusive)	5	5	0.25	5	0.25	4	0.2	4.67	0.23	3.33	0.17
5	Technology performance	20	Energy consumption	10	3	0.3	3.33	0.33	1.67	0.17	1.33	0.13	2	0.2
			Functionality: Does the technology perform the required functions effectively?	5	3	0.15	4.33	0.22	4.33	0.22	4	0.2	4	0.2
			Sustainability: Is the technology environmentally sustainable?	5	3	0.15	3.67	0.18	4	0.2	4.33	0.22	4	0.2
	Total max score					3.58		3.58		3.48		3.75		3.43

Annex 6: Scoring of agricultural technology in Patarasi Rural Municipality

SN	Main criteria	Weight (%)	Sub-criteria	Weight (%)	Biopesticide		Plastic tunnel		Mulching		Plastic pond		Drip irrigation	
					Score	Weight score	Score	Weight score	Score	Weight score	Score	Weight score	Score	Weight score
1	Drudgery reduction	20	Reduction in manual labour required	10	3	0.3	3.33	0.33	3.75	0.38	4	0.4	3.67	0.37
			Reduction in time required to complete tasks	10	3	0.3	3	0.3	3.75	0.375	3.75	0.375	4	0.4
2	Affordability	20	Initial cost of technology	10	4.5	0.45	2.33	0.23	4	0.4	2.25	0.225	3.33	0.33
			Maintenance costs	5	4	0.2	2	0.1	3.75	0.1875	3	0.15	3	0.15
			Total cost of ownership	5	4.25	0.21	2	0.1	3.75	0.188	3.75	0.188	3.33	0.167
3	Utility	20	User-friendliness: Is the technology easy to use?	10	3.25	0.325	3.33	0.33	3.75	0.375	4.5	0.45	4	0.4
			Training requirements: What level of training is required for users?	5	3.5	0.175	3.33	0.167	3.75	0.1875	3.75	0.1875	3.67	0.183
			Scalability: Can the technology scale to meet future needs?	5	3.5	0.175	3.67	0.183	3.75	0.1875	3.75	0.1875	3.67	0.183
4	Accessibility	20	Available in market and easy to repair	10	4.5	0.45	4	0.4	3.75	0.375	3.25	0.325	3.67	0.367
			Availability of training and support resources	5	4	0.2	4	0.2	4.25	0.2125	3.25	0.1625	3.33	0.167
			Inclusivity (gender responsive as well socially inclusive)	5	3.75	0.1875	3.67	0.183	4.25	0.213	3.5	0.175	4.33	0.217
5	Technology performance	20	Energy consumption	10	3.25	0.325	4.33	0.43	3	0.3	3.5	0.35	3.33	0.33
			Functionality: Does the technology perform the required functions effectively?	5	3.5	0.175	3.667	0.183	3.75	0.188	3.25	0.163	3.33	0.167
			Sustainability: Is the technology environmentally sustainable?	5	4.5	0.225	4	0.2	4.25	0.2125	3.5	0.175	4	0.2
	Total max score:					3.7		3.35		3.78		3.51		3.63

Annex 7: Case studies

CASE STUDY 1: EMPOWERING COMMUNITIES THROUGH CLIMATE-SMART AGRICULTURE


Tika Oli Giri explaining the gray water collection system

As part of the LI-BIRD project, Tika Oli Giri, a Local Resource Person (LRP) at Tatopani, is leading the dissemination of climate-smart agriculture technologies. Her work focuses on innovative solutions such as tunnel houses, biopesticides, vermicompost, rainwater harvesting ponds, and gray water collection systems. Tika's efforts in adapting these technologies are already yielding remarkable results. The introduction of tunnel houses and biopesticides has enabled the production of off-season crops while ensuring healthier plant growth. Vermicompost and rainwater harvesting have improved the availability of organic manure and water resources, greatly enhancing crop productivity. Tika is also dedicated to empowering women in her community by sharing her knowledge and skills, helping them understand and adopt these technologies, which leads to improved productivity and livelihoods beyond her own household. Her community-centred approach ensures that the benefits of these innovations go beyond her own farming activities. While the adoption of these technologies is promising, continuous support and training are necessary to maximise their potential. Tika's work exemplifies the critical role of LRPs in facilitating sustainable agricultural practices and highlights the importance of supporting women-led initiatives in rural areas. Her commitment to enhancing agricultural practices through climate-smart technologies not only boosts her productivity but also fosters a culture of shared growth and development in Tatopani, illustrating the transformative power of innovative agricultural solutions in improving both economic and social outcomes for rural communities.

CASE STUDY 2: EMPOWERING WOMEN THROUGH POTATO CHIPS PRODUCTION IN PATARASI


Women farmers associated with Durga Devi Bahudeshiya Sahakari Sanstha Ltd.

In the heart of Patarasi, Durga Devi Bahudeshiya Sahakari Sanstha, a women-led cooperative consisting of 300 households, is dedicated to generating income through the production of potato chips. By leveraging local potato harvests, these women have successfully added value to a traditional regional product, creating a robust income stream for their community. The cooperative's success is bolstered by support from the Department of Agriculture and the installation of necessary machinery by KIRDARC. This strategic collaboration has enabled the efficient processing of potatoes, transforming them into a popular snack that caters to local markets and beyond. To ensure the potato chips meet quality standards, ongoing food testing is being conducted to refine taste and appeal. Profits generated from sales are strategically reinvested into the cooperative, ensuring the organisation's sustainability and potential for growth. Despite their success, the cooperative faces significant challenges regarding machinery maintenance. With limited access to spare parts and skilled repair personnel in the area, ensuring the continued operation of their production line has become increasingly difficult. Addressing this gap is crucial for sustaining their business momentum. The introduction of machinery has dramatically reduced the physical labour traditionally associated with potato processing, making tasks 100% more efficient. This technological advancement has not only improved productivity but has also empowered women by saving time, allowing them to focus on other productive activities and family commitments. This case study of Durga Devi Bahudeshiya Sahakari Sanstha highlights the transformative potential of combining local agricultural resources with modern technology and support from government and NGOs. To further advance, the establishment of a local market for machine parts and the training of skilled technicians are critical. Promoting technologies that improve both time management and economic returns is essential for the broader development of women-led initiatives in rural communities.

CASE STUDY 3: CHALLENGES IN RENEWABLE ENERGY IMPLEMENTATION IN DANGIBADHA, TATOPANI

Solar power system of Tatopani, Jumla

The experience in Dangibadha, Tatopani, with the installation of solar and wind power systems offers crucial insights into technology adoption, particularly regarding gender-responsive technologies (GRTs). Initially successful in enhancing residents' quality of life, the project eventually faltered due to prohibitive repair costs, echoing challenges that GRTs might face if sustainable maintenance and support plans are lacking. Just as the solar systems were abandoned, GRTs can become obsolete without financial strategies that secure ongoing funds for maintenance and upgrades. This underscores the importance of local capacity building, empowering community members, especially women, with skills for maintenance and troubleshooting to prevent technological failure. Training female technicians can specifically address gender disparities and promote women's active roles in technology management, ensuring sustainability. Moreover, the financial barriers observed in Dangibadha are analogous to those encountered in GRT adoption, necessitating the establishment of financial models such as microcredit or subsidy programmes to make these technologies affordable and sustainable. Community engagement is also critical involving women in decision making ensures technologies meet local needs and enhances community buy-in, vital for long-term success. Partnerships for continuous technical support can further prevent the abandonment of technologies, mirroring the need to avoid similar setbacks in GRT projects. Overall, comprehensive planning that includes sustainable maintenance, financial strategies, and robust community involvement is essential to prevent pitfalls and ensure lasting empowerment and benefits.

CASE STUDY 4: THE CHALLENGES OF A WOMEN FARMER IN AGRICULTURE

Hari Devi Budha is a young married woman and mother of two children, managing her household and farm work alone while her husband works in India. She faces the immense challenge of balancing agricultural duties with her role as a mother, having returned to the fields just two months after giving birth. Her 3-year-old son attends school on his own, as her demanding schedule leaves her with little time for self-care or nurturing her children. Lacking community support, she has limited access to agricultural technologies and information, exacerbating her daily struggles. Her isolation from community networks prevents her from accessing vital resources and support systems. As a young mother with minimal guidance, she feels shy and hesitant to participate in programmes that could offer assistance, highlighting the challenges faced by women when men migrate for work. This situation emphasises the need for targeted outreach and support for isolated women in agriculture. Solutions should include encouraging inclusive community practices, developing targeted programmes to reach isolated women, providing empowerment initiatives to build confidence, and creating childcare support to allow mothers to focus on their work and personal well-being. To truly empower women in similar situations, agricultural and community systems must be inclusive and responsive to their unique challenges, providing accessible support and information to significantly improve their livelihoods and family well-being.

Hari Devi Budha working harvesting beans from her field (left) and weeding the rice field (right)

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ICIMOD and its Regional Member Countries gratefully acknowledge the generous support of Austria, Norway, Sweden and Switzerland for core and programme funding, and the Adaptation Fund, Aerospace Information Research Institute of the Chinese Academy of Sciences, Asian Development Bank, Australia, Canada's International Development Research Centre, Carleton University, Finland, Germany, Global Affairs Canada, Global Biodiversity Information Facility, Japan's Sasakawa Peace Foundation, Oxfam Novib, the United Kingdom, United Nations Environment Programme, and United Nations Development Programme and the World Bank Group for project funding.

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