

ROLE OF GENDER, IMPROVED AGRICULTURAL TECHNOLOGY AND NON-FARM
EMPLOYMENT IN HOUSEHOLD WELLBEING IN NEPAL

By

Bineeta Gurung

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

Community Sustainability – Doctor of Philosophy

2023

ABSTRACT

Nepal is a developing country with 65% of its population engaged in agriculture and more than 25% of its population living below poverty line. Given the importance of agricultural growth for poverty reduction, substantial amount of resources have been invested to promote agricultural growth. Despite the emphasis on agricultural growth through research, extension and related services, farm productivity in Nepal remains significantly low. The agricultural sector in Nepal has grown much slower than elsewhere in South Asia. As a result, many questions have been raised about rural household wellbeing: What role does gender play in rural agricultural systems? How effective are current development interventions in improving household welfare? What impact does the non-farm sector have on the welfare of rural households? To explore these questions, among others, this dissertation examined three elements of rural development efforts in an international context: empirical examination of gender differences in rural livestock production; evaluation of the effect of agricultural technology on rural households' welfare; and analysis of the role of non-farm sector in rural household food security.

This dissertation is built around three independent essays based on data collected from villages in Nepal's Kaski district. The first essay titled **“Gender and Livestock Ownership in Rural Households of Kaski District in Nepal,”** incorporates an analysis of gender component into livestock research by using sex-disaggregated data to empirically analyze women's ownership of livestock in rural farm households. The second essay titled **“Effect of Off-Season Tomato Production on Crop Income and Food Security in Nepal,”** establishes a causal linkage between off-season tomato production inside plastic tunnels and households' crop income and food security using the nearest neighbor matching method. The final essay titled **“Impact of Rural Non-Farm Employment on Food Security in Nepal,”** examines the effect of

rural non-farm employment on rural household food security by using two distinct matching methods: propensity score matching and direct covariate matching. On the basis of findings from the three essays, this dissertation provides gender sensitive and evidence based feedback for policy making to promote positive and sustainable development.

To my dear father, Lalit Man Gurung, in loving memory.

ACKNOWLEDGEMENTS

First and foremost, I would like to thank my advisor and mentor Dr. Michael Kaplowitz. This dissertation would not have been possible without your expert guidance, kind patience and continued support during setbacks in my academic and personal life. Thank you for always offering me encouragement and seeing me through to the end of the program. I would also like to express my profound gratitude to my advisory committee, starting with Dr. Frank Lupi. I am deeply grateful to you for giving me countless hours of your valuable time to meticulously work on this dissertation. I am eternally thankful to Dr. Murari Suvedi for believing in me, always championing my research ideas and providing disciplinary insights whenever I needed it. Thank you for everything you have done for me both at professional and personal levels to help me achieve my goal. I will forever remain indebted to you. Finally, to Dr. Maria Lopez, thank you for your valuable research inputs early in my doctoral program.

I am deeply thankful to the incredible people of Hamsapur, Siddha and Thumki villages along with the field assistants who helped me in conducting the survey. This dissertation would not have been possible without your cooperation and participation. I am also grateful to the Department of Community Sustainability (CSUS) for funding this dissertation and providing me a lifetime opportunity to pursue my dream of getting a doctoral degree. I will forever cherish my time with the CSUS family.

To my family, I thank you for being my rock. Words cannot express my gratitude to my husband Sanjay and our dearest son Siddhi for bringing so much joy in my life and making me a better person. Although I began my PhD journey without you, I feel blessed to have you both witness it conclude successfully. To my mother, father-in-law, mother-in-law, brother, sisters-in-law, brother-in-law, nieces and nephews, thank you for your unconditional love, sacrifice, unwavering support, and faith in me. I love you all very much.

And finally, to my dear father in heaven, thank you for watching over me. You are gone but your belief in me has made this journey possible.

TABLE OF CONTENTS

LIST OF TABLES.....	viii
LIST OF FIGURES	x
LIST OF ABBREVIATIONS.....	xi
INTRODUCTION	1
REFERENCES.....	4
ESSAY ONE: GENDER AND LIVESTOCK OWNERSHIP IN RURAL HOUSEHOLDS OF KASKI DISTRICT IN NEPAL	5
REFERENCES.....	51
ESSAY TWO: EFFECT OF OFF-SEASON TOMATO PRODUCTION ON CROP INCOME AND FOOD SECURITY IN NEPAL	58
REFERENCES.....	85
ESSAY THREE: IMPACT OF RURAL NON-FARM EMPLOYMENT ON FOOD SECURITY IN NEPAL.....	89
REFERENCES.....	116
CONCLUSION AND IMPLICATION FOR POLICY AND RESEARCH	123
APPENDIX A: HOUSEHOLD SURVEY QUESTIONNAIRE (ENGLISH VERSION).....	128
APPENDIX B: HOUSEHOLD SURVEY QUESTIONNAIRE (NEPALI VERSION).....	154
APPENDIX C: SURVEY DATA COLLECTION MANUAL	191

LIST OF TABLES

Table 1.1: TLU conversion rate for South East Asia.....	19
Table 1.2: Characteristics of sampled households by caste/ethnicity	23
Table 1.3: Livestock owned by men, women and jointly according to women and men respondent in Hamsapur village.....	27
Table 1.4: Livestock owned by women, men and jointly by different caste group according to women in Hamsapur village	29
Table 1.5: TLU held by men, women and jointly according to female and male respondents in Hamsapur village	31
Table 1.6: TLU held by men, women and jointly among different caste and ethnic groups according to women in Hamsapur village.....	32
Table 1.7: Food security score (FSS) reported by women in households that raised livestock Vs households that did not raise livestock (N=263).....	40
Table 1.8: Food security score (FSS) reported by men in households that raised livestock Vs households that did not raise livestock (N=263).....	40
Table 1.9: Description of variables with their mean and standard deviation.....	42
Table 1.10: Regression results of FS score for female respondents using model 1a	44
Table 1.11: Regression results of FS score for female respondents using model 2a	45
Table 1.12: Regression results of FS score for male respondents using model 2a	45
Table 1.13: Regression results of FS score for male respondents using model 2b.....	46
Table 2.1: Average characteristics of the households in comparison group and treatment group... ..	71
Table 2.2: Average characteristics of the households in control group and treatment group after matching.....	72
Table 2.3: Impacts of offseason tomato production in plastic tunnel on crop income and food security using nearest neighbor matching method.....	73
Table 2.4: Challenges associated with off-season tomato production.....	74
Table 2.5: Perception to off-season tomato production among off-season tomato growers.....	75
Table 2.6: Barriers associated with adoption of off-season tomato.....	76

Table 2.7: Barriers associated with adoption of off-season tomato according to three caste groups	77
Table 2.8: Reasons for discontinuation of off-season tomato in plastic tunnels (N= 58)	78
Table 2.9: Average characteristics of households that discontinued vs continued growing off-season tomato in plastic tunnels.....	78
Table 3.1: Choice of variables used in the probit model for propensity score matching	97
Table 3.2: Average characteristics of sampled households and farm managers	105
Table 3.3: Probit estimates of propensity score for participation in non-farm employment	107
Table 3.4: Results of balancing test after propensity score matching.....	108
Table 3.5: Impacts of non-farm work participation on food security score using propensity score matching model and direct covariate matching model	111
Table 3.6: Characteristics of sampled households and farm managers after direct covariate matching showing no difference in covariates between the two groups	112

LIST OF FIGURES

Figure 1.1: Map of Nepal showing Kaski district (highlighted in red).....	16
Figure 3.2: Distribution showing standard percent bias across covariates in the matched and unmatched samples	110
Figure 3.3: Kernel density distribution showing overlap between participant and non-participant households.....	110

LIST OF ABBREVIATIONS

ATT	Average treatment effect
DCM	Direct covariate matching
FS	Food security
HFIAS	Household food insecurity access scale
ICDF	Indragufa Community Development Foundation
Kg	Kilogram
NNM	Nearest neighbor matching
NRs	Nepalese rupee
ODK	Open data kit
PSM	Propensity score matching
SDG	Sustainable development goal
TLU	Tropical livestock unit

INTRODUCTION

Poverty elimination and food security are global challenges and continue to be important issues in the field of international development. Goal one of the United Nations' Sustainable Development Goals (SDGs) targets to "end poverty in all its forms everywhere" by the year 2030 (UN, 2015). Stated another way, by the year 2030, no person in the world will live below \$1.25 per day. To address the issue of food security, goal two of the United Nations' SDGs aims to "end hunger, achieve food security and improved nutrition, and promote sustainable agriculture," by the year 2030 (UN, 2015).

Given the important role of agricultural growth for poverty reduction and food security in developing countries (Christiansen et al., 2011; De Janvry and Sadoulet, 2010; Valdés and Foster, 2010; World Bank, 2007), international and domestic development efforts have increasingly focused on improving agricultural productivity by promoting new farming technologies and practices among farmers with the hope that doing so will enhance the livelihoods and opportunities for rural households engaged in agriculture. Nepal, a developing country with 65% of its population engaged in agriculture and more than 25% of its population living below poverty line (World Bank, 2020), provides an ideal opportunity to study, evaluate and better understand agriculture's roles in promoting sustainable and positive rural development.

Nearly 80% of Nepal's population live in rural areas and depend on subsistence farming for their livelihoods with 55% of the rural population living in poverty (World Bank, 2020). In spite of this large section of population engaging in agriculture, Nepal is not able to produce sufficient food. The country has become reliant on food import to a large extent and food security remains a challenge (Adhikari et al., 2021). A recent survey conducted by the World

Food Programme (WFP), reported 23% of the 4416 surveyed households across Nepal had inadequate food and 7% had poor dietary diversity (WFP, 2020). To address the issue of rural poverty and food insecurity, over the years, Nepal government has invested substantial amount of resources in promoting agricultural growth in the country. Despite the emphasis on agricultural growth, farm productivity remains low in Nepal (Anik et al., 2017). Agriculture in Nepal has grown much slower than elsewhere in South Asia (Dekvota and Upadhyay, 2013). Loss of agricultural productivity due to environmental degradation, non-adoption of improved farm technologies, inefficient market mechanisms, and inadequate outreach of agricultural extension agents in remote areas have been identified as possible reasons for poor agricultural growth (Bhandari & Grant, 2007).

As a result, many questions have been raised about farming systems in rural Nepal. For example; What role, if any, does gender play in rural agricultural production systems and how does gender differences affect household welfare? How effective are current development interventions in increasing and securing rural household welfare? What impact does the non-farm sector have in improving welfare of rural households? To explore these questions, among others, this dissertation will examine three elements of rural development efforts in an international context: empirical examination of gender differences in rural households' livestock production; evaluation of the effect of agricultural technology on rural households' welfare; and analysis of the role of non-farm sector on rural household food security.

This dissertation is built around three independent essays based on data collected from Nepal's Kaski district. The first essay seeks to incorporate the gender component into livestock research by empirically analyzing female farmer's ownership of livestock. The second essay investigates the impact of off-season tomato production in plastic tunnels (also known as

polyhouse) on household's crop income and food security. The final essay examines the impact of rural non-farm employment on household food security.

The following sections consist of three essays presented as separate manuscripts. The dissertation ends with a conclusion based on findings from all three studies.

REFERENCES

- Adhikari, J., Timsina, J., Khadka, S. R., Ghale, Y., & Ojha, H. (2021). COVID-19 impacts on agriculture and food systems in Nepal: Implications for SDGs. *Agricultural Systems*, 186, 102990.
- Anik, A. R., Rahman, S., & Sarker, J. R. (2017). Agricultural Productivity Growth and the Role of Capital in South Asia (1980–2013). *Sustainability*, 9(3), 470.
- Bhandari, B. S., & Grant, M. (2007). Analysis of livelihood security: A case study in the Kali-Khola watershed of Nepal. *Journal of environmental Management*, 85(1), 17-26.
- Christiaensen, L., Demery, L., & Kuhl, J. (2011). The (evolving) role of agriculture in poverty reduction—An empirical perspective. *Journal of development economics*, 96(2), 239-254.
- De Janvry, A., & Sadoulet, E. (2010). Agricultural growth and poverty reduction: Additional evidence. *World Bank Research Observer*, 25(1), 1-20.
- Devkota, S., & Upadhyay, M. (2013). Agricultural productivity and poverty reduction in Nepal. *Review of Development Economics*, 17(4), 732-746.
- United Nations. (2015). Open Working Group of the General Assembly on Sustainable Development Goals.
- Valdés, A., & Foster, W. (2010). Reflections on the role of agriculture in pro-poor growth. *World Development*, 38(10), 1362-1374.
- World Bank. (2007). *World Development Report: Agriculture for Development*. New York: Oxford University Press.
- World Bank. (2020). Food security and COVID-19.
- World Food Programme. (2020). COVID-19 will double number of people facing food crises unless swift action is taken. *Media release*.

ESSAY ONE: GENDER AND LIVESTOCK OWNERSHIP IN RURAL HOUSEHOLDS OF KASKI DISTRICT IN NEPAL

Introduction

Livestock play an integral role in the livelihoods of smallholder farmers in developing countries. Livestock are an important source of protein and help households achieve food security. Additionally, they generate employment opportunities and provide income. In rural households, livestock also serve as insurance in times of crop failure, illnesses, and other emergencies. Because livestock are the only productive assets owned by vulnerable groups such as women and the landless, livestock production is widely promoted as a pathway out of poverty for women and disadvantaged rural households with limited assets (Heffernan et al., 2003).

Globally, women contribute more labour and devote more time than men in farm activities (Kristjanson et al., 2010). Unfortunately, studies show that women have not benefitted equally from farm-related activities (Kristjanson et al., 2010). Traditionally, most decisions related to farm management including livestock production have been made by male heads of household. Women's exclusion from decision-making roles in the farm and household has been hypothesized to be because they have no control on the means of production like land, livestock, water etc. (Galab & Rao, 2003; Shicai & Jie, 2009). Women's lack of access to service and input delivery systems in livestock production also severely constrain women's production potential (Sinn et al., 1999; Shicai & Jie 2009). According to FAO (2011), when women are given equal access to the same level of resources as men, agricultural productivity is likely to increase by 10-30 % and agricultural output by 4%. Therefore, sustainable development interventions aimed at improving the wellbeing of female farmers must work in and account for community contexts and help create space for advancing gender equity. This study attempts to advance our

understanding of the role of livestock ownership by female smallholder household members as part of efforts to improve the welfare of rural women and their households in Nepal.

Livestock in Nepal

In Nepal, livestock production accounts for 26 percent of the agricultural GDP (MOALD, 2022) and is an important economic activity in rural areas. Farm animals such as cattle, buffalo, goats, pigs, and chickens form part of the livelihood portfolios of Nepali farmers. Gender roles in farm households in rural Nepal include women keeping livestock (farm animals are women's domain) while growing crops is considered men's domain (Upadhyay, 2005). Women are enlisted with tasks such as preparing animal feed, collecting manure, cleaning sheds, and making milk products. Activities like collecting fodder, animal grazing, and milking are undertaken by both men and women (Upadhyay, 2005). This difference in roles and responsibilities between men and women has resulted in women's livestock production significant role across wealth groups and agro-ecologies in Nepal (Gurung et al., 2005).

Women and livestock

Livestock are popular non-land assets owned by rural households (Kristjanson et al., 2010). Assets of a household determine its ability to meet the material needs of the family (Sparr & Moser, 2007). In addition to fulfilling material needs, household assets provide the basis of agency. Agency is described as the "power to act, to reproduce, challenge or change the rules that govern the control, use, and transformation of resources" (Sen, 1997). Women's asset ownership has been found to increase women's bargaining power (Friedemann-Sánchez 2006) and their role in household decision-making (Agarwal, 1998, Agarwal, 2002; Mason, 1998). Women's ownership of livestock has been also found to reduce the gender asset gap within

households (Kristjanson et al., 2010). The gender asset gap provides a measure of gender inequality and is used as an indicator of women's empowerment (Grown et al., 2005).

Despite the importance of asset distribution for women and household welfare, information on intra-household ownership is scant because most data on asset ownership are collected at the household level (Doss et al., 2007). Furthermore, information on intra-household asset ownership and decision-making has not been typically collected in household studies. Though empirical information on women's livestock ownership across the world is limited, we know and there is evidence showing women do own livestock (Kristjanson et al., 2010). Usually, smallholder farmer women tend to own smaller livestock such as chicken, goats, and pigs while men own larger farm animals like cattle and buffaloes (Kristjanson et al., 2010). Despite the common perception that women do not own cattle and buffalo, Heffernan et al. (2003) reported that landless women in India owned bullocks and rented them to other farmers. In another study, men and women were found to report owning similar numbers of cattle in East Africa (Grace, 2007). In Nepal, Devkota et al. (2015) reported that women owned buffaloes.

It is important to note that ownership of livestock by women however does not necessarily mean that women actually control and enjoy decision-making power over the animal or the income from it (Doss, 2013). Likewise, women may have access to livestock, livestock products, and income from their sale while not being the owners of livestock (Huss-Ashmore, 1996). Devkota et al. (2015) found that decisions regarding buffalo production and marketing in Nepal were usually made jointly. In cases where decisions were made by a single gender, more men than women were found to be dominant in the decision-making process. Due to the complex nature of livestock ownership, control, and benefits, it is important to establish if women can make livestock decisions independently or if they need to consult with male members of the

family. Therefore, it is important to look at access and control over livestock while studying gender dimensions of livestock ownership in Nepal.

Research focus

This paper identifies and works to address three research gaps. First, there is very limited empirical information on women's livestock ownership and decision-making in rural Nepal. Devkota et al. (2015) reported that most decisions regarding buffalo production and marketing in Nepal are made jointly by a husband and wife. However, joint decision-making could often be a form of male dominance in disguise. Better understanding of intra-household decisions can shed light on possible gender inequities. Gender inequalities may be better understood by examining the number and value of livestock owned by women, women's control and benefit from such livestock, and the role of animal agriculture on women's household food security. To this end, this paper seeks to empirically examine women's ownership of livestock and food security in rural Nepal.

Second, most data on asset ownership in developing country contexts are collected at the household level in ways that were not designed to capture intra-household dynamics and asset (livestock) ownership (Doss et al., 2007). Studies using household level data on livestock ownership have made comparisons between male-headed households and female-headed households but they do not shed light on intra-household dynamics, household decision-making processes, and female ownership and/or control of livestock. Collecting individual level data on livestock ownership may be an improvement over the household level data collection method because data collection on household assets and access to resources provides insights on the relationship between heads of household. Gender studies on livestock in Nepal (Gurung et al., 2005; Upadhyay, 2005) to date have tended to collect individual data from female respondents

only when they are solo heads of household. This approach of data collection, while nominally capturing some input from women, has neglected to address men's and women's joint roles in livestock production. Therefore, to address such a gap in the literature, this study collected individual-level data on livestock ownership and decision making from both male and female heads of a household, when a household had both a male and female head of household. Thus sex-disaggregated data were collected from our sample. Ambler et al. (2021), Devkota et al. (2015), and Njuki, et al. (2013) have used this approach in their studies to help determine who in a household owns livestock. Collecting sex-disaggregated data also allows for an opportunity to capture the interaction between men and women in a household. Asking men and women from the same household the same question adds a meaningful and unique dimension because previous empirical evidence has shown that men and women from the same households do not operate as a single unit, but instead individual household members are likely to have different objectives and thus are likely to function independently (Ambler et al., 2021; Njuki, et al., 2013). At the same time, individual household members can also choose to function jointly.

Finally, a host of studies have shown that livestock ownership benefits households by improving welfare outcomes such as food security (Miller et al., 2022; Nkomoki et al., 2019; Dumas et al., 2018; Hetherington et al., 2017; Mango et al., 2014; Ali & Khan, 2013). Livestock ownership can play an important role in improving household food security by increasing availability of animal-sourced food as well as increasing household income through sale of animals and animal products (Njuki et al., 2013). However, such studies have overlooked the influence of intra-household livestock ownership patterns on household food security. Therefore, this paper attempts to examine if women's livestock ownership is related to households' level of food security.

Objectives

This study aims to use sex-disaggregated data to:

- Explore patterns of livestock ownership by men and women in smallholder farms in Kaski district, Nepal.
- Understand the contribution of different livestock species as well as total livestock owned by men and women in Kaski district of Nepal.
- Study the means of livestock acquisition of women in Kaski district of Nepal.
- Investigate the association between women's ownership of livestock and household food security.

Methodology

Food security and livestock ownership

Food security was initially defined by USAID (1992) and WFS (1996) as “a situation when all people at all times have both physical and economic access to sufficient, safe and nutritious, food to meet their dietary needs and food preferences for an active, productive and healthy life.” Later in 2002, FAO included the “social” access dimension in the definition, stating “food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.” This expansion of the concept of food security resulted in the comprehensive framing of the availability, access, utilization, and stability dimensions of food security (Qureshi, Dixon, & Wood, 2015).

According to FAO (2017), an estimated 815 million people worldwide suffered from food insecurity in 2016 compared to 777 million people in 2015. In more recent years, the global covid pandemic negatively affected food security in low and middle-income countries (LMICs)

by impacting employment, income generation, and associated purchasing power (Picchioni et al., 2021). This increasing trend in food insecurity poses a challenge to achieving the United Nations' second sustainable development goal to end hunger, reduce food insecurity, and improve nutrition by 2030.

In the context of increasing food insecurity, understanding the determinants of household food security has been a priority for researchers, planners, and policymakers across the world. Many studies have been carried out using different variables and methodologies to identify determinants of food security. Some important determinants of food security among rural smallholder farmers have included individual characteristics like gender and education of household head; household characteristics such as family size, farm size, livestock ownership, and institutional characteristics such as access to credit and group membership. Female-headed households were found to be more food insecure than male-headed households in studies from South Africa (Tibesigwa & Visser, 2016) and Kenya (Kassie et al., 2014). Higher level of household head's education has been found to increase household's food security status in South Africa (De Cock et al., 2013), India (Maitra & Rao, 2015), Pakistan (Zhou et al., 2019), and Nepal (Regmi et al., 2019). Households with smaller family size were less likely to be food insecure in rural South Africa (De Cock et al., 2013); Kenya (Kabunga et al., 2014), India (Maitra & Rao, 2015) and Nepal (Regmi et al., 2019). Regarding farm size, household food security has been found to increase with increases in farm size (Regmi et al., 2019; Frelat et al., 2016; Koirala et al., 2016). Farmer's membership in groups has been found to indirectly contribute to improving food security by increasing household income (Mojo et al., 2017; Ma & Abdulai, 2016; Verhofstadt & Maetens, 2015; Fischer and Qaim, 2012). Livestock ownership and income from livestock were also found to positively influence food security (Miller et al.,

2022; Nkomoki et al., 2019; Dumas et al., 2018; Hetherington et al., 2017; Mango et al., 2014; Ali & Khan, 2013).

The role of livestock in improving household food security is well documented in literature (Njuki et al., 2013). Livestock ownership improves nutritional security by providing direct access to animal-source protein (Hetherington et al., 2017; Rawlins et al., 2014). Livestock also contribute to food security by acting as buffer against external shocks like droughts, flood and more recently the global covid pandemic. When there is food shortage, income from sale of livestock and livestock products directly contribute towards food security by increasing households' purchasing power (Miller et al., 2022). Even when there is no shortage of food, income from livestock was found to improve nutritional security by increasing diversity in diet (Fratkin & Smith, 1995). However, the degree to which livestock influences household food security is dependent on the intra household dynamics. For instance, women and men differ in how they use and make decisions regarding the assets they own. And studies have shown that women tend to have fewer assets than men (Deere & Doss, 2006). Therefore, it is critical to study the role of intra-household allocation of livestock assets in order to properly understand the implication of livestock on improving household food security.

Calculating food security

Many approaches have been developed globally to measure food security (Jones et al., 2013). In our study, to measure household food security status, we used the Household Food Insecurity Access Scale (HFIAS) developed in 2007 by USAID. The HFIAS was developed in an effort to better manage the complications associated with measuring food security (Bilinsky & Swindale, 2010; Coates, Swindale, & Bilinsky, 2007). The HFIAS measures household food security using three core domains to measure food access. The three domains are: i) anxiety and

uncertainty about the household food supply, ii) insufficient quality including variety and preferences of the type of food, and iii) insufficient food intake and its physical consequences. This somewhat subjective rapid rural appraisal analyses respondents' perceptions of their household food security experiences over the previous four weeks. This approach relies on individual perceptions of food security which may be criticized for potential inaccuracies or biases associated with short-term self-reporting (Headey & Ecker, 2013).

In our study, we used the “short version” of the HFIAS to measure respondents' perception of household food security. We asked three occurrence questions relating to: i) uncertainty about household food supply, ii) insufficient quality and assortment of food, and iii) insufficient food intake. Each primary occurrence question was followed by a subsequent question on frequency of the occurrence. The three domain questions reflecting the occurrence of food insecurity were:

1. In the past four weeks, did you worry that your household would not have enough food?
2. Because of a lack of resources in the past four weeks, did you or any household member have to eat some foods that you really did not want to eat?
3. Because of lack of resources in the past four weeks, did you or any household member have less food than you needed in a day?

Each occurrence question had a ‘Yes’ or ‘No’ response. A ‘Yes’ response prompted the frequency question, which has 3-response options- rarely, sometimes, or often-coded in order of increasing frequency from 1 to 3. The sum of frequencies of occurrence (during the past four weeks) resulted in a food insecurity score ranging from 0 to 9, with 0 indicating food secure and

9 indicating food insecure. To create a score with a positive direction, a food security score was calculated as:

$$\text{Food security score} = (\text{Food insecurity score} - 9) * (-1)$$

Thus, our study's food security score ranges from 0 to 9 with, 0 indicating food insecure and 9 indicating food secure.

Materials and methods

Study area

The study was conducted in and around Hamsapur village of Kaski district in Nepal. Kaski district, one of 77 districts in Nepal, covers an area of 2017 square kilometers in the western part of Nepal (Fig.1.1). Kaski includes the 'major' city of Pokhara as well as parts of the Annapurna mountain range. The study area is markedly rural being more than 17 km away from the nearest city, Pokhara. The study area stretches from 600 to 1200 metres above sea level. Subsistence agriculture with a mixed crop-livestock production system is the chief source of livelihood in the study area (Suvedi et al., 2017). Due to the mixed crop-livestock production system, livestock play an important livelihood function in the region making it ideally suitable to study the system of women's livestock ownership and decision-making in rural households of Nepal.

Hamsapur village is a small village consisting of 691 households in Rupa 7 of Rupa Rural Municipality of Kaski district. There are three predominant caste/ethnic groups of people in Hamsapur village. The Hindu high caste group comprising of Brahmin and Chhetri makes up 44% of the total population in Hamsapur (Field survey, 2018). This high caste group has traditionally high social and political status. The second group (hereafter referred to as ethnic minority) is comprised of people belonging to different ethnic groups with their own languages

and Nepali as their second language. This group makes up 29% of the total population of Hamsapur village. The third group of people (low caste) in Hamsapur is made up of the people in the Dalit group that falls at the bottom of the caste hierarchy system with low social and political status. This group makes up 27% of the total population in Hamsapur.

Data collection

Data for this study was collected using household surveys during April and May 2018. For the household survey, a comprehensive list of all households in Rupa 7 was compiled with the help of the local NGO, Indragufa Community Development Foundation (ICDF). The ICDF staff used official household lists from election office, together with follow-up and supplemental interviews with local officials and key informants, to assemble a household list for Rupa 7. This list includes the heads of household's name as well as the neighborhood of the household within the village. Subsequently, each household on the list was also coded as high caste, ethnic minority, or low caste based on the family names of the household heads. In this region of Nepal, family names almost always signal individual's ethnicity/caste. When a household's family name was ambiguous, follow-up inquiries were made with key informants to properly code the household in question. The resulting household list provided a high-quality basis for drawing random samples for the household survey.



Figure 1.1: Map of Nepal showing Kaski district (highlighted in red)

A stratified random sampling method was followed to incorporate caste and ethnicity components in the study sample. A total of 263 households were randomly selected for the survey. Before conducting the interviews, the survey instrument was appropriately pretested in the field and uploaded in the local Nepali language on Android tablets using Open Data Kit (ODK) software. Two Nepali female enumerators were hired to assist the primary field researcher in data collection. The enumerators were thoroughly trained to conduct interviews as well as to operate the Android tablet to enter (and backup) survey data.

The survey questionnaire was administered to 263 randomly selected households that had both male and female heads because we wanted to capture intra-household dynamics of livestock ownership. In the field, 91 households were found to be single-headed households (one of household heads (spouses) was absent due to death, divorce, or emigration). We did not include these households in our study. To compensate for solo-headed households dropped from the study, additional random households were added to the sample. In the end, a total of 526 face-to-face interviews were administered to the final sample of 263 households with both a male and female head.

The survey questionnaire had two separate modules, one administered to primary respondents and another to secondary respondents. Primary respondents in this study are defined as the adult household member that made the majority of the farm decisions. The primary respondent could be either the male head or the female head of the household. Secondary respondent are the second head of the household that did not necessarily make key farm decisions. The participants in this study self identified as primary or secondary respondents based on whether they made the majority of the farm decisions or not. Each household in this study had one primary and one secondary respondent. Both modules administered to primary and secondary respondents contained information on household livestock, assets, and food security. The primary module contained additional information on farm activities and different sources of household income. The module administered to the secondary respondents contained supplementary information on household members. In total the 526 interviews were conducted with 101 women and 162 men who were primary respondents. Among the secondary respondents, 162 were women and 101 were men.

To increase the likelihood of capturing respondent's objective perspective of livestock ownership, men and women were interviewed away from each other as much as possible. Two different enumerators interviewed the male and female respondents from the same household, simultaneously and separately. In some cases, men and women were interviewed on different dates when it was not possible to interview both on the same day.

Data analysis

Data obtained from the survey was analyzed using STATA software. Both descriptive and inferential statistics were employed to investigate the link between gender, livestock ownership, and household food security in the study area. In addition to means comparison,

simple regression analysis was used to explore the association between gendered ownership of livestock and household food security. The explanatory variables were tested for multicollinearity by calculating the variance inflation factor (VIF). Some of the calculations used to assist our analysis of data are described below.

Defining livestock ownership at intra-household level

Women ownership of livestock does not necessarily mean women control and enjoy decision-making power over the animal or the income from it (Doss, 2013). Similarly, while women may have access to livestock, livestock products and income from sale, they may not be owners of livestock (Huss-Ashmore, 1996). Devkota et al. (2015) found that decisions regarding buffalo production and marketing were usually made jointly. In cases where decisions were made by a single gender, more men than women were found by Devkota et al. to be dominant in the decision-making process. Due to the complex nature of livestock ownership, it is important to establish if women can make decisions independently or if they need to consult with male members of the family. Therefore, in this study, ownership of livestock is defined as not only having access to livestock but also being able to make decisions regarding the sale of livestock. To obtain the number of livestock, for instance cattle, owned by an individual, respondents were asked the following questions: out of the total cattle in your household, a) how many cattle belongs to you that you can sell without consulting your spouse? b) how many cattle belongs to your spouse that s/he can sell without consulting you? The remaining cattle that could not be sold without consulting with each other was counted as jointly owned cattle.

Tropical livestock units (TLU)

Tropical Livestock Units (TLUs) was used to compare the relative value of a household's livestock owned separately and jointly by men and women. The TLU calculation in this study

follows the South East Asia values recommended by Chilonda & Otte (2006) for Food and Agriculture Organization (Table 1.1). The TLU calculated in this study does not account for the breed differences.

$$\text{Total livestock holding} = \sum_{i=1}^n \text{TLU}_i$$

Where n = number of species, TLU_i = TLU for species i .

Table 1.1: TLU conversion rate for South East Asia

Species	TLU equivalent
Cattle	0.65
Buffalo	0.7
Sheep/goat	0.1
Pig	0.25
Chicken	0.01
Duck/Turkey/Geese	0.03

Source: Chilonda & Otte (2006)

Infrastructure index

Household infrastructure providing access to basic facilities such as 1) toilet, 2) safe drinking water, 3) electricity and 4) improved stoves are well known to influence household wellbeing and food security (Gautam & Andersen, 2016). We used the above-mentioned four sub-components of household infrastructure to calculate a household infrastructure index. The index ranges from 0 to 1 to indicate low to high score respectively and has no measurement unit. To create the infrastructure index score we used the equation developed by UNDP (2014) to calculate human development indices. First, an index value was generated for all four sub-components using the following formula.

$$\text{Index } A_i = \frac{A_i - A_{\min}}{A_{\max} - A_{\min}}$$

where, A_i is the value of an indicator of a sub-component (e.g. access to toilet) and $A_{\max}$ and $A_{\min}$ are the maximum and minimum values of the indicator (0 & 1). Then, the remaining

three sub-components were standardized in a similar fashion. Averaging the index score of each sub-component using the following equation then derived a single index score:

$$I_i = \frac{\sum_{i=1}^n \text{Index } A_i}{n}$$

where I_i is the infrastructure index score for the household i , $\text{Index } A_i$ is index score of the sub-component of infrastructure and n is the number of sub-components which is 4 in this case.

Multiple linear regression models

Simple regression analysis was performed to analyze the relationship between dependent and independent variables. In our model, the dependent variable was food security score (FS score). When assessing correlation between livestock and food security, studies have taken either livestock income (Nkomoki et al., 2019; Wong et al., 2018) or the binary variable livestock ownership (Regmi et al., 2019) to assess if livestock influence food security. However, Dumas et al. (2018) found in their study that owning chicken affected dietary diversity negatively while increasing number of chicken affects dietary diversity positively. This indicates that using TLU, which represents the actual value of livestock owned instead of simply livestock ownership (yes or no), can give a better understanding of the relationship between livestock and food security for rural households. Mason et al. (2014) have used TLU for a livestock variable to assess the determinants of food security in Tanzania. Therefore, we use TLU for our livestock variable in the regression model. The independent variables in our model are: total household TLU, TLU held by men, TLU held by women, TLU held jointly, along with different individual and household characteristics. The other independent variables included in our model were age of

respondent, education of respondent, ethnicity, family size, farm size, infrastructure index, property ownership, and group membership. Description of all variables along with their mean and standard deviation are presented in Table 1.9.

When sex-disaggregated data is collected from multiple household members, studies have shown that spouses do not always give the same answer when asked who owns household assets or who makes decisions regarding those assets. For instance, men and women have been observed giving different answers when asked who owned household assets in previous studies (Kilic & Moylan, 2016). This difference in responses by men and women in the same household has been particularly evident when measuring bargaining power in the household (Ambler et al., 2020). Many studies have found lack of concordance between spouses' responses regarding women's autonomy and consumption decisions (Ambler et al., 2020; Anderson et al., 2017; Deere & Twyman, 2012; Allendorf, 2007; Ghuman et al., 2006; Becker et al., 2006). Men and women have reportedly disagreed about joint ownership of land and house (Jacobs & Kes, 2015; Twyman et al., 2015). We observed respective TLUs being reported differently by men and women in our study. Due to this difference in TLUs reported by men and women, we separately analyzed the regression models for men and women, because our household model did not explicitly allow for difference in perception of asset ownership. As a result, gender is not included as an independent variable in our regression model. Instead, we have opted to run independent regression models for men and women.

Model estimation

The models were estimated based on the following theoretical linear regression model:

$$Y_i = \beta_0 + \beta_1 X_i + \mu_i$$

Where, Y_i is the dependent variable (i.e. FS score), β_0 is the intercept, β_1 to β_n are the coefficients of corresponding independent variables, μ_i is a normal random distribution term of error and X_i represents independent variables i.e. individual and farm household characteristics.

Based on the above-mentioned theoretical model, we selected our independent variables and defined our linear regression models as follows:

$$\text{FS score}_i = \beta_0 + \beta_1 \text{TLU held by household}_i + \beta_2 \text{Age}_i + \beta_3 \text{Education}_i + \beta_4 \text{Ethnicity}_i + \beta_5 \text{Family size}_i + \beta_6 \text{Farm size}_i + \beta_7 \text{Infrastructure Index}_i + \beta_8 \text{Property ownership}_i + \beta_9 \text{Group membership}_i + \mu_i \dots \dots \dots \textbf{(Model 1a- women participants only)}$$

$$\text{FS score}_i = \beta_0 + \beta_1 \text{TLU held by household}_i + \beta_2 \text{Age}_i + \beta_3 \text{Education}_i + \beta_4 \text{Ethnicity}_i + \beta_5 \text{Family size}_i + \beta_6 \text{Farm size}_i + \beta_7 \text{Infrastructure Index}_i + \beta_8 \text{Property ownership}_i + \beta_9 \text{Group membership}_i + \mu_i \dots \dots \dots \textbf{(Model 1b- men participants only)}$$

$$\text{FS score}_i = \beta_0 + \beta_1 \text{TLU held by women}_i + \beta_2 \text{TLU held by men}_i + \beta_3 \text{TLU held jointly}_i + \beta_4 \text{Age}_i + \beta_5 \text{Education}_i + \beta_6 \text{Ethnicity}_i + \beta_7 \text{Family size}_i + \beta_8 \text{Farm size}_i + \beta_9 \text{Infrastructure Index}_i + \beta_{10} \text{Property ownership}_i + \beta_{11} \text{Group membership}_i + \mu_i \dots \dots \dots \textbf{(Model 2a- women participants only)}$$

$$\text{FS score}_i = \beta_0 + \beta_1 \text{TLU held by women}_i + \beta_2 \text{TLU held by men}_i + \beta_3 \text{TLU held jointly}_i + \beta_4 \text{Age}_i + \beta_5 \text{Education}_i + \beta_6 \text{Ethnicity}_i + \beta_7 \text{Family size}_i + \beta_8 \text{Farm size}_i + \beta_9 \text{Infrastructure Index}_i + \beta_{10} \text{Property ownership}_i + \beta_{11} \text{Group membership}_i + \mu_i \dots \dots \dots \textbf{(Model 2b- women participants only)}$$

Results and discussion

There were no distinct differences in household size and age of respondents across the different caste and ethnic groups in Hamsapur though male heads of the household were typically older than their female counterparts by six years (Table 1.2). Men had almost two times

more years of schooling compared to women with people from the low caste group reporting the least educational attainment. Buffalo, goat, and cattle were livestock kept by more than half of the households in all caste groups in Hamsapur. Disaggregated data shows that high caste group tended to keep big to medium livestock like buffalo, cattle and goat as compared to the other groups. Among the low caste group and ethnic group, local chickens are kept by a large majority of households. Broiler chicken were kept by only 8 percent high caste households, with 13 percent of ethnic households and 3 percent of low caste households reporting owning local chickens.

Table 1.2: Characteristics of sampled households by caste/ethnicity

	Caste/ ethnicity			Total
	High caste group	Ethnic group	Low caste group	
Number of households surveyed	126	79	58	263
Household size	3.17	3.73	3.48	3.41
Farm size (ha)	0.81	0.59	0.38	0.65
Male respondent characteristics				
Age (years)	57.19	55.13	54.36	55.94
Education (years of schooling)	7.89	6.34	4.56	6.69
Female respondent characteristics				
Age (years)	49.92	48.6	50.4	49.62
Education (years of schooling)	3.9	4.05	1.79	3.48
Household livestock information				
% keeping at least one livestock	91.27	87.34	94.83	90.87
% keeping cattle	51.59	34.18	65.52	49.43
% keeping buffalo	87.3	64.56	79.31	78.7
% keeping goat	78.57	67.09	53.45	69.2
% keeping pig	0	6.33	20.69	6.46
% keeping local chicken	12.7	54.43	68.97	37.64
% keeping broiler chicken	7.93	12.66	3.45	8.36

Source: Field survey, 2018

Patterns of livestock ownership

Men and women in our study reported different number of livestock they owned, their spouses owned, and both owned jointly (Table 1.3). Our findings are in line with evidence from other studies where men and women gave different responses when measuring asset ownership (Ambler et al., 2020; Jacobs & Kes, 2015; Twyman et al, 2015). To better understand the pattern

of livestock owned by women, we first looked at the frequency of households where women kept some form of livestock before turning to an inquiry into the proportion of livestock value owned by women.

Frequency of households in which women keep livestock

From the sample of livestock keeping households, according to women, the highest number of women keeping livestock reporting having local chicken, 44 percent of households' women report owning some local chicken. Across the different caste groups, 50 percent of high caste women reported owning some local chicken while 40 percent of low caste women and 47 percent of ethnic women reported keeping local chicken. In contrast, based on data collected from men, only 32 percent households had women owning some chicken. This seems to reveal that men and women have different perception of who owns their household's local chicken. Despite this difference in perception, it is clear that both men and women think that, compared to other livestock, local chicken is most frequently owned by women in Hamsapur.

According to women respondents, women owned broiler chicken in 19 percent of households that reported having broiler chicken. Broiler chickens were reported in less than 8 percent of households in the sample. This may reflect the commercial nature of broiler chicken farming which requires more skill and investment. Out of the households that reared broiler chicken, 50 percent of low caste households reported women owning some broiler chicken, while 30 percent of ethnic group households had broilers. Women in the high caste group apparently did not own broiler chickens. However, men reported that 32 percent of households had women owing some broiler chicken. This figure is 1.6 times more than the figure reported by women. While women in high caste households reported that they did not own any broiler chicken, men in high caste households keeping broiler chicken reported that women in 41.57

percent of these households owned some broiler chicken. While 50 percent women in low caste households owning broiler chicken reported they owned some of it, men reported this figure to be 33.33 per. Men in the ethnic group reported only 20 percent households compared to 30 percent reported by women, had women owning broiler chicken. Our findings suggest that while women in high caste households tend to perceive they have no ownership of broiler chicken, women in low caste and ethnic households tend to think they own more broiler chicken. Only a relatively small number of households (21) reported owning broiler chicken and therefore, caution in interpreting these results is warranted.

After local chicken, goat ownership was reported by about 26 percent of households. About 27 percent of households in the high caste group reported women owning goats, followed by 26 percentage of women in low caste group households, with 23 percent of women in the ethnic group reportedly owning goat.

In farm households with pig, it was reported that 24 percent of these households had pig owned by women. Overall, pig was reported to be raised by only 6 percent of households in the study area (Table 1.2). This reflects the social convention that high caste households, which make up the majority of the study population, do not raise pigs for religious reasons. Therefore, only women in the lower caste group and the ethnic group reported owning some pigs. This small pool of households (17 households) engaged in raising pig report only 4 households with women owning pigs.

Buffalo and cattle were reported to be raised by more than half of the surveyed households. Buffalo and cattle were reportedly owned by women in about 20 percent and 18 percent of households, respectively. Women in the high caste group and the low caste group reported owning more of these larger livestock than women in the ethnic group.

Our findings regarding women's high ownership of local chicken align with reports from other parts of the world. For instance, in the study by Njuki et al. (2013), women in Mozambique owned local chicken in over 50 percent of households that owned livestock. Okitoi et al. (2007) found 63 percent of chickens to be owned by women in Kenya. Similarly, Oluka et al. (2005) reported that 23 percent of chickens were owned by women in Uganda. Similarly, high goat ownership by women has also been reported in literature. Jaitner et al. (2001) reported that women owned 52 percent of goats in livestock owning households. Njuki et al. (2013) found that goat were owned by women in about 33 percent of households across Kenya, Tanzania, and Mozambique.

Our results are in line with the literature; women in the study are more likely to own small livestock (e.g., poultry, goats, and pigs) as compared to larger livestock (e.g., cattle and buffalo). The patterns of women's ownership of livestock across species have typically been determined by percentage of households in which women own different species. However, simply frequency of ownership data does not allow for the comparisons based on the relative value of livestock assets owned by men and women. That is, one cow owned by a person is much more valuable than several chickens. Therefore, we looked at the proportion of livestock owned by men, women, and jointly in households owning livestock.

Proportion of livestock owned by women, men, and both/jointly

Joint ownership was reported, by both men and women, for more than 50 percent of all livestock in the study area except broiler chicken where men were reported to own more broiler chicken than women (Table 1.3). Our results are somewhat in line with findings of Bonis-Profumo et al., (2022), who reported that more than 90 percent men and women identified livestock in the farm household to be jointly owned by spouses regardless of animal type/size.

Although a high number of households in our survey reported that women owned local chicken, the proportion of local chicken that women owned was not as high (Table 1.3). Meanwhile, women reported owning 2.6 times the number of local chicken (1.24) reportedly owned by men (0.47). However, when we look at the data reported by men, men reported owning more local chicken than local chicken owned by women. This conflicting report by men and women suggests that men and women do not necessarily have the same understanding of ownership of local chicken. In case of broiler chicken, although both men and women seem to agree that more men than women owned broiler chicken, the number of women-owned broiler chicken reported by women was almost double the number reported by men. This shows that determining ownership of small animals like poultry can be very tricky. Aside from local and broiler chicken data, there were no significant differences in the reports by men and women concerning ownership of other livestock.

Table 1.3: Livestock owned by men, women and jointly according to women and men respondents in Hamsapur village

	Stat	Women respondent			Men respondent		
		Women	Men	Joint	Women	Men	Joint
Cattle	Mean	0.13	0.2	0.43	0.16	0.21	0.38
	SD	0.51	0.59	0.78	0.57	0.53	0.76
	%	17.28	26.17	56.29	21.07	27.75	50.87
Buffalo	Mean	0.34	0.39	1.00	0.37	0.43	0.97
	SD	0.84	0.88	1.31	0.89	1.02	1.42
	%	19.56	22.64	58.02	20.72	24.35	54.68
Goat	Mean	0.98	0.92	1.95	0.95	0.87	2.08
	SD	2.5	2.85	3.17	2.62	2.19	3.62
	%	25.51	24.02	51.03	24.34	22.38	53.37
Pig	Mean	0.02	0.04	0.07	0.02	0.04	0.06
	SD	0.16	0.62	0.36	0.15	0.42	0.32
	%	14.62	32.17	52.65	13.83	34.57	51.85
Local chicken	Mean	1.24	0.47	1.76	0.82	1.06	1.62
	SD	3.61	2.33	4.92	2.99	3.75	4.45
	%	35.72	13.48	50.73	23.36	30.2	46.39
Broiler	Mean	2.19	13.96	6.76	1.33	15.59	10.96

Table 1.3 (cont'd)

SD	30.99	118.45	80.07	13.02	122.18	93.08
%	9.56	60.94	29.49	4.77	55.92	39.3

Source: Field survey, 2018

The data show that men were reported to have more cattle, buffalo, pig, and broiler chicken than women. According to women, women owned about 20 percent of cattle, 21 percent of buffalo, 15 percent of pig and 10 percent of broiler chicken. Women also reported men to own about 29 percent of cattle, 24 percent of buffalo, 31 percent of pig, and 61 percent of broiler chicken. Men had significantly greater numbers of cattle and broiler chicken than women. These findings further confirm the importance of local chicken and goats in women's livestock portfolio.

In terms of ethnicity, proportion of women's ownership of local chicken tends to be higher for women in the ethnic group than for those in high caste and low caste groups where a majority of local chicken is held jointly although, in all cases it appears that women own more local chicken than men own (Table 1.4). Previously, while studying the pattern of livestock ownership, more high caste households had women owning some local chicken than women in ethnic caste households. This finding suggests pattern of livestock ownership does not accurately reflect the proportion of livestock owned by women. Women in the high caste group reported joint ownership to be the most common form of ownership for all livestock. Women in the ethnic group reported more than 50 percent joint ownership for cattle, buffalo and goat. A high proportion of men reported owning pig and broiler chicken, while women owned the largest proportion of local chicken in the ethnic group. The women in the low caste group reported joint ownership as the most common form of ownership for all livestock except broiler chicken where women owned almost 84 percent of all broiler chicken.

It is important to keep in mind that percentages of livestock owned can be misleading if treated in isolation from the actual numbers of animals owned. For example, the percentage of the local chickens owned by women was about 36 percent of chickens owned, a much higher percentage than the 13 percent owned by men. However, in actual numbers, these percentages refer to an average flock size per household 3.5 birds. For broiler chicken, about 19 percent of households reported women owning broiler chicken. The proportion owned by women (about 10 percent) as compared to about 61 percent owned by men concerns an average flock size of about 25 birds. Broiler chicken was the only livestock where joint ownership was reported to be about 29 percent, as mentioned, joint ownership accounted for almost half of all other livestock owned by the household.

Table 1.4: Livestock owned by women, men and jointly by different caste group according to women in Hamsapur village

	Stat	High caste			Ethnic group			Low caste		
		Women	Men	Joint	Women	Men	Joint	Women	Men	Joint
Cattle	Mean	0.13	0.22	0.39	0.14	0.18	0.35	0.14	0.19	0.64
	SD	0.42	0.62	0.70	0.67	0.62	0.85	0.44	0.48	0.83
	%	17.16	30.03	52.55	20.78	26.45	52.90	14.22	19.55	65.77
Buffalo	Mean	0.42	0.56	1.04	0.24	0.23	0.84	0.29	0.24	1.16
	SD	0.97	1.06	1.25	0.68	0.62	1.33	0.70	0.63	1.39
	%	20.82	27.90	51.47	18.50	17.53	64.26	17.34	14.28	68.35
Goat	Mean	0.98	1.19	1.83	0.90	0.86	2.33	0.78	0.41	1.72
	SD	1.12	2.79	2.82	2.45	3.62	3.66	2.35	1.38	3.17
	%	24.49	29.84	45.75	21.97	21.05	56.95	26.66	14.22	59.25
Pig	Mean	0.00	0.00	0.00	0.03	0.13	0.04	0.05	0.02	0.26
	SD	0.00	0.00	0.00	0.23	1.13	0.19	0.22	0.13	0.71
	%	0.00	0.00	0.00	13.32	66.62	19.99	15.67	5.22	78.37
Local chicken	Mean	0.20	0.14	0.97	2.19	0.81	1.89	2.21	0.71	3.31
	SD	0.96	1.35	4.63	5.00	2.81	4.34	4.36	3.10	5.88
	%	15.15	10.91	73.91	44.78	16.57	38.57	35.48	11.36	53.22
Broiler chicken	Mean	0.00	12.00	13.65	6.66	27.22	0.72	0.86	0.17	0.00
	SD	0.00	95.76	115.47	56.26	179.17	4.17	6.57	1.31	0.00

Table 1.4 (cont'd)

%	0.00	46.78	53.22	19.25	78.68	2.09	83.70	16.74	0.00
---	------	-------	-------	-------	-------	------	-------	-------	------

Source: Field survey, 2018

Gender disparity in livestock ownership

In terms of gender disparity in livestock ownership, women owned 2.6 times more local chicken than men while men owned 6.37 times more broiler chicken than women (Table 1.3). Although women owned more goats than men there was no significant difference. Women reported men as owning significantly more cattle than women. Both men and women agreed that men owned a larger proportion of cattle than women.

Our findings are consistent with reports from Timor-leste (Bettencourt et al., 2015) and Kenya (Njuki et al., 2013) where men were found to own significantly more cattle than women and women owned more local chicken than men. In Tanzania, men owned 1.5 times more improved chickens (similar to broiler chicken) than women (Njuki et al., 2013).

Contribution of different species to total livestock holding

To understand farm household animal assets, we generated TLU for each household based on their reported animal ownership. Our findings show that for every unit of TLU owned by women, men owned 1.41 units of TLU. Most of women's TLUs came from owning buffalos (52.17 percent) and goat (21.74 percent) followed by cattle. Though women had greater ownership 'numbers' of local chicken compared to men, the total contribution of local chicken to women's TLU was only 2 percent (2.17 percent according to women/1.67 percent according to men). Broiler chicken contributed 4.35 percent to women's total TLU, which is higher than that contributed by local chicken although more women own local chicken than broiler chicken. Pigs contributed least TLU to women's livestock portfolio.

Despite claims that smaller livestock like chicken and goats are important to women because women have more decision-making authority over them, our findings suggest that larger animals are the key contributors to women's total TLU. For example, buffalo contributed more TLU than all other livestock put together.

Caste breakdown of proportion of TLU owned by men, women, and jointly, shows that while buffalo is still the major contributor of women's TLU, women in the ethnic group have only 38 percent contribution from buffalo, compared to women in high caste group who report 60 percent of TLU from buffalo and women in low caste group who report about 49 of TLU from buffalo. This shows the importance of buffalo for women in high caste group. In contrast, women in the low caste group and ethnic group report greater TLU contribution from cattle (~21 percent) than women in high caste group (~17 percent).

Table 1.5: TLU held by men, women and jointly according to female and male respondents in Hamsapur village

Livestock TLU	Women				Men			
	TLU (women-owned livestock)	TLU (men-owned livestock)	TLU (jointly-owned livestock)	t-values (women-owned, men-owned)	TLU (women-owned livestock)	TLU (men-owned livestock)	TLU (jointly-owned livestock)	t-values (women-owned, men-owned)
Cattle	0.09 (19.57)	0.13 (20.00)	0.28 (21.88)	-1.3668	0.10 (20.83)	0.13 (18.57)	0.24 (18.90)	-0.9716
Buffalo	0.24 (52.17)	0.27 (41.54)	0.70 (54.69)	-0.6622	0.26 (54.17)	0.30 (42.85)	0.68 (53.50)	-0.7223
Goat	0.10 (21.74)	0.09 (13.85)	0.20 (15.62)	0.2346	0.09 (18.75)	0.09 (12.86)	0.21 (16.54)	0.3456
Pig	0.005 (1.09)	0.01 (1.54)	0.02 (1.56)	-0.5766	0.004 (0.83)	0.01 (1.43)	0.01 (0.78)	-0.8316
Local chicken	0.01 (2.17)	0.005 (0.77)	0.02 (1.56)	2.842***	0.008 (1.67)	0.01 (1.43)	0.02 (1.57)	-0.8021
Broiler	0.02 (4.35)	0.14 (21.54)	0.07 (5.47)	-1.5561	0.01 (2.1)	0.16 (22.86)	0.11 (8.66)	-1.879**
Total	0.46	0.65	1.28	-1.5012	0.48	0.70	1.27	-1.614*

Notes: Numbers in brackets are percentage contribution of the species to TLUs.

***, **, *significant at 1%, 5% and 10% respectively.

Smaller animals like pig and chickens were not important contributors to women-held TLU for women in high caste group. Women in the low caste and ethnic groups held more TLU

from goat than men. High caste women held less TLU in goat compared to men however, the contribution of TLU from goat was greater for women than men in this group as in the other two caste groups. Therefore, goat appears to be an important livestock for women from an ownership perspective.

For women in the ethnic group, broiler chicken was an important TLU contributor (~15 percent) though it was much less compared to that of men (~41 percent). In high caste group, broiler chicken's contribution to TLU was much greater for men (~15 percent) compared to women (0.20 percent). Only in the low caste group, broiler chicken's TLU contribution was greater for women (~2 percent) than for men (~0.5 percent). This finding suggests that commercial production of livestock such as broiler chicken can be a highly gendered enterprise with more men benefitting than women.

We also found that women own significantly more TLU of local chicken than men in both the ethnic and low caste groups. In the high caste group, women own local chicken but there is no significant difference from men owning local chicken in this group. This finding supports the relative importance of local chicken ownership for women in developing countries like Nepal.

Table 1.6: TLU held by men, women and jointly among different caste and ethnic groups according to women in Hamsapur village

High caste	TLU (women-owned livestock)	TLU (men-owned livestock)	TLU (jointly-owned livestock)	t-values (women-owned, men-owned)
Cattle	0.08 (16.84)	0.14 (18.52)	0.25 (19.30)	-1.3634
Buffalo	0.29 (60.09)	0.39 (50.57)	0.73 (55.56)	-1.0192
Goat	0.11 (22.84)	0.12 (15.26)	0.18 (13.93)	-0.2006
Pig	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	N/A
Local chicken	0.002 (0.40)	0.001 (0.18)	0.01 (0.74)	0.3767
Broiler	0.001 (0.20)	0.12 (15.38)	0.14 (10.42)	-1.4066
Total	0.49	0.78	1.31	-1.553
Ethnic group				
Cattle	0.09 (20.57)	0.12 (17.19)	0.23 (21.33)	-0.3592

Table 1.6 (cont'd)

Buffalo	0.17 (38.26)	0.16 (23.81)	0.58 (54.15)	0.1147
Goat	0.09 (20.43)	0.09 (12.85)	0.23 (21.57)	0.0743
Pig	0.01 (1.44)	0.03 (4.72)	0.01 (0.88)	-0.7825
Local chicken	0.02 (4.98)	0.01 (1.21)	0.02 (1.75)	2.0379**
Broiler	0.07 (15.13)	0.27 (40.62)	0.01 (0.67)	-0.9679
Total	0.44	0.67	1.08	-0.8076
Low caste				
Cattle	0.09 (21.35)	0.12 (35.22)	0.41 (27.83)	-0.574
Buffalo	0.21 (48.85)	0.17 (48.28)	0.81 (54.27)	0.3877
Goat	0.08 (18.47)	0.04 (11.82)	0.17 (11.57)	0.9713
Pig	0.01 (3.08)	0.004 (1.23)	0.06 (4.34)	1.00
Local chicken	0.02 (5.25)	0.01 (2.02)	0.03 (2.22)	2.0371**
Broiler	0.01 (2.05)	0.002 (0.49)	0.00 (0.00)	0.7818
Total	0.42	0.35	1.49	0.4469

Notes: Numbers in brackets are percentage contribution of the species to TLUs.

***, **, *significant at 1%, 5% and 10% respectively.

Gender difference in perception of livestock ownership

As established in earlier sections, we found that men and women differed in their perceptions of who owned local chicken. There was not much difference in perception of who owned livestock such as cattle, buffalo, goat and pigs with both men and women agreeing that men owned more of these livestock than women. However both men and women reported they owned more local chicken than their spouse. Based on this finding, we may assume that the difference in the response between men and women to some extent reflects gendered roles and responsibilities. For instance, women might be inclined to think that they own more local chicken because they are the main caretakers and have more control over the sale of smaller livestock such as local chicken. On the other hand, men might think that since they have better access to market and market information compared to their female counterpart, they can make the decision to sell off the livestock without consulting their spouse.

We would not have been able to capture this difference in perception if we had not collected sex-disaggregated data from both men and women respondents in each household.

However, not much difference was reported for the ownership of majority of livestock, which begs the question if it is really worth interviewing both male and female participants given that significant time, and effort is consumed in the process. This is not to say that it is not important to collect sex-disaggregated data from both male and female participants in gender studies. As our findings suggest, interviewing both spouses reveal information asymmetries. Whether both spouses need to be interviewed depends on the research objectives, time and budget constraints. For instance, in this study our research question was limited to ownership of livestock based on who makes the decision to sell the livestock. However, if the study were to focus on assessing wide range of decisions such as who makes the decision to buy livestock (how many, what breed), the decision regarding feed type (crop residue, fodder, grazing), the decision concerning tasks (provision of feed, feed processing and storage, and feed sales or purchases), the decision to sell livestock (where/ when/ for how much) etc., it would be worth investigating the difference in response between both spouses. The contradiction in perceived decision-making could provide valuable insight into the gender roles and responsibilities assumed by men and women in livestock management. Similarly, if the research goal is to assess women's wellbeing, Ambler et al. (2022) state that it is better to take women's response when there is time and budget constraint.

Our study further revealed that both men and women perceived joint ownership for more than 50 percent livestock. While at first glance it may seem like men and women have equal role in making decisions regarding the sale of these jointly owned livestock, we did not further investigate what this joint ownership entailed. Ambler et al. (2022) reported that respondents often viewed joint decision-making as the “socially correct answer” and therefore reported joint

ownership although focal group discussions later revealed that men were more dominant than women in making decisions of jointly owned animals.

Means of acquisition of livestock by women

Understanding how women acquire livestock may help women build, secure and safeguard their assets. Knowledge about women's means of acquisition of livestock can help guide design and implementation of development interventions (Kristjanson et al. 2010). The principal means of livestock acquisition for women in Hamsapur was found to be through purchase with their own income (~56 percent) followed by livestock born into the herd (~33 percent). Gift from women's parents locally known as "pewa" was observed for ~6 percent of women owned livestock. Loans and grants were not common means of gaining livestock. Loan was reported for <4 percent of women-owned livestock and grants from both government and non-government organizations (NGOs) was reported for ~1 percent of women owned livestock.

It was reported that large livestock like cattle and buffalo were principally acquired through purchase (~73 percent and ~49 percent) and then by birth into the herd (~13 percent and ~41 percent). Pewa was reported as a source of acquisition for about 7 percent of buffalo and 7 percent of cattle. Goat was acquired by purchase (~46 percent), birth into the herd (~44 percent), pewa (~5 percent) and grants or support from government and non-government organizations (~5 percent). Goat was the only livestock that was reportedly acquired through grants. Pig was primarily acquired by purchase (80 percent) and then through loan (20 percent). Local chicken was mainly purchased (~64 percent), born into the flock (~28 percent), gifted as pewa by women's family (~6 percent) and acquired through loan (~3 percent). In the case of broiler chicken, 60 percent were purchased and 40 percent were acquired through loan.

With regard to caste, high caste women tended to acquire ~78 percent of cattle through purchase with own income, ~11 percent of cattle were born into the herd and ~11 percent of cattle were obtained from husband's family. Buffalo was primarily acquired through purchase with own income and birth into the herd, both reported at ~44 percent. With about 6 percent of buffalo acquired as pewa and similar number acquired through loans. Goat was primarily acquired through purchase with own income (~46 percent) and birth into the herd (~46 percent). About 8 percent of women in high caste received goat from grant projects. High caste women did not own any pig. Local chicken was mainly acquired through purchase with own money (~71 percent). Birth into the herd (14.28 percent) and purchase through loan (14.28 percent) were other sources of local chicken acquisition. Women in the high caste group did not report owning any broiler chicken.

Women belonging to the ethnic group acquired cattle through purchase with own income (75 percent) and pewa (25 percent). Buffalo was obtained through purchase (55.56 percent), birth into the herd (33.33 percent) and pewa (11.11 percent). Goat was principally acquired through purchase with own income (50 percent). 33.33 percent goat was born into the herd and 16.67 percent was acquired as pewa. Pig was 100 percent acquired through loan. Local chicken was mainly purchase (57.12 percent). 35.71 percent local chicken was born into the herd and pewa accounted for 7.14 percent of local chicken owned by women. Broiler chicken was mainly purchased with own income (66.66 percent) followed by loan (33.33 percent).

Women in the low caste group reported purchasing half of their cattle with own money and the other half was born into the herd. Similarly, 60 percent buffalo was born into the herd and 40 percent was purchased using own money. Likewise, 60 percent goat was born into the herd and 40 percent goat was purchased. All the pigs they owned were purchased using own

income. In case of local chicken, 66.66 percent was purchased, 26.66 percent was born into the herd and 6.66 percent was gifted as pewa. All the broiler chicken they owned was purchased using own money.

Caste comparison of women's acquisition of livestock shows that, purchase using own income is the primary means of livestock acquisition for all livestock. For bigger livestock like cattle and buffalo, high caste women and ethnic women reported purchase as the primary source of acquisition. However, women in the lower caste reported birth into the herd as the primary means of obtaining larger livestock.

Pewa seemed to be common among women in the ethnic community. Women in the upper caste benefitted from grants for acquiring goats, while ethnic women and low caste women did not receive grant support for any of the livestock they owned. Women in the lower caste also did not seem to have access to loan while women in the upper caste used loan to acquire buffalo, local chicken and broiler chicken. Women from ethnic community seemed to have access to loans for the purchase of broiler chicken.

Our findings are in line with findings from elsewhere in the world. Studies in Nigeria showed that purchase from the market was the source of livestock for 45 percent of women farmers (Olojede & Njoku 2007). Landless women in India used personal savings and earnings from their husband, and sometimes even using loans from government and private agencies to buy dairy cows (Kristjanson et al. 2010). Some literature claims that women are more likely to use informal social networks such as gifts and inheritance instead of formal market channels (Kristjanson et al. 2010). A major reason why women do not purchase livestock from commercial market channels has been seen as women's limited access and control over capital.

In Zimbabwe, 60 percent women lacked capital to participate in the commercial market because men controlled income from the sale of crops and livestock (Chawatama et al. 2005).

Livestock ownership and household food security

To see if there was difference in food security score (FS score) between households that owned livestock and households that did not own livestock, we first applied a simple paired t-test. The average FS score reported by men and women was 7.79. Our results showed that FS score was lower for households that raised livestock compared to households that did not raise livestock (Table 1.7 and Table 1.8). While this finding was insignificant for female respondents, it was significant ($p < 0.05$) for male respondents. Both men and women reported significantly lower FS score for households that raised pigs. Men reported lower FS score for households rearing local poultry while higher FS score was reported for households raising broiler chicken by both men and women reported higher. When households raised broiler chicken, both men and women reported higher FS score compared to households that did not raise broiler chicken.

Our findings showed a general trend of decrease in households' reported food security status when raising livestock except for broiler chicken. Our findings are in contrast with findings in literature where livestock generally contribute positively to household food security. One possible explanation for lower food security score for households that owned livestock could be that households with livestock often increase time burden on women as reported by Kabunga et al. (2017). When women spend more time tending to livestock, they may not be able to give much time to growing crops and other farm household work. It is interesting to note that in our study there is no significant difference in FS score between households raising cattle and buffalo, which provide milk. By providing milk on a daily basis both these animals need not be killed or sold off in order to benefit from food security. However, households that raised pigs

that can only contribute to food security after being sold off or consumed, had significantly lower FS score than households that did not raise pigs. This points to the likely role of time burden in reducing food security. In other words, although cattle and buffalo increased burden for women, since they were able to provide milk they did not necessarily decrease household's FS score. On the other hand, rearing pigs could have added burden on a daily basis without immediate gain in food security.

Higher FS score for households that raised broiler chicken compared to households that did not raise broiler chicken highlights the important role of commercial livestock production in improving food security. This finding is in line with the study by Wong et al. (2017) who reported that small-scale intensive production of chicken (>200 broilers) directly contributed to household food security by increasing income and animal source protein.

We need to cautiously interpret our finding that food security was lower for households that raised livestock compared to households that did not raise livestock. We did not take into account the possible role of remittance in our study, which could probably explain why livestock rearing households were less food secure than households that did not raise livestock. To control for the role of outmigration to some extent, we chose only dual headed households that had both male and female heads in our study. However, in Nepalese context, joint family is still the norm with three generations living under the same roof and sharing the same kitchen. The joint family structure makes it likely that even when an adult male or female has out-migrated; they are sending remittance back home to support their parents, spouse, children, and adult siblings living in the same house. Therefore, it is likely that remittance- both domestic and international- plays an important role in household food security among the sampled households in our study. In Nepal where one in every four households has a member working abroad at any given time

(GRID- Arendal and ICIMOD, 2022), remittance plays a vital role in household welfare. In 2021, remittance accounted for 30% of GDP, making Nepal one of the top remittance recipient countries in the world (GRID- Arendal and ICIMOD, 2022). Therefore, we cannot ignore the role of remittance in household food security particularly when studies have shown positive effect of remittance on household food security in Nepal (Cedamon et al., 2019). Maharjan et al. (2012) reported that number of households without livestock was higher in migrant households compared to nonmigrant households in Syangja and Baitadi districts of Nepal. Therefore, it is likely that households that did not raise livestock possibly received supplemental income from remittance and thus were more food secure.

Table 1.7: Food security score (FSS) reported by women in households that raised livestock Vs households that did not raise livestock (N=263)

Animal (Yes/ No)	Household raised livestock Mean (SD)	Household did not raise livestock Mean (SD)	t-value
Livestock (239/24)	7.77 (1.73)	8.00 (1.67)	0.62
Cattle (129/134)	7.81 (1.62)	7.77 (1.82)	-0.21
Buffalo (207/56)	7.85 (1.63)	7.57 (2.05)	-1.07
Goat (183/80)	7.73 (1.75)	7.9 (1.67)	0.76
Pig (17/ 246)	7.12 (1.65)	7.84 (1.72)	1.67*
Local chicken (99/164)	7.71 (1.73)	7.84(1.68)	0.61
Broiler chicken (21/242)	8.62 (0.80)	7.72 (1.77)	-2.31**

Notes: Numbers in brackets are percentage contribution of the species to TLUs.

***, **, *significant at 1%, 5% and 10% respectively.

Table 1.8: Food security score (FSS) reported by men in households that raised livestock Vs households that did not raise livestock (N=263)

Animal (Yes/ No)	Household raised livestock Mean (SD)	Household did not raise livestock Mean (SD)	t-value
Livestock (239/24)	7.72 (1.79)	8.50 (0.88)	2.11**
Cattle (126/137)	7.67 (1.69)	7.91 (1.79)	1.12
Buffalo (206/57)	7.83 (1.67)	7.67 (2.00)	-0.61
Goat (184/79)	7.79 (1.72)	7.78 (1.80)	-0.04

Table 1.8 (cont'd)

Pig (16/ 247)	6.5 (1.71)	7.87 (1.71)	3.11***
Local chicken (97/166)	7.49 (1.97)	7.96(1.57)	2.12**
Broiler chicken (24/239)	8.62(0/97)	7.71 (1.78)	-2.48**

Notes: Numbers in brackets represent standard deviations.

***, **, *significant at 1%, 5% and 10% respectively.

Link between livestock ownership and household food security

To further study the link between livestock ownership and household food security, we regressed the food security score (FS score) against different independent variables including Household TLU (model 1a, 1b) and TLUs held by men and women separately as well as jointly (model 2a, 2b). As we have established in our earlier section, men and women had different perception about who owned livestock i.e., the TLU held by men, women and both jointly were reported differently by men and women respondents. Keeping this in mind, we performed the regression analysis separately for men and women respondents to see how livestock influences household's FS score.

Description of the dependent and independent variables used in our study are reported in Table 1.8. The average FS score was 7.79 for both men and women. Total household TLU, TLU held by women, men and jointly was reported by women respondents as 2.38, 0.46, 0.65, and 1.28 respectively. Men reported total household TLU, TLU held by women, men and jointly to be 2.44, 0.46, 0.70, and 1.27 respectively. The average age of female respondents was 49.62 years with 3.48 years of education. Average age of men was 55.94 with 6.69 years of education. In terms of ethnicity, 48 percent of women in our study belonged to high caste, 30 percent belonged to ethnic group and 22 percent belonged to low caste group reflecting the proportion of different caste groups in Hamsapur. The mean family size residing in the village was 3.4, which is a little less than the national average of 4.6 members (CBS, 2014). The total agricultural land owned by the household in the study area was 0.65 ha which is close to the national average of

0.7 ha (CBS, 2014). This indicates that the farmers involved in our sample are smallholder farmers. Smallholder farmers are farmers with less than three hectare of cropland (Morton, 2007). The mean infrastructure index was 0.71. Of the total households surveyed, 19.39 percent had additional property outside Hamsapur. 75.09 percent were members of a group or cooperative.

Our results show that for women respondents, the FS score was affected by neither household TLU (Table 1.10) nor women-held TLU (Table 1.11). However, property ownership tended to increase FS score ($p < 0.01$) (Table 1.10 and Table 1.11)). When we looked at the regression estimates using male respondents (Table 1.12 and Table 1.13), education ($p < 0.01$) and property ownership ($p < 0.10$) increased FS score. While there was no significant effect of household TLU on FS score (Table 1.12), women-held TLU increased household's FS score ($p < 0.05$) (Table 1.13). We checked variance inflation factor (VIF) for each of our regression model to test if there was collinearity between different independent variables. The VIFs were sufficiently low within a range of 1.33 and 1.39. The small VIF value of less than 3 for the predictor variables in all our regression models indicates that including the different independent variables in our model is statistically valid.

Table 1.9: Description of variables with their mean and standard deviation

Variables	Description	Mean	SD
<i>Dependent variables</i>			
FSS ^a	Food security score ranging from 0 to 9	7.79	1.73
<i>Independent variables</i>			
<i>Individual characteristics</i>			
Age- male	Age of male respondents	55.94	14.13
Age- female	Age of female respondents	49.62	12.95
Education- male	Years of formal schooling of male respondents	6.69	6.70
Education- female	Years of formal schooling of female respondents	3.48	3.48
<i>Household characteristics</i>			
<i>TLUs reported by women</i>			

Table 1.9 (cont'd)

Household TLU	Total TLU owned by household	2.38	
TLU held by women	Total TLU held by women	0.46	
TLU held by men	Total TLU held by men	0.65	
TLU held jointly	Total TLU held jointly	1.28	
<i>TLUs reported by men</i>			
Household TLU	Total TLU owned by household	2.44	
TLU held by women	Total TLU held by women	0.46	
TLU held by men	Total TLU held by men	0.70	
TLU held jointly	Total TLU held jointly	1.28	
Ethnicity	1 if upper caste, =2 if ethnic group, =3 if lower caste		
Family size	Number of family members in the village	3.40	1.63
Farm size	Total agricultural land in the current year (hectare)	0.65	0.58
Infrastructure index	Index score ranging from 0 to 1	0.71	0.14
Property ownership women	1 if additional property owned outside village, 0		
Group membership	1 if member in farmers group/ cooperatives, 0		

Source: Field survey, 2018

Note: ^a Both male and female respondents reported same FS score for each household.

Our findings align with findings from other studies that show ownership of assets including land was an important factor affecting household food security (Gautam & Andersen, 2016). Harris-Fry et al., (2015) reported wealth and land ownership as the biggest protective factor against food insecurity in rural Bangladesh. Household wealth and land ownership reduced the risk of food insecurity by more than 70 percent and 80 percent respectively in their study. Therefore, food security programs for poor households should be promoted differently than for wealthier households.

In our study, when men respondents were interviewed we found that education of respondents along with total TLU held by women tended to increase food security score of households. However, when women were interviewed age and education of respondents, as well as women-held TLU did not seem to affect food security score. This difference in results, when

different people from the same households are surveyed, points out that who is interviewed becomes an important element in any survey design. Our findings from the analysis of male respondents concur with most studies interviewing household head that is usually a male. For instance, increase in levels of education has been reported to positively influence food security (Regmi et al., 2019; Maitra & Rao, 2015; Mason et al., 2015). On the other hand when women were interviewed, there was no significant effect of age or education on household food security. Therefore, development intervention targeting women should also take women's account into consideration even if they are not the key decision maker. Finally, based on men's response, women-held TLU were found to positively influence household food security. Our finding is in line with findings from the study by Kariuki et al., (2013) which showed that household's consumption of animal source food in the form of meat, milk and egg are greater for households where women owned livestock compared to those where women did not own livestock. We must note that in their study, Kariuki et al., (2013) did not attempt to associate animal source food consumption with women-owned livestock, but simply used a paired t-test to see if there was difference in animal source food consumption between households where women owned livestock vs households where women did not own livestock. As mentioned above, we found that although smaller livestock like chicken and goats were important for women's livestock portfolio, buffalo contributed more TLU than all other livestock put together. Given the significance of women held TLU in improving household food security, promotion of larger livestock such as buffalo and cattle may provide a pathway to improve household food security.

Table 1.10: Regression results of FS score for female respondents using model 1a

Dependent variable: FS score			
	Coefficient	Std. Err.	t
Age	0.01	0.01	0.77
Education	0.04	0.04	1.25
Household TLU	0.09	0.06	1.57

Table 1.10 (cont'd)

Family size	-0.05	0.07	-0.70
Total farmsize	0.21	0.22	0.99
Infrastructure index	1.15	0.75	1.55
Property ownership	0.78	0.28	2.75***
Group membership	-0.003	0.26	-0.01
Ethnicity			
Ethnic caste group	0.19	0.25	0.74
Lower caste group	-0.30	0.29	-1.05
Constant	6.04	0.88	6.86***
R-squared = 0.1031			
F (10, 252) = 3.89, p-value < 0.001			
N= 263			

Note: ***, **, *significant at 1%, 5% and 10% respectively.

Table 1.11: Regression results of FS score for female respondents using model 2a

Dependent variable: FS score			
	Coefficient	Std. Err.	t
Age	0.01	0.01	0.78
Education	0.04	0.04	1.25
Women-held TLU	0.05	0.11	0.45
Men-held TLU	0.09	0.07	1.42
Jointly-held TLU	0.09	0.07	1.17
Family size	-0.04	0.07	-0.60
Total farmsize	0.22	0.22	0.99
Infrastructure index	1.12	0.76	1.48
Property ownership	0.77	0.29	2.68***
Group membership	0.002	0.26	0.01
Ethnicity			
Ethnic caste group	0.18	0.25	0.71
Lower caste group	-0.31	0.28	-1.05
Constant	6.06	0.88	6.85***
R-squared = 0.1037			
F (12, 250) = 2.41, p-value < 0.001			
N= 263			

Note: ***, **, *significant at 1%, 5% and 10% respectively.

Table 1.12: Regression results of FS score for male respondents using model 1b

Dependent variable: FS score			
	Coefficient	Std. Err.	t-value
Age	0.02	0.01	1.61
Education	0.13	0.03	4.27***
Household TLU	0.07	0.05	1.41

Table 1.12 (cont'd)

Family size	-0.01	0.07	-0.20
Total farmsize	-0.07	0.17	-0.40
Infrastructure index	-0.22	0.81	-0.27
Property ownership	0.54	0.28	1.97*
Group membership	-0.13	0.24	-0.53
Ethnicity			
Ethnic caste group	-0.07	0.25	-0.27
Lower caste group	-0.31	0.29	-1.09
Constant	6.21	0.95	6.54***
R-squared = 0.1483			
F (10, 252) = 4.39, p-value < 0.001			
N= 263			

Note: ***, **, *significant at 1%, 5% and 10% respectively.

Table 1.13: Regression results of FS score for male respondents using model 2b

Dependent variable: FS score			
	Coefficient	Std. Err.	t
Age	0.02	0.01	1.71*
Education	0.14	0.03	4.44***
Women-held TLU	0.22	0.10	2.16**
Men-held TLU	0.08	0.06	1.16
Jointly-held TLU	0.05	0.07	0.81
Family size	-0.02	0.07	-0.31
Total farmsize	-0.05	0.17	-0.31
Infrastructure index	-0.14	0.81	-0.18
Property ownership	0.51	0.28	1.83*
Group membership	-0.12	0.24	-0.50
Ethnicity			
Ethnic caste group	-0.01	0.25	-0.05
Lower caste group	-0.23	0.29	-0.79
Constant	6.00	0.96	6.25***
R-squared = 0.1585			
F (12, 250) = 3.92, p-value < 0.001			
N= 263			

Note: ***, **, *significant at 1%, 5% and 10% respectively.

Conclusion and recommendations for policy and research

Livestock are prevalent non-land assets owned by rural households. Most often, they are the only productive assets owned by vulnerable groups like women and the landless. However,

information on the ownership of livestock at the intra-household level is scant because most data on livestock ownership are collected at household level. Without knowing whether women actually own livestock and make important livestock decisions, it is not possible to understand the role of livestock production as a means for advancing gender equity and sustainable development. In this study, by collecting sex-disaggregated data, we empirically examined women's ownership of livestock in rural Nepal and sought to understand if women's ownership of livestock had any impact on household food security.

In our first objective, we looked at the patterns of livestock ownership in Kaski district. Patterns of livestock ownership showed that livestock are usually owned jointly by both men and women. Men and women jointly owned more than 50 percent of all livestock except broiler chicken. Given the importance of joint ownership, in order to fully understand the dynamics of intra-household livestock ownership further investigation need to be done on how decisions are made between spouses when livestock are owned jointly. Local chicken and goats were important livestock for women in Hamsapur. However, men and women seem to differ in their perception of who owned local chicken and broiler chicken. This suggests that analysis of women's ownership of livestock should use multiple methods and look at different dimensions of ownership.

To fulfill our second objective, we looked at the contribution of different livestock to the total TLU held by men and women. Despite the importance of local chicken, our study revealed that they contributed negligibly to women's total TLU. Although buffalo was the major contributor to women's total TLU, men still had more TLUs of buffaloes than women revealing the gender gap in livestock ownership. Goats on the other hand were an important contributor to women's total TLU after buffalo and were also owned by more women than men. Therefore,

goats can be promoted as an important livestock for research and development of interventions targeting the increase women's asset through livestock. If the goal is to simply increase women's asset, buffalo is a good option too, but it becomes important to ensure that women remain in control since studies have shown that men are more likely to control larger livestock than women. Our findings show that although higher proportion of households has women owning livestock, women still own fewer livestock than men. Development programs should therefore not only aim to have more women own livestock but also ensure that the gender gap in livestock ownership is reduced.

Our third objective aimed to examine how women acquired livestock, since gender gap in livestock ownership can only be addressed by understanding this process. Our study found that women mainly acquired livestock through purchase using their own income. This shows that it is important for women to have access to money through other income generating activities in order to acquire their own livestock. Programs targeted at improving women's income could potentially help reduce the gender gap in livestock ownership. Only high caste women benefitted from grants and loans. While ethnic women were able to access loan for the purchase of broiler chicken, they did not receive any support from grants or local NGOs. Low caste women did not benefit from either grants or loans highlighting the importance to account for social context while implementing development projects so that disadvantaged groups can be targeted to benefit from the scheme.

We also found that production of commercial livestock such as broiler chicken was a highly gendered enterprise with more men in charge than women. When women did own more broiler chicken than men, it was because broiler chicken was raised at a small scale as in the case of low caste group in our study. Women and low caste group's lack of participation in the

commercial sector could be attributed to their historically low status in Nepali society. They are disadvantaged due to their limited access to grants, loans and other resources crucial to the raise livestock on a commercial scale.

Finally, with regard to household food security, we analyzed the responses from men and women separately. Based on men's response, women-held TLU positively contributed to food security. Given that buffalo is the principle contributor of women-held TLU, our findings confirm that although small livestock like poultry is important to women, it is important to understand that household can benefit equally when women own larger livestock. Therefore, development interventions should also focus on larger livestock in addition to smaller livestock for better welfare outcomes at household level. Further, studies need to be conducted to better understand how women's access to larger livestock can be improved.

Limitations

One of the main limitation of this study is the lack of qualitative analysis in examining the contextual significance in livestock ownership and decision making process. A case study from Timor-Leste (Bonis-Profumo et al., 2022) showed that while quantitative results from their study suggested men and women mostly owned livestock jointly, only through qualitative analysis such as semi-structured interview, it became apparent that joint ownership often implied women had limited agency while making final decisions. Ambler et al. (2022) reported that respondents often viewed joint decision-making as the "socially correct answer" and therefore reported joint decision making although focal group discussions later revealed that men were more dominant than women in making decisions of jointly owned animals. Our study could have benefitted from a mixed- method approach involving qualitative analyses such as focal group discussion and semi-structured interview to help us understand how joint decisions were made

given that both men and women reported joint ownership for more than 50 percent livestock. Despite the limitations, our results represent a pivotal steppingstone towards understanding livestock ownership pattern in Nepal through a gendered lens. Further, the gender difference in relationship between livestock ownership and household food security provide valuable implication for gender-sensitive policymaking.

REFERENCES

- Agarwal, B. (1998). Widows vs. daughters or widows as daughters? Property, land and economic security in rural India. In M. A. Chen (ed.) *Widows in India: Social Neglect and Public Action*. New Delhi: Sage, pp. 124–169.
- Agarwal, B. (2002). Bargaining and Legal Change: Toward Gender Equality in India's Inheritance Laws. Working Paper. Brighton, UK: Institute for Development Studies.
- Ali, A., & Khan, M. (2013). Livestock ownership in ensuring rural household food security in Pakistan. *J Anim Plant Sci*, 23(1), 313-8.
- Allendorf, K. (2007). Couples' reports of women's autonomy and health-care use in Nepal. *Studies in family planning*, 38(1), 35-46.
- Ambler, K., Doss, C., Kieran, C., & Passarelli, S. (2021). He says, she says: Spousal disagreement in survey measures of bargaining power. *Economic Development and Cultural Change*, 69(2), 765-788.
- Ambler, K., Doss, C., Kieran, C., & Passarelli, S. (2022). Spousal concordance in joint and separate households: Survey evidence from Nepal. *World Development*, 151, 105744.
- Anderson, C. L., Reynolds, T. W., & Gugerty, M. K. (2017). Husband and wife perspectives on farm household decision-making authority and evidence on intra-household accord in rural Tanzania. *World development*, 90, 169-183.
- Becker, S., Hossain, M. B., & Thomson, E. (2006). Disagreement in spousal reports of current contraceptive use in sub-Saharan Africa. *Journal of biosocial science*, 38(6), 779-796.
- Bettencourt, E. M. V., Tilman, M., Narciso, V., Carvalho, M. L. D. S., & Henriques, P. D. D. S. (2015). The livestock roles in the wellbeing of rural communities of Timor-Leste. *Revista de Economia e Sociologia Rural*, 53, 63-80.
- Bilinsky, P., & Swindale, A. (2010). Months of adequate household food provisioning (MAHFP) for measurement of household food access: Indicator guide (Version 4). *Washington, DC: FHI*, 360.
- Bonis-Profumo, G., do Rosario Pereira, D., Brimblecombe, J., & Stacey, N. (2022). Gender relations in livestock production and animal-source food acquisition and consumption among smallholders in rural Timor-Leste: A mixed-methods exploration. *Journal of Rural Studies*, 89, 222-234.
- Cedamon, E. D., Nuberg, I., Mulia, R., Lusiana, B., Subedi, Y. R., & Shrestha, K. K. (2019). Contribution of integrated forest-farm system on household food security in the mid-hills of Nepal: assessment with EnLiFT model. *Australian Forestry*, 82(sup1), 32-44.

- Chawatama, S., Mutisi, C., & Mupawaenda, A. C. (2005). The socio-economic status of smallholder livestock production in Zimbabwe: a diagnostic study. *Livestock Research for Rural Development*, 17(12), 988-1003.
- Chilonda, P., & Otte, J. (2006). Indicators to monitor trends in livestock production at national, regional and international levels. *Livestock Research for Rural Development*, 18(8), 117.
- Coates, J., Swindale, A., & Bilinsky, P. (2007). Household Food Insecurity Access Scale (HFIAS) for measurement of food access: indicator guide: version 3.
- De Cock, N., D'Haese, M., Vink, N., Van Rooyen, C. J., Staelens, L., Schönfeldt, H. C., & D'Haese, L. (2013). Food security in rural areas of Limpopo province, South Africa. *Food security*, 5, 269-282.
- Deere, C. D., & Doss, C. R. (2006). The gender asset gap: What do we know and why does it matter?. *Feminist economics*, 12(1-2), 1-50.
- Deere, C. D., & Twyman, J. (2012). Asset ownership and egalitarian decision making in dual-headed households in Ecuador. *Review of Radical Political Economics*, 44(3), 313-320.
- Devkota, D., Devkota, N. R., & Joshi, N. P. (2015). Gender role and buffalo rearing decisions in Nepal. *Nepalese Journal of Agricultural Sciences*, 13, 176-193.
- Doss, C. (2013). Data needs for gender analysis in agriculture. In *Gender in Agriculture* (pp. 55-68). Springer Netherlands.
- Doss, C. R., Grown, C., & Deere, C. D. (2007). Gender and asset ownership: a guide to collecting individual-level data. World Bank.
- Dumas, S. E., Kassa, L., Young, S. L., & Travis, A. J. (2018). Examining the association between livestock ownership typologies and child nutrition in the Luangwa Valley, Zambia. *PloS one*, 13(2), e0191339.
- FAO (2002). World agriculture towards 2015/2030. Rome: FAO.
- FAO (2017). The state of food security and nutrition in the world 2017. Food and Agricultural Organization of the United Nations, Rome.
- FAO. (2011). The State of Food Agriculture: Women and Agriculture, Closing the Gender Gap for Development. Rome: FAO.
- Fischer, E., & Qaim, M. (2012). Gender, agricultural commercialization, and collective action in Kenya. *Food security*, 4, 441-453.

Fratkin, E., & Smith, K. (1995). Women's changing economic roles with pastoral sedentarization: varying strategies in alternate Rendille communities. *Human Ecology*, 23, 433-454.

Frelat, R., Lopez-Ridaura, S., Giller, K. E., Herrero, M., Douchamps, S., Djurfeldt, A. A., & Van Wijk, M. T. (2016). Drivers of household food availability in sub-Saharan Africa based on big data from small farms. *Proceedings of the National Academy of Sciences*, 113(2), 458-463.

Friedemann-Sánchez, G. (2006). Assets in intrahousehold bargaining among women workers in Colombia's cut-flower industry. *Feminist Economics*, 12(1-2), 247-269.

Galab, S., & Rao, N. C. (2003). Women's self-help groups, poverty alleviation and empowerment. *Economic and Political weekly*, 1274-1283.

Gautam, Y., & Andersen, P. (2016). Rural livelihood diversification and household well-being: Insights from Humla, Nepal. *Journal of Rural Studies*, 44, 239-249.

Ghuman, S. J., Lee, H. J., & Smith, H. L. (2006). Measurement of women's autonomy according to women and their husbands: Results from five Asian countries. *Social Science Research*, 35(1), 1-28.

Grace, D. (2007). Women's reliance on livestock in developing-country cities. *International Livestock Research Institute*.

GRID-Arendal & ICIMOD (2022). Stories of outmigration from Nepal: The complex and diverse, positive and negative. Accessed at:
<https://storymaps.arcgis.com/stories/fc7ee0b810b34d1fad896f7b4c045232>

Grown, C., Gupta, G. R., & Kes, A. (2005). Taking Action: Achieving gender equality and empowering women. Earthscan.

Gurung, K., Tulachan, P. M., & Gauchan, D. (2005). Gender and Social Dynamics in Livestock Management: A Case Study from Three Ecological Zones in Nepal. *Gender Component-LPP Project*.

Harris-Fry, H., Azad, K., Kuddus, A., Shaha, S., Nahar, B., Hossen, M., Younes, L., Costello, A., & Fottrell, E. (2015). Socio-economic determinants of household food security and women's dietary diversity in rural Bangladesh: a cross-sectional study. *Journal of Health, Population and Nutrition*, 33(1), 1-12.

Headey, D., & Ecker, O. (2013). Rethinking the measurement of food security: from first principles to best practice. *Food security*, 5(3), 327-343.

Heffernan, C., Misturelli, F., & Pilling, D. (2003). Livestock and the poor: findings from Kenya, India and Bolivia. *Animal Health Programme, Department for International Development, London*.

- Heffernan, C., Misturelli, F., & Pilling, D. (2003). Livestock and the poor: findings from Kenya, India and Bolivia. *Animal Health Programme, Department for International Development, London*.
- Hetherington, J. B., Wiethoelter, A. K., Negin, J., & Mor, S. M. (2017). Livestock ownership, animal source foods and child nutritional outcomes in seven rural village clusters in Sub-Saharan Africa. *Agriculture & Food Security*, 6, 1-11.
- Huss-Ashmore, R. (1996). Livestock, nutrition, and intrahousehold resource control in Uasin Gishu District, Kenya. *Human Ecology*, 24(2), 191-213.
- Jacobs, K., & Kes, A. (2015). The ambiguity of joint asset ownership: cautionary tales from Uganda and South Africa. *Feminist Economics*, 21(3), 23-55.
- Jaitner, J., Sowe, J., Secka-Njie, E., & Dempfle, L. (2001). Ownership pattern and management practices of small ruminants in The Gambia—implications for a breeding programme. *Small ruminant research*, 40(2), 101-108.
- Jones, A. D., Ngure, F. M., Peltó, G., & Young, S. L. (2013). What are we assessing when we measure food security? A compendium and review of current metrics. *Advances in nutrition*, 4(5), 481-505.
- Kabunga, N. S., Dubois, T., & Qaim, M. (2014). Impact of tissue culture banana technology on farm household income and food security in Kenya. *Food policy*, 45, 25-34.
- Kabunga, N. S., Ghosh, S., & Webb, P. (2017). Does ownership of improved dairy cow breeds improve child nutrition? A pathway analysis for Uganda. *PloS one*, 12(11), e0187816.
- Kariuki, J., Njuki, J., Mburu, S., & Waithanji, E. (2013). Women, livestock ownership and food security. In *Women, livestock ownership and markets* (pp. 115-130). Routledge.
- Kassie, M., Ndiritu, S. W., & Stage, J. (2014). What determines gender inequality in household food security in Kenya? Application of exogenous switching treatment regression. *World development*, 56, 153-171.
- Kilic, T., & Moylan, H. (2016). Methodological experiment on measuring asset ownership from a gender perspective.
- Koirala, K. H., Mishra, A., & Mohanty, S. (2016). Impact of land ownership on productivity and efficiency of rice farmers: The case of the Philippines. *Land use policy*, 50, 371-378.
- Kristjanson, P., Waters-Bayer, A., Johnson, N., Tipilda, A., Njuki, J., & Baltenweck, I. (2010). *Livestock and Women's Livelihoods: A Review of the Recent Evidence*. ILRI Discussion Paper No. 20. Nairobi: ILRI.

- Ma, W., & Abdulai, A. (2016). Does cooperative membership improve household welfare? Evidence from apple farmers in China. *Food Policy*, 58, 94-102.
- Maitra, C., & Rao, D. P. (2015). Poverty–food security Nexus: evidence from a survey of urban slum dwellers in Kolkata. *World Development*, 72, 308-325.
- Maharjan, A., Bauer, S., & Knerr, B. (2012). Do rural women who stay behind benefit from male out-migration? A case study in the hills of Nepal. *Gender, Technology and Development*, 16(1), 95-123.
- Mango, N., Zamasiya, B., Makate, C., Nyikahadzoi, K., & Siziba, S. (2014). Factors influencing household food security among smallholder farmers in the Mudzi district of Zimbabwe. *Development Southern Africa*, 31(4), 625-640.
- Mason, R., Ndlovu, P., Parkins, J. R., & Luckert, M. K. (2015). Determinants of food security in Tanzania: gendered dimensions of household headship and control of resources. *Agriculture and human values*, 32, 539-549.
- Miller, L. C., Neupane, S., Joshi, N., Lohani, M., Sah, K., & Shrestha, B. (2022). Dairy Animal Ownership and Household Milk Production Associated with Better Child and Family Diet in Rural Nepal during the COVID-19 Pandemic. *Nutrients*, 14(10), 2074.
- Ministry of Agriculture and Livestock Development (MOALD). (2022). Statistical information on Nepalese agriculture (2020/21). Planning & Development Cooperation Coordination Division, Kathmandu, Nepal.
- Mojo, D., Fischer, C., & Degefa, T. (2017). The determinants and economic impacts of membership in coffee farmer cooperatives: recent evidence from rural Ethiopia. *Journal of Rural studies*, 50, 84-94.
- Njuki, J., & Sanginga, P. C. (2013). Women, livestock ownership and markets: Bridging the gender gap in eastern and southern Africa. Routledge.
- Nkomoki, W., Bavorová, M., & Banout, J. (2019). Factors associated with household food security in Zambia. *Sustainability*, 11(9), 2715.
- Okitoi, L. O., Ondwasy, H. O., & Nkurumah, D. (2007). Traditional herbal preparations for indigenous poultry health management in Western Kenya.
- Olojede, J. C., & Njoku, M. E. (2007). Involvement of women in livestock production: a means of reducing hunger and malnutrition in Ikwuano local government area of Abia State. *Nigeria. Agricultural Journal*, 2, 231-235.
- Oluka, J., Owoyesigire, B., Esenu, B., & Ssesewanyana, E. (2005). Small stock and women in livestock production in the Teso Farming System region of Uganda¹. *Small stock in development*, 151.

Picchioni, F., Goulao, L. F., & Roberfroid, D. (2022). The impact of COVID-19 on diet quality, food security and nutrition in low and middle income countries: A systematic review of the evidence. *Clinical Nutrition*, 41(12), 2955-2964.

Qureshi, M. E., Dixon, J., & Wood, M. (2015). Public policies for improving food and nutrition security at different scales. *Food Security*, 7(2), 393-403.

Rawlins, R., Pimkina, S., Barrett, C. B., Pedersen, S., & Wydick, B. (2014). Got milk? The impact of Heifer International's livestock donation programs in Rwanda on nutritional outcomes. *Food policy*, 44, 202-213.

Regmi, H. R., Rijal, K., Joshi, G. R., Sapkota, R. P., & Thapa, S. (2019). Factors influencing food insecurity in nepal. *Journal of Institute of Science and Technology*, 24(2), 22-29.

Sen, A. K. (1997). *Choice, welfare and measurement*. Harvard University Press.

Shicai, S. and Jie, Q. (2009). Livestock projects in southwest China: women participate, everybody benefits. *Leisa Magazine* 25 (3 Sept).

Sinn, R., Ketzis, J., & Chen, T. (1999). The role of woman in the sheep and goat sector. *Small Ruminant Research*, 34(3), 259-269.

Sparr, P., & Moser, C. (2007). International NGOs and poverty reduction strategies: The contribution of an asset-based approach. *Brookings Global Economy and Development Working Paper*, (8).

Suvedi, M., Ghimire, R., & Kaplowitz, M. (2017). Farmers' participation in extension programs and technology adoption in rural Nepal: a logistic regression analysis. *The Journal of Agricultural Education and Extension*, 23(4), 351-371.

Tibesigwa, B., & Visser, M. (2016). Assessing gender inequality in food security among small-holder farm households in urban and rural South Africa. *World Development*, 88, 33-49.

Twyman, J., Useche, P., & Deere, C. D. (2015). Gendered perceptions of land ownership and agricultural decision-making in Ecuador: Who are the farm managers?. *Land Economics*, 91(3), 479-500.

Upadhyay, B. (2005). Women and natural resource management: Illustrations from India and Nepal. In *Natural resources forum* (Vol. 29, No. 3, pp. 224-232). Blackwell Publishing, Ltd.

USAID (1992). USAID policy determination: Definition of food security. Accessed on 28 January 2021 from <http://pdf.usaid.gov/pdf_docs/Pnaav468.pdf>

Verhofstadt, E., & Maertens, M. (2015). Can agricultural cooperatives reduce poverty? Heterogeneous impact of cooperative membership on farmers' welfare in Rwanda. *Applied Economic Perspectives and Policy*, 37(1), 86-106.

- WFS (1996). World food summit plan of action. World Food Summit (WFS): Rome.
- Wong, J. T., Bagnol, B., Grieve, H., da Costa Jong, J. B., Li, M., & Alders, R. G. (2018). Factors influencing animal-source food consumption in Timor-Leste. *Food Security*, 10, 741-762.
- Wong, J. T., de Bruyn, J., Bagnol, B., Grieve, H., Li, M., Pym, R., & Alders, R. G. (2017). Small-scale poultry and food security in resource-poor settings: A review. *Global Food Security*, 15, 43-52.
- Zhou, D., Shah, T., Ali, S., Ahmad, W., Din, I. U., & Ilyas, A. (2019). Factors affecting household food security in rural northern hinterland of Pakistan. *Journal of the Saudi Society of Agricultural Sciences*, 18(2), 201-210.

ESSAY TWO: EFFECT OF OFF-SEASON TOMATO PRODUCTION ON CROP INCOME AND FOOD SECURITY IN NEPAL

Introduction

Substantial amount of resources have been invested in promoting improved agricultural technologies in developing countries. However, many of these technologies have not yielded desired results (Faltermeier & Abdulai, 2009). Evaluating the impact of such interventions on the livelihoods and well being of targeted beneficiaries is crucial to providing evidence-based feedback to donor agencies, research programs, policy makers, and development practitioners (Manyong et al., 2001). Furthermore, impact assessment of agricultural interventions can generate a better understanding of the complexities of the links between agricultural technologies and poverty reduction. This study attempts to explore the effect of off-season cultivation of tomato (*Solanum lycopersicum*) in lowcost polyhouses locally known as plastic tunnels- a rapidly spreading technology in Nepal.

Tomato has been identified as an important agricultural and commercial commodity in Nepal (Lamichhane et al., 2017). Tomato crop is the second largest contributor to income associated with vegetable production after cauliflower in the Nepalese vegetable sector (CBS, 2010). Tomato production in Nepal, as in most regions of South East Asia, is an extremely seasonal activity. Typically, tomatoes are grown in both the hills and plain regions of Nepal during the spring season (March– May) (Pandey et al., 2006). In the rainy season (June– August) however, high temperature, humidity, and floods adversely impact tomato production by inducing low fruit set, low flowering, and bacterial wilt (Pandey et al., 2006). Due to these constraints, tomato yield is relatively low in the rainy season. Low tomato production during this period leads to soaring tomato prices in the market. In order to overcome this seasonality

problem, the plastic tunnel technology has been developed to produce off-season tomatoes (Chapagain et al. 2010). In the hilly region, plastic tunnels offer protection against the rain, and flooding is not an issue because land is well drained. In the plains, however, plastic tunnels can only protect crops from rain but flooding condition persists (Chapagain et al., 2010). This makes the plastic tunnel technology ideally suitable for hilly areas, offering comparative advantage to farmers in the region.

Off-season tomato in Nepal is reported to fetch relatively high market prices (Kunwar & Maharjan, 2019; Budhathoki et al., 2004). As a result, commercial production of off-season tomato in plastic tunnels has emerged as a profitable undertaking in Nepal's hilly region. Despite Nepali farmers' increased engagement in off-season tomato production, the literature on the use of plastic tunnels for off-season production is limited. A review of the literature reveals that previous studies on off-season production of tomatoes in Nepal have focused on technical aspects of varietal performance in research stations (Chapagain et al., 2012; Budhathoki et al., 2004; Pandey et al., 2006; Chapagain et al., 2010). Further, these studies are based on experiments in research stations and therefore the estimates may not truly be representative of average farmers. Other studies have focused on economics of off-season tomato production by looking at the cost benefit ratio (Pokharel, 2021; Kunwar & Maharjan, 2019; Paudel & Adhirai, 2018). A study by Suvedi et al. (2017) investigated the impact of off-season tomato production in Hamsapur on cash income from vegetable, using a paired t-test using data taken at two points time: before intervention (2013) and after intervention (2015) of the technology. The study reported that off-season tomato production significantly increased cash income from vegetables. However, this study ignores socio-economic changes over time that might have influenced household income. When we compare the outcomes of the same household before and after

intervention, the change in outcome may be because of other socioeconomic factors (Gertler et al., 2011; Ravallion, 2001) and not necessarily because of the intervention. A more recent study by Kc et al. (2021) reported that off-season tomato production increased both crop productivity and net crop income. They made a comparison between 62 adopters and 92 non-adopters of the technology using instrumental variable (IV) approach. While IV is a good method to estimate the impact in observational studies, Bound (1995) and Laborde-Castérot et al. (2015) have reported that IV cannot always be assumed as unbiased estimator particularly because finding a reliable instrument is a challenge. Secondly, even when the results show that an instrument is valid, it is justifiable to assume that there could have been better alternative instruments that were missing in the dataset (Cawley, 2018). Therefore, to strengthen credibility of findings different analytical methods of impact estimation are often used to better account for bias. To this end, this study aims to conduct an ex-post evaluation of off-season tomato production in Kaski district of Nepal using a valid counterfactual and applying matching method of impact evaluation.

Objectives

The objectives of this study are:

- To quantify the effect of off-season tomato production on crop income and food security.
- To identify problems associated with off-season tomato production in plastic tunnels.
- To identify perceived barriers to adoption of this technology among non-adopters.

This paper begins by describing the intervention under evaluation, i.e., the production of off-season tomato in plastic tunnels in Nepal's Kaski district. It then explains the study design used to collect data and to minimize the confounding effects of selection bias and technology spillovers. Once the results are presented, we discuss the findings of this study and its

implication on future research and development in the production of off-season tomato in plastic tunnels in Nepal and elsewhere.

Materials and methods

Study area

This study was conducted in Rupa Gaupalika (rural municipality) of Kaski district in Nepal. Kaski covers an area of 2017 square kilometers in the western part of Nepal. Though Kaski is a relatively developed district in Nepal, the study area is markedly rural at 17 km away from the nearest major city, Pokhara. The study area stretches from 600 to 1200 meters above sea level and consists of sloping hills with terraces. Subsistence agriculture with a mixed crop-livestock production system is the chief source of livelihood in the study area (Suvedi et al., 2017).

Off-season tomato production intervention in study area

Off-season production of tomato in plastic tunnels was promoted in Hamsapur village (Rupa-7) of Rupa Gaupalika in three distinct phases through a collaborative effort among Indragufa Community Development Foundation (ICDF), an NGO based out of Hamsapur, Empower Nepal Foundation (ENF), and Michigan State University (MSU). The first phase in 2012 involved investigating off-season tomato production in the region by setting up a pilot project (Suvedi et al., 2017). In this phase, 92 farmers received support for plastic tunnel construction. Farmers also received vegetable production training and some were trained to be leader farmers (village level agriculture extension worker). The results from the first phase demonstrated that off-season tomato production was technically, economically, and socially feasible in the region (Suvedi et al., 2017). Following the positive response in the first phase, support for plastic tunnel construction was extended to 200 additional households in 2014.

Production and harvesting of off-season tomato greatly increased in the second phase. In the third phase, off-season tomato production was future encouraged, primarily by addressing problems of marketing and storage through establishing a vegetable collection center.

Study design

The main objective of impact evaluation is to estimate the effect of an intervention in order to establish a cause- effect relationship (Cerulli, 2015; Khandker et al., 2009). One of the key challenges in evaluating impact is that we cannot observe the outcomes of an intervention as well as no intervention in the same household. A household either receives an intervention or does not receive it. The second challenge in impact evaluation is that when we compare the outcomes in the same household before and after intervention, the change in outcome may not necessarily be due to the intervention itself but because of other socioeconomic factors (Gertler et al., 2011; Ravallion, 2001). Frequently, there is no control group. Therefore, we would like a comparison group with characteristics similar to the treatment group but one that did not receive the treatment in order to stand in for the counterfactual outcome, what would have happened but for the innovation. Further, to avoid possible spillover effects (e.g., farmers learning from each other about the treatment/technology/approach), the comparison/control group should ideally be situated away from the treatment group.

Selection bias

After selecting a comparison group there might still be pre-existing difference in characteristics between treatment and comparison groups resulting in the problem of selection bias, which is a major concern with studying observational data. In this study, there are two potential sources of selection bias. First, there is high likelihood of progressive farmers self-selecting. In our study, farmers adopting the plastic tunnel technology in the initial phase of the

project were mostly leader farmers willing to experiment with new technology so they may have characteristics that might make them different from the average vegetable farmer. Second, program placement bias due to purposeful targeting of resource poor farmers in rural villages may lead to differences in their characteristics from that of the so-called average farmer. In our case, the offseason tomato project, at times, was aimed at resource poor farmers from marginalized groups in the society. Therefore, to minimize the effect of both selection bias and program placement bias we used the matching method (Stuart, 2010) to ensure that the resultant control group was comparable.

Matching

The aim of using a matching method is to identify untreated households in the comparison/control group that have structural characteristics homogeneous to those of the treated units. In our study, for each household in the treatment group, the matching method finds a suitable household in the comparison group to serve as a control based on the similarity of observable attributes. The matching method controls for a set of observable attributes known as covariates to obtain a comparable subset of control group from the larger comparison group to act as the counterfactual (what would have happened if the households did not participant in the program). After controlling for these observable covariates, the difference in the outcome indicator between the treatment and the control group represents the net effect of off-season tomato production on the outcome measures.

Based on previous studies and our knowledge of the off-season tomato intervention in Hamsapur, we used a set of farm household variables to identify suitable matches in the treatment and control group. The covariates we used in this study were: a) number of working age adults in the household because off-season tomato production is labor intense, b) number of

non-working age members in the household (together with working age adults gives us household size), c) gender, age and education of respondents, d) caste and ethnicity of household members, and e) household head type which includes two-headed household as well as single-headed household.

Sensitivity analysis

While the matching method helps to eliminate selection bias due to observable attributes, it cannot address bias due to unobserved or hidden factors such as risk aversion, work ethic, and entrepreneurial ability. To check whether our results are sensitive to hidden biases, we used the Rosenbaum bounds test (Rosenbaum, 2002).

Outcome indicators

There are two outcome measures in our comparisons: crop income and household food security status. To measure crop income, we calculated total crop output and total crop input. Crop output (NRs) was calculated by adding up usable crop produced and valued at farmgate selling price. This included all crop products sold, consumed at home, and given away or shared with people outside the household. Crop input (NRs) was calculated by adding the cost of variable inputs such as seeds, fertilizers, pesticides, hired labour, other inputs) as well as land rent used in crop production. Total crop income for each household was then calculated by subtracting crop input from crop output. Crop income thus calculated represents the net income household received from growing off-season tomato inside plastic tunnels. We hypothesized that production of off-season tomato increases crop income.

Our second outcome indicator was household's food security status. We used a shortened version of the Household Food Insecurity Access Scale (HFIAS) developed in 2007 by USAID, to measure the food access component of household food security. We aimed to capture the

severity of food insecurity faced by households due to lack of or limited resources to access food. The HFIAS measures household food security using three core domains to measure food access. The three domains are i) anxiety and uncertainty about the household food supply, ii) insufficient quality including variety and preferences of the type of food, and iii) insufficient food intake and its physical consequences. In our shortened version, we asked three occurrence questions relating to the three domains. Each occurrence question was followed by a sub-question on frequency of occurrence. The three questions reflecting the three domains were as follows:

- 1) In the past four weeks, did you worry that your household would not have enough food?
- 2) Because of a lack of resources in the past four weeks, did you or any household member have to eat some foods that you really did not want to eat?
- 3) Because of lack of resources in the past four weeks, did you or any household member have less food than you needed in a day?

Each occurrence question had a ‘Yes’ or ‘No’ response. A ‘Yes’ response prompted the frequency question, which had 3-response options- rarely, sometimes, or often -which were coded in order of increasing frequency from 1 to 3. The sum of frequency of occurrence during the past four weeks provided a food insecurity score ranging from 0 to 9, with 0 indicating food secure and 9 indicating food insecure. To set the score in a positive direction, the food security score was calculated as:

$$\text{Food security score} = (\text{Food insecurity score} - 9) * (-1)$$

The above calculation gave us the food security score ranging from 0 to 9 with, 0 indicating food insecure and 9 indicating food secure. We assessed the internal consistency of

the responses to the three questions using Cronbach's alpha statistics. All the responses correlated positively with an alpha value of 0.55, which does not satisfy the desired level of 0.70 proposed by Nunnally (1978). However, Cronbach's alpha coefficient is quite sensitive to the number of items on the scale (Brigg & Cheek, 1986). A small number of items is likely to yield lower alpha value, in which case reporting the mean inter-item correlation is recommended to establish the reliability of the scale (Pallant, 2020). Brigg and Cheek (1986) suggested a range of 0.20 to 0.40 to be appropriate for inter-item correlation. In our case, the mean inter-item correlation of the scale was 0.29. Given the desirable value of 0.29 for inter-item correlation for the items, we considered the alpha value of 0.55 satisfactory for the purpose of our study. Our hypothesis is that production of off-season tomato improves household food security status.

Data collection

In our study, to evaluate the impact of off-season tomato production, two villages in Rupa Gaupalika, namely Siddha (Rupa-4) and Thumki (Rupa-2), were chosen for selection of the control group. These two villages were selected based on their agro-ecological similarities with Hamsapur (Rupa-7). All three villages lie on successive south-facing slopes in Rupa Gaupalika of Kaski district. These villages are roughly 1.5 to 2 hours drive from Pokhara. The households in all three villages depend on agricultural activities in heavily terraced slopes for their subsistence and livelihoods. Various ethnic groups, predominantly Brahmins/Chhetries, Gurungs/Magars, and Kami/Sarki populate the communities. Each of the villages are connected by a windy, partially paved roadway that connects them to the principal 'highway' located about 25 km away. Despite the similarities between the three villages, Siddha and Thumki were not included in the off-season tomato project thereby providing an ideal counterfactual while

ensuring that possible spillover effects likely to occur between farmers within the same village are avoided.

Household survey

We conducted household surveys in both treatment group (Hamsapur) and control group (Siddha and Thumki) from April to May in 2018. Face-to-face interviews were conducted with adult household members who made majority of the farm decisions and were familiar with household affairs. For sample selection, we compiled a comprehensive list of all households in the three villages with the help of local ICDF staff. The list consisted of 619 households in Hamsapur, 290 households in Siddha, and 312 households in Thumki. This list included the household head's name along with ward/neighborhood of the household within the village. Each household on the list was then coded as high caste, ethnic minority, or low caste based on the family name of the household head. In Nepal, family name almost always signals individual's ethnicity/caste. When a household's family name was ambiguous, follow-up inquiries were made with key informants to properly code the household in question. The resulting household list provided a high-quality basis for drawing random samples for the household survey.

After establishing the sampling frame, we used a stratified random sampling method to incorporate caste and ethnicity component in the study sample. A total of 345 households from Hamsapur and a combined total of 351 households from Siddha and Thumki were randomly selected. While surveys were carried out in all 345 households of Hamsapur village, only 99 households out of the 345 randomly selected households were found to have grown off-season tomato in the last 12 months. These 99 households in Hamsapur acted as the treatment group in our study. Additionally, 58 households out of the remaining 274 households in Hamsapur were found to have discontinued growing off-season tomato in the last 12 months. These households

were interviewed additionally to find out the possible reasons for discontinuing the production of off-season tomato in plastic tunnel. The 351 randomly selected households in Siddha and Thumki served as our control group.

Before conducting the interviews, the survey instrument was appropriately pretested in the field using the local Nepali language to enhance reliability. The pretested Nepali questionnaire was uploaded on android tablet using Open Data Kit (ODK) software. Seven Nepali enumerators including the primary researcher conducted face-to-face interviews. The enumerators were trained using training materials specially prepared in the Nepali language. The enumerator training helped to ensure that high-quality state of the art procedures were used so that unbiased responses and data could be collected for the study. The training also ensured that the enumerators knew how to properly operate the android tablets, save responses, and upload data in the project database.

We asked questions about household's socioeconomic, demographic, institutional, and farm characteristics including information about cost and revenue for each crop and livestock using a 12-month recall period. For food security related questions, we used a recall period of 4 weeks. Due to the comprehensive list of questions, each interview took at least 2 hours to complete. Before starting the interview, survey participants were clearly explained that the information would be used solely for research purpose. Verbal consent for voluntary participation was acquired for each interview in accordance with the requirement of the Institutional Review Board of Michigan State University.

Estimating the impact of off-season tomato production on crop income and food security

We estimated the impact of off-season tomato production on crop income and food security using the matching method. In recent years, the matching method has emerged as a

popular method to evaluate the impact of any given intervention in social science (King & Nielsen, 2016). The matching method is preferred over a generalized linear model, because matching methods do not have strict assumptions and are more robust to model misspecification. Previous studies (Schreinemachers, et al., 2016; Rahman & Acharjee, 2020) have used matching methods such as propensity score matching (PSM), and inverse probability weighting (IPW) to estimate the impact of farmer training and off-season vegetable farming on income. Matching using these methods is based on the propensity score, which is an estimated probability of receiving the treatment. Further, because PSM follows random pruning, it is independent of the covariates (King & Nielsen, 2016) making this method blind to information not represented in the propensity score. To avoid this problem, King & Nielsen (2016) recommend matching directly on the covariates instead of propensity scores to select the nearest neighbor. To this end, we used the nearest neighbor matching (NNM) method, to find the closest match in the comparison group for each household in the treatment group. By dropping the functional form assumptions of linear, logit, and probit models, NNM presents itself as a much more flexible estimator. Despite NNM's high degree of flexibility, matching on more than one continuous covariate can cause large-sample bias (Abadie and Imbens, 2006). To tackle this issue, we used a biased adjustment estimator, thereby improving the quality of our matches. Further, we used exact matching for discrete covariates such as gender and ethnicity.

We controlled for many covariates including household size, household type (single vs dual headed), and respondent's characteristics such as gender, age, education and ethnicity. We used the one-to-one matching method with replacement. The quality of matching was further improved by using a caliper of 0.025 standard deviation for each matching covariate. We estimated the impact of off-season tomato production on crop income and household food

security in STATA, using the “teffects nnmatch” command. Additionally, we used the option “biasadj” to remove large sample bias (Abadie & Imbens, 2011) and the “ematch” option to obtain exact matches on discrete covariates. Before matching, there were significant differences in different covariates between the treatment and comparison group (Table 2.1). Such differences between the treatment and comparison group justified the use of the matching method. After matching, there were no significant differences in these covariates between the treatment and control groups, suggesting that the quality of the matching was good (Table 2.2). For instance, after matching, the average number of men aged between 18 and 65 who represented working male members of the household changed from 1.12 to 0.91 (Table 2.2).

Although we tried controlling for all observed sources of bias, we still needed to control for unobserved sources of biases that could affect the sensitivity of our model. To this effect, we performed Rosenbaum’s sensitivity analyses to see if the conclusions of our study were altered by hidden biases. We used the option “rbounds” to perform the sensitivity analysis in STATA.

To understand problems associated with off-season tomato production, farmers in the treatment group were asked to identify whether they viewed a list of items as “major challenge”, “minor challenge” or “not a challenge.” These same famers were asked to rate their level of agreement with eight statements aimed to measure their perceptions about the effect of off-season tomato production. Levels of agreement were measured on a scale of 1 – strongly disagree to 5 –strongly agree for all statements. Further, farmers in the control group were asked about their level of agreement to 13 statements in relation to barriers associated with off-season tomato production. As before, levels of agreement read from a scale of 1- strongly disagree to 5- strongly agree. We used the Kruskal- Wallis test to measure the differences in mean scores for

levels of agreement across the three groups of respondents in our study. All analyses for this study were performed using STATA 14.0.

Results

Farm characteristics

There were striking differences between households that received off-season tomato intervention and households that did not receive the intervention (Table 2.1). Households that grew off-season tomato had smaller family size with more land. The proportion of households belonging to low caste and ethnic caste groups were higher for the treatment group than for the comparison group probably because ethnic groups and low caste groups were targeted for selection into the project. These differences between the treatment and comparison group suggests that there is an issue of selection bias justifying the use of matching method in our study.

Table 2.1: Average characteristics of the households in comparison group and treatment group

Characteristics	Comparison group (N=351)		Treatment group (N=99)		ttest (comparison–treated)	
	Mean	SD	Mean	SD	Mean	t-value
Number of working age men	1.12	0.86	0.88	0.72	0.24	2.54**
Number of working age women	1.27	0.73	1.13	0.58	0.14	1.76*
Number of non working members	1.79	1.54	1.35	1.31	0.43	2.55**
Total family size	4.18	2.10	3.37	1.77	0.81	3.52***
Age of HH head (years)	52.45	14.12	51.61	13.69	0.85	0.53
Education of HH head (years)	5.19	4.03	5.99	4.56	-0.80	-1.70*
Total agricultural land (ha)	0.58	0.55	0.69	0.49	-0.11	-1.74*
Gender of HH head (0,1)	Women= 46.15%, Men= 53.84%		Women= 49.50 %, Men= 50.50 %		Chi-squared test	ns
Ethnicity (1,2,3)	High caste= 60.11 %, Ethnic group= 21.93 %, Low caste= 17.95 %		High caste= 46.46 %, Ethnic group= 31.31 %, Low caste= 22.22 %		Chi-squared test	**
HH type (Single-headed Vs Dual headed)	Single-headed= 26.21%, Dual-headed= 73.78 %		Single-headed= 18.18 %, Dual-headed= 81.82 %		Chi-squared test	ns

Note: ***, **, *significant at 1%, 5% and 10% respectively, ns= not significant at 10%.

Average treatment effect

After matching, the difference in the mean values of the covariates in the treatment and the control group was reduced to zero (Table 2.2). We were thus able to effectively reduce the bias in observable characteristics between the treatment and comparison group.

Our results showed that crop income was greater for households that grew off-season tomato by NRs 13876.51 compared to households that did not grow off-season tomato (Table 2.3). This increase in crop income was also significant ($p < 0.001$). By contrast, household's food security was significantly lower for households in treatment group compared to households in control group.

Table 2.2: Average characteristics of the households in control group and treatment group after matching

Characteristics	Control group (N=66)		Treatment group (N= 99)		ttest (control – treated)	
	Mean	SD	Mean	SD	Mean	t-value
Number of working age men	0.91	0.67	0.88	0.72	0.29	0.26ns
Number of working age women	1.17	0.51	1.13	0.58	0.03	0.37ns
Number of non-working HH members	1.52	1.01	1.35	1.31	0.16	0.85ns
Total family size	3.59	1.47	3.37	1.77	0.22	0.85ns
Age of HH head (years)	49.17	12.54	51.61	13.69	-2.44	-1.16ns
Education of HH head (years)	6.47	4.01	5.99	4.56	0.48	0.69ns
Total agricultural land (ha)	0.58	0.64	0.69	0.49	-0.11	-1.25ns
Gender of HH head (0,1)	Women= 50 %, Men= 50%		Women= 49.50 %, Men= 50.50 %		Chi-squared test	ns
Ethnicity (1,2,3)	High caste= 48.48%, Ethnic group= 30.30 %, Low caste= 21.21 %		High caste= 46.46 %, Ethnic group= 31.31 %, Low caste= 22.22 %		Chi-squared test	ns

Table 2.2 (cont'd)

HH type (Single-headed Vs Dual headed)	Single-headed= 18.18 %, Dual-headed=81.81 %	Single-headed= 18.18 %, Dual-headed= 81.82 %	Chi-squared test	ns
--	---	--	------------------	----

Note: ***, **, *significant at 1%, 5% and 10% respectively, ns= not significant at 10%.

Table 2.3: Impacts of offseason tomato production in plastic tunnel on crop income and food security using nearest neighbor matching method.

	Crop income (NRs)	Food Security Score
Impact estimate using matching [†]	13876.51 (3898.808) ***	-1.002686 (0.168555) ***
Γ sensitivity (Hodges-Lehmann) [‡]	1.6	4.3
[Number of treated and control]	[99, 66]	[99, 66]
Means of the treated and the control	29437.39, 16579.1	7.878788, 8.893939

[†] The numbers in parentheses of this row are Abadie-Imbens standard errors.

[‡] The value of Γ at which the lower bound of 95% confidence interval for the Hodges-Lehmann point estimate of the effect includes zero.

Note: ***, **, *significant at 1%, 5% and 10% respectively, ns= not significant at 10%.

The results were moderately sensitive to hidden bias. For crop income, the lower bound were significant at $p < 0.001$ while the upper bound was significant ($p < 0.01$) when the gamma was 1.6. This result suggests that, even if the odds of one household receiving intervention is only 1.6 times higher, our inference changes due to different values on unobserved covariates despite being identical on the matched covariates. For food security, the upper bound was significant at $p < 0.001$, while the lower bound was significant ($p < 0.010$) when the gamma was 4.3. A higher value of gamma is desirable. The lower the value of gamma the higher the likelihood that our inference is sensitive to hidden biases. Although a lower value of gamma does not prove that there has been a violation of assumptions, it does warrant a caution in interpreting the results.

Problems associated with off-season tomato production technology

Among off-season tomato producers, 88.88 % reported disease as a major challenge associated with off-season tomato production (Table 2.4). 86.86 %, 81.81 %, and 75.75% farmers reported loss from monkey, insects, and lack of irrigation as major challenge while low market price, difficulty in finding market and lack of technical knowledge were reported as major challenges by more than 50 % of off-season tomato producers. Majority farmers agreed that theft of vegetables was not a challenge in producing off-season tomato. 48.48 % farmers reported that weeds were not a challenge at all.

Table 2.4: Challenges associated with off-season tomato production

Factors	Major challenge	Minor challenge	Not a challenge	Total
Weeds	17	34	48	99
Diseases	88	10	1	99
Insects	81	18	0	99
Lack of irrigation	75	7	17	99
Lack of labor	22	29	48	99
Lack of access to credit	12	42	45	99
Farm inputs difficult to get	29	36	34	99
Finding a market	51	30	18	99
Low market price	60	16	23	99
Theft of vegetables from farm	6	5	88	99
Lack of technical knowledge	53	33	13	99
Damage from monkey	86	2	11	99

Source: Field survey, 2018

Perceptions about the effects of off-season tomato production technology

With regard to perception about the effects of off-season tomato production technology, farmers agreed to a high extent that off-season tomato production technology had a positive impact for all eight statements mentioned (Table 2.5). We performed the Kruskal- Wallis test to see if there were significant differences in the mean scores across the three caste groups. Our results suggest there were no differences across the three groups for seven statements. For one of eight statements, “knowledge and information sharing among community members have

improved,” there was significant difference in score based on the Kruskal-Wallis test with higher caste groups scoring 3.68, while ethnic caste and lower caste group scoring 3.19 and 3.22 respectively. When asked if they would have grown off-season tomato if they had not received any form of support, 32.67 % said yes, 51.48 % said no, 1.98 % reported, “don’t know”, and 13.86 % refused to answer.

Table 2.5: Perception to off-season tomato production among off-season tomato growers

Statements	Total	Mean	SD
My access to agricultural information has increased.	99	4.15	0.72ns
My skill and knowledge on vegetable production has increased.	99	4.31	0.80ns
I am able to save some cash that I use to buy food, pay for health services, children’s education etc.	99	4.23	0.74ns
My family income has improved.	99	4.17	0.95ns
My family consumes more homegrown vegetables than before.	99	4.23	0.92ns
My community is better off.	99	3.67	1.05ns
Knowledge and information sharing among community members have improved.	99	3.44	1.10*
Socially and economically marginalized farmers have benefited and are more empowered.	99	3.27	1.32ns

Note: ***, **, * denote significance of difference in mean score across three caste groups at 1%, 5% and 10% respectively using the Kruskal-Wallis test; ns = not significant at 10%.

Perceived barriers to the adoption of off-season tomato production

351 households in our comparison group reported they never grew off-season tomato in the past. They agreed that lack of knowledge about the technology and lack of education and skills to adopt the technology were important barriers to adopting the technology (mean scores of 4.25 and 3.98 respectively) (Table 2.6). Respondents also agreed that lack of irrigation (mean score 3.94) and lack of access to market (mean score 3.63) and market information (mean score 3.68) were hindering the adoption of off-season tomato production technology. For factors such as small farm size, farm unsuitability, and lack of sufficient money for adopting the technology, farmers’ level of agreement was closer to neutral (mean score of 2.86, 2.67, 2.56 respectively). Farmers slightly disagreed that lack of access to credit for adopting the technology was a barrier (mean score 2.29). Farmers disagreed that they did not think adopting the technology would

increase their income (mean score 1.97). They also disagreed that them not receiving the intervention was due to political bias (mean score 1.75), or male favoritism (mean score 1.49). They disagreed with the statement that growing off-season tomato was not worth the effort (mean score 1.70).

The Kruskal-Wallis test indicated that there were significant differences between the mean scores for seven out of 13 statements across different caste groups. The test showed chi-square values of 10.325 ($p < 0.01$), and 18.080 ($p < 0.01$) for small farm size and lack of irrigation, respectively. Chi-square values of 9.134 ($p < 0.01$), and 7.975 ($p < 0.05$) were reported respectively for lack of education, and lack of market. Lack of knowledge was significant at a chi-square value of 7.114 ($p < 0.05$).

Table 2.6: Barriers associated with adoption of off-season tomato

Statements	Total	Mean	SD
I do not have sufficient knowledge or details about the technology.	351	4.25	0.89**
I do not have the education or skills to adopt the technology.	351	3.98	0.86***
This agricultural technology is not suitable for my farm.	351	2.67	1.06ns
I do not have sufficient money to adopt the technology.	351	2.56	1.06ns
I cannot get credit needed to adopt the new technology.	351	2.29	1.15ns
My farm is too small.	351	2.86	1.18***
My farm has no access to irrigation.	351	3.94	1.20***
I do not have access to the market for my products.	351	3.63	0.84**
I do not have access to market information when needed.	351	3.69	0.81ns
I do not think it will increase my income.	351	1.97	1.06ns
I have a different political ideology for NGO/Donors doing project	351	1.75	0.76ns
These programs favor male farmers	351	1.49	0.72ns
I do not think it is worth the effort.	351	1.70	0.65ns

Note: *, **, and *** denote significance of difference in mean score across three caste groups at the 10%, 5%, and 1% level respectively using the Kruskal-Wallis test and ns = not significant at 10%.

Our result suggests that perceptions of barriers to adoption are different for people belonging to different caste groups (Table 2.7). For instance, farmers belonging to low caste agreed that small farm size was a barrier to adoption of off-season tomato technology (mean

score 3.25) while farmers belonging to high caste and ethnic caste group were more neutral on this (mean score of 2.8 and 2.6 respectively).

When non-grower farmers were asked if they would grow off-season tomato if they received support to build plastic tunnel, 61.82% reported yes, 37.32% reported no and less than 1% said, “don’t know.”

Table 2.7: Barriers associated with adoption of off-season tomato according to three caste groups

Statements	High caste (N=212)	Ethnic caste (N=77)	Low caste (N= 63)
I do not have sufficient knowledge or details about the technology.	4.20 (0.88)	4.16(1.06)	4.52(0.6)
I do not have the education or skills to adopt the technology.	3.91(0.83)	3.92(1.035)	4.27(0.627)
My farm is too small.	2.82(1.17)	2.63(1.16)	3.25(1.10)
My farm has no access to irrigation.	4.00(1.15)	3.49(1.29)	4.30(1.11)
I do not have access to the market for my products.	3.73(0.759)	3.43(1.03)	3.53(0.876)
I do not have access to market information when needed.	3.767(0.715)	3.50(1.02)	3.65(0.806)
These programs favor male farmers	1.55(0.74)	1.40(0.63)	1.41(0.71)

Note: The numbers in the parentheses represent the standard errors.

Reasons for discontinuation of off-season tomato production technology

We tracked and interviewed 58 additional households in Hamsapur that were not part of our matching study, but were part of the off-season tomato intervention program. These households had reportedly discontinued growing off-season tomato in plastic tunnel. 39.66% farmers reported lack of time as an important reason for discontinuing the production of off-season tomato. 32.76% farmers reported difficulty in disease and pest management and only 24.14% farmers viewed it as unprofitable (Table 2.8). It must be noted that there was no significant difference in household characteristics between continuing and discontinuing farmers (Table 2.9).

Table 2.8: Reasons for discontinuation of off-season tomato in plastic tunnels (N= 58)

Reasons	No	Yes
1. It was not profitable.	44 (75.86)	14 (24.14)
2. Disease management was difficult.	39 (67.24)	19 (32.76)

Table 2.8 (cont'd)

3. I sold away my land.	58 (100)	0 (0)
4. I did not have enough time to look after the tunnel.	35 (60.34)	23 (39.66)
5. Tomatoes were frequently stolen from the tunnel.	55 (94.83)	3 (5.17)

Note: The numbers in paranthesis represents the percentage value.

Table 2.9: Average characteristics of households that discontinued vs continued growing off-season tomato in plastic tunnels

Characteristics	Discontinued group (N=58)		Continued group (N= 99)		ttest (control – treated)	
	Mean	SD	Mean	SD	Mean	t-value
Number of working age men	0.86	0.74	0.88	0.72	0.86	0.74ns
Number of working age women	1.07	0.62	1.13	0.58	1.07	0.62ns
Number of non working HH members	1.31	1.14	1.35	1.31	1.31	1.14ns
Total family size	0.24	1.55	3.37	1.77	0.24	1.55ns
Age of HH head (years)	51.84	13.64	51.61	13.69	51.84	13.64ns
Education of HH head (years)	5.88	4.60	5.99	4.56	5.88	4.60ns
Total agricultural land (ha)	0.58	0.55	0.69	0.49	0.58	0.55ns
Gender of HH head (0,1)	Women= 39.66 %, Men= 60.34 %		Women= 49.50 %, Men= 50.50 %		Chi-squared test	ns
Ethnicity (1,2,3)	High caste= 39.66 %, Ethnic group= 29.31 %, Low caste= 31.03 %		High caste= 46.46 %, Ethnic group= 31.31 %, Low caste= 22.22 %		Chi-squared test	ns
HH type (Single-headed Vs Dual headed)	Single-headed= 20.69 %, Dual-headed= 79.31 %		Single-headed= 18.18 %, Dual-headed= 81.82 %		Chi-squared test	ns

Note: *, **, and *** denote significance of mean difference at the 10%, 5%, and 1% level respectively; ns = not significant at 10%.

Discussion

Growing off-season tomato in plastic tunnels is a profitable enterprise in Nepal's hilly region (Lamchhane, 2017; Pandey & Chaudhary, 2004). Our study confirms that off-season tomato production in plastic tunnels increases crop income in rural households supporting the findings from Suvedi et al. (2017) and Kc et al. (2021). Further, our findings are in line with studies from Bangladesh (Rahman & Acharjee, 2020; Schreinemachers et al., 2016) showing

increase in crop income and subsequently household income as a result of off-season tomato production. The increase in crop income could be due to higher profitability of off-season tomato as reported by Lamichhane et al. (2017). Lamichhane et al. (2017) highlights the fact that strategic production of off-season tomato between the months of July to October when tomatoes fetch higher price can help increase profit per unit area in Nepal's hilly region. Additionally, providing quality seed as well as training for appropriate management practices in off-season tomato production have can help increase income from off-season tomato.

In terms of household food security, our findings suggest off-season tomato production did not improve household's food security status. As opposed to findings from Bangladesh (Rahman & Acharjee, 2020), farmers growing off-season tomato reported experiencing lower food security compared to farmers who did not grow off-season tomato. This result was not as expected, particularly when off-season tomato producers reported higher crop income compared to control group. Higher crop income means farmers are likely to have more access to cash to buy food, which also improves food security. Further, when the treatment group was asked to rate their perception about the effect of off-season tomato, two statements: "I am able to save some cash that I use to buy food, pay for health services, children's education etc.," and "My family consumes more homegrown vegetables than before" were ranked second with a mean score of 4.27. This rating also supports the fact that off-season tomato growers experienced greater food security. However, our contradicting result while estimating the impact of off-season tomato on food security score, suggests that the food security indicator that we used in our study based on the short version of the Household Food Insecurity Access Scale (HFIAS) did not accurately capture the food security status. One possible reason could be that in our survey we used a recall period of the last four weeks to analyze farmer's perception of household food

security with an intention to reduce recall bias associated with long timeframe. However, in Nepali context, there is a seasonal variation in food availability and consumption with increased risk of food insecurity during the planting or lean period between May and July. When we collected data for this study in the months of April and May, households were nearing the lean period and therefore did not accurately reflect the level of food security experienced by households throughout the year. To account for the seasonal variation, Singh et al. (2014) and Osei et al. (2010) used the annualized version of HFIAS i.e. the questions they asked pertained to the last 12 months instead of the last four weeks. Another issue with the implementation of HFIAS was that we used only three out of the original nine questions, to represent the three core domains of food security namely: i) anxiety and uncertainty about household food supply, ii) insufficient quality including variety and preferences of the type of food, and iii) insufficient food intake and its physical consequences. The main reason for using three out of the nine questions was due to problem in translation with all questions sounding very similar to each other in the local Nepali language. The shortening of the HFIAS could also have possibly contributed to the inaccuracy of food security indicator in our study.

A majority of the off-season tomato growers reported disease management and insect pests as major challenges associated with off-season tomato production. Previous studies (Rahman & Acharjee, 2020; Schreinemachers et al., 2016) have reported disease pest management as an important problem associated with off-season tomato although no distinction was made between disease management and pest management. Kafle and Shrestha (2017) reported late blight and viral complexes to be major diseases associated with off-season tomato production in plastic tunnels in Hemja VDC of Nepal's Kaski district. Supporting farmers by providing Integrated Pest Management (IPM) training have been proven to improve farm income

from off-season tomato in Bangladesh (Rahman & Acharjee, 2020; Schreinemachers et al., 2016). Interestingly, weed infestation was not perceived as a challenge by almost half of the farmers. This is probably because unlike disease and insect pest management, weed management is relatively simple and does not require farmers to have extensive technical knowledge.

Another key finding of our study is that farmers across all caste groups strongly perceived off-season tomato production technology to have positive impact at both household and community level. At household level, tomato growers were not only able to increase income; they were also able to save some money to buy food and pay for health services and children's education. At the community level, farmers perceived off-season tomato production to improve the status of socially and economically marginalized groups in the society. Our findings support the statement from Suvedi and Ghimire (2016) that vegetable production could eventually lead to sustainable development by preparing farmers for leadership roles.

Among non-growers, lack of knowledge, education, and skills to adopt the technology was viewed as major barriers to technology adoption by all groups. We found that barriers to adoption of off-season tomato, differs among three groups. Small farm size and lack of access to irrigation were perceived as barriers to a greater degree by the low-caste group compared to the other two groups. This could be explained by the fact that 53% households in the low caste group have no land ownership certificates in Nepal (NDC, 2005). Any development interventions including dissemination of improved agricultural technologies should account for the fact that marginalized communities have limited access to agricultural resources. Confirming lack of resources as an important barrier, more than half of off-season tomato growers in our study said they would not have adopted the technology if they had not received support to build plastic tunnel. Also, more than half of non-adopters stated they would like to adopt the technology if

they received support. This highlights the fact that farmers are interested in off-season tomato technology but are unable to adopt it due to limited resources.

Further, our study reveals that lack of access to institutions could be a barrier in adoption of agricultural technology particularly among the socially marginalized classes in the society. In our study, compared to the upper and lower caste group, the ethnic group found lack of access to market and market information as barriers to a greater extent probably due to Nepali being their second language. This finding is not surprising because often minority groups that do not share the dominant culture, language and religion have limited access to information and participation in public space due to linguistic and religion-based exclusion (Gurung et al., 2014). For instance, ethnic groups are likely to be excluded from the market due to lack of access to information in their mother tongue. Despite these barriers, farmers across all caste recognized the importance of off-season tomato production in increasing income.

Finally, our study shows that lack of time and difficulty in disease-pest management are an important contributing factors leading to discontinuation of off-season tomato technology. Our findings are consistent with findings from Bangladesh (Rahman & Acharjee, 2020) where farmers reported lack of time and excess money spent on disease pest management as main reasons for discontinuing off-season tomato farming. Unlike the Bangladeshi farmers, more than three quarter of farmers who discontinued the technology, in our study, recognized that it was a profitable enterprise. Farmers could benefit from appropriate training to increase their knowledge and skills associated with off-season production in plastic tunnels.

Conclusion and recommendations for policy and research

Off-season tomato production in plastic tunnels is highly profitable in Nepal's mid-hill region. The sloping landscape provides comparative advantage to farmers in the rainy season if

they grow tomatoes inside plastic tunnels. Our study highlights that by strategically growing off-season tomato inside plastic tunnels in the rainy season, households are able to increase their crop income. Farmers perceived the technology to have positive impact at both household and community level. At household level, farmers agreed that the technology improved their income, savings and food security. At community level, farmers agreed that marginalized members of the society were better off than before as a result of growing off-season tomato inside plastic tunnels. Disease management was identified as a major problem associated with off-season tomato production. While farmers belonging to all three groups reported lack of education, knowledge and skills as key barriers to the adoption of this technology, we found that farmers' perception of barriers was to some degree influenced by their caste. Lower caste farmers identified inadequate land and lack of access to irrigation as barriers to a greater extent while farmers belonging to ethnic group, identified lack of access to market and market information as barriers to a greater degree. Our study also reveals lack of time and difficulty in disease-pest management despite the profit as major reasons for farmers to discontinue the technology.

Based on our findings, we make the following recommendations for research and policy:

a) Promotion of off-season tomato production inside plastic tunnels need to be tailored to meet the needs of farmers belonging to diverse economic and social background. To this end, bottom-up and demand driven participatory extension service need to be adopted. b) Given that disease and insect pest management is a major problem experienced by farmers, public sector investment is recommended to increase farmers' access to IPM training and improved IPM methods.

Research should focus on developing IPM methods that are both cost effective and profitable.

Limitations

The results of this study should be interpreted with the possibility of various limitations. Firstly, as in all impact evaluation studies, potential source of bias may be present due to unobserved factors while matching control (non-growers) and treatment (growers) group. Secondly, as in any survey data, there may be some inaccuracies while reporting information despite taking measures to minimize errors. To ensure that our estimates are less sensitive to those uncertainties, we performed the Rosenbaum sensitivity analysis. The Rosenbaum sensitivity analysis gives us an idea about how likely the conclusion from our study may change due to the above-mentioned limitations. Finally, with the benefit of hindsight, we can conclude that the food security indicator used in this study did not accurately capture the food security status of households in the last 12 months. Therefore, the study could have benefitted from an improved version of the food security scale that accounted for seasonal variability in food availability in Nepal. While our analysis is restricted to farmers in Nepal's Kaski district, our study provides evidence-based feedback to stakeholders. Findings from this study is relevant to food policy decisions in developing country contexts due to the direct linkage between improved agricultural technology and household wellbeing.

REFERENCES

- Abadie, A., & Imbens, G. W. (2006). Large sample properties of matching estimators for average treatment effects. *econometrica*, 74(1), 235-267.
- Abadie, A., & Imbens, G. W. (2011). Bias-corrected matching estimators for average treatment effects. *Journal of Business & Economic Statistics*, 29(1), 1-11.
- Bound, J., Jaeger, D. A., & Baker, R. M. (1995). Problems with instrumental variables estimation when the correlation between the instruments and the endogenous explanatory variable is weak. *Journal of the American statistical association*, 90(430), 443-450.
- Briggs, S. R., & Cheek, J. M. (1986). The role of factor analysis in the development and evaluation of personality scales. *Journal of personality*, 54(1), 106-148.
- Budhathoki, K., Pradhan, N.G., H. N. Regmi, H.N., & Bhurtyal, P.R. (2004). Evaluation of tomato cultivars for off-season production under polyhouse and open field condition. In *Proceedings of the Fourth National Horticultural Research Workshop* (March 2-4, 2004), Kathmandu (eds. B.B. Khatri, B.P. Sharma, P.P. Khatriwada, K.P. Paudyal, B.R. Khadge and H.N. Regmi). Horticulture Research Division, National Agriculture Research Council, Kathmandu, pp. 413-418.
- Cawley, A., O'Donoghue, C., Heanue, K., Hilliard, R., Sheehan, M., & Stefanou, S. (2018). The impact of extension services on farm-level income: An instrumental variable approach to combat endogeneity concerns. *Applied Economic Perspectives and Policy*, 40(4), 585-612.
- Central Bureau of Statistics (CBS). (2010). Nepal Vegetable Crops Survey: A Statistical Report.
- Central Bureau of Statistics, National Planning Commission, Kathmandu, Nepal.
- Cerulli, G. (2015). Econometric evaluation of socio-economic programs. *Advanced Studies in Theoretical and Applied Econometrics Series*, 49.
- Chapagain, T. R., Khatri, B. B., & Mandal, J. L. (2012). Performance of tomato varieties during rainy season under plastic house conditions. *Nepal Journal of Science and Technology*, 12, 17-22.
- Chapagain, T. R., Piya, S., Mandal, J. L., & Chaudhary, B. P. (2010). Up-scaling of polyhouse tomato production technology in mid and high hills of eastern Nepal. In *Proceedings of ninth national outreach research workshop* (pp. 7-8).
- Faltermeier, L., & Abdulai, A. (2009). The impact of water conservation and intensification technologies: empirical evidence for rice farmers in Ghana. *Agricultural Economics*, 40(3), 365-379.
- Gertler, P. J., Martínez, S., Premand, P., Rawlings, L. B., & Vermeersch, C. M. (2011). *Impact Evaluation in Practice; La Evaluación de Impacto en la Práctica*. World Bank Publications.

- Gurung, O., Tamang, M. S., & Mark, T. (2014). *PersPectives on social inclusion and exclusion in nePal*. Department of Sociology/Anthropology, Tribhuvan University.
- Headey, D., & Ecker, O. (2013). Rethinking the measurement of food security: from first principles to best practice. *Food security*, 5(3), 327-343.
- Kafle, A., & Shrestha, L. K. (2017). Economics of tomato cultivation using plastic house: a case of Hemja VDC, Kaski, Nepal. *International Journal of Agriculture, Environment and Biotechnology*, 2(01).
- Kc, D., Jamarkattel, D., Maraseni, T., Nandwani, D., & Karki, P. (2021). The effects of tunnel technology on crop productivity and livelihood of smallholder farmers in Nepal. *Sustainability*, 13(14), 7935.
- Kc, D., Jamarkattel, D., Maraseni, T., Nandwani, D., & Karki, P. (2021). The effects of tunnel technology on crop productivity and livelihood of smallholder farmers in Nepal. *Sustainability*, 13(14), 7935.
- Khandker, S. R., Koolwal, G. B., & Samad, H. A. (2009). *Handbook on impact evaluation: quantitative methods and practices*. World Bank Publications.
- King, G., & Nielsen, R. (2016). Why propensity scores should not be used for matching: Supplementary appendix.
- Kunwar, B., & Maharjan, B. (2019). Economic Analysis of Off-Season Tomato Production under Poly-House in Okhldhunga, Nepal. *Journal of Agriculture and Environment*, 20, 67-77.
- Laborde-Castérot, H., Agrinier, N., & Thilly, N. (2015). Performing both propensity score and instrumental variable analyses in observational studies often leads to discrepant results: a systematic review. *Journal of clinical epidemiology*, 68(10), 1232-1240.
- Lamichhane, J., Ghimire, Y. N., Timsina, K., Magar, D. T., Sharma, T., Timilsina, C., & Adhikari, S. P. (2017, September). Profitability assessment of tomato cultivation under plastic house in western hills of Nepal. In *Proceedings of the 9th National Horticulture Workshop, Burlington, VE, USA* (pp. 8-9).
- Manyong, V. M., Douthwaite, B., Coulibaly, O., & Keatinge, J. D. H. (2001). Participatory impact assessment at the International Institute of Tropical Agriculture: functions and mechanisms. In *Proceedings of a workshop organized by the Standing Panel on Impact Assessment*, CGIAR.
- National Dalit Commission. (2005). Citizenship and land ownership status of Dalit community in Nepal.
- Nunnally, J. C. (1994). *Psychometric theory 3E*. Tata McGraw-hill education.

Osei, A., Pandey, P., Spiro, D., Nielson, J., Shrestha, R., Talukder, Z., ... & Haselow, N. (2010). Household food insecurity and nutritional status of children aged 6 to 23 months in Kailali District of Nepal. *Food and nutrition bulletin*, 31(4), 483-494.

Pallant, J. (2020). *SPSS survival manual: A step by step guide to data analysis using IBM SPSS*. Routledge.

Pandey, Y. R., & Chaudhary, B. N. (2004, March). Evaluation of tomato varieties and their planting dates for commercial production under Jumla agro-ecological condition. In *Proceedings of the Fourth National Horticultural Research Workshop* (pp. 2-4). Horticulture Research Division-NARC, Khumaltar.

Pandey, Y. R., Pun, A. B., & Upadhyay, K. P. (2006). Participatory varietal evaluation of rainy season tomato under plastic house condition. *Nepal Agric. Res. J*, 7, 11-15.

Paudel, P., & Adhikari, R. K. (2018). Economic analysis of tomato farming under different production system in Dhading district of Nepal. *Nepalese Journal of Agricultural Sciences*, 16, 217-224.

Pokharel, A. (2021). Economic analysis of offseason tomato production in Kathmandu, Nepal: A Study of Nepalese tomato growers.

Rahman, M. S., & Acharjee, D. C. (2020). Impact of Off-Season Summer Tomato Cultivation on Income and Food Security of the Growers. In *Agricultural Economics*. IntechOpen.

Ravallion, M. (2001). The mystery of the vanishing benefits: An introduction to impact evaluation. *the world bank economic review*, 15(1), 115-140.

Rosenbaum, P. R. (2002). Sensitivity to hidden bias. In *Observational studies* (pp. 105-170). Springer, New York, NY.

Schreinemachers, P., Wu, M. H., Uddin, M. N., Ahmad, S., & Hanson, P. (2016). Farmer training in off-season vegetables: Effects on income and pesticide use in Bangladesh. *Food Policy*, 61, 132-140.

Singh, A., Singh, A., & Ram, F. (2014). Household food insecurity and nutritional status of children and women in Nepal. *Food and nutrition bulletin*, 35(1), 3-11.

Stuart, E. A. (2010). Matching methods for causal inference: A review and a look forward. *Statistical science: a review journal of the Institute of Mathematical Statistics*, 25(1), 1.

Suvedi, M., & Ghimire, P. R. (2016). In search of an alternative agricultural extension strategy: An action research on off-season vegetable production in Nepal. *Journal of International Agricultural and Extension Education*, 23(2), 50-62.

Suvedi, M., Ghimire, R., & Kaplowitz, M. (2017). Farmers' participation in extension programs and technology adoption in rural Nepal: a logistic regression analysis. *The Journal of Agricultural Education and Extension*, 1-21.

Suvedi, M., Ghimire, R., & Kaplowitz, M. (2017). Revitalizing agricultural extension services in developing countries: Lessons from off-season vegetable production in rural Nepal. *Journal of the International Society for Southeast Asian Agricultural Sciences*, 23(1), 1-11.

ESSAY THREE: IMPACT OF RURAL NON-FARM EMPLOYMENT ON FOOD SECURITY IN NEPAL

Introduction

Improving food security continues to be an important issue in the field of international development. The second goal of the United Nations' Sustainable Development Goals (SDGs) aims "to end hunger, achieve food security and improved nutrition, and promote sustainable agriculture," by the year 2030 (UN, 2015). To achieve this goal, it is essential that there is universal access to sufficient quantities of food produced. A recent report by Food and Agriculture Organization (FAO) on the state of food security and nutrition in 2021 raised concern that SDG-2 may not be achieved by 2030 (FAO, 2021). Nearly 2.37 billion people in the world faced food insecurity in 2021 despite numerous efforts by governments around the world (FAO, 2021). This situation is particularly worse for rural households in developing countries where agriculture plays a key role in reducing food insecurity and hunger (World Bank, 2020). Despite the pivotal role of agriculture, with declining productivity, agriculture sector on its own is unable to overcome the issue of food insecurity. Food insecurity is defined by the FAO (2014) as "a situation that exists when people lack secure access to enough amounts of safe and nutritious food for normal growth and development and an active and healthy life. It may be caused by the unavailability of food, insufficient purchasing power, inappropriate distribution, or inadequate use of food at the household level."

One possible pathway to pull rural households out of food insecurity is to promote the development and growth of non-farm sector (Barrett et al., 2001; Gladwin et al., 2001). In many developing countries, participation in non-farm work has become an important livelihood strategy among rural households. Non-farm work refers to all remunerative activities outside of

livestock and crop production. In the last few decades, income from non-farm activities has been reported to contribute both substantially and increasingly to total household income (Ruben, 2001; de Janvry and Sadoulet, 2001; Haggblade et al., 2007). In the 1990s, the rural non-farm sector contributed roughly between 32 to 40 percent of total household income (Reardon et al., 1998). This contribution increased to 60 percent in the 2000s (Davis, 2003). The level of contribution of rural non-farm sector is expected to grow over time (Fox & Pimhidzai, 2013; Haggblade et al., 2005). This increasing trend in non-farm sector participation can be explained by different “push” and “pull” factors that motivate households to participate in non-farm activities. Households are pushed into the non-farm sector when farming becomes less profitable due to declining agricultural productivity and increasing market risks (Kijima et al., 2006; Matsumoto et al., 2006; Reardon, 1997). On the other hand, when returns from non-farm employment are higher or less risky than agriculture, households are pulled into non-farm work.

The literature on non-farm sector has mostly focused on the nature and determinants of non-farm work in developing countries (Anang & Yeboah, 2019; Chhetri 2017, Rahut et al., 2014; Ghimire et al., 2014; Abdulai and CroleRees, 2001; Barrett et al., 2001; Canagarajah et al., 2001; Abdulai and Delgado, 1999). Household’s decision to participate in non-farm activities is influenced by the characteristics of both household and household head. For instance, younger farmers are more likely to participate in off-farm work due to progressive thinking (Olale and Henson, 2012). Women are less likely to engage in off-farm activity compared to men due to women’s limited access to information (Doss and Morris, 2000). Education facilitates access to non-farm employment opportunities in high paying jobs (Huffman, 1980). Bigger family size and larger number of dependent members increase household’s likelihood of participating in non-farm employment (Anang, 2017).

Investigations on the welfare impact of non-farm work have often been limited to studying the correlation between non-farm work and different welfare outcomes. For instance, studies have reported non-farm work to be positively correlated with household income and food security (Babatunde & Qaim, 2010; Chang & Mishra, 2008; Lanjouw & Lanjouw 2001; Reardon et al., 1992). By increasing household income, participation in non-farm employment contributes to poverty reduction and equality in income distribution (de Janvry & Sadoulet, 2001; Reardon et al., 2001). Households use income from non-farm work to buy food, which improves household's nutrition status and food security (Owusu et al., 2011; Reardon et al., 2001). Some studies have shown that engaging in non-farm activities may sometimes decrease food security due to competition of household resources between farm and non-farm activities (Mabuza et al., 2016; Pfeiffer et al., 2009).

However, the question remains whether households' participation in non-farm work improves welfare outcomes or if it is indeed the well-off households that participate in non-farm employment due to greater access to non-farm employment opportunities. Because the decision to participate in non-farm employment is not random, many households tend to self-select leading to selection bias. Barrett et al. (2001) rightly pointed out that the positive relationship between non-farm work participation and welfare outcomes should be interpreted with caution, because the results are limited by biases related to potential reverse causality. Few studies have attempted to investigate the direct causal effect of participation in non-farm employment on food security. The problem of self-selection bias has been addressed in these studies by using different empirical approaches such as Heckman's two-step model (Anang et al., 2020; Berdegue et al., 2001; Lanjouw, 2001), Instrumental Variable approach (Pfeiffer et al., 2009), and propensity score matching method (Shehu & Sidique, 2014, Ackah, 2013; Owusu et al., 2011; Owusu &

Abdulai, 2009). Most of these studies have been conducted in African countries. Limited studies have addressed selection bias in estimating the impact of off-farm employment participation on food security in south east Asia (Duong et al., 2021; Do et al., 2019). In Nepal, most studies on non-farm employment (often under the heading of rural livelihood and income diversification) have focused on determining the factors that enable households to diversify (Paudel et al., 2017; Sharma et al., 2015; Ghimire et al., 2014; Rahut et al., 2014; Blaikie and Coppard, 1998). Gautam and Anderson (2016) have reported positive correlation between livelihood diversification and household well being in Nepal. However, there are no studies establishing a causal linkage between non-farm work and food security in Nepal.

Objectives

The main objective of this study is to assess the impact of non-farm employment on food security of rural households in Nepal's Kaski district. The specific objectives of this paper are:

- To identify factors influencing household's participation in non-farm employment in Nepal's Kaski district.
- To estimate the effect of non-farm work on households' food security in Kaski district using two different matching methods namely, propensity score matching and direct covariate matching.

This study contributes to the limited knowledgebase on rural non-farm employment in southeast Asia by empirically examining the linkage between participation in non-farm employment and food security status in Nepal. Secondly, this study contributes methodologically by using two different matching methods to address potential selection bias problem. The two different matching methods used in this study are propensity score matching and direct covariate matching. Although propensity score matching has been well established in literature, in recent

years, direct covariate matching has emerged as a popular choice in the field of impact evaluation due to the limitations of propensity score matching and flexibility of direct covariate matching (King & Nielsen, 2016). To the best of my knowledge, there are currently no publications that have applied direct covariate matching to assess the impact of non-farm employment participation. Finally, at policy level, by establishing a causal relationship between participation in non-farm activities and food security, this paper addresses the counterfactual question to provide evidence-based feedback for policy recommendations.

The organization of the paper is as follows. We begin by discussing food security and non-farm work in Nepal. Then in the materials and methods section we describe the study area followed by data collection process. The next section outlines the methodological approach including description of variables used in this study. In the following section we present the results and discussions followed by conclusion and recommendations based on our findings. Finally, we end the paper by highlighting the limitations of the study.

Food security and non-farm work in Nepal

Nearly 80% of Nepal's population lives in rural areas with 55% of the rural population living in poverty (Paudel et al., 2017). These rural households primarily depend on subsistence farming for their livelihoods (Rahut et al., 2014). Despite this large section of population engaging in agriculture, Nepal is not able to produce sufficient food. The country has become reliant on food import to a large extent and food security remains a challenge (Adhikari et al., 2021). A recent survey conducted by the World Food Programme (WFP) in 2020, reported 23% of the 4416 surveyed households across Nepal had inadequate food and 7% had poor dietary diversity (WFP, 2020).

In a predominantly agrarian country like Nepal there is no doubt that agricultural productivity is essential for food security. However, when agricultural sector alone is not enough to address food crisis, the rural non-farm sector has been observed to play a significant role in reducing food insecurity (Babatunde and Qaim, 2010). To this end the Nepali government has been promoting the growth and development of rural non-farm sector by increasing farmer's access to non-farm opportunities. Subsequently, in the last few years non-farm economic activities have increased significantly in Nepal (CBS, 2011). Compared to the 22% contribution to household income in 1995/96, the non-farm sector contributed 37.2 % of total household income in 2010/2011. Furthermore, contribution of non-agricultural sector to the GDP has been increasing while that of the agricultural sector has been gradually decreasing over the years. For instance, agricultural sector contributed 28.1 percent to the GDP in 2017, but this contribution decreased to 20.02 percent in 2021 (CBS, 2021). On the other hand contribution of non-agricultural sector increased from 71.9 percent in 2017 to 79.8 percent in 2021 (CBS 2021). This structural shift in Nepalese economy clearly indicates the important role of non-farm sector in addressing food security issue in Nepal.

Materials and methods

Study area

We carried out this study in three villages namely Hamsapur, Thumki and Siddha of Rupa Gaupalika in Nepal's Kaski district. Kaski district lies in the mid hills of western Nepal at an altitude ranging from 600 to 1200 metres above sea level. The study area is only 1.5 hours drive away from Pokhara, which is a major city in Kaski district. Despite its close proximity to Pokhara, the study area is remarkably rural with subsistence agriculture being the major source of livelihood. Given its closeness to Pokhara, the predominantly subsistence farmers in the study

area have plenty of non-farm employment opportunities. Further, no studies on non-farm activities have been previously conducted in this area, making it an ideal setting to investigate the impact of rural non-farm employment on food security.

Data collection

We conducted household surveys in Hamsapur, Thumki and Siddha villages from April to May in 2018. Before conducting the survey, we compiled a list of households in the three villages with the assistance of local key informants and staff of a local non-governmental office named Indragufa Community Development Foundation (ICDF). There were a total of 619 households in Hamsapur, 290 households in Siddha, and 312 households in Thumki. This comprehensive list of households provided a reliable sampling frame for drawing samples. To account for different castes and ethnicity we used the stratified random sampling method to draw samples. We assigned a unique ID to each household in our sampling frame. We then randomly selected 357 households in Hamsapur, 176 households in Siddha, and 241 households in Thumki. Before conducting face-to-face interviews, the survey instrument was pretested in the local Nepali language and uploaded to an android tablet using the open data kit (ODK) with the aim of directly entering the survey data on the device. Seven enumerators were hired and trained to understand the purpose of the survey and the method of data collection. The enumerators were also trained to operate the ODK software on the android tablet so that data could be entered, saved and uploaded in the project database. For the survey, adult household members who made the majority of household decisions were chosen for face-to-face interviews. The interview was conducted in participants' house in the local Nepali language. Using a recall period of 12 months, survey participants were asked questions about households' socioeconomic,

demographic, institutional, and farm characteristics including cost and revenue generated in the farm. For the food security questions, we used a recall period of four weeks.

Methodological approach

Factors influencing non-farm employment decision

Although the main aim of this study is to assess the effect of non-farm work on household's food security status, it is important to understand what factors influence household's decision to participate in non-farm work in Kaski district of Nepal. Whether a household decides to participate in non-farm work or not is assumed to be influenced by a host of factors related to farmer's available resources and constraints. A household chooses to participate in non-farm work if the potential market wage is greater than farm income. However, these differential wages are not observable. Instead, we can observe the decision to participate in non-farm employment. Household's probability of participating in non-farm activities can be determined by using a binary choice model. In our study, we first observed if there was any difference in characteristics between households that participated in non-farm employment and households that did not participate in non-farm employment. We then used a probit model, following Ahearn et al. (2006) and Gould and Saupe (1989), to determine the probability of households choosing non-farm work. Based on theoretical and empirical considerations from previous studies (Uaiene, 2011; Conley & Urdy, 2010; El- Osta et al., 2008), we specified the following model for household's participation in non-farm work:

$$\begin{aligned} \text{NFarm}_i = & \beta_0 + \beta_1 \text{Gender}_i + \beta_2 \text{Age}_i + \beta_3 \text{Agesq}_i + \beta_4 \text{Primary education}_i + \beta_5 \text{High caste}_i + \\ & \beta_6 \text{Low caste}_i + \beta_7 \text{Household size}_i + \beta_8 \text{Dependent persons}_i + \beta_9 \text{Farm size}_i + \beta_{10} \text{Group} \\ & \text{membership}_i + \beta_{11} \text{Livestock ownership}_i + U_i \dots \dots \dots (1) \end{aligned}$$

The dependent variable represents participation in non-farm work and takes the value of 1 or 0. The value of the dependent variable is 1 if household earns income from non-farm employment, and zero otherwise. Household's participation in non-farm employment is specified as a function of household's demographic, socio-economic and institutional variables. The definition and measurement of the explanatory variables used in our study are presented in Table 3.1.

Table 3.1: Choice of variables used in the probit model for propensity score matching

Variable	Description	Comment
Gender of household head	0=Female, 1= Male	Men are more likely to participate in non-farm work than women
Age of household head	Years	Younger people are more willing to participate than older people
Primary education (completed) ^a	0= No, 1= yes	Educated people are more likely to get high paying jobs in non-farm sector
Ethnicity (Ethnic caste is based)		Caste based occupation is common, particularly among the lower caste people in Nepal
High caste	0= No, 1= yes	
Low caste	0= No, 1= yes	
Household size	persons	Household size is a proxy of labour availability
Dependent persons ^b	persons	Household with more dependent persons is more likely to participate in non-farm work
Total farmland owned	Hectare	Small farm holders are more likely to participate in non-farm sector
Livestock ownership	0= No, 1= yes	Less livestock means more time to work off-farm
Membership in farmers group/cooperative	0= No, 1= yes	Network effects may influence farmers decision to participate in non-farm sector as they learn from each other

Notes: a: primary education= 5 years of education; junior high= 10 years of education; senior high= 12 years of education; tertiary= more than 12 years of education
b: dependent persons are defined as people outside the 18–64 year-old range.

Estimating effect of non-farm work on household's food security status

To understand how household's decision to participate in off farm work affects the outcomes, we sought to quantify the average treatment effect on the treated (ATT). When the

experimental design is random, ATT is calculated as the difference in mean value of outcomes between the treated and the control (non participating) group. However, the decision to participate in non-farm work is not random and households often self-select. Due to households' tendency to self-select, there is a concern that households that participate in non-farm activities may have characteristics different from non-participating households. If this selectivity bias is not corrected or accounted for, the econometric model's coefficients could be biased (Lanjouw, 2001; Yunez-Naude & Taylor, 2001). To overcome this issue of selection bias, many studies have used Heckman two-step model to evaluate the impact of non-farm income (Berdegue et al., 2001; Lanjouw, 2001). Nevertheless, the Heckman two-step model depends on the restrictive assumption that the errors are normally distributed. An alternative way of controlling for selection bias is to use instrumental variable (IV) method. A major limitation of the IV approach is the difficulty in identifying appropriate instruments in the estimation process. In addition to these limitations, both Heckman's two-step model and IV procedures tend to impose a linear functional form assumption, implying that the coefficients on the control variables are similar for participants and non-participants. However, this assumption may not hold, the coefficients could differ.

To overcome the issues with using Heckman's two-step model and IV procedures, Dehejia and Wahba (2002) recommend using the matching method for non-experimental causal studies. In the matching method, the treated and untreated are paired after controlling for a set of observable attributes known as covariates (Rubin, 1977). In other words, selection bias is accounted for by balancing the determinants Z of the treatment T (Morgan & Winship, 2010). After controlling for these observable covariates, the difference in the outcome indicator between the treatment and the control group represents the effect of treatment on the said outcome.

Many studies investigating the impact of non-farm employment have used propensity score matching (PSM) as an appropriate matching method for evaluating impact of non-farm activities (Shehu & Sidique, 2014; Owusu, 2011). In our study, to strengthen the robustness of our results, we applied two matching models: a) PSM method and b) direct covariate matching (DCM) method.

a) Propensity score matching model

In the first model, we used propensity score matching method (Heckman et al., 1998; and implemented in Stata by Leuven and Sianesi, 2003), to estimate the impact of non-farm-work on different outcomes. The PSM method is based on the propensity score, which is the conditional probability of receiving a treatment given pre-treatment characteristics. This method ranks households according to their propensity score. In our model, we estimated the propensity score $p(Z)$ on the fitted values with a parametric probit model where treatment assignment i.e., participation in off-farm work (yes/no) was used as the explained variable and Z was used as the explanatory variables. After the propensity scores were estimated, the nearest ranked neighbor in the treatment group was matched with the nearest ranked household in the control group. The effect of treatment was then calculated as the difference in outcome indicator between the treatment and control household in each matched pairs. The differences for each matched pair were averaged over entire sample to obtain the average treatment effect (ATT).

In order to successfully use propensity scores for matching, the distribution of covariates in the treatment and control group need to be balanced. In our study, we checked the quality of balance by using three different methods because different methods may produce contradictory results as explained by Lee (2013). First, we used unpaired t-test to see if there is significant difference in mean value of covariates between households participating in non-farm work and

households not participating in non-farm work. The balancing requirement demands that there should be no significant difference in mean value of covariates after matching. Second, we looked at the pseudo- R^2 value before and after matching. The pseudo R^2 value should be lower after matching to satisfy the balancing requirement. Finally, we judged the balance quality by using the standard percentage bias reduction (SPBR) mentioned by Rosenbaum and Rubin (1985). Ideally, after matching, the SPBR should be less than 10% on average over all covariates and less than 20% for each covariates (Rosenbaum and Rubin, 1983).

Another key requirement while using propensity score matching is to ensure that there is an overlap of propensity scores between the treated and the untreated group. In other words, there should be a region of common support. Having a common support region guarantees that there is a comparable household in the control group for every household in the treatment group. We visually checked for this region of common support by plotting the propensity score distribution of the two groups.

Finally, since propensity score method controls only for observable covariates such as age, education, and gender; hidden biases due to possible unobserved covariates may influence the result. To ensure that our results were not sensitive to unobserved covariates such as risk aversion, entrepreneurial ability, we used the Rosenbaum bounds test (Rosenbaum, 2002).

b) Direct covariate matching model

An issue with the PSM model is that it is blind to information not represented in the propensity score since there is random pruning making it independent of covariates (King & Nielsen, 2016). To avoid this problem, King & Nielsen (2016) recommend matching directly on the covariates instead of propensity scores to select the nearest neighbor. Our second matching model employs the direct covariate matching (DCM) technique. By dropping the functional form

assumptions of linear, logit, and probit models, DCM presents itself as a much more flexible estimator that is more robust to model misspecification. Using such a direct comparison approach is also appealing due to its simplicity. We used the nearest neighbor matching approach in our DCM model to identify the closest match in the non-participant group for each household participating in non-farm work. Once the matching was accomplished, ATT was computed similarly as in the PSM approach, by first calculating the difference in outcome indicator between the treated and untreated households in each matched pair and then averaging out the differences in the entire sample. Due to relaxed assumptions, we were not required to test any assumptions. However, to account for sensitivity to hidden bias, we used the Rosenbaum bounds test (Rosenbaum, 2002).

All analyses in our study were conducted using the STATA software, version 14. In both matching models we applied a one to one matching algorithm with replacement. This means that each treated household was matched with one untreated household. However, any non-participant household could serve as a control for more than one participant household. To further improve the quality of our matched pair, we applied a caliper of 0.025 SD for each pair. The aim of applying caliper is to define how much divergence is allowed between the treated unit and the respective control unit.

In the PSM model, we used the “psmatch2” command to calculate ATT based on the propensity score generated using the “pscore” command. To test the assumptions of our PSM model, we used commands such as “pstest”, “pbalchk”, and “kdensity”. In our second model involving direct covariate matching, we used the “teffects nnmatch” command to perform the nearest neighbor one to one matching. Further, to address sample bias, we used the option “biasadj”. To obtain exact matches on discrete covariates, we used the “ematch” command in the

DCM model. The sensitivity analyses for both models were performed using the “rbounds” package.

Covariate selection and outcome indicator

In the propensity score matching method, matching should be based on covariates that influence both self-selection and outcome that is not affected by the treatment (Smith & Todd, 2005). Stuart and Rubin (2008) recommend using a large set of covariates to improve accuracy. Based on previous studies, we used a large set of covariates to identify suitable matches in the treatment and control group (Table 3.1).

In the direct covariate matching model we used six covariates to identify comparable matches in the control and treatment group: gender of household head (0=female, 1=male), age of household head (years), education of household head (years), caste (1=high caste, 2=ethnic caste, 3= low caste), total family size (number of persons), total agricultural land owned by the household (ha), and household type: whether headed by a solo head or dual heads.

Food security indicator

To measure household’s food security status, we used a shortened version of the Household Food Insecurity Access Scale (HFIAS). The HFIAS scale was developed in 2007 by USAID in an attempt to manage the complexity associated with quantifying food security status (Bilinsky & Swindale, 2010; Coates et al., 2007; Coates, 2004). This scale is used to measure the household’s access to food using three core domains. The three core domains are: a) anxiety and uncertainty about household’s food supply b) insufficient quality of food including variety and preferences, and iii) insufficient food intake and its physical consequences. Instead of separately measuring the four dimensions of food security: availability, access, utilization, and stability; the HFIAS measures respondents’ perceptions of household food security experiences over the last

four-week-period. Due to its simplicity and effectiveness, many studies in Nepal have used HFIAS to measure food insecurity among rural households (Singh et al., 2020; Pandey & Bardsley, 2019; Osei et al., 2010).

In our study, we asked three occurrence questions relating to the three domains. Each occurrence question was followed by a sub-question on frequency of occurrence. The three questions reflecting the three domains were as follows:

- In the past four weeks, did you worry that your household would not have enough food?
- Because of a lack of resources in the past four weeks, did you or any household member have to eat some foods that you really did not want to eat?
- Because of lack of resources in the past four weeks, did you or any household member have less food than you needed in a day?

There was a “Yes” or “No” response for each occurrence question. If the response was “No” a value of 0 was assigned. In case the response was “Yes” it led to the frequency question, which in turn had 3 options - rarely, sometimes, or often. The response to the frequency question was coded in order of increasing frequency from 1- 3, i.e., if the response was “rarely”, it scored a value of 1, if the response was “sometimes”, it scored a value of 2, and if the response was “often”, a value of 3 was assigned. Household food insecurity score was then calculated by adding the frequency of occurrence. The food insecurity score ranged from 0 to 9 with 0 indicating food secure and 9 indicating food insecure. For our convenience, the food insecurity score thus calculated was set in a positive direction by using the following formula:

$$\text{Food security score} = (\text{Food insecurity score} - 9) * (-1).$$

The new food security score then ranged from 0-9 with 0 being food insecure and 9 being food secure. To assess the internal consistency of the responses to the three occurrence questions, we used Cronbach's alpha statistics. Our alpha value of 0.60 did not satisfy the desired value of 0.70 proposed by Nunnally (1978). This is because the Cronbach's alpha coefficient is very sensitive to the number of items on the scale (Brigg & Cheek, 1986), which in our case was limited to three items. In such a situation, the mean inter-item correlation can be used to establish the reliability of the scale (Pallant, 2020). A mean value of inter-item correlation ranging from 0.20 to 0.40 is viewed as desirable (Brigg & Cheek, 1986). For the purpose of our study, the value of 0.3465 for inter-item correlations for the items allowed us to conclude that the responses are internally consistent. In the study we hypothesized that participation in rural non-farm activity increases household food security.

Results and discussion

Household characteristics

Forty five percent households in our study sample participated in non-farm activities. Households participating in non-farm activities were similar to households that did not participate in non-farm activities in terms of household size and agricultural land owned by the household (Table 3.2). Yet, there was a marked difference in characteristics of household head making farm decisions. Households that participated in non-farm activities consisted of heads that were younger, better educated, member of farmers' group or organization. Further, participating households had more number of working age people, i.e adults between 18 and 64 years of age. Moreover, less number of participating households owned livestock compared to non-participating households. These differences in both household and household head

characteristics suggest that the participant and the non-participant groups are not directly comparable, justifying the use of matching methods to assess the impact of non-farm activities.

Table 3.2: Average characteristics of sampled households and farm managers

Characteristics	Non-participating households (N= 425)		Participating households (N= 349)	
	Sample Mean	Standard Deviation	Sample Mean	Standard Deviation
Household characteristics				
Household size (persons)	3.61	2.00	3.79ns	1.96
Persons of working age ^a	1.94	1.34	2.26***	1.25
Dependent persons ^a	1.67	1.38	1.53ns	1.42
Agricultural land owned (ha)	0.62	0.61	0.57ns	0.51
Owns livestock (proportion) ^b	0.94		0.89**	
Household head characteristics				
Gender (proportion) ^b	0.48		0.54	
Age (years)	54.27	15.00	51.38*	13.63
Education (years)	4.50	4.26	5.60***	4.41
Primary education completed (proportions)	0.38		0.45**	
Member of farmers organization (proportion) ^b	0.65		0.77**	

Notes: *, **, and *** denote significance of mean difference at the 10%, 5%, and 1% level, respectively; ns = not significant at 10%.

a: Persons of working age defined as 18–64 years old. Dependents are persons outside this age range.

b: Difference in means tested using chi2, unpaired t-test used otherwise.

Factors influencing non-farm employment decision

The estimates of our probit model representing households' propensity to participate in non-farm employment are presented in Table 3.3. We found that the likelihood of households participating in non-farm work is influenced by variables such as ethnicity, household size, number of dependent persons in the household, membership in farmers group/ cooperative and livestock owned by households. Our findings are in line with findings from previous studies showing that demographic and household characteristics play important role in household's decision to participate in non-farm work. Our results showed that households belonging to low caste group were more likely to participate in non-farm work compared to households belonging

to ethnic group. One possible explanation for this could be because households belonging to low castes are often land poor. More than 53% households belonging to low caste in Nepal did not own any land ownership documents in 2005 according to National Dalit Commission (NDC, 2005).

Our study also revealed that household size significantly and positively influenced participation in non-farm work. Our results support the findings of Ghimire et al. (2014) who reported that the probability of working off-farm increases when household size increases. Duong et al. (2021) suggested that greater household size represents larger intra-household labour supply enabling household members to participate in non-farm work. While greater family size increased the probability of household participating in non-farm work, we found that greater number of dependent members in the family had an opposite effect. In other words, when there are more dependent members, household is less likely to participate in off-farm work. Our finding with regard to dependent members negatively influencing off-farm work participation is consistent with those by Anang et al., (2020). When there are more dependent members in the household, there is a greater financial burden and less opportunity for members to add new skills required to join the non-farm sector.

Consistent with a priori expectation, participation in non-farm work was found to be positively correlated with farmer's membership in groups and cooperatives. Membership in groups and cooperatives, allow farmers to share information and learn from each other. Further, in Nepalese context, when farmers become members of groups and cooperatives, they also gain access to credit. This access to credit facilitates farmers' decision to participate in non-farm sector. Our findings are consistent with those from Vietnam (Duong et al., 2021) and Peru (Escobal, 2001) where access to credit was positively associated with non-farm employment.

When farmers have access to credit, they are able to borrow cash to cover the cost involved in securing non-farm jobs. For instance, having cash allows farmers to travel to nearby towns and cities to look for job. In our study, household's ownership of livestock was found to negatively effect participation in non-farm sector. This could likely be because raising livestock is often very time consuming leaving little time for household members to explore off-farm opportunities. Other variables such as gender of household head, age of household head, ethnicity of household head, and total farmland did not have significant effect on household's decision to participate in non-farm activities.

Table 3.3: Probit estimates of propensity score for participation in non-farm employment

Covariate	Probit regression (N= 774)		
	Coefficient	Standard error	Z
Gender	0.15	0.17	1.43
Age	0.17	0.02	0.79
Age ²	0.00	0.02	0.79
Primary education	0.06	0.12	0.47
Ethnicity (Ethnic caste is based)			
High caste	0.15	0.11	1.3
Low caste	0.35	0.14	2.5**
Household size	0.11	0.04	2.88***
Dependent persons	-0.14	0.54	-2.63***
Total farmland owned	-0.07	0.09	-0.83
Membership in farmers group/cooperative	0.36	0.10	3.41***
Livestock ownership	-0.57	0.17	-3.28***
Constant	-0.46	0.60	-0.77
Pseudo R2	0.05		

Notes: *, **, and *** denote significance of mean difference at the 10%, 5%, and 1% level.

Average treatment effects

Propensity score matching model

To calculate the average treatment effect, we used the results reported in the previous section to calculate the propensity scores. The estimates of our probit model are presented in Table 3.3. The propensity scores serve as a tool to balance the observed distribution of covariates across the treatment and control group. Therefore, to check if the balancing requirement was satisfied, we used three tests. Our first test used the unpaired t-test. After matching there were no significant differences between covariates of the participating and non-participating households (Table 3.4). The second test used pseudo R^2 value, which was 0.049 before matching and 0.008 after matching. A lower value of pseudo R^2 after matching indicates that the balancing requirement has been met. Finally, the third test involved looking at the standard percent bias. In our model, each covariate had a standard percent bias less than 20% (Table 3.4, Fig. 3.1). The mean absolute standardized bias was less than 10 percent for the model. Satisfying all three balancing requirements showed that the bias in observable characteristics between the participant and non-participant groups in our study had been effectively reduced by the use of propensity score estimators. The distribution of propensity scores of both participant and non-participant groups (Fig. 3.2) showed an overlap suggesting the presence of common support region essential for propensity score matching.

Table 3.4: Results of balancing test after propensity score matching

Covariate	Unmatched	Mean		%bias	%reduction in bias	t-value
	Matched	Participant	Non-participant			
Gender	U	0.54	0.48	11.40		1.57
	M	0.54	0.56	-4.60	59.70	-0.61

Table 3.4 (cont'd)

Age	U	51.38	54.27	20.20		-2.78***
	M	51.38	51.89	-3.50	83.50	-0.49
Age2	U	2825.30	3169.80	-22.50		-3.10***
	M	2825.3	2869.80	-2.90	87.10	-0.42
Primary education	U	0.45	0.38	14.40		2.00
	M	0.45	0.45	0.00	100.00	0.00
Ethnicity						
High caste	U	0.52	0.53	-2.70		-0.38
	M	0.52	0.56	-8.00	-193.80	-1.06
Low caste	U	0.25	0.19	15.40		2.15**
	M	0.24	0.26	-0.70	95.50	-0.09
Household size	U	3.79	3.61	9.50		1.32
	M	3.794	3.96	-8.30	12.90	-1.09
Dependent persons	U	1.53	1.67	-9.80		-1.35
	M	1.53	1.54	-0.20	97.70	-0.03
Total farmland owned	U	0.57	0.62	-9.00		-1.24
	M	0.57	0.59	-3.00	67.20	-0.44
Membership in farmers group/cooperative						
	U	0.77	0.65	26.10		3.59***
	M	0.77	0.75	3.80	85.40	0.53
Livestock ownership	U	0.89	0.94	-16.20		-2.27**
	M	0.89	0.93	-12.30	24.20	-1.57

Notes: *, **, and *** denote significance of mean difference at the 10%, 5%, and 1% level.

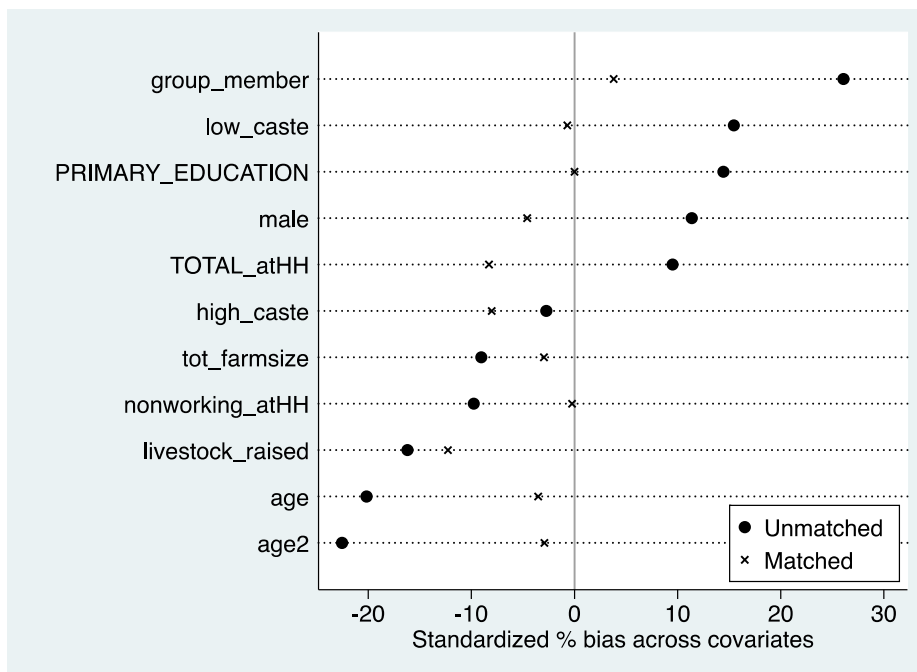


Figure 3.1: Distribution showing standard percent bias across covariates in the matched and unmatched samples

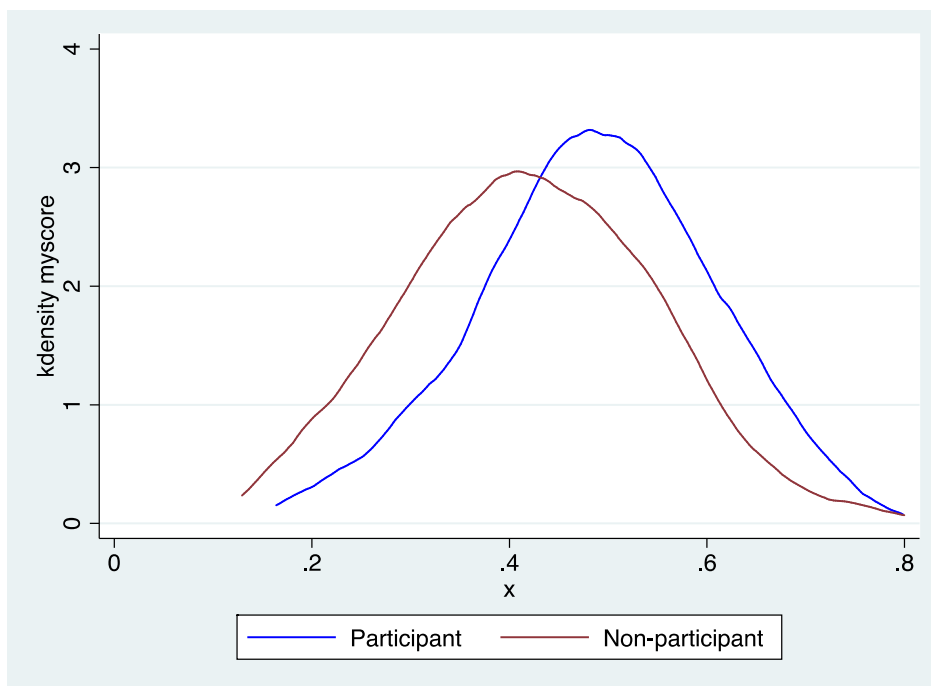


Figure 3.2: Kernel density distribution showing overlap between participant and non-participant households

The average treatment effect of non-farm work participation on food security is presented in Table 3.5. Our results show that households participating in non-farm work had greater food

security score compared to households that did not participate in non-farm activities. This increase in food security score was also significant ($p < 0.05$).

Our result was moderately sensitive to hidden bias for food security score. Both the lower bound and the upper bound were significant ($p < 0.05$, $p < 0.01$) at a gamma value of 1.07. While a higher value of gamma is desirable, a lower value of gamma does not prove that there has been a violation of assumptions. However, it does warrant caution while interpreting the results.

Table 3.5: Impacts of non-farm work participation on food security score using propensity score matching model and direct covariate matching model

	PSM model	DCM model
Impact estimate using matching [†]	0.28**	0.22*
Γ sensitivity (Hodges-Lehmann) [‡]	1.07	1.23
[Number of treated and control]	[349, 425]	[349, 211]
Means of the treated and the control	8.44, 8.15	8.45, 8.17

Notes: *, **, and *** denote significance of mean difference at the 10%, 5%, and 1% level.

Direct covariate matching model

After households were matched directly on covariates using the nearest neighbor algorithm, the difference in the mean value of covariates between the participant and non-participant households were significantly reduced (Table 3.6). We were thus able to effectively remove bias in observable characteristics between the two groups. Our results showed that household's food security score was higher for households participating in non-farm employment compared to non-participating households ($p = 0.086$). This finding is similar to the results from propensity score matching model.

Rosenbaum's sensitivity test revealed that our finding was moderately sensitive to hidden bias. The gamma value of 1.23 was observed when both upper bound and lower bound were significant at $p < 0.05$ and $p < 0.01$. This result suggests that our study provides a reliable estimate

on the impact of non-farm activities on food security although caution is warranted while interpreting the results.

Table 3.6: Characteristics of sampled households and farm managers after direct covariate matching showing no difference in covariates between the two groups

Characteristics	Non-participating households (N= 211)		Participating households (N= 349)	
	Sample Mean	Standard Deviation	Sample Mean	Standard Deviation
Household characteristics				
Household size (persons)	3.67	1.83	3.79	1.96ns
Dependent persons ^a	1.64	1.32	1.53	1.42ns
Agricultural land owned (ha)	0.57	0.43	0.57	0.51ns
Household head characteristics				
Gender (proportion) ^b	0.51		0.54	ns
Age (years)	52.90	13.45	51.38	13.63ns
Education (years)	4.94	4.10	5.60	4.41ns

Notes: *, **, and *** denote significance of mean difference at the 10%, 5%, and 1% level, respectively; ns = not significant at 10%.

a: Persons of working age defined as 18–64 years old. Dependents are persons outside this age range.

b: Difference in means tested using chi2, unpaired t-test used otherwise.

Our results are in line with findings from Vietnam (Duong et al., 2021); India (Dsouza et al., 2020); Nigeria (Sani et al., 2014); and Ghana (Owusu et al., 2011) where non-farm work had positive and significant effect on household food security. In the study conducted by Paudel et al. (2017), non-farm employment was shown to increase household income in Nepal. However, they had not investigated the correlation between non-farm sector and household food security. As households diversified into non-farm sector, Paudel et al., (2017) raised a concern that it could

compromise household's food security since resources were diverted away from agriculture. Our findings confirm that it is not necessarily the case. Instead, non-farm work has a positive effect on food security status of rural households. Participation in non-farm employment can increase household food security through two possible ways. First, the increase in income allows households to spend more on food that in turn increases food consumption as reported by Duong et al. (2021). Second, when households have greater disposable income, they also tend to invest some of it to purchase agricultural inputs, which can lead to higher agricultural productivity.

Conclusion and recommendations

Despite numerous efforts by governments around the world, food insecurity remains a challenge (FAO, 2021), particularly in rural agrarian economies where agricultural productivity continues to decline (World Bank, 2021). As such, the expanding non-farm sector plays a vital role in addressing the issue of food insecurity. In this study, we sought to investigate the impact of rural non-farm employment on household food security in Nepal by surveying 774 households in Kaski district.

One key challenge in impact evaluation studies is the problem of self-selection bias due to systematically different characteristics between treatment and control groups. Our study shows that this challenge also applies to our study population since households participating in non-farm employment are systematically different from non-participating households particularly in terms of characteristics of household heads. We found that households that participated in non-farm activities had heads that were younger, and member of farmer's group. Participating households also had significantly more adults of working age ranging from 18 to 64 years. Households that did not participate in non-farm work often had more livestock than participating households. To overcome this problem of self-selection bias due to systematic difference

between the treatment and control groups of households we applied the matching method with an understanding of the selection mechanism.

To increase the robustness of the study, instead of limiting ourselves to one matching method we used two methods. First we applied the commonly used propensity score matching model. Secondly, we used the non-parametric method in the form of direct covariate matching model to analyze the impact of non-farm activities on crop income and food security. Both models used in this study yielded a balanced datasets, with fairly comparable ATT- results. Further, the quality of our results was improved by the use of two different matching models arriving at a similar conclusion. We found a positive and significant ATT value with regard to the impact of non-farm employment participation on food security. In other words, there was significant positive effect of participation in non-farm activities on household's food security score.

When investigating factors influencing households' participation in non-farm employment, our study showed that households were less likely to participate in non-farm employment when there was more number of dependent persons. Similarly, ownership of livestock decreased household's probability of participating in non-farm employment. On the other hand, increase in household size and group membership increased household's probability of participating in non-farm employment. Households belonging to lower castes were also more likely to participate in non-farm sector compared to households belonging to ethnic caste.

The findings of this study are in line with the widely held view that non-farm work plays an important role in reducing food insecurity in rural parts of developing countries. Our findings indicate that policy efforts geared towards promoting rural non-farm sector in developing countries are moving in the right direction. Policy measures should aim at reducing entry barriers

in the non-farm sector by building human capital through education and skill-based training, and improving access to credit. These efforts should be complemented with investment in rural infrastructure such as road and communication network to increase connectivity with the market. Despite the important role of the non-farm sector in Nepal, commercialization of the agricultural sector is equally important for poverty reduction and food security in rural Nepal. Hence, policymakers need to ensure that the non-farm sector is complementing rather than competing with efforts to develop the agricultural sector. Only when the agricultural and non-agricultural sectors are in harmony with each other can we achieve the United Nations' sustainable development goal of hunger reduction.

Limitations

As in all impact evaluation studies, the findings of this study should be interpreted with the possibility of potential source of bias due to unobserved factors. We have used the Rosenbaum's sensitivity test to ensure that our estimates are less sensitive to such hidden biases. In future research, including qualitative aspects in the analysis can help to enrich the discussion on this topic. Although the data for this study was collected before the covid-19 pandemic, findings from this study have become even more relevant in the present time due to increasing food insecurity triggered by the pandemic.

REFERENCES

- Abdulai, A., & CroleRees, A. (2001). Determinants of income diversification amongst rural households in Southern Mali. *Food policy*, 26(4), 437-452.
- Abdulai, A., & Delgado, C. L. (1999). Determinants of nonfarm earnings of farm-based husbands and wives in northern Ghana. *American Journal of Agricultural Economics*, 81(1), 117-130.
- Ackah, C. (2013). Nonfarm employment and incomes in rural Ghana. *Journal of International Development*, 25(3), 325-339.
- Adhikari, J., Timsina, J., Khadka, S. R., Ghale, Y., & Ojha, H. (2021). COVID-19 impacts on agriculture and food systems in Nepal: Implications for SDGs. *Agricultural Systems*, 186, 102990.
- Ahearn, M. C., El-Osta, H., & Dewbre, J. (2006). The impact of coupled and decoupled government subsidies on off-farm labor participation of US farm operators. *American journal of agricultural economics*, 88(2), 393-408.
- Anang, B. T. (2017). *Effect of non-farm work on agricultural productivity: Empirical evidence from northern Ghana* (No. 2017/38). WIDER Working paper.
- Anang, B. T., & Yeboah, R. W. (2019). Determinants of off-farm income among smallholder rice farmers in Northern Ghana: Application of a double-hurdle model. *Advances in Agriculture*, 2019.
- Anang, B. T., Bäckman, S., & Sipiläinen, T. (2020). Adoption and income effects of agricultural extension in northern Ghana. *Scientific African*, 7, e00219.
- Babatunde, R. O., & Qaim, M. (2010). Impact of off-farm income on food security and nutrition in Nigeria. *Food policy*, 35(4), 303-311.
- Barrett, C. B., Reardon, T., & Webb, P. (2001). Nonfarm income diversification and household livelihood strategies in rural Africa: concepts, dynamics, and policy implications. *Food policy*, 26(4), 315-331.
- Barrett, C. B., Reardon, T., & Webb, P. (2001). Nonfarm income diversification and household livelihood strategies in rural Africa: concepts, dynamics, and policy implications. *Food policy*, 26(4), 315-331.
- Berdegue, J.A., Ramirez, E., Reardon, T., & Escobar, G. (2001). Rural nonfarm employment and incomes in Chile. *World Development*, 29(3), 411-425.

Bilinsky, P., & Swindale, A. (2007). *Months of adequate household food provisioning (MAHFP) for measurement of household food access: indicator guide*. Food and Nutritional Technical Assistance Project, Academy for Educational Development.

Blaikie, P., & Coppard, D. (1998). Environmental change and livelihood diversification in Nepal: Where is the problem?. *HIMALAYA, the Journal of the Association for Nepal and Himalayan Studies*, 18(2), 11.

Briggs, S. R., & Cheek, J. M. (1986). The role of factor analysis in the development and evaluation of personality scales. *Journal of personality*, 54(1), 106-148.

Canagarajah, S., Newman, C., & Bhattamishra, R. (2001). Non-farm income, gender, and inequality: evidence from rural Ghana and Uganda. *Food policy*, 26(4), 405-420.

CBS (Central Bureau of Statistics). (2011). Nepal living standard survey.

CBS (Central Bureau of Statistics). (2021). Nepal Ministry of finance, economic survey 2021.

Chang, H. H., & Mishra, A. (2008). Impact of off-farm labor supply on food expenditures of the farm household. *Food Policy*, 33(6), 657-664.

Chhetri, B. B. K. (2017). Importance of non-farm income to community forest user households in rural Nepal. *FORMATH*, 16-001.

Coates, J. C. (2004). *Experience and expression of food insecurity across cultures: practical implications for valid measurement*. Food and Nutrition Technical Assistance Project, Academy for Educational Development.

Coates, J., Swindale, A., & Bilinsky, P. (2007). Household Food Insecurity Access Scale (HFIAS) for measurement of food access: indicator guide: version 3.

Conley, T. G., & Udry, C. R. (2010). Learning about a new technology: Pineapple in Ghana. *American economic review*, 100(1), 35-69.

Davis, J. R. (2003). The rural-non-farm economy, livelihoods and their diversification: Issues and options. *Livelihoods and their Diversification: Issues and Options (July 2003)*.

De Janvry, A., & Sadoulet, E. (2001). Income strategies among rural households in Mexico: The role of off-farm activities. *World development*, 29(3), 467-480.

Dehejia, R. H., & Wahba, S. (2002). Propensity score-matching methods for nonexperimental causal studies. *Review of Economics and statistics*, 84(1), 151-161.

Do, T. L., Nguyen, T. T., & Grote, U. (2019). Nonfarm employment and household food security: Evidence from panel data for rural Cambodia. *Food Security*, 11(3), 703-718.

- Doss, C. R., & Morris, M. L. (2000). How does gender affect the adoption of agricultural innovations? The case of improved maize technology in Ghana. *Agricultural economics*, 25(1), 27-39.
- Dsouza, A., Mishra, A. K., & Sonoda, T. (2020). Impact of causal and permanent off-farm activities on food security: the case of India. *The Role of Smallholder Farms in Food and Nutrition Security*, 211-230.
- Duong, P. B., Thanh, P. T., & Ancev, T. (2021). Impacts of off-farm employment on welfare, food security and poverty: Evidence from rural Vietnam. *International Journal of Social Welfare*, 30(1), 84-96.
- El-Osta, H. S., Mishra, A. K., & Morehart, M. J. (2008). Off-farm labor participation decisions of married farm couples and the role of government payments. *Applied Economic Perspectives and Policy*, 30(2), 311-332.
- Escobal, J. (2001). The determinants of nonfarm income diversification in rural Peru. *World development*, 29(3), 497-508.
- FAO (2014). The state of food insecurity in the world 2014. Food and Agricultural Organization of the United Nations, Rome.
- FAO. (2021). The state of food security and nutrition in the world 2021. Food and Agricultural Organization of the United Nations, Rome, Italy; 2021.
- Fox, L., & Pimhidzai, O. (2013). Different dreams, same bed: collecting, using, and interpreting employment statistics in Sub-Saharan Africa--the case of Uganda. *World Bank Policy Research Working Paper*, (6436).
- Gautam, Y., & Andersen, P. (2016). Rural livelihood diversification and household well-being: Insights from Humla, Nepal. *Journal of Rural Studies*, 44, 239-249.
- Ghimire, R., HUANG, W. C., & Shrestha, R. B. (2014). Factors affecting nonfarm income diversification among rural farm households in central Nepal.
- Gladwin, C. H., Thomson, A. M., Peterson, J. S., & Anderson, A. S. (2001). Addressing food security in Africa via multiple livelihood strategies of women farmers. *Food policy*, 26(2), 177-207.
- Gould, B. W., & Saupe, W. E. (1989). Off-farm labor market entry and exit. *American Journal of Agricultural Economics*, 71(4), 960-969.
- Haggblade, S., Hazell, P. B., & Reardon, T. (Eds.). (2007). *Transforming the rural nonfarm economy: Opportunities and threats in the developing world*. Intl Food Policy Res Inst.

- Haggblade, S., Hazell, P., & Reardon, T. (2005, June). The rural nonfarm economy: Pathway out of poverty or pathway in?. In *International Food Policy Research Institute. The future of small farms. Proceedings of a research workshop, Wye, UK* (pp. 151-178).
- Heckman, J. J., Ichimura, H., Smith, J. A., & Todd, P. E. (1998). Characterizing selection bias using experimental data.
- Huffman, W. E. (1980). Farm and off-farm work decisions: The role of human capital. *The Review of Economics and Statistics*, 14-23.
- Huffman, W. E., & Lange, M. D. (1989). Off-farm work decisions of husbands and wives: joint decision making. *The Review of Economics and Statistics*, 471-480.
- Kijima, Y., Matsumoto, T., & Yamano, T. (2006). Nonfarm employment, agricultural shocks, and poverty dynamics: evidence from rural Uganda. *Agricultural Economics*, 35, 459-467.
- King, G., & Nielsen, R. (2016). Why propensity scores should not be used for matching: Supplementary appendix.
- Lanjouw, J. O., & Lanjouw, P. (2001). The rural non-farm sector: issues and evidence from developing countries. *Agricultural economics*, 26(1), 1-23.
- Lanjouw, P. (2001). Nonfarm employment and poverty in rural El Salvador. *World development*, 29(3), 529-547.
- Lee, W. S. (2013). Propensity score matching and variations on the balancing test. *Empirical economics*, 44(1), 47-80.
- Leuven, E., & Sianesi, B. (2003). PSMATCH2: Stata module to perform full Mahalanobis and propensity score matching, common support graphing, and covariate imbalance testing.
- Mabuza, M. L., Ortmann, G. F., Wale, E., & Mutenje, M. J. (2016). The effect of major income sources on rural household food (in) security: Evidence from Swaziland and implications for policy. *Ecology of food and nutrition*, 55(2), 209-230.
- Matsumoto, T., Kijima, Y., & Yamano, T. (2006). The role of local nonfarm activities and migration in reducing poverty: evidence from Ethiopia, Kenya, and Uganda. *Agricultural Economics*, 35, 449-458.
- Mishra, A. K., & Goodwin, B. K. (1997). Farm income variability and the supply of off-farm labor. *American Journal of Agricultural Economics*, 79(3), 880-887.
- Morgan, S. L., & Winship, C. (2010). Counterfactuals and Causal Inference. Methods and Principles for Social Science Research.

Nunnally, J. C. (1978). An overview of psychological measurement. *Clinical diagnosis of mental disorders*, 97-146.

National Dalit Commission. (2005). Citizenship and land ownership status of Dalit community in Nepal.

Olale, E., & Henson, S. (2012). Determinants of income diversification among fishing communities in Western Kenya. *Fisheries Research*, 125, 235-242.

Osei, A., Pandey, P., Spiro, D., Nielson, J., Shrestha, R., Talukder, Z., ... & Haselow, N. (2010). Household food insecurity and nutritional status of children aged 6 to 23 months in Kailali District of Nepal. *Food and nutrition bulletin*, 31(4), 483-494.

Owusu, V., & Abdulai, A. (2009). *Nonfarm Employment and Poverty Reduction in Rural Ghana: A Propensity-Score Matching Analysis* (No. 1005-2016-78992).

Owusu, V., Abdulai, A., & Abdul-Rahman, S. (2011). Non-farm work and food security among farm households in Northern Ghana. *Food policy*, 36(2), 108-118.

Pallant, J. (2020). *SPSS survival manual: A step by step guide to data analysis using IBM SPSS*. Routledge.

Pandey, R., & Bardsley, D. K. (2019). An application of the Household Food Insecurity Access Scale to assess food security in rural communities of Nepal. *Asia & the Pacific Policy Studies*, 6(2), 130-150.

Paudel Khatiwada, S., Deng, W., Paudel, B., Khatiwada, J. R., Zhang, J., & Su, Y. (2017). Household livelihood strategies and implication for poverty reduction in rural areas of central Nepal. *Sustainability*, 9(4), 612.

Pfeiffer, L., López-Feldman, A., & Taylor, J. E. (2009). Is off-farm income reforming the farm? Evidence from Mexico. *Agricultural Economics*, 40(2), 125-138.

Rahut, D. B., Ali, A., Kassie, M., Marennya, P. P., & Basnet, C. (2014). Rural livelihood diversification strategies in Nepal. *Poverty & Public Policy*, 6(3), 259-281.

Reardon, T. (1997). Using evidence of household income diversification to inform study of the rural nonfarm labor market in Africa. *World development*, 25(5), 735-747.

Reardon, T., Berdegue, J., & Escobar, G. (2001). Rural nonfarm employment and incomes in Latin America: overview and policy implications. *World development*, 29(3), 395-409.

Reardon, T., Delgado, C., & Matlon, P. (1992). Determinants and effects of income diversification amongst farm households in Burkina Faso. *The Journal of Development Studies*, 28(2), 264-296.

- Reardon, T., Stamoulis, K., Balisacan, A., Cruz, M. E., Berdegue, J., & Banks, B. (1998). Rural non-farm income in developing countries. *The state of food and agriculture, 1998*, 283-356.
- Rosenbaum, P. R. (2002). Overt bias in observational studies. In *Observational studies* (pp. 71-104). Springer, New York, NY.
- Rosenbaum, P. R., & Rubin, D. B. (1985). Constructing a control group using multivariate matched sampling methods that incorporate the propensity score. *The American Statistician*, 39(1), 33-38.
- Rosenbaum, P. R., & Rubin, D. B. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika*, 70(1), 41-55.
- Ruben, R. (2001). Nonfarm employment and poverty alleviation of rural farm households in Honduras. *World development*, 29(3), 549-560.
- Rubin, D. B. (1977). Assignment to treatment group on the basis of a covariate. *Journal of educational Statistics*, 2(1), 1-26.
- Sani, J. M., Mansor, I. M., Nasir, S. M., & Mahir, A. A. (2014). The impact of non-farm income generating activities on the food security status of rural households in Nigeria. *Int J Agric Sci Vet Med*, 2(4), 121-31.
- Sharma, G. P., Pandit, R., White, B., & Polyakov, M. (2015). *The income diversification strategies of smallholder coffee producers in Nepal* (No. 1784-2016-141876).
- Shehu, A., & Sidique, S. F. (2014). A propensity score matching analysis of the impact of participation in non-farm enterprise activities on household wellbeing in rural Nigeria. *UMK Procedia*, 1, 26-32.
- Singh, D. R., Ghimire, S., Upadhayay, S. R., Singh, S., & Ghimire, U. (2020). Food insecurity and dietary diversity among lactating mothers in the urban municipality in the mountains of Nepal. *PloS one*, 15(1), e0227873.
- Smith, J. A., & Todd, P. E. (2005). Does matching overcome LaLonde's critique of nonexperimental estimators?. *Journal of econometrics*, 125(1-2), 305-353.
- Stuart, E. A., & Rubin, D. B. (2008). Best practices in quasi-experimental designs. *Best practices in quantitative methods*, 155-176.
- Uaiene, R. N. (2011). Determinants of agricultural technology adoption in Mozambique. In *10th African Crop Science Conference Proceedings, Maputo, Mozambique, 10-13 October 2011*. African Crop Science Society.
- United Nations. (2015). Open Working Group of the General Assembly on Sustainable Development Goals.

World Bank. (2020). Food security and COVID-19.

World Food Programme. (2020). COVID-19 will double number of people facing food crises unless swift action is taken. *Media release*.

Yúnez-Naude, A., & Taylor, J. E. (2001). The determinants of nonfarm activities and incomes of rural households in Mexico, with emphasis on education. *World Development*, 29(3), 561-572.

CONCLUSION AND IMPLICATION FOR POLICY AND RESEARCH

This dissertation investigated three elements of rural development: gender difference in livestock ownership; impact evaluation of plastic tunnel technology on crop income and food security; and the effect of non-farm employment on household food security. From a methodological point of view, each of the three studies contributes in a unique way. For instance, in our first study, while trying to understand the gender difference in livestock ownership, we took sex-disaggregated data from both male and female heads of the household. This relatively new approach of data collection adds a meaningful and unique dimension because men and women from the same household function independently and do not always behave as a single unit. Our study revealed that men and women do indeed differ in their perceptions of who owns different livestock in the household. This finding while providing an important stepping-stone in documenting gendered patterns of livestock ownership in Nepal also highlights the significant role of sex-disaggregated data collection in livestock research as a means for advancing gender equity and sustainable development. In our second study, by applying the nearest neighbor matching method we were able to minimize the selection bias and program placement bias, which in turn allowed us to estimate the direct effect of the plastic tunnel technology on crop income and food security. In our third study, by using two different matching methods to establish a causal relationship between participation in non-farm activities and food security, we were able to address the issue of self-selection bias. By directly establishing a causal linkage, essay two and essay three of this dissertation addresses the counterfactual question to provide evidence-based policy feedback for promotion of sustainable development using the Nepali context.

Essay one of this dissertation highlighted that men and women jointly owned more than half of the livestock owned by households. Although joint ownership of livestock was the predominant form of ownership reported by both men and women, when we looked at sole ownership, women owned fewer livestock than men. Local chicken and goats were important livestock for women, but large livestock like buffalo contributed more to women held TLU compared to smaller livestock. Women chiefly acquired livestock through purchase using their own income. Despite the importance of small livestock such as local chicken for women's livestock portfolio, when livestock was commercially important, as in the case of broiler chicken, women were disadvantaged due to their limited access to grants, loans, market other resources crucial to raise livestock on a commercial scale. Our study also found that when men were interviewed, household food security score was positively associated with women-held TLU. Based on the findings from our first study, we make the following recommendations for policy and future research: a) Goats and buffaloes should be promoted as important livestock by research and development interventions targeting to increase women's asset through livestock; b) Since women mainly acquire livestock by using their own income to purchase, women's access to money should be improved by researching and promoting income generating activities to help reduce the gender gap in livestock ownership; c) Only high caste women benefitted from grants and loans, therefore development interventions should take into account the social context and target disadvantaged groups; d) Women's access to market and market information should be improved to increase women's ownership of commercial livestock; e) Livestock research aimed at empowering women and increasing gender equity should collect sex disaggregated data in order to fully understand the dynamics between men and women.

Essay two, of this dissertation showed that by strategically growing off-season tomato inside plastic tunnels in the rainy season, households in Nepal's Kaski district were able to increase their crop income. Farmers perceived off-season tomato production inside plastic tunnels to positively impact at household level by improving income, savings and food security. At community level, farmers perceived the technology to improve marginalized households' financial status making them "better off than before." Farmers in our study identified disease management as a major challenge associated with off-season tomato production inside plastic tunnels. All farmers reported lack of education, knowledge and skills as key barriers to adoption of this technology. Farmers' perception of barriers to adoption of this technology was also influenced to some extent by their caste. For instance, lower caste farmers identified inadequate land and lack of access to irrigation as barriers to a greater degree. On the other hand farmers belonging to ethnic groups identified lack of access to market and market information as barriers to a greater extent. Among farmers that discontinued this technology, lack of time and difficulty in management of disease and pests were reported as the key reasons. Based on the findings of our study, we make the following recommendations for research and policy: a) Promotion of off-season tomato production inside plastic tunnels need to be tailored to meet the needs of farmers belonging to diverse economic and social background. To this end, bottom-up and demand driven participatory extension service need to be adopted. b) Given that disease and insect pest management is a major problem experienced by farmers, public sector investment is recommended to increase farmers' access to IPM training and improved IPM methods. Research should focus on developing IPM methods that are both cost effective and profitable.

Essay three of this dissertation revealed that participation in rural non-farm employment improved household's food security status in Nepal's Kaski district. Our study also found that

household's participation in the non-farm sector was influenced by a host of factors. Households were less likely to participate in non-farm employment when household head did not have any education. Similarly when there were more dependent persons and households' owned livestock households were less likely to participate in non-farm sector. On the other hand, households were more likely to participate in non-farm activities when household size increased, and at least one member of the household was member of a group or cooperative and had access to extension service. Our findings highlight the important role of the rural non-farm sector in improving household's food security status. On the basis of our findings, we make the following recommendations: a) Policy measures should aim at reducing entry barriers in the non-farm sector by building human capital through education and skill-based training, and improving access to credit. b) Investment in rural infrastructure such as roads and communication network should be increased to improve access to market and market information.

A major limitation in all three studies of this dissertation is the lack of qualitative study to complement and justify the findings from our quantitative survey at household level. This dissertation could have benefitted from a mixed- method approach involving qualitative analyses such as focal group discussion and semi-structured interview to help understand the findings from our study. For instance, in our first study, including qualitative data could have provided valuable insights into what joint-ownership of livestock reported by more than 50 percent households in our study looked like. In both essay two and essay three, including semi-structured interviews could have provided further evidence about the impact of off-season tomato production inside plastic tunnels, and the effect of participation in non-farm activities on crop income and household food security. Despite the limitations, findings from this dissertation

provide valuable implication for gender-sensitive and evidence-based policy making to promote sustainable and positive development in rural agrarian economies across the world.

Finally, although our analysis is restricted to farmers in Nepal's Kaski district, this dissertation provides gender sensitive and evidence-based feedback, which is relevant to food policy decisions in developing country contexts. This dissertation illustrates the significance of both agricultural sector (essay one and essay two) and the non-agricultural sector (essay three) as a pathway to reduce poverty and improve food security. Hence, policymakers need to ensure that the non-farm sector is complementing rather than competing with efforts to develop the agricultural sector. Only when the agricultural and non-agricultural sectors are in harmony with each other can we achieve the United Nations' sustainable development goal of poverty elimination and hunger reduction.

APPENDIX A: HOUSEHOLD SURVEY QUESTIONNAIRE (ENGLISH VERSION)

ROLE OF GENDER, IMPROVED AGRICULTURAL TECHNOLOGY AND NON-FARM EMPLOYMENT IN HOUSEHOLD WELLBEING IN NEPAL

Household survey questionnaire
2018

Department of Community Sustainability
Michigan State University

INFORMED CONSENT

My name is Bineeta Gurung. I am working on my PhD dissertation at Michigan State University. Are you at least 18 year old? *[If not, thank and terminate interview]*.

Before we go any further, I'd like to follow the university's research protocol and go over a few things with you. You are being asked to voluntarily participate in a research study of agricultural practices and livelihoods in Nepal. The findings of this study will help form the basis for policy recommendations regarding livelihood-related development initiatives in Nepal.

If you agree to participate, I will ask you some questions about agricultural practices, agricultural technologies, and livelihood approaches. I will also ask you some questions regarding your household and farm, farmer organizations, and the community.

The interview will take approximately one and a half hour of your time. You should know that your identity and responses to questions will be kept confidential and your privacy will be protected to the maximum extent. All reports and publications resulting from this interview will be written and shared using pseudonyms and code numbers, not names or addresses. Only the researchers will have access to your responses and the data will be stored on a secure, password-protected computer and in offices at Michigan State University with no identifying information linking them to you.

Your participation is voluntary and you may choose not to participate at all, refuse to answer certain questions, or stop the interview at any time without any consequences. It is also important for you to know that there are no right or wrong answers.

If you have any questions or concerns regarding your participation in this study, you may contact the researchers whose contact information is on the sheet I am handing you [hand Information Sheet to respondent]. If you feel your rights have been violated or you are dissatisfied with any aspect of the study, please contact Michigan State University's Human Research Protection Program using the contact information on the Information Sheet.

Q1: *Do you have any questions?*

Yes [if yes, answer questions and then proceed]

No

You indicate your voluntary agreement to participate in this study by beginning the interview with me.

Q2: *May I begin?*

Yes [proceed]

No *[thank and end]*.

SECTION A: BASIC INFORMATION [ASK TO ALL FOUR GROUPS: 1, 2, 3, 4]

NOTE: INSTRUCTIONS TO INTERVIEWER ARE IN UPPERCASE. WORDS AND PHRASES TO BE EMPHASIZED ARE IN ITALIC.

Q00. Household Unique ID (TO BE FILLED BY INTERVIEWER):

Q000. Respondent Group

1. Primary Respondent- Rupa 7
2. Respondent- Rupa 7
3. Respondent- Rupa 7
4. Household Head- Rupa 2 or Rupa 4

Q000a. Respondent's Gender

- Male
- Female

Q1. What is your marital status?

- Married
- Divorced
- Widowed
- Never married

If married,

Q1.1 Does your spouse live here or away?

- Here
- Away

Now, I'd like to ask you some questions about you and your household.

SECTION B: INDIVIDUAL AND HOUSEHOLD INFORMATION [ASK TO ALL FOUR GROUPS: 1, 2, 3, 4]

Q4.	Q5.	Q6.
How old are you?	How many years of formal schooling have you had?	IF Q5 IS LESS THAN 1: Can you read and write 1 = Cannot read and write 2 = Can read only 3 = Can read and write

SECTION B.1: HOUSEHOLD MEMBER INFORMATION [ASK TO GROUP: 2, 3, 4]

<i>We'd like to know the ages and gender of people in your household.</i>	Male			Female		
	a. < 18 yrs	b. 18- 64 yrs	c. > 64 yrs	d. < 18 yrs	e. 18- 64 yrs	f. > 64 yrs
Q7. Of the males that currently live in your household HERE in Nepal, how many are...?						
Q7.1. Now, of the females that currently live in your household HERE in Nepal, how many are...?						
<i>We'd like to know the ages and gender of people in your household that...are currently living ELSEWHERE IN Nepal.</i>						
Q8. For males of the household currently living ELSEWHERE IN Nepal, how many are...?						
Q8.1 For females of the household currently living ELSEWHERE IN Nepal, how many are...?						
<i>Next, we'd like to know the ages and gender of people in your household that are currently living OUTSIDE OF Nepal.</i>						
Q9. For males of the household currently living OUTSIDE OF Nepal, how many are...?						
Q9.1 For females of the household currently living OUTSIDE of Nepal, how many are...?						

SECTION C1.1 FARM INFORMATION [ASK TO GROUP: 1, 2, 3, 4]

Now, I'd like to ask you about your agricultural land.

Q10. What is the total size of agricultural lands owned by your household?
_____ (SELECT ONE: Ropani, Hectare, Hal, Katha, Dhur, Aana, Daam, Paisa)

Q10a. Did you RENT OUT some or all of your agricultural land during the past 12 months?

- Yes
- No [SKIP TO Q10C]
- Don't Know/ Refused [SKIP TO Q10C]

Q10b. How much agricultural land did you "RENT OUT" during the past 12 months?
_____ (Select one: Ropani, Hectare, Hal, Katha, Dhur, Aana, Daam, Paisa)

Q10c. Did you "RENT IN" land for your agricultural purposes during the past 12 months?

- Yes
- No [SKIP TO Q10E]
- Don't Know/ Refused [SKIP TO Q10E]

Q10d. How much agricultural land did you "RENT IN" during the past 12 months?
_____ (SELECT ONE: Ropani, Hectare, Hal, Katha, Dhur, Aana, Daam, Paisa)

Q10e. Not including land that you may have "RENTED OUT", how much land did you utilize for agricultural purposes during the past 12 months?
_____ (SELECT ONE: Ropani, Hectare, Hal, Katha, Dhur, Aana, Daam, Paisa)

Of those lands used by your household for agricultural purposes, how much would you say are lowlands and how much are uplands?

Q10e.i. Lowlands

_____ (SELECT ONE: Ropani, Hectare, Hal, Katha, Dhur, Aana, Daam, Paisa)

Q10e.ii. Uplands

_____ (SELECT ONE: Ropani, Hectare, Hal, Katha, Dhur, Aana, Daam, Paisa)

Q10f. Not including land you may have "rented out," how much of your agricultural land was left fallow during the last 12 months?

_____ (SELECT ONE: Ropani, Hectare, Hal, Katha, Dhur, Aana, Daam, Paisa)

SECTION C1.2 CROP INFORMATION [ASK TO GROUP: 1, 3, 4]

OK, now let's talk about the crops and agricultural products your household may have produced in the last 12 months.

This does not include crops/products that were grown on land that your household rented out.

Q11. Did you grow or produce cereals, vegetables, fruit, cash crops, or other agricultural products during the last 12 months?

- Yes [SKIP TO Q12]
- No
- Don't Know/ Refused

Q11a. So to be clear, you and your household did not grow or produce things like rice, cauliflower, tomatoes, and honey during the last 12 months?

- That's right, we did not grow products during the last 12 months [SKIP TO Q46]
- We did grow some agricultural products during the last 12 months [CONTINUE TO Q12]

Since different farm households grow different things, I am going to identify some specific crops and farm Products and ask you about those that you grow or produce.

Crop	Q12. Did your household produce the following crop in the last 12 months? • Yes [GO TO Q16] • No [SKIP TO NEXT CROP] • Don't Know [SKIP TO NEXT CROP]	Q16. What was the total amount of given crop produced during the last 12 months? (Units: For crops a-e; p-r: see next section For crops f-n: Kg)	Q17. What amount did you use for domestic consumption during the last 12 months? (Units: For crops f-n: Kg)	Q18. What amount did you give away to others during the last 12 months? (Units: For crops f-n: Kg)	Q19. Did you sell some of it during the last 12 months? 1. Yes [GO TO Q20] 2. No [SKIP TO NEXT CROP]	Q20. What amount of the produce did you sell during the last 12 months? (Units: For crops a-e; p-r: see next section For crops f-n: Kg)	Q21. What was the average price per unit you received while selling this product during the last 12 months?	Q22. How did you sell majority of your product during the last 12 months? 1= Sold directly at market 2= Sold at collection center 3= Sold through farmer group/cooperative 4= Sold through middle men at home/farm 5= Sold to consumers from the farm 6= Other
CEREAL CROPS (12a- 12e) ASK Q12, Q16, Q19, Q20, Q21 (NOTE: Q17 AND Q18 NOT APPLICABLE FOR CEREAL CROPS)								
a. Lowland rice			N/A	N/A				
b. Upland rice			N/A	N/A				
c. Maize			N/A	N/A				

d. Wheat			N/A	N/A				
e. Millet			N/A	N/A				
VEGETABLE CROPS (12f-12n): ASK Q12, Q16- Q22								
f. Regular season tomato								
g. Off season tomato (inside plastic tunnel)								
h. Off season tomato (outside plastic tunnel)								
i. Cabbage								
j. Cauliflower								
k. Radish								
l. Potato								
m. Cowpea								
n. Cucumber								
For other vegetables (12o): Ask Q12, Q21.1.o, Q22)								
o. Other vegetables (such as gourds, pumpkin squash, greens but not cash crops like ginger, garlic, onion, turmeric, coffee)		Q21.1.o. How much did you earn in total from the sale of vegetables such as gourds, pumpkins, squash, and greens but not the ‘cash crops’ of ginger, garlic, onion, turmeric, or coffee during the last 12 months? (Nrs)						

FRUITS (12p) ASK Q12, Q21.1.p, Q22		
p. Fruits such as orange, guava, mango, banana, papaya, jackfruit etc.		Q21.1.p. How much did you earn in total from the sale of fruits such as orange, guava, mango, papaya, jackfruit, lemons during the last 12 months?

CASH CROPS (12q) ASK Q12, Q21.1.q, Q22		
q. Cash crops such as ginger, garlic, turmeric, onion etc.		Q21.1.q. How much did you earn in total from the sale of ginger, garlic, turmeric or onion during the last 12 months?

OTHER AGRICULTURAL PRODUCTS (12r- 12t) ASK Q12, Q21.1, Q22
--

r. Honey produced for sale		Q21.1.r. How much did you earn in total from the sale of honey during the last 12 months?
s. Mushroom produced for sale		Q21.1.s. How much did you earn in total from the sale of mushroom during the last 12 months?
t. Farmed fish produced for sale		Q21.1.t. How much did you earn in total from the sale of farmed fish during the last 12 months?

Units of production for crops a-e, p-r

- a. Lowland Rice: Muri, Pathi, Kg, Quintal
- b. Upland Rice: Muri, Pathi, Kg, Quintal
- c. Wheat: Muri, Pathi, Kg, Quintal
- d. Maize: Kg, Doko, Bhari, Muri, Pathi
- e. Millet: Muri, Pathi, Kg, Quintal
- p. Fruits: Ghari, Kaainyo, Jhuppa, Quintal, Doko, Gota (number)
- q. Cash crops: Kg, Quintal
- r. Honey: Kg, Mana, Litre

SECTION C.1.3 COST OF PRODUCTION [ASK TO GROUP: 1, 3, 4]
Q23-Q29

For some crops you reported growing, we would like to know a little bit about how much money you spent on growing them during the last 12 months.

If		Then show	
Q12.a= Yes	a. Lowland rice	Q23a	Cereal crops
Q12.b= Yes	b. Upland rice		
Q12.c= Yes	c. Maize		
Q12.d= Yes	d. Wheat		
Q12.e= Yes	e. Millet		
Q12.f= Yes	f. Regular season tomato		
Q12.g= Yes	g. Off season tomato inside plastic tunnel	Q23b	Off season tomato inside plastic tunnel
Q12.h= Yes	h. Off season tomato outside plastic tunnel	Q23c	All vegetables reported other than off-season tomato grown in plastic tunnel
Q12.i= Yes	i. Cabbage		
Q12.j= Yes	j. Cauliflower		
Q12.k= Yes	k. Radish		
Q12.l= Yes	l. Potato		
Q12.m= Yes	m. Cowpea		
Q12.n= Yes	n. Cucumber		
Q12.o= Yes	o. Other vegetables (such as gourds, pumpkin squash, greens but not cash crops like ginger, garlic, onion, turmeric, coffee)		
Q12.p= Yes	p. Fruits such as orange, guava, mango, banana, papaya, jackfruit etc.		

Q12.q= Yes	q. Cash crops such as ginger, garlic, turmeric, onion etc.	Q23d	Cash crops
Q12.r= Yes	r. Honey produced for sale.	Q23e	Honey
Q12.s= Yes	s. Mushroom produced for sale	Q23f	Mushroom
Q12.t= Yes	t. Farmed fish produced for sale	Q23g	Farmed fish

[IF Q23a IS SHOWN ASK]

Q24.1a. In the last 12 months how much money in Nrs did you spend in total for seed, seedling, fertilizers, rent, labour etc to produce all cereal crops? _____

[IF Q23c IS SHOWN ASK]

Q26. In the last 12 months how much money in Nrs did you spend in total for seed, seedling, fertilizers, rent, labour etc to produce all vegetable crops except for off-season tomato in plastic tunnel? _____

[IF Q23d IS SHOWN ASK]

Q27. In the last 12 months how much money in Nrs did you spend in total for seed, seedling, fertilizers, rent, labour etc to produce all cash crops? _____

[IF Q23e IS SHOWN ASK]

Q28. In the last 12 months how much money in Nrs did you spend in total to produce honey for sale? _____

[IF Q23f IS SHOWN ASK]

Q29. In the last 12 months how much money in Nrs did you spend in total to produce mushroom for sale? _____

[IF Q23g IS SHOWN ASK]

Q30. In the last 12 months how much money in Nrs did you spend in total to produce farmed fish for sale? _____

[IF Q23b IS SHOWN ASK]

Q25. For your off-season tomatoes in plastic tunnel(s), how much did you spend in Nrs on the following items?

Q25.a. Seed/ seedlings _____

Q25.b. Chemical fertilizers _____

Q25.c. FYM/ compost _____

Q25.d. Chemical pesticides_____

Q25.e. Land rent_____

Q25.f. Hired labor_____

Q25.g. Machinery/ equipment_____

Q25.h. Transport_____

Q30. Did you borrow money in the last 12 months to buy inputs for producing your crops?

- Yes
- No [SKIP TO Q33]

Q31. Did you use any of the money you borrowed in the last 12 months for following items?

Q31a. Cereal crops

- Yes
- No

Q31b. Off-season tomato

- Yes
- No

Q31c. Other vegetables

- Yes
- No

Q31d. Cash crops

- Yes
- No

Q32. From whom did you borrow the money you used for your household's farm?

- Relatives
- Neighbors
- Local money lenders
- Farmer group/ cooperative
- Government bank/ scheme
- Private banks
- Other

SECTION C.2. OFF-SEASON TOMATO IN PLASTIC TUNNEL [ASK TO GROUP: 1, 3, 4]

IF Q12g= YES, SHOW Q33

IF Q12g= NO, SKIP TO Q44

You mentioned that you grew off-season tomatoes in plastic tunnel during the last 12 months.

Q33. When did you first build a plastic tunnel on your farm? (Year in BS) _____

Q34. How many plastic tunnels do you currently have on your farm? _____

Q35. How many plastic tunnels did you use to grow off-season tomato during the last 12 months? _____

Q36. Did you receive any support such as plastic sheet, or training for off-season tomato production in plastic tunnel?

- Yes
- No [SKIP TO 40]

a. Plastic tunnel support	Q37a. Did you receive plastic sheets? Yes [ASK Q38A AND Q39A] No [SKIP TO Q37B]	Q38a. Who did you receive that support from? ICDF_____ Other NGOs_____ GOs_____ Others_____	Q39a. For how many tunnels did the following organisations provide you with plastic sheets? ICDF_____ Other NGOs_____ GOs_____ Others_____
b. Other support	Q37b.a. Did you receive training? Yes [ASK Q39B.A] No [SKIP TO Q37B.B]	Q39b.a. Who did you receive that training from? ICDF_____ Other NGOs_____ GOs_____ Others_____	
	Q37b.b. Did you receive any equipment? Yes [ASK Q39B.B] No [SKIP TO Q38B.C]	Q39b.b. Who did you receive the equipment from? ICDF_____ Other NGOs_____ GOs_____ Others_____	
	Q38b.c. Did you receive any subsidized seed? Yes [ASK Q39B.C] No [SKIP TO Q40]	Q39b.c. Who did you receive the subsidized seeds from? ICDF_____ Other NGOs_____ GOs_____ Others_____	

SECTION C2: OFF-SEASON TOMATO [ASK TO GROUP: 1, 3, 4]

Q40. For the following factors associated with off-season tomato production, would you say whether the factor is a major challenge; a minor challenge; or not a challenge for your off-season tomato production?

Would you say that [Factor a-k] is a major challenge, minor challenge or not a challenge for your off-season tomato production?

Factors	Major Challenge= 3 Minor challenge= 2 Not a challenge at all= 1
Q40a. Weeds	
Q40b. Diseases	
Q40c. Insects	
Q40d. Lack of irrigation	
Q40e. Lack of labor	
Q40f. Lack of access to credit	
Q40g. Farm inputs difficult to get	
Q40h. Finding a market	
Q40i. Low market price	
Q40j. Theft of vegetables from farm	
Q40k. Lack of technical knowledge	
Q40l. Damage from monkey	

Q42. To what extent do you agree or disagree with the following statements related to off-season tomato production in plastic tunnels.

Do you...(1) Strongly disagree, (2) Disagree, (3) Neither agree nor disagree, (4) Agree, or (5) Strongly agree...with the statement that

Statements	Level of agreement
Q42a. My access to agricultural information has increased.	
Q42b. My skill and knowledge on vegetable production has increased.	
Q42c. I am able to save some cash that I use to buy food, pay for health services, children's education etc.	
Q42d. My family income has improved.	

Q42e. My family consumes more homegrown vegetables than before.	
Q42f. My community is better off	
Q42g. Knowledge and information sharing among community members have improved.	
Q42h. Socially and economically marginalized farmers have benefited and are more empowered.	

Q43. Would you have grown off-season tomato in plastic tunnel if you had NOT received support for plastic tunnel construction?

- Yes
- No
- Don't Know/ Refused

[NOW SKIP SECTION D AND GO TO Q48]

SECTION D: ADOPTION OF CLIMATE SMART PRACTICES [ASK TO GROUP: 1, 3, 4]

This section is only for respondents that did not grow off-season tomatoes, i.e. Q12g= No.

Q44. You said that you did not grow off-season tomatoes in plastic tunnels during the last 12 months, before that time period did you grow off-season tomato in plastic tunnels?

- Yes
- No [SKIP TO Q46]

Q45. What are the reasons that you stopped growing off-season tomato in plastic tunnel? Choose all that apply.

- a. It was not profitable.
- b. Disease management was difficult.
- c. I sold away my land.
- d. I did not have enough time to look after the tunnel.
- e. Tomatoes were frequently stolen from the tunnel.
- f. Other: (specify)_____

AFTER ASKING Q45 SKIP TO Q48

Q46 AND Q47 ARE ONLY FOR RESPONDENTS WHO HAVE NEVER GROWN OFF-SEASON TOMATO IN PLASTIC TUNNEL I.E. IF Q12g= NO AND Q44= NO

Q46. You reported that you have never grown off-season tomatoes in plastic tunnels, to what extent do you agree with the following reasons that people give for not adopting plastic tunnel technology?

*Do you... (1) Strongly disagree, (2) disagree, (3) Neither agree nor disagree, (4) agree, or (5) Strongly agree...that you do not grow off-season tomatoes in plastic tunnels because

Statements	Level of agreement
a) I do not have sufficient knowledge or details about the technology.	
b) I do not have the education or skills to adopt the technology.	
c) This agricultural technology is not suitable for my farm.	
d) I do not have sufficient money to adopt the technology.	
e) I cannot get credit needed to adopt the new technology.	
g) My farm is too small.	
h) My farm has no access to irrigation.	
i) I do not have access to the market for my products.	
j) I do not have access to market information when needed.	
k) I do not think it will increase my income.	
l) I have a different political ideology for NGO/Donors doing project	
m) These programs favor male farmers	
n) I do not think it is worth the effort.	

Q47. Would you grow off-season tomato in plastic tunnel if you received plastic sheets and training for building a plastic tunnel on your farm?

- Yes
- No
- Don't Know

I would like to learn about some farming practices that you may have used or know about.

	Q49. Did you use the following technology on your farm during the last 12 months? Yes [SKIP TO Q51] No [Skip to next technology] Don't Know [SKIP TO Q50]	Q50. Are you aware of the use of this technology on farms like yours? Yes [SKIP TO Q51] No [SKIP TO NEXT TECHNOLOGY] Don't Know [SKIP TO NEXT TECHNOLOGY]	Q51. From whom did you hear about this technology? 1= Friends 2= Neighbors 3= NGO 4= DADO 5= Others
Drip irrigation			
Rooftop water harvesting			
Cement water tank			
Bio-pesticide			

Improved cattle shed for urine collection			
Earthworms for composting			
Drought resistant rice varieties			
Drought resistant vegetable varieties			
Plastic tunnel for vegetables besides tomatoes			

SECTION E: LIVESTOCK INFORMATION [ASK TO GROUP: 1, 2, 3, 4]

NOTE: Q55- Q58, Q66 ARE NOT FOR GROUP 3

Now, let's focus on your household's livestock. When we talk about livestock, we mean farm animals such as cattle, buffalo, goats, pigs, and chicken.

Q52. In the past 12 months, did you have livestock on your farm?

- Yes
- No [SKIP TO Q77]
- Don't Know [SKIP TO Q77]

IF YES, FOR EACH ANIMAL (a- f) ASK Q53 AND Q54

	a. Cattle	b. Buffalo	c. Goat	d. Pig	e. Local poultry	f. Broiler chicken
Q53. Does your household currently raise animals (a-f) on your farm? IF ANIMALS (a-f) = YES, ASK Q54 FOR ANIMALS (a-f); If NO, MOVE ON TO NEXT ANIMAL.	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Q54. How many animals (a-f) does your household currently have? (ONLY FOR ANIMALS REPORTED YES IN Q53)						
<i>Now I'd like to ask you about the selling of animals you can do without consulting with your spouse and the selling of animals that your spouse can do without consulting you.</i> Q55. Of the ____ number of animals (a-f) you have, how many could you decide to sell without consulting your spouse?						
Q56. Of the remaining ____ number of animals (a-f), how many could your spouse decide to sell without consulting you?						
Q58. Of your animal (a-f) how many of them did [you (if R=woman)/ your wife (if R=man)] acquire? [ASK ONLY IF ANSWER TO Q54 (a-f) IS > 0]						
Q58.1. How did [you (if R=woman)/ your wife (if R=man)] acquire the animal (a-f)? [ASK ONLY IF Q58 (a-f) >0] 1= Born 2= Purchased using personal income/resources 3= Pewa (gift from woman's father's house) 4= Gift from husband's family 5= Purchase using loans 6= Grants from projects						
Q59. Over the last 12 months, did your household buy any animal (a-f)?	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No

Q60. How many animals (a-f) did your household buy during the last 12 months? [ASK ONLY IF Q59 (a-f)= YES]						
Q61. How much did your household pay in Nrs to buy these animals (a-f)? [ASK ONLY IF Q59= YES]						
Q62. In the last 12 months, apart from cost of acquisition, how much amount in Nrs did you spend on feed, medicine, vaccine, breeding & housing for animal (a-f)? [ASK ONLY IF Q53 (a-f)= YES]						
Q63. Did your household sell any animal (a-f) during the last 12 months?	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Q64. How much money in Nrs did your household earn in the last 12 months from selling animal (a-f)? [ASK ONLY IF Q63 (a-f)= YES]						
Q65. Where did you mainly sell them? Choose only one. [ASK ONLY IF Q63 (a-f)= YES. DO NOT PROMPT.] 1= Farmgate (consumers) 2= Farmgate (traders) 3= Home delivery 4= Village market 5= Collection center 6= City market 7= Group/cooperative						
Q66. Who controlled income from the sale of animal (a-f) in the last 12 months? [ASK ONLY IF Q63 (a-f)= YES] 1= Male Household Head only 2= Female Household Head only 3= Both together (either can use after spouse consultation) 4= Either separately (without spouse consultation) 5= Other						

SALE OF LIVESTOCK PRODUCT [ASK TO GROUP: 1, 2, 3, 4]

Product	Q74. Did you or your household sell the following animal products (a-c) in the last 12 months? 1= Yes 2= No	Q75. Where did you mainly sell the product (a-c)? Choose only one. [ASK ONLY IF Q74= YES. DO NOT PROMPT.] 1= Farmgate (consumers) 2= Farmgate (traders) 3= Home delivery 4= Village market 5= Collection center 6= City market 7= Group/cooperative	Q75b. How much revenue in Nrs did you or your household earn from the sale of these products (a-c) in the last 12 months? [ASK ONLY IF Q74= YES.]	Q76. Who controlled income from the sale of the product (a-c)? Choose only one. [ASK ONLY IF Q74= YES. DO NOT PROMPT.] 1= Male Household Head only 2= Female Household Head only 3= Both together (either can after spouse consultation) 4= Either separately (without spouse consultation) 5= Other
a. Milk	1. Yes 2. No			
b. Milk products	1. Yes 2. No			
c. Eggs	1. Yes 2. No			

SECTION F: CONTACT WITH AGENCIES/EXTENSION SERVICE [ASK TO GROUP: 1, 2, 3, 4]

Contact with agencies/extension service	Q77. During the last 12 months, have you had contact with personnel (technicians) from the following agencies (a-d)? 1. Yes 2. No	Q78. How many times did you have contact with personnel from that agency (a-d) in the past 12 months?	Q79. Would you say that you have been: 1= Very dissatisfied 2= Dissatisfied 3= Neither satisfied nor dissatisfied 4= Satisfied 5= Very satisfied
a. District Agriculture Development Office (DADO)			
b. Local Non Government Organization (NGO)			
c. Rural Municipality			
d. Local Development Office (LDO)			

SECTION G: HOUSEHOLD AFFILIATIONS [ASK TO GROUP: 1, 2, 3, 4]

Q82. Are you or any member of your household affiliated with an agricultural-related group or cooperative?

- Yes
- No
- Don't Know/ Refused

Q83. If yes, what is the name of the group(s)?

SECTION H: HOUSEHOLD INFRASTRUCTURE AND ASSETS [ASK TO GROUP: 1, 2, 3, 4]

Q85. What is the main source of drinking water in your household?

- a. Tap/pipe
- b. Tubewell/hand pump
- c. Covered well/kuwa
- d. Uncovered well/kuwa

Q86. What is the usual type of fuel used for cooking in your household?

- a. Wood
- b. Kerosene
- c. Lp gas

- d. Cow dung
- e. Biogas
- f. Electricity

Q87. Do you currently use a “rocket stove” also called an “improved stove” in your household?

- Yes
- No

Q88. What is the source of lighting in your household?

- a. Electricity
- b. Kerosene
- c. Biogas
- d. Solar

Q89. Does your household have a solar water pump?

- Yes
- No
-

Q90. What type of toilet facilities do you have in your household?

- a. Flush (public sewage)
- b. Flush (septic tank)
- c. Ordinary
- d. No toilet

Q91. Please indicate with a yes or no, if you have any of the following items in your household?

Items	1=Yes, 2= No
a. Radio	
b. TV	
c. Cable TV	
d. Computer	
e. Internet	
f. Telephone (landline)	
g. Mobile phone	
h. Motorpump	
i. Motorcycle	
j. Cycle	
k. Other type of vehicle	
l. Refrigerator	
m. Sewing machine	

SECTION I: SATISFACTION WITH LIFE [ASK TO GROUP: 1, 2, 3, 4]

Q95. Next, I would like to ask some questions about your satisfaction with life, in general. Do you Strongly disagree (1), disagree (2), Neither agree or disagree (3), agree (4) , or Strongly agree (5) with the following statements?

Statements	Response
a. In most ways, my life is close to my ideal.	
b. The conditions of my life are excellent.	
c. I am satisfied with my life.	
d. So far I have gotten the important things I want in life.	
e. If I could live this life over, I would change very little.	

SECTION J: HOUSEHOLD'S FOOD SECURITY [ASK TO GROUP: 1, 2, 3, 4]

Q96. In the past four weeks, did you worry that your household would not have enough food?

- Yes
- No

Q96a. In the past four weeks, how many times did this happen?

1 = Rarely (once or twice in the past four weeks)

2 = Sometimes (three to ten times in the past four weeks)

3 = Often (more than ten times in the past four weeks)

Okay. The next 2 questions ask whether you lacked resources for acquiring food for the family.

A lack of resources means:

You did not have enough stock at home and that

You did not have money to buy those foods

Q99. Because of a lack of resources in the past four weeks, did you or any household member have to eat some foods that you really did not want to eat?

- Yes
- No

Q99a. In the past four weeks, how many times did this happen?

1 = Rarely (once or twice in the past four weeks)

2 = Sometimes (three to ten times in the past four weeks)

3 = Often (more than ten times in the past four weeks)

Q103b. Because of lack of resources in the past four weeks, did you or any household member have less food than you needed in a day?

- Yes
- No

Q103c. In the past four weeks, how many times did this happen?

1 = Rarely (once or twice in the past four weeks)

2 = Sometimes (three to ten times in the past four weeks)

3 = Often (more than ten times in the past four weeks)

SECTION K: CLIMATE CHANGE [ASK TO GROUP: 1, 2, 3, 4]

Q110. Now I have some questions about the weather. Is the weather you have experienced in this area during the last 12 months about the same as it has been in previous years?

- Yes
- No

Q111. Focusing on your experience during the last two years please let me know if the following events have (1) decreased, (2) stayed the same, or (3) increased...

Events	Response
a. Average temperature during growing season	
b. Amount of rainfall during the growing season	
c. Frequency of rainfall during the growing season	
d. Incidence of dry spells during growing season	
e. Unpredictable rainfall during the 'rainy season'	
f. Length of time of the 'rainy season'	
g. Incidences of crop pests and diseases	

SECTION L: SOURCES OF INCOME [ASK TO GROUP: 1, 3, 4]

Now I would like to ask you about your household's other income sources besides the agricultural income we talked about already.

These are the same types of questions asked in the census and your answers will help the research and future policy recommendations. Remember your answers will be strictly confidential.

Q115. Did you or members of your household ____ (i) from ____ (ii) during the last 12 months?

	Items			Q116. How much income did your household earn from the (a) of (b) during the last 12 months? [ASK IF Q116= YES]
	[i]	[ii]		
aa.	earn money	sale of millet-based alcohol	1= Yes, 2= No	
a.	earn	agricultural wages (not mentioned above)	1= Yes, 2= No	

b.	earn	non-agricultural wages	1= Yes, 2= No	
c.	have	job with salary	1= Yes, 2= No	
d.	have	business	1= Yes, 2= No	
e.	have	pension	1= Yes, 2= No	
f.	have	government allowance (elderly, widowed, disabled)	1= Yes, 2= No	
g.	provide	tourism (home stays/ guide)	1= Yes, 2= No	
h.	receive	domestic remittance	1= Yes, 2= No	
i.	receive	international remittance	1= Yes, 2= No	
j.	receive	support money from GOs/NGOs	1= Yes, 2= No	
k.	earn money	sale of forest products or services (timber, firewood, ntfp)	1= Yes, 2= No	
l.	earn money	land rented	1= Yes, 2= No	
m.	earn money	house/room rented out (not for tourism)	1= Yes, 2= No	
n.	earn money	equipment rented out	1= Yes, 2= No	
o.	earn money	animal services provided, (breeding/ ploughing)	1= Yes, 2= No	
p.	earn money	something else not mentioned (specify)	1= Yes, 2= No	

[ASK TO GROUP: 1, 3, 4]

Thank you; there are only a few more questions.

Q91. Do you or your spouse own property (land or house) in Kathmandu, Chitwan, or Pokhara?

- Yes
- No

Q94a. Does your household have cash savings in a group/cooperative/bank or elsewhere?

- Yes
- No

Q94b. How much savings in Nrs does your household currently have in groups/ cooperative/ banks/ elsewhere? _____

IF REFUSED, REMIND RESPONDENT THAT INFORMATION IS STRICTLY CONFIDENTIAL AND WILL NOT BE SHARED.

Q94c. Well can you tell me if your household cash savings are greater than or less than 100,000 rupees?

Less than 100,000 Nepali rupees

More than or equal to 100,000 Nepali rupees

Closing:

Thank you so much for taking the time to meet with us. We know you are busy and appreciate your participation in the project.

Enumerator ID_____

Interview end time_____

Verify and Save location info (GPS coordinate) of household_____

APPENDIX B: HOUSEHOLD SURVEY QUESTIONNAIRE (NEPALI VERSION)

ग्रामीण नेपालको जीवनस्तर सुधारमा लिंग, कृषि, प्रविधि र गैर कृषि क्षेत्रको भूमिका

घरधुरी सर्वेक्षण प्रश्नावली संस्करण

२०१८

IRB number: x17-918e

कम्युनिटी सस्टेनेबिलिटी विभाग

मिशिगन स्टेट युनिभर्सिटी

सचेत सहमती

मेरो नाम विनीता गुरुङ हो। म मिचिगन विश्वविद्यालयमा PhD पढ्दैछु। के तपाईं १८ वर्ष पुग्नुभएको छ? [छैन भने अन्तर्वाता टुडाउनुहोस्।]

अघि जान अगावै म हाम्रो विश्वविद्यालयको अध्ययन र सोध तवरका बारेमा केही कुरा यहाँलाई जानकारी दिन चाहन्छु।

नेपालको कृषीकार्य र जीवीकोपार्जन बिच गरिएको यस अध्ययनमा स्वैच्छिक रुपमा सहभागी हुन यहाँलाई आग्रह गरिएको छ। नेपालको जीवीकोपार्जनका लागि निती विकासका क्रममा यस अध्ययनले धेरै सुझाव अनि तथ्यहरु पेश गर्नेछ। सहभागी हुन स्वीकार गर्नुभएको छ भने म यहाँलाई केही कृषीकार्य, प्रविधि र जीवीकोपार्जनसंग सम्बन्धीत प्रश्नहरु सोध्ने छु।

तपाईंको परिवार, घरायसी खेती, कृषककर्म, संघसंस्था र समुदायका बारेमा पनि केही प्रश्न सोध्नेछु। करिब १ घण्टा ३० मिनेट लाग्ने यस प्रश्नोत्तरमा तपाईंका सम्पूर्ण प्रतिक्रिया र जवाफहरु पूर्णत गोप्य राखिनेछ। हरेक प्रतिवेदन र अन्तर्वार्ताहरु मान्छेका नाम नभई सूचकांक र कोड नंबरका आधारमा अभिव्यक्त गरिनेछ। केवल शोधकर्ताहरुलाई मात्र यहासंगको प्रश्नोत्तरको जानकारी रहनेछ र त्यसपश्चात सम्पूर्ण डाटाहरुलाई पासवर्डले पूर्णत सुरक्षित कम्प्युटरमा अमेरिकाको मिचिगन विश्वविद्यालयमा राखिनेछ। यी तथ्यांकको यहाँसंग कुनै व्यक्तिगत सम्बन्ध रहनेछैन।

तपाईंको सहभागीता स्वैच्छिक रहनेछ र ईच्छा नलागेमा यहाँले सहभागी नहुन या केही प्रश्नको उत्तर नदिन र अन्तर्वार्तालाई कुनै पनि समयमा रोक्न पाउनुहुनेछ। र यी प्रश्नावलीका कुनै सही या गलत उत्तर हुँदैनन्।

यस अध्ययनका बारेमा केही प्रश्न या जिज्ञासा रहेमा अध्ययनकर्ताहरुको नंबरमा फोन गरेर बुझ्न सक्नुहुनेछ र यी नंबरहरु मैले यहाँलाई दिएको सुचनापत्रमा रहेको छ। यदि यहाँलाई यस अध्ययनमा आफ्नो अधिकार र स्वतन्त्रता हनन भएको या कुनै गुनासो भएमा त्यसैपत्रमा रहेको विश्वविद्यालयको मानवीय अध्ययन संरक्षण विभागमा सम्पर्क गर्न सक्नुहुनेछ।

प्रश्न १: केही प्रश्न सोध्न चाहनुहुन्छ?

यदि छ भने प्रश्न सुनेर उत्तर दिएर अघि बढ्नुहोस्

छैन भने प्रश्नावली शुरु गर्नुहोस्।

यहाँले ऐच्छिक रुपमा मसंग यो अन्तर्वार्तालाई सहमती जनाउनुभएको छ, के म अन्तर्वार्ता शुरु गरौं?

- हुन्छ
- हुँदैन

हुन्छ भनेमा अघि बढ्नुहोस्
हुँदैन भने अन्त्य गर्नुहोस्।

खण्ड क: आधारभूत जानकारी {समूह: क, ख, ग, घ}

प्र ००. घरको क्रम सङ्ख्या:

प्र ०००. अन्तर्वार्तामा सहभागीको समूह [प्रश्नकर्ताले भर्नुपर्ने]:

क. समूह क- प्राथमिक सहभागी (रूपा-७)

ख. समूह ख- सहायक सहभागी (रूपा-७)

ग. समूह ग- एकलो सहभागी (रूपा-७)

घ. समूह घ- घरमुली (रूपा-२,४)

प्र ०००क. सहभागीको लिङ्ग [प्रश्नकर्ताले भर्नुपर्ने]:

क. पुरुष

ख. महिला

अन्तर्वार्ता शुरु गरौं है त!

प्र १. तपाईंको वैवाहिक अवस्था?

क. विवाहित

प्र १.१. [विवाहित भएमा] तपाईंको पति/पत्नी यहीं बस्नुहुन्छ या अन्यत्र?

क. यहीं ख. अन्यत्र

ख. सम्बन्ध विच्छेद भएको

ग. एकल महिला या एकल पुरुष (विधुर/विधवा)

घ. अविवाहित

खण्ड ख: व्यक्तिगत र पारिवारिक जानकारी {समूह: क, ख, ग, घ}

अब तपाईं र तपाईंको घर-परिवारबारे केही प्रश्नहरू सोध्न चाहन्छु।

	प्र ४.	प्र ५.	प्र ६.
	तपाईं उमेर कति भयो? (वर्षमा)	तपाईंले कति वर्षको औपचारिक शिक्षा हाँसिल गर्नु भएको छ?(वर्षमा)	यदि प्र ५ को उत्तर १ भन्दा कम भएमा: के तपाईंलाई पढ्न र लेख्न आउँछ? के तपाईं साक्षर हुनुहुन्छ? १ =पढ्न र लेख्न दुवै सक्दिन २ =पढ्न मात्र सक्दछु अक्षर चिन्दछु ३ = पढ्न र लेख्न दुवै सक्दछु
उत्तर			

खण्ड ग १.१ खेतीपातीबारे जानकारी {समूह: क, ख, ग, घ}

अब म तपाईंको खेतीयोग्य जमीनबारे केही सोध्न चाहन्छु ।

प्र १०. तपाईंको परिवारको आफ्नै खेतीयोग्य जमीन कति छ?

_____ (यीमध्ये एक छान्नु होस्:रोपनी, हेक्टर, हल, कठ्ठा, धुर, आना, दाम, पैसा)

प्र १० क. गएको १२ महिनामा के तपाईंले आफ्नो केही या सबै खेतीयोग्य जग्गा भाडामा दिनुभयो?

१. दिएँ (जवाफ दिएँ भएमा प्र १०ख सोध्नुहोस्)
२. दिइँन (जवाफ दिइँन भएमा प्र १०ग सोध्नुहोस्)

प्र १० ख. गएको १२ महिनामा तपाईंले कति खेतीयोग्य जमीन भाडामा दिनुभयो?

_____ (यीमध्ये एक छान्नुहोस्: रोपनी, हेक्टर, हल, कठ्ठा, धुर, आना, दाम, पैसा)

प्र १० ग. गएको १२ महिनामा के तपाईंले कृषि प्रयोजनका लागि जग्गा भाडामा लिनुभयो?

१. लिएँ (जवाफ लिएँ भएमा प्र १०घ सोध्नुहोस्)
२. लिइँन (जवाफ लिइँन भएमा प्र १०ङ सोध्नुहोस्)

प्र १० घ. गएको १२ महिनामा तपाईंले कति खेतीयोग्य जमीन भाडामा लिनुभयो?

_____ (यीमध्ये एक छान्नु होस्: रोपनी, हेक्टर, हल, कठ्ठा, धुर, आना, दाम, पैसा)

प्र १० ड. गएको १२ महिनामा तपाईंले कति जग्गा कृषिको लागि प्रयोग गर्नुभयो? यदि खेतीयोग्य जमीन भाडामा दिएको भए भाडामा दिएको जग्गा नजोड्नुहोला।

_____ (यीमध्ये एक छान्नु होस्: रोपनी, हेक्टर, हल, कठ्ठा, धुर, आना, दाम, पैसा)

कृषिको लागि प्रयोग गरिएको जग्गाहरूमध्ये कति खेत र कति पाखो बारी थिए?

प्र १० ड. अ. खेत _____ (यीमध्ये एक छान्नुहोस्: रोपनी, हेक्टर, हल, कठ्ठा, धुर, आना, दाम, पैसा)

प्र १० ड. आ. पाखो बारी _____ (यीमध्ये एक छान्नुहोस्: रोपनी, हेक्टर, हल, कठ्ठा, धुर, आना, दाम, पैसा)

प्र १० च. गएको १२ महिनामा तपाईंको खेतीयोग्य जग्गाहरूमध्ये कति बाँझो रह्यो? यदि खेतीयोग्य जग्गा भाडामा दिएको भए भाडामा दिएको जग्गा नजोड्नुहोला।

_____ (यीमध्ये एक छान्नुहोस्: रोपनी, हेक्टर, हल, कठ्ठा, धुर, आना, दाम, पैसा)

अब तपाईंको घरले गएको १२ महिनामा उत्पादन गरेका बाली तथा कृषि उपजहरूबारे कुरा गरौं।

[यदि प्र १० क = दिँ भएमा भन्नुहोस्:] खेतीयोग्य जग्गा भाडामा दिएको भए भाडामा दिएको जग्गाको उपज नजोड्नुहोला।

खण्ड ग १.२ बालीबारे जानकारी {समूह: क, ग, घ}

प्र ११. गएको १२ महिनामा के तपाईंले अनाज, तरकारी, फलफूल, नगदेबाली, वा अरु कृषिजन्य उपजहरू उत्पादन गर्नुभयो?

क. गरें [प्र१२मा जानुहोस्]

ख. गरिन्न

[यदि प्र ११= ख. गरिन्न]

प्र ११.क. त्यसको मतलब तपाईंले गएको १२ महिनामा धान, काउली, गोलभेंडा, मह जस्ता सामान्य उत्पादन गर्नुभएन?

- क. हो, गएको १२ महिनामा हामीले केही उत्पादन गरेनौं। [प्र४६मा जानुहोस]
- ख. हामीले गएको १२ महिनामा केही कृषिजन्य उपजहरु उत्पादन गरेकाथियौं। [प्र१२मा जानुहोस]

प्र १२-२९ परिचय

कुन बाली लगाउने र के उत्पादन गर्ने भन्ने कुरा घरैपिच्छे फरक पर्ने भएकोले म केही बाली र कृषि उपजहरुको नाम लिन चाहन्छु र तपाईंले यो वाली लगाउनु भयो या भएन वा कृषि उपजहरु उत्पादन गर्नु भयो या भएन सोध्दछु।

बाली	प्र १२. गएको १२ महिनामा के तपाईंको घरले [बाली क-भ] उत्पादन गर्‍यो? १=गर्‍यो २=गरेन [उत्तर गर्‍यो भएमा उक्त बालीको प्र १६ सोध्नुहोस्। उत्तर गरेन भएमा उपखण्डको अर्को बाली या नयाँ	प्र १६. गएको १२ महिनामा [बाली क-भ] कति उत्पादन भयो? (किलो)	प्र १७. गएको १२ महिनामा उत्पादित बाली कतिजति घरमै खपत भयो? (किलो)	प्र १८. गएको १२ महिनामा उत्पादन भएमध्ये तपाईंले कतिजति अरुलाई बाँड्नुभ यो? (किलो)	प्र १९. गएको १२ महिनामा उत्पादित बालीमध्ये के तपाईंले केही बेच्नुभयो? १=बेचें २=बेचिन्न उत्तर बेचिन्न भएमा उपखण्डको अर्को बाली या नयाँ उपखण्डमा जानुहोस्।]	प्र २०. गएको १२ महिनामा उत्पादन भएमध्ये तपाईंले कति बेच्नुभयो ? (किलो)	प्र २१. गएको १२ महिनामा यो बाली बेच्दा प्रति किलो कति रुपैया पाउनुभयो ?	प्र २२. गएको १२ महिनामा उत्पादित बाली प्रायः कसरी बेच्नुभयो? सहभागीला ई संकेत/ सहयोग नगर्नुहस्। (प्र २२ प्रतिक्रियाह रु प्रयोग गर्नु होस्; २ पेज तल हेर्नुहो स)
------	--	---	--	--	---	---	--	--

	उपखण्डमा जानुहोस्।]							
उपखण्ड १- अन्न बाली (१२क- १२ड): सोध्नुस् यी प्रश्नहरु: प्र१२, प्र१६ - प्र१७, प्र१९- प्र२१								
क) धान (खेतमा लगाएको)			n/a	n/a				
ख) घैंया धान (पाखो बारीमा लगाएको)			n/a	n/a				
ग) मकै			n/a	n/a				
घ) गहुँ			n/a	n/a				
ड) कोदो			n/a	n/a				

उपखण्ड २ - तरकारी बाली (१२च - १२ण): सोध्नुस् यी प्रश्नहरु: प्र१२, प्र१६ - प्र२२								
च) गोलभेंडा (मौसमी)								
छ) बेमौसमी गोलभेंडा (प्लाष्टिक टनेल भित्र)								
ज) बेमौसमी गोलभेंडा (प्लाष्टिक टनेल बाहिर)								
झ) बन्दाकोपी								
ञ) काउली								

ट) मूला								
ठ) आलु								
ड) बोडी								
ढ) काँक्रो								

उपखण्ड ३- फलफूल (१२त): यी प्रश्नहरु सोध्नुस्: प्र१२, प्र२१.१, प्र२२								
त) फलफूलहरु, जस्तै सुनताला, अम्बा, आँप, मेवा, कटहर, कागति		n/a	n/a	n/a	n/a	n/a	कुल आय	

उपखण्ड४ - नगदे बाली (१२थ): यी प्रश्नहरु सोध्नुस्: प्र१२, प्र२१.१, प्र२२								
थ) अदुव, लसुन, प्याज		n/a	n/a	n/a	n/a	n/a	कुल आय	

उपखण्ड ५ - अन्य कृषिजन्त उब्जनीहरु (१२द - १२न): यी प्रश्नहरु सोध्नुस्: प्र१२, प्र२१.१, प्र२२								
द) मह उब्जनी (बिक्रीका लागि)		n/a	n/a	n/a	n/a	n/a	कुल आय	
ध) च्याउ खेती (बिक्रीका लागि)		n/a	n/a	n/a	n/a	n/a	कुल आय	
न) माछा पालन (बिक्रीका लागि)		n/a	n/a	n/a	n/a	n/a	कुल आय	

प्र २१.१.ण. गएको १२ महिनामा तपाईंले लौका, फर्सी, सागपात, घिरौंला जस्ता तरकारी (अदुव, लसुन, प्याज जस्ता नगदेबाली बाहेक) बेचेर कति रुपैया कमाउनुभयो?_____

प्र २१.१.त. गएको १२ महिनामा तपाईंले सुनताला, अम्बा, आँप, मेवा, कटहर, कागति जस्ता फलफूलहरु बेचेर कति रुपैया कमाउनुभयो?_____

प्र २१.१.त. गएको १२ महिनामा तपाईंले अदुवा, लसुन, प्याज जस्ता नगदेबाली बेचेर कति रुपैया कमाउनुभयो?_____

प्र २१.१.थ. गएको १२ महिनामा तपाईंले मह बेचेर कति रुपैया कमाउनुभयो?_____

प्र २१.१.थ. गएको १२ महिनामा तपाईंले च्याउ बेचेर कति रुपैया कमाउनुभयो?_____

प्र २१.१.द. गएको १२ महिनामा तपाईंले माछा बेचेर कति रुपैया कमाउनुभयो?_____

प्र २२. प्रतिक्रियाहरु (बिक्रीका प्रकारहरु):

१= बजारमा आफैं लगेर बेचेको

२ = संकलन केन्द्रमा बेचेको

३= कृषक समूह या सहकारीमार्फत बेचेको

४= बिचौलिया/दलाललाई घर या खेतबारीबाटै बेचेको

५= ग्राहकलाई घर या खेतबारीबाटै बेचेको

६= अरु

उब्जनीका इकाइहरु:

अन्न बाली:

- धान: मुरी, पाथी, किलोग्राम, क्विन्टल
- गहुँ: मुरी, पाथी, किलोग्राम, क्विन्टल
- मकै: मुरी, पाथी, किलोग्राम, डोको, भारी (नोट: मुरी आयतनको इकाइ हो र यसलाई किलोग्राममा रुपान्तर गर्दा बालीपिच्छे फरक हुन्छ। उदाहरणका लागि: १ मुरी धान र १ मुरी मकै जोख्दा तिनको तौल फरक हुन्छ।)
- कोदो: मुरी, पाथी, किलोग्राम, क्विन्टल

तरकारी: किलोग्राम

फलफूल:

- केरा: घारी, काइँयो, झुप्पा, किलोग्राम
- सुन्तला: किलोग्राम, क्विन्टल, डोको
- मेवा: गोटा (संख्या)
- अम्बा: किलोग्राम, डोको
- रुख कटहर: गोटा (संख्या), किलोग्राम

नगदे बाली:

- सबै किलोग्राम या क्विन्टलमा

अरु उब्जनीहरु:

- मह: किलोग्राम, माना, लिटर
- च्याउ: किलोग्राम
- माछा: किलोग्राम

खण्ड ग १.३ उत्पादन लागत {समूह: क, ग, घ}

प्र २३ - २९ परिचय

गएको १२ महिनामा तपाईंले केही बालीहरुका लागि कति रकम निम्न चिजहरुमा खर्चनुभयो भनेर बुझ्न चाहन्छौं।

तपाईंले गएको १२ महिनामा निम्नानुसारका बाली लगाउनु भएको रहेछ। [प्र१२ मा सोधिएका बालीहरु] का लागि [क-झ] मा कति खर्च गर्नुभयो?

यदि		देखाउनु	
प्र१२क=गर्यो	क) धान (खेतमा लगाएको)	प्र२३क	धान, मकै, गहुँ, कोदो जस्ता अन्न बाली
१२ख=गर्यो	ख) घैंया धान (पाखो बारीमा लगाएको)		
१२ग=गर्यो	ग) मकै		
१२घ=गर्यो	घ) गहुँ		
१२ङ=गर्यो	ङ) कोदो		
१२च=गर्यो	च) गोलभेंडा (मौसमी)		
१२छ=गर्यो	छ) बेमौसमी गोलभेंडा (प्लाष्टिक टनेल भित्र)	प्र२३ख	बेमौसमी गोलभेंडा (प्लाष्टिक टनेल भित्र)

१२३=गर्यो	ज) बेमौसमी गोलभेंडा	प्र२३ग	प्लाष्टिक टनेल भित्रको बेमौसमी गोलभेंडा र नगदे बाली बाहेकका लौका, फर्सी, सागपात, घिरौँला जस्ता तरकारी
१२४=गर्यो	(प्लाष्टिक टनेल बाहिर)		
१२५=गर्यो	झ) बन्दाकोपी		
१२६=गर्यो	ञ) काउली		
१२७=गर्यो	ट) मूला		
१२८=गर्यो	ठ) आलु		
१२९=गर्यो	ड) बोडी		
१३०=गर्यो	ढ) काँक्रो		
१३१=गर्यो	ण) अरु तरकारीहरु। जस्तै: लौका, फर्सी, सागपात, घिरौँला, आदि (अदुवा, लसुन, प्याज जस्ता नगदेबाली बाहेक)		
१३२=गर्यो	त) फलफूलहरु, जस्तै सुनताला, अम्बा, आँप, मेवा, कटहर, कागति	प्र२३घ	अदुवा, लसुन, प्याज जस्ता नगदेबाली
१३३=गर्यो	थ) अदुवा, लसुन, प्याज	प्र२३ङ	मह
१३४=गर्यो	द) मह उत्पादनउब्जनी (बिक्रीका लागि)	प्र२३च	च्याउ
१३५=गर्यो	ध) च्याउ खेती (बिक्रीका लागि)	प्र२३छ	माछा

प्र२३क देखि प्र२३छ सम्मका उत्पादनहरु देखिएको खण्डमा (अर्थात् प्र१२ मा देखाइएका
उत्पादनहरु लगाएको भएमा) निम्न प्रश्न सोध्नु होला:
[यदि २३क देखिएमा]

प्र२३क.१: गएको १२ महिनामा तपाईंले धान, मकै, गहुँ, कोदो जस्ता अन्नबाली उत्पादन गर्न
बीउ/बेर्ना, रासायनिक मल, रासायनिक विषादी, प्राङ्गारिक मल, जग्गा भाडा, कामदार ज्याला,
औजार, ढुवानी आदिमा जम्मा कति खर्च गर्नुभयो?

[यदि २३ग देखिएमा]

प्र२३ग.१: गएको १२ महिनामा तपाईंले बेमौसमी गोलभेंडा र नगदे बाली बाहेकका तरकारी बाली उत्पादन गर्न बीउ/बेर्ना, रासायनिक मल, रासायनिक विषादी, प्राङ्गारिक मल, जग्गा भाडा, कामदार ज्याला, औजार, ढुवानी आदिमा जम्मा कति खर्च गर्नुभयो?

[यदि २३घ देखिएमा]

प्र२३घ.१: गएको १२ महिनामा तपाईंले अदुवा, लसुन, प्याज जस्ता नगदेबाली उत्पादन गर्न बीउ/बेर्ना, रासायनिक मल, रासायनिक विषादी, प्राङ्गारिक मल, जग्गा भाडा, कामदार ज्याला, औजार, ढुवानी आदिमा जम्मा कति खर्च गर्नुभयो? _____

[यदि २३ङ देखिएमा]

प्र२३ङ.१: गएको १२ महिनामा तपाईंले मह उत्पादन गर्न माहुरी, रसायन, जग्गा भाडा, कामदार ज्याला, औजार, ढुवानी आदिमा जम्मा कति खर्च गर्नुभयो? _____

[यदि २३च देखिएमा]

प्र२३च.१: गएको १२ महिनामा तपाईंले च्याउ उत्पादन गर्न बीउ/बेर्ना, रासायनिक मल, जग्गा भाडा, कामदार ज्याला, औजार, ढुवानी आदिमा जम्मा कति खर्च गर्नुभयो? _____

[यदि २३छ देखिएमा]

प्र२३छ.१: गएको १२ महिनामा तपाईंले माछा उत्पादन गर्न बीउ माछा, रसायन, माछा पोखरी, कामदार ज्याला, औजार, ढुवानी आदिमा जम्मा कति खर्च गर्नुभयो? _____

प्र२४ [यदि प्र१२क=गर्यो, प्र२३ख माथि देखाइनेछ]

गएको १२ महिनामा तपाईंले प्लाष्टिक टनेल भित्र बेमौसमी गोलभेंडा उत्पादन गर्न निम्न वस्तुहरूमा जम्मा कति खर्च गर्नुभयो?

- | | |
|--------------------|-------|
| क. बीउ/बेर्ना | _____ |
| ख. रासायनिक मल | _____ |
| ग. प्राङ्गारिक मल | _____ |
| घ. रासायनिक विषादी | _____ |
| ङ. जग्गा भाडा | _____ |
| च. कामदार/ज्याला | _____ |

छ. मिसिन र उपकरणहरु _____
ज. गाडी ढुवानी _____

प्र ३०. गएको १२ महिनामा के तपाईंले बाली उत्पादनका लागि आवश्यक पर्ने सामाग्री किन्न रकम ऋण वा सापटी लिनुभयो?

- क) लिएँ
- ख) लिइनँ

प्र ३१. गएको १२ महिनामा रकम ऋण वा सापटी लिएको पैसा तलका के के कुरामा खर्च गर्नुभयो?

(मिल्ने जति सबै छान्नुहोस्)

- | | |
|--|---------------------------|
| क) [प्र १२ क-ड मध्ये कुनैको उत्तर = १ भएमा] | अन्न बाली - हो/हैन |
| ख) [प्र १२ छ को उत्तर = १ भएमा] | बेमौसमी गोलभेंडा - हो/हैन |
| ग) [प्र १२ च, र-ण मध्ये कुनैको उत्तर = १ भएमा] | अरु तरकारी बाली - हो/हैन |
| घ) [प्र १२ थ-प मध्ये कुनैको उत्तर = १ भएमा] | नगदे बाली - हो/हैन |

प्र ३२. कृषि गर्न भनेर ऋण/सापटी कोसँग लिनुभएको थियो? (मिल्ने जति सबै छान्नुहोस्)

- १) नातेदार
- २) छिमेकी
- ३) साहू
- ४) कृषि समूह वा सहकारी
- ५) सरकारी बैंक या प्रोजेक्ट/आयोजना
- ६) निजी बैंक
- ७) अरु

[प्र १२ छ को उत्तर = हो/छ/सकारात्मक भएमा प्र ३३ को परिचय दिनुहोस्]

[प्र १२ छ को उत्तर = हैन/छैन/नकारात्मक भएमा प्र ४४ सोध्नुहोस्]

खण्ड ग २: बेमौसमी गोलभेंडा {समूह: क, ग, घ}

प्र ३३ परिचय

तपाईंले अघि भन्नुभयो कि गएको १२ महिनामा प्लाष्टिक टनेलभित्र बेमौसमी गोलभेंडा खेती गर्नुभएको थियो।

प्र ३३. तपाईंले पहिलोपटक प्लाष्टिक टनेल कहिले बनाउनुभएको थियो? [साल, वि.सं.]

प्र ३४. तपाईंसँग अहिले कतिवटा प्लाष्टिक टनेल छन्? _____

प्र ३५. गएको १२ महिनामा बेमौसमी गोलभेंडा खेतीको लागि कतिवटा प्लाष्टिक टनेल प्रयोग गर्नुभयो? _____

प्र ३६. के तपाईंले बेमौसमी गोलभेंडा खेतीका लागि बनाएको प्लाष्टिक टनेल निर्माण गर्न कतैबाट प्लाष्टिक, सहयोग, प्रशिक्षण पाउनुभयो?

क) पाएँ

ख) पाइनँ (उत्तर यो भएमा प्र ४० सोध्नुहोस्)

	प्र ३७.क	प्र ३८.क	प्र ३९.क
	१= पाएँ २= पाइनँ [प्र ३७ क = पाएँ भएमा प्र ३७ ख सोध्नु अगाडि प्र ३८क र ३९क सोध्नुहोस्]	उक्त सहयोग कहाँबाट पाउनुभयो? १= ICDF (इन्द्रगुफा सामुदायिक बिकास मन्च) २= अरु गैर सरकारी संस्था (गैससं) ३= सरकारी निकाय ४= अरु [सहभागीलाई संकेत/सहयोग नगर्नुहोस्।]	[प्र ३७ क = १भएमा] [प्र ३८ क को उत्तर] ले कतिवटा प्लाष्टिक टनेल बनाउन पुग्ने गरी प्लाष्टिक दियो?
क) तपाईंले पाउनु भएका			

सहयोगमध्ये के तपाईले प्लाष्टिक सहयोग पाउनुभयो?			
ख) के तपाईले अरु सहयोग जस्तै प्रशिक्षण, उपकरण, सस्तो मूल्यमा बीऊ, औजार पाउनुभयो?	प्र ३७.क १= पाएँ २= पाइनेँ [प्र ३७ ख = पाएँ भएमा प्र ३८ख र ३९ख सोध्नुहोस्, व्यवहारिक भएमा]	प्र ३८.ख अरु सहयोग मिल्नेजति सबै छान्नुहोस् १) प्रशिक्षण २) उपकरण ३) सस्तो बीऊ [यदि प्र ३८.१ को उत्तर सकारात्मक भएमा प्र ३८.२ सोध्नुहोस्]	प्र ३९.ख उक्त सहयोग कहाँबाट पाउनुभयो? १= ICDF २= अरु गैससं ३= सरकारी निकाय ४= अरु [सहभागीलाई संकेत/सहयोग नगर्नुहोस्।]

प्र ४०. बेमौसमी गोलभेंडा उत्पादनसंग सम्बन्धित तलका कारकहरूलाई “ठूलो चुनौती”, “सानो चुनौती”, या “चुनौती हैन” गरी ३ वर्गमा छुट्याउनु पर्दा कसरी छुट्याउनु हुन्छ?

[तलका कारकहरू १-२ चोटि पूरै (सबै शब्दहरू) पढ्नुहोस्। त्यसपछि मुख्य कुरा मात्र भन्नुहोस्]

बेमौसमी गोलभेंडा उत्पादनसंग सम्बन्धित तलका कारकहरूलाई तपाईं “ठूलो चुनौती”, “सानो चुनौती”, या “चुनौती हैन” के भन्नुहुन्छ?

कारकहरू	ठूलो चुनौती = ३, सानो चुनौती = २, चुनौती हैन = १
---------	--

क) झारपात	
ख) रोगको प्रकोप	
ग) किरा-फट्याङ्ग्रा	
घ) सिचाइँको अभाव	
ङ) ज्यालादारी खेतालाको अभाव	
च) ऋणमा पहुँचको अभाव	
छ) कृषि सामाग्री पाउन गाह्रो	
ज) बजार पाउन गाह्रो	
झ) सस्तो बजार भाउ	
ञ) बारी बाट तरकारी चोरी हुने	
ट) प्राविधिक ज्ञानको अभाव	
ठ) बाँदर	

प्र ४२. प्लाष्टिक टनेलमा गरिने बेमौसमी गोलभेंडा खेतीबारे तलका भनाइहरूसँग तपाईँ कतिको सहमत हुनुहुन्छ?

*तलको भनाइसँग (१) पूर्ण असहमत, (२) केही असहमत, (३) न सहमत न असहमत, (४) केही सहमत, वा (५) पूर्ण सहमत मध्ये के हुनुहुन्छ?

[*यो वाक्य तलको क) पढ्नु अगाडि भन्नुहोस्। चाहिएको खण्डमा ख-ज पढ्नु अगाडि यो वाक्य फेरि दोहोर्याउनुहोस्।]

भनाइ	जवाफ
क) कृषि सम्बन्धि सूचनाहरुमा मेरो पहुँच बढेको छ।	
ख) तरकारी खेतीबारे मेरो सीप र ज्ञान बढेको छ।	
ग) म केही नगद बचाउन सक्षम छु, जुन म खाना, स्वास्थ्य, बालबच्चाको पढाइ आदिमा खर्च गर्दछु।	
घ) मेरो घरको आम्दानी बढेको छ।	
ङ) हाम्रो परिवारले घरमै उत्पादित तरकारी पहिलेभन्दा धेरै सेवन गर्दछ।	

च) मेरो समुदाय पहिलेभन्दा राम्रो अवस्थामा छ।	
छ) समुदायका सदस्यहरूबीच सूचना आदान प्रदान गर्ने कुरामा सुधार आएको छ।	
ज) सामाजिक र आर्थिक रूपले पिछडिएका कृषकहरूले लाभ पाएका छन् र उनीहरू	

प्र ४३. [सहयोग पाउनेहरूलाई मात्र सोध्नुहोस्; प्र ३६ = पाएँ]

प्लाष्टिक टनेल बनाउन सहयोग नपाउनु भएको भए के तपाईंले प्लाष्टिक टनेलभित्र बेमौसमी गोलभेंडा खेती गर्नु हुन्थ्यो?

- क) गर्थेँ
- ख) गर्दिनथेँ
- ग) थाहा छैन

[प्र ४२/४३ पछि प्र ४८ मा जानुहोस्।]

[प्र ४४ बेमौसमी गोलभेंडा खेती नगर्ने हरुलाई सोध्नु होस्; प्र १२ छ= २/नकारात्मक भएमा]

प्र ४४. गएको १२ महिनामा तपाईंले प्लाष्टिक टनेलमा बेमौसमी गोलभेंडा खेती गरेको छैन भन्नुभयो। गएको १२ महिना भन्दा अगाडि के तपाईंले प्लाष्टिक टनेलमा बेमौसमी गोलभेंडा खेती गर्नुभएको थियो?

- क) थिएँ
- ख) थिइनँ [उत्तर यो भएमा प्र ४६ सोध्नुहोस्।]

	जवाफ
क) मसँग यो प्रविधिबारे पर्याप्त ज्ञान र जानकारी छैन।	
ख) यो प्रविधि अपनाउन मसँग शिक्षा वा सीप छैन।	
ग) यो प्रविधि मेरो खेतका लागि उचित छैन।	
घ) यो प्रविधि अपनाउन मसँग पर्याप्त रकम छैन।	
ङ) मैले नयाँ प्रविधि अपनाउन आवश्यक पर्ने ऋण पाउन सकिदैन।	
च) मेरो बारी/जग्गा निकै सानो छ।	
छ) मेरो खेतीलाई सिँचाइको पहुँच छैन।	

ज) उपज बेचनका लागि चाहिने बजारम मेरो पहुँच छैन।	
झ) चाहिएको बेलामा बजारबारे सुचनामा मेरो पहुँच छैन।	
ञ) यो प्रविधिले मेरो आय बढ्छ जस्तो लाग्दैन।	
ट) यो आयोजना संचालन गर्ने गैसस र दाताहरु भन्दा मेरो राजनैतिक आस्था फरक छ।	
ठ) यो प्रविधि पुरुषको लागि हो।	
ड) यो प्रविधिमा बल गर्नु बेकार छ।	

प्र ४५. के कारणहरुले गर्दा प्लाष्टिक टनेलमा बेमौसमी गोलभेंडा खेती गर्न छोड्नुभयो?

[सहभागीलाई संकेत/सहयोग नगर्नुहोस्।]

क. कारण १

ख. कारण २

ग. कारण ३

घ. कारण ४

ड. कारण ५

{नोट: ICDF कर्मचारीसँग छलफल र परीक्षण गरेपछि शोधकर्ताले ५ मुख्य कारणहरु छान्नुहुनेछ,

जुन प्र ४५ का उत्तरहरु हुनेछन।}

[प्र ४५ को उत्तरपछि प्र ४८ सोध्नुहोस्।]

[प्र ४६/४७ प्लाष्टिक टनेलमा कहिल्यै पनि बेमौसमी गोलभेंडा खेती नगरेको भए सोध्नुहोस्।]

प्र ४६. तपाईंले प्लाष्टिक टनेलमा बेमौसमी गोलभेंडा खेती कहिल्यै गरेको छैन भन्नुभयो। प्लाष्टिक टनेल प्रयोग नगर्नाका कारणहरु मध्ये तलका तलका भनाइहरूसँग कति सहमत हुनुहुन्छ?

* तलको भनाइसँग (१) पूर्ण असहमत, (२) केही असहमत, (३) न सहमत न असहमत, (४) केही सहमत, वा (५) पूर्ण सहमत मध्ये के हुनुहुन्छ?

प्र ४७. प्लाष्टिक टनेल बनाउनलाई प्लाष्टिक र प्रशिक्षण पाउनुभयो भने प्लाष्टिक टनेलमा बेमौसमी गोलभेंडा खेती गर्नुहुन्छ?

- क) गर्छु
ख) गर्दिनँ
ग) थाहा छैन

खण्ड घ: जलवायु / वातावरण मैत्री अभ्यासहरू {समूह: क, ग, घ}

प्र ४८. अब तपाईंले खेतीमा प्रयोग गर्नुहुने वा थाहा पाउनुभएका केही तरिकाहरूबारे जान्न चाहन्छु।

	प्र ४९. गएको १२ महिनामा क-झ मध्ये कुनै प्रयोग गर्नुभएको थियो? १=थिएँ २=थिइँ ८=थाहा छैन [उत्तर २ वा ८ भएमा क-झ लिस्टबाट अर्को सोध्नुहोस्।]	प्र ५०. [प्र ४९ को उत्तर २ वा थिइँ भएमा...] क-झ को प्रयोग अरु कसैको खेतीमा गरेबारे जानकार हुनुहुन्छ? १= छु २= छुइन ८= थाहा छैन [प्र ५० = २ वा ८ भएमा क-झ लिस्टबाट अर्को सोध्नुहोस् वा प्र ५२ सोध्नुहोस्।]	प्र ५१. [प्र ४९ क-झ = १/थिएँ वा प्र ५० = १/छु भएमा...] क-झ बारे कोबाट सुन्नुभयो? १= साथीहरु २= छिमेकी ३= गैससं ४= DADO ५= अरु [क-झ लिस्टबाट अर्को सोध्नुहोस् वा प्र ५२ सोध्नुहोस्।]
क) ड्रिप / थोपा सिँचाइ			
ख) बर्खे पानी संकलन			
ग) सिमेन्टीको पानी ट्याङ्की			

घ) जैविक विषादी			
ड) पशुको मूत्र संकलन गर्न सुधारिएको गोठ			
च) गड्यौली मल			
छ) खडेरी प्रतिरोधी धानको जात			
ज) खडेरी प्रतिरोधी तरकारीका जात			
झ) गोलभेंडा बाहेक अरु तरकारी खेतीका लागि प्लाष्टिक टनेलको प्रयोग			

खण्ड ड: पशुपालनबारे जानकारी {समूह: क, ख, ग, घ}

नोट: *प्र ५५ - प्र ६६ {३} का लागि हुन्।

प्र ५२. अब तपाईंको घरको पशुपालनबारे कुरा गरौं। पशुपालनमा गाईगोरु, भैंसी, खसीबाख्रा, सुँगुर, र कुखुरा पर्दछन्। गएको १२ महिनामा के तपाईंले पशुपालन गर्नुभएको थियो?

क) थिएँ

ख) थिइनँ (उत्तर यो भएमा खण्ड च को प्र ७७ सोध्नुहोस्।)

[नोट: हरेक जनावर (क-छ) बारे प्र ५३ र प्र ५४ सोध्नुहोस्। त्यसपछि प्र ५५ - प्र ६६ पालिएका जनावरबारे मात्र सोध्नुहोस्।]

उमेरमा भिन्नता छैन। लोकल/ब्रोइलर कुखुरा राख्नुहोस्।

	क. गाईगोरु	ख. भैंसी	ग. खसीबा ख्रा	घ. सुँगुर	ड. लोकल कुखुरा	च. ब्रोइलर कुखुरा
प्र ५३.तपाईंले अहिले [क-च] मध्येका कुनै पशु पाल्नुभएको छ? [यदि प्र ५३ [क-च]=१ भएमा प्र ५४ [क-च] सोध्नुहोस्; यदि प्र ५३ [क-च]=२ भएमा अर्को पशुबारे सोध्नुहोस्।]	१= छ, २= छैन	१= छ, २= छैन	१= छ, २= छैन	१= छ, २= छैन	१= छ, २= छैन	१= छ, २= छैन
प्र ५४. [प्र ५३ [क-च]=१/छ भएमा], अहिले तपाईंको घरमा [क-च] का कुन पशु कतिवटा छन्? [यसपछि अर्को जनावरबारे प्र ५३ सोध्नुहोस्; सबै जनावर						

सकिएपछि प्र ५५]						
प्र ५५. अब म तपाईं र तपाईंको श्रीमान/श्रीमतीले एक-अर्कासँग छलफल नगरीकनै गर्न मिल्ने पशु बेचबिखनबारे केही सोध्न चाहन्छु। तपाईंहरूसँग भएका प्र ५४ [क-च] पशु [क-च] मध्ये, तपाईंले कतिवटा आफ्नो श्रीमान/श्रीमतीसँग छलफल नगरी बेच्न सक्नुहुन्छ?						
प्र ५६. बाँकी पशु [क-च] मध्ये तपाईंको श्रीमान/श्रीमतीले तपाईंसँग छलफल नगरी कतिवटा बेच्न सक्नुहुन्छ?						
प्र ५८. [यदि प्र ५४ क-च > ०] तपाईंहरूसँग भएका पशु [क-च] मध्ये तपाईंले(सहभागी महिला भएमा) वा तपाईंको श्रीमतीले (सहभागी पुरुष भएमा) कतिवटा जोड्नुभएको हो?						
प्र ५८. १ [यदि प्र ५७ क-च > ०] पशु [क-च] तपाईंले कसरी र तपाईंको श्रीमान/श्रीमतीले						

कसरी जोड्नुभएको हो? सहभागीलाई सङ्केत/सहयोग नगर्नुहोस्। मिल्ने उत्तर सबै छान्नुहोस्। १= आफ्नै गोठमा जन्मेको २= निजी आम्दानी/श्रोतबाट किनेको ३= पेवा (महिलाको माइतबाट प्राप्त) ४= पुरुषको परिवारबाट प्राप्त ५= ऋण लिएर किनेको ६= आयोजनाहरुबाट अनुदानमा पाएको						
प्र ५९. गएको १२ महिनामा तपाईंले कुनै पशु [क-च] किन्नुभएको छ?	१= छ २= छैन	१= छ २= छैन	१= छ २= छैन	१= छ २= छैन	१= छ २= छैन	१= छ २= छैन
प्र ६०. [प्र ५९ = छ भएमा हरेक पशुको लागि] गएको १२ महिनामा पशु [क-च] कतिवटा किन्नुभयो?						
प्र ६१. [प्र ५९ = छ भएमा हरेक पशुको लागि] पशु [क-च] को लागि कति तिर्नुभयो? (रुपैयाँमा)						
प्र ६२. [यदि प्र ५३ क-च=१] गएको १२ महिनामा पशु [क-च] किन्दा परेको पैसाबाहेक पशुलाई खाना, औषधी, प्रजनन (भाले लगाउने), खोर, आदि मा कति खर्च गर्नुभयो?						

प्र ६३. गएको १२ महिनामा कुनै पशु बेच्नुभयो? १= बेच्यौं २= बेचेनौं [उत्तर यो भएमा क-च मध्ये अर्को पशुबारे सोध्नुहोस्।]	१= बेच्यौं २= बेचेनौं	१= बेच्यौं २= बेचेनौं	१= बेच्यौं २= बेचेनौं	१= बेच्यौं २= बेचेनौं	१= बेच्यौं २= बेचेनौं	१= बेच्यौं २= बेचेनौं
प्र ६४. [प्र ६३ मा उत्तर = १ भएका पशुहरुका लागि] गएको १२ महिनामा पशु /क-च/ बेचेर कति आम्दानी गर्नुभयो? (रुपैयाँमा)						
प्र ६५. [प्र ६३ मा उत्तर = १ भएका पशुहरुका लागि] विशेषगरी पशु कहाँ बेच्नुभयो? (एउटा मात्र उत्तर छान्नुहोस्; सहभागीलाई सङ्केत/सहयोग नगर्नुहोस्।) १= ग्राहकले घरबाट किनेको २= व्यापारीले घरबाट किनेको ३= ग्राहकको घरमै पुर्याइदिएको ४= गाउँको बजार ५= संकलन केन्द्र ६= शहरको बजार ७= समुह/सहकारी						
प्र ६६. [प्र ६३ मा उत्तर = १ भएका पशुहरुका लागि] गएको १२ महिनामा पशु [क-च] बेचेर आएको आम्दानीमा कसको नियन्त्रण रहयो? १= पुरुष घरमूलीले मात्र २= महिला घरमूलीले मात्र						

३= दुबै पुरुष र महिलाले (एकअर्काको स्वीकारोक्ती पछि) ४= दुबै पुरुष र महिलाले (एकअर्काको स्वीकारोक्ती विना) ५=अरु _____ [अब प्र ५८/अर्को जनावरबारे सोध्नुहोस्; अनि प्र ७४ सोध्नुहोस्।]						
---	--	--	--	--	--	--

उत्पादन	प्र ७४. गएको १२ महिनामा तपाईं वा तपाईंको घरले तलका उत्पादनहरु बेच्नुभयो? {क-ग गल्तेख गर्नुहोस्।} १= बेच्यौं २= बेचेनौं	प्र ७५. [यदि प्र ७४ क-ग=१ भएमा] [क-ग] विशेषगरी कहाँ बेच्नुभयो? (एउटा मात्र छान्नुहोस्।) १= ग्राहकले घरबाट किनेको २= व्यापारीले घरबाट किनेको ३= ग्राहकको घरमै पुर्याइदिएको ४= गाउँको बजार ५= संकलन केन्द्र ६= शहरको बजार ७= समुह/सहकारी	प्र ७५ ख. गएको १२ महिनामा [क-ग] बेचेर तपाईं वा तपाईंको घरले कति आम्दानी गर्नुभयो?	प्र ७६. [यदि प्र ७४ क-ग=१ भएमा] [क-ग] बेचेर आएको रकम कसले राख्यो? (एउटा मात्र छान्नुहोस्।) १= पुरुष घरमूलीले मात्र २= महिला घरमूलीले मात्र ३= दुबै पुरुष र
---------	---	--	---	--

				महिलाले (एकअर्काको स्वीकारोक्ती पछि) ४= दुबै पुरुष र महिलाले (एकअर्काको स्वीकारोक्ती विना)
क) दूध	१= बेच्यौँ २= बेचेनौँ			
ख) दूधजन्य पदार्थ	१= बेच्यौँ २= बेचेनौँ			
ग) अण्डा	१= बेच्यौँ २= बेचेनौँ			

खण्ड च: एजेन्सी / सरकारी र स्थानीय निकायहरूसँग सम्पर्क {समूह: क, ख, ग, घ}	प्र ७७. गएको १२ महिनामा निकाय [क-घ] का कुनै प्राविधिक कर्मचारीसँग के तपाईंको सम्पर्क (भेटघाट/कुराकानी) भएको थियो? १ = थियो, २ = थिएन (उत्तर २ भएमा क-घ मध्ये अर्को निकायबारे सोध्नुहोस्।)	प्र ७८. [प्र ७७=१ भएमा] उक्त निकायका कर्मचारीसँग कतिपटक भेटघाट/कुराकानी भएको थियो?	प्र ७९. [प्र ७७=१ भएमा] गएको १२ महिनामा निकाय [क-घ] का कर्मचारीसँग भएको भेटघाटबारे के भन्नुहुन्छ? (१) धेरै असन्तुष्ट, (२) असन्तुष्ट, (३) न सन्तुष्ट न असन्तुष्ट, तठस्त (४) सन्तुष्ट, (५) धेरै सन्तुष्ट
क) जिल्ला कृषि विकास कार्यालय			
ख) स्थानीय गैससं			
ग) गाउँपालिका			
घ) स्थानीय विकास अधिकृत			

खण्ड छः संघ-संगठनसँगको आबद्धता {समूहः क, ख, ग, घ}

प्र ८२. तपाईं वा तपाईंको घरको कुनै सदस्य कुनै कृषि-सम्बन्धी समूह वा सहकारीको सदस्य हुनु हुन्छ?

क) छु

ख) छुइन (उत्तर यो भएमा प्र ११६ सोध्नुहोस्।)

प्र ८३. सदस्य हुनुहुन्छ भने ती समूहहरूको नाम के हो?

खण्ड जः घरायसी सम्पति र पूर्वाधारहरू {समूहः क, ख, ग, घ}

प्र ८५. तपाईंको घरको खानेपानीको मुख्य श्रोत के हो? [सङ्केत/सहयोग नगर्नुहोस्।]

क. धारा/पाइप

ख. ट्युबवेल/हाते पम्प

ग. छोपिएको ईनार/कुवा

घ. खुला ईनार/कुवा

ङ. ढुङ्गेधारा

प्र ८६. तपाईंको घरमा खाना पकाउन के प्रयोग गर्नुहुन्छ?

• क. दाउरा/सिटा

ख. मट्टीतेल

ग. एलपी ग्यास

घ. गुइँठा

ङ. बायोग्यास

च. बिजुली

प्र ८६.१ तपाईंको घरमा सुधारिएको चूल्हो वा रकेट चूल्हो प्रयोग हुन्छ?

क. हुन्छ

ख. हुँदैन

प्र ८७. तपाईंको घरमा बत्ती कसरी बाल्नु हुन्छ ?

क. बिजुली

ख. मट्टीतेल

ग. बायोग्यास

घ. सोलार

प्र ८८.१ तपाईंको घरमा पानी तान्ने सोलार पम्प छ?

क. छ

ख. छैन

प्र ८९. तपाईंको घरमा चर्पीको कस्तो व्यवस्था छ?

क. फलश गर्न मिल्ने चर्पी - नालीमा खस्छ

ख. फलश गर्न मिल्ने चर्पी - सेप्टिक ट्याङ्कीमा खस्छ

ग. साधारण

घ. चर्पी छैन

प्र ९०. तपाईंको घरमा निम्न सामानहरु छन या छैनन, कृपया भनिदिनुहोला:

सामान	छ = १, छैन = २
क. रेडियो	
ख. टिभी	
ग. केबल टिभी च्यानल	
घ. कम्प्युटर	
ङ. ईन्टरनेट सेवा	
च. टेलिफोन (तार)	
छ. मोबाइल फोन	
ज. पानी तान्ने मोटर	
झ. मोटरसाइकल	
ञ. साइकल	
ट. अरु किसिमका सवारी साधन	
ठ. फ्रिज	
ड. लुगा सिउने कल/मेशिन	

खण्ड झः जीवनसँग सन्तुष्टि {समूहः क, ख, ग, घ}

प्र ९५. अब तपाईं आफ्नो जीवनसँग सामान्यतया कति सन्तुष्ट हुनुहुन्छ, त्यो बारे केही प्रश्नहरू सोध्न चाहन्छु।

के तपाईं तलका भनाइहरूसँग (१) पूर्ण असहमत, (२) असहमत, (३) न सहमत न असहमत (तठस्त), (४) सहमत, वा (५) पूर्ण सहमत हुनुहुन्छ?

भनाइहरू	१-५ जवाफ
क. धेरै हिसाबमा मेरो जीवन आफूले चाहेजस्तै छ।	
ख. मेरो जीवनमा धेरै कुराहरू उत्तम छन्।	
ग. म मेरो जीवनसँग सन्तुष्ट छ।	
घ. अहिलेसम्म मैले जीवनमा चाहेका महत्वपूर्ण कुराहरू पाएको छु।	
ड. यहि जीवन फेरी जिउनु परेमा म थोरै कुराहरू मात्र बदल्न चाहन्छु।	

खण्ड जः घरको खाद्य सुरक्षाको अवस्था {समूहः क, ख, ग, घ}

प्र ९६. गएको ४ हप्तामा तपाईंको घरमा पर्याप्त खानेकुरा छैन भनेर चिन्तित हुनुभएको थियो?

क. थिएँ (प्र ९६ क सोध्नुहोस्)

ख. थिइनँ (प्र ९७ सोध्नुहोस्)

प्र ९६ क. गएको ४ हप्तामा यस्तो कति पटक भयो?

१ = विरलै (गएको ४ हप्तामा १-२ पटक)

२ = कहिलेकाहीँ (गएको ४ हप्तामा ३-१० पटक)

३ = प्राय (गएको ४ हप्तामा १० पटक भन्दा बढी)

अब आगामी २ प्रश्नहरूले तपाईंसँग खानेकुरा जम्मा गर्ने श्रोतहरूको अभाव थियो कि भनी सोध्नेछन। श्रोतको अभाव भन्नाले निम्न बुझ्नुपर्दछः

क. तपाईंसँग घरमा पर्याप्त खानेकुरा थिएन, र

ख. तपाईंसँग खानेकुरा किन्ने पैसा थिएन।

प्र ९७. श्रोतको अभावले गर्दा गएको ४ हप्तामा तपाईं वा तपाईंको घरको कुनै सदस्यले प्रायजसो मनपराउने खानेकुरा खान पाएनन् कि?

क. पाएनन् (प्र ९७ क)

ख. पाए (प्र ९८)

प्र ९७ क. गएको ४ हप्तामा यस्तो कति पटक भयो?

१ = विरलै (गएको ४ हप्तामा १-२ पटक)

२ = कहिलेकाहीँ (गएको ४ हप्तामा ३-१० पटक)

३ = प्राय (गएको ४ हप्तामा १० पटक भन्दा बढी)

प्र १०३ख. श्रोतको अभावले गर्दा गएको ४ हप्तामा तपाईं वा तपाईंको घरको कुनै सदस्यले दैनिक चाहिने भन्दा कम मात्रामा खाना खानु परेको थियो?

क. थियो (प्र १०३ क)

ख. थिएन (प्र १०४)

प्र १०३ क. गएको ४ हप्तामा यस्तो कति पटक भयो?

१ = विरलै (गएको ४ हप्तामा १-२ पटक)

२ = कहिलेकाहीँ (गएको ४ हप्तामा ३-१० पटक)

३ = प्राय (गएको ४ हप्तामा १० पटक भन्दा बढी)

खण्ड ट: जलवायु परिवर्तन {समूह: क, ख, ग, घ}

अब जलवायु परिवर्तन सम्बन्धी केही प्रश्न सोध्न जाँदैछु।

प्र ११०. गएको १२ महिनामा यो क्षेत्रमा तपाईंले अनुभव गर्नुभएको मौसम के बिगतका वर्षहरूमा जस्तै थियो?

क. थियो

ख. थिएन

प्र १११. गएको २ वर्षको अनुभवलाई हेरेर भन्नुपर्दा के तलका घटनाहरु (१) कम भएका छन्, (२) बराबर छन्, वा (३) बढेका छन्?

घटना	जवाफ
क. खेती गर्ने ऋतु/मौसमको औसत तापक्रम	
ख. खेती गर्ने ऋतु/मौसममा परेको वर्षातको मात्रा	
ग. खेती गर्ने ऋतु/मौसममा वर्षात परेको संख्या	
घ. खेती गर्ने मौसममा पर्ने खडेरीको संख्या	
ङ. वर्षातको मौसममा अप्रत्याशित पानी पर्ने	
च. वर्षा मौसमको लम्बाई	
छ. बालीमा लाग्ने रोग र किराहरुको प्रकोप	

खण्ड ठ: आम्दानीका श्रोतहरु {समूह: क, ग, घ}

प्र ११५. अब म तपाईंलाई तपाईंको घरको कृषिबाहेक अन्य आम्दानीका श्रोतहरु बारे सोध्न चाहन्छु।

यी प्रश्नहरु जनगणनाको बेलामा सोधिएका प्रश्नहरु जस्तै हुन् र तपाईंको उत्तरले भविष्यमा गरिने नीति निर्माणमा सहयोग पुर्याउने छन्। र, तपाईंका उत्तरहरु अति नै गोप्य पनि राखिनेछन्।
गएको १२ महिनामा तपाईं या तपाईंको घरका सदस्यले_____ ([आ] कुरा भन्नुहोस्) _____
_____([अ] कुरा भन्नुहोस्)_____ भएको थियो?

		कुरा		प्र ११६. {प्र ११५=१ भएमा} गएको १२ महिनामा यसरी कति कमाउनु भएको थियो? [रुपैया]
	[अ]	[आ]		

	कमाउनु	कोदो बेचेर	१ = थियो २ = थिएन	
क.	कमाउनु	कृषि ज्याला (माथि उल्लेख नगरिएको)	१ = थियो २ = थिएन	
ख.	कमाउनु	गैर कृषि ज्याला	१ = थियो २ = थिएन	
ग.	खानु	तलब सहितको जागिर	१ = थियो २ = थिएन	
घ.	चलाउनु	व्यापार-व्यवसाय	१ = थियो २ = थिएन	
ङ.	लिनु	पेन्सन	१ = थियो २ = थिएन	
च.	लिनु	सरकारी भत्ता (वृद्ध-वृद्धा, विधुवा, अशक्त)	१ = थियो २ = थिएन	
छ.	दिनु	पर्यटन सेवा (होमस्टे/ गाइड)	१ = थियो २ = थिएन	
ज.	पाउनु	आन्तरिक रेमिटेन्स	१ = थियो २ = थिएन	
छ.	पाउनु	बाहिर देशबाट आएको अन्तर्राष्ट्रिय रेमिटेन्स /बिप्रेषण	१ = थियो २ = थिएन	
ज.	लिनु	ससं वा गैससंबाट रकम सहयोग	१ = थियो २ = थिएन	.
झ.	बेच्नु	वन्य उत्पादन वा सेवा बिक्रीबाट (काठदाउरा, जडीबुटी, फलफूल, आदि)	१ = थियो २ = थिएन	
ञ.	दिनु	जग्गा भाडामा	१ = थियो २ = थिएन	
ट.	दिनु	घर भाडामा (पर्यटन बाहेक)	१ = थियो २ = थिएन	

ठ.	दिनु	मेसिन, औजार भाडामा	१ = थियो २ = थिएन	
ड.	दिनु	पशु सेवा (बीऊ लगाउनु, खेत जोत्नु)	१ = थियो २ = थिएन	
ढ.	गर्नु/दिनु	अरु कुनै काम / सेवा (उल्लेख गर्नुहोस्:.....)	१ = थियो २ = थिएन	

प्र ९१. तपाईंलाई धेरै धन्यवाद! अब थोरै मात्र प्रश्न बाँकी छन।

तपाईं वा तपाईंको श्रीमान/श्रीमतीले काठमाडौं, चितवन, वा पोखरामा सम्पत्ति (घर, जग्गा) जोडनुभएको छ?

- क) छ
- ख) छैन

प्र ९४ क. तपाईं वा तपाईंको घरका सदस्यले कुनै समूह/सहकारी/बैंक वा अन्यत्र नगद बचत गर्नुभएको छ?

- क) छ
- ख) छैन

प्र ९४ ख. [प्र ९४ क=छ भएमा]

तपाईंले समूह/सहकारी/बैंक वा अन्यत्र गरी हाल कति नगद बचत गर्नुभएको छ?
_____ (रुपैया)

उत्तर दिन नमानेमा सहभागीलाई बुझाउनुहोस् कि यो सूचना अति नै गोप्य राखिनेछ र कसैसँग बाँडिनेछैन ।

सहभागीले अझै पनि भन्न नचाहेमा प्र ९४ ग सोध्नुहोस्।

प्र ९४ ग. त्यसोभए तपाईंको घरले १ लाख भन्दा थोरै वा धेरै बचत गरेको छ भनेर भनिदिनु हुन्छ कि?

- क) १ लाख रुपैयाभन्दा थोरै
- ख) १ लाख रुपैया वा सो भन्दा धेरै

[कुराकानी टुङ्ग्याउनुहोस्।]

अन्तर्वार्ता समाप्तिको भाषा/धन्यवाद ज्ञापन।

अन्तर्वार्ताको लागि समय निकालेर हामीसँग बोलिदिनु भएकोमा यहाँलाई धेरै धन्यवाद छ।
व्यस्तताका बावजुद हामीलाई सहयोग गरिदिनु भएकोमा हामी आभारी छौं। फेरि पनि धन्यवाद।

APPENDIX C: SURVEY DATA COLLECTION MANUAL

**ROLE OF GENDER, IMPROVED AGRICULTURAL TECHNOLOGY AND NON-FARM
EMPLOYMENT ON HOUSEHOLD WELLBEING IN NEPAL**

**SURVEY DATA COLLECTION MANUAL
2018**

**DEPARTMENT OF COMMUNITY SUSTAINABILITY
MICHIGAN STATE UNIVERSITY**

Have a question?

For questions about the schedule, directions, and help in the field, your first contact is Bineeta Gurung (gurungbi@msu.edu) – 9823642544

For other questions about the survey, contact Bineeta. The study leader: Dr. Michael Kaplowitz is also available: Michael Kaplowitz (kaplowit@msu.edu)

CONTENTS

CHAPTER 1: INTRODUCTION

CHAPTER 2: BEFORE VISITING THE FIELD

CHAPTER 3: FIELD PROCEDURES

CHAPTER 4: TECHNOLOGY

CHAPTER 5: HOUSEHOLD QUESTIONNAIRE

APPENDIX C.1: SCREENING QUESTIONS

APPENDIX C.2: INFORMED CONSENT

CHAPTER 1: INTRODUCTION

What is this survey about?

The study seeks to understand local livelihoods and development initiatives in the Kaski district of Nepal. This study is conducting a household survey that involves face-to-face interviews to collect data. The survey, which you are working on, gathers information on demographics and household characteristics, farming operations and characteristics, respondents' (people being interviewed) access to extension and development services as well as measures of their well-being, food security and income sources.

Face to face interviews play an important role in the success of this project. Special skills are needed to be a survey enumerator. Good survey enumerators require persistence, patience, discipline and confidence in order to effectively interview respondents. This manual will help you become an effective and successful survey enumerator by helping you become familiar with the methods and procedures that will be used in the survey. This manual will also help you develop better understanding of the contents of the household questionnaire being used in this project.

The goal of this training is to help you acquire the skills and knowledge to enable you to be a high-quality survey enumerator so that you are comfortable with your role, the survey instrument, and procedures in order to gather reliable data from respondents in our study.

Field team

Project manager

The project manager will organise and coordinate all field operations and will be responsible for making decisions on all field operations. The project manager should be contacted as soon as possible if there are unusual circumstances during the data collection. The project manager might make random visits to communities as an independent quality control check outside of the interview team. The project manager may participate as an observer in interviews, and may support interviewers in implementing the survey.

Interviewers

After successfully completing the training program, interviewers will work as two teams on each interview day. Each of the two teams will have one team leader: Bineeta Gurung in Rupa-7 (Hamsapur) and Bhisma Subedi in Rupa-4 and Rupa-2. As an interviewer, you will be responsible to work in your respective team for interviewing households in selected communities for the survey. Households to be interviewed will have already been selected randomly by the project manager. The interviewers cannot make changes to this list of households to be interviewed. The households that are selected, as part of the study sample must be contacted multiple times before they may be considered "unavailable." Each interviewer will sign a service contract to define his/her status and obligations within the survey. Training, field materials and logistics will be provided to you.

The survey collection phase is expected to last for about four to six weeks. Depending on a mutual agreement with the project manager, all interviewers are expected to be fully available on

the interview days. The team leaders will be responsible for locating the selected communities, contacting selected households through telephone (when needed/possible). After the team leaders have established contact with households to be surveyed and they have set up a date and time for the interview, the team members will interview households according to the norms, procedures, and instructions contained in this manual. You will be required to conduct the household survey interview using the tablet to fill in responses for all selected and assigned households. At the end of the day, you should bring the tablets back to your meeting place/home/field base and hand it over to the team leader. It is the job of the team leader to make sure data is saved in the micro SD cards, and uploaded on the Internet. Remember, as an interviewer, you cannot delegate your tasks and obligations to another person.

Interviewer's role

Your role as an interviewer is to establish a good rapport with survey respondents. Making sure respondents are comfortable with you will help you get complete and accurate answers to the interview questions.

If this is your first time conducting survey interviews, you might be nervous or might take longer than expected to complete the survey. Don't worry. You will get better with practice.

Here are some interviewing tips:

- Create the right impression by appearing professional and presenting yourself well.
- Make respondents at ease during the interview process.
- Know why the information you are collecting is valuable and let the respondents know it too.
- Let the respondents know that the information they are providing is confidential.
- Remain neutral and avoid influencing how respondents might answer the questions.
- Keep the interview on track by being tactful. You can keep them on track by offering to talk more after the interview is complete.
- If respondents find it difficult to answer the questions, use the PAUSE-REPEAT-PROBE technique to help them.

Interviewers' specific tasks and obligations:

- To actively participate in the training program and complete it.
- To carefully study this manual in order to fully understand and to comply with the instructions and recommendations in this manual.
- To locate households selected for this survey, establish contact with them after the interview has been scheduled by the team leader (in person as the interview time or via telephone if changes are needed) and carry out face-to-face interviews through personal visits to households. Remember that an interviewer's task cannot be delegated or transferred to anybody else.
- To interview appropriate household member(s) as specified in this manual.
- To fill complete and accurate answers using the tablet during the survey interview.
- To visit the household as many times as needed in order to find the appropriate respondent, to complete the information or to correct inaccurate information.
- To conduct all interviews as scheduled. If it is not possible to interview a selected household, you should inform the project manager, so that necessary changes can be

made in accordance with established procedures. As an interviewer, you are not allowed to select or replace households to be interviewed as per your will.

What an interviewer MUST NOT DO

- The interviewer is obligated to do his/her job without delegating it to other individuals. In other words, no one else can do your work.
- You are not allowed to make changes to any information provided by the respondent. You receive their information and record their information, not what you think (although you should make notes of observations such as those).
- The information given by the respondent is confidential. Therefore, you must not disclose information revealed by the respondent during the interview to any person other than the project manager. Only you and the survey manager should have access to the completed questionnaire.
- Do not bring anybody to the interview that is not a team member of the project.
- Do not encourage respondents to answer by giving false promises or offers.
- Avoid putting any pressure on respondents during the interview period.
- Hand over all collected information to the project manager without making changes or destroying any information collected during the interview.

Materials for the interviewers

Each interviewer will be given the following materials for the fieldwork:

- A copy of this manual
- A daily list of scheduled interviews to be performed on that day (including phone numbers whenever possible)
- A hard copy of the survey form
- Tablet and charger for data entry
- Portable power bank (for each team)
- Notebook and pen (to note down answers if necessary)
- Recharge cards for making phone calls while in the field
- A first aid kit (for each team)

Interviewers should bring with them additional items for personal comfort and safety. The following checklist might be helpful.

- Cell phone (all interviewers must have a cell phone with them)
- Appropriate clothing and sunscreen
- An umbrella/ raincoat
- Food and water (note: daily food allowance will be given to the interviewer)

CHAPTER 2: BEFORE VISITING THE FIELD

Sampling

This survey has been designed using well-established principles of statistics. All the information to be collected has been carefully thought out to ensure that when the data are collected as assigned, it gives an accurate picture of the household being interviewed. Therefore, the households you are assigned to interview **CANNOT BE SUBSTITUTED**.

Contacting selected households to be interviewed

Your team leader will make an initial phone contact with an adult member of the household to set a time and date for the interview. The team leader will follow the phone contact script on the household questionnaire.

Steps for contacting selected households to be interviewed [ONLY FOR TEAM LEADERS]

A) When telephone number is available

- Contact households by telephone phone.
- After the respondent agrees to participate in the survey (in the telephone conversation) fix a date and time for personal visit to the household
- If refused, try to convince to participate. If respondent still refuses, leave contact number in case they change their mind, and make note about the refusal.

B) When telephone number is not available

- Visit the household (after locating it with help from other villagers)
- If household head is present and willing to participate, conduct the interview if they have time.
- If household head is present and willing to participate, but unable to participate during that visit, schedule time for next meeting.
- If household head is not present, get the household head's phone number from his family members and contact him via phone. If the household head doesn't have a phone number, ask other household members to know the most convenient time for interviewer to come back and meet the household head.

After an interview has been scheduled, stick to the plan. Do not postpone the interview. If you have to change the time and date of the interview due to sickness or other emergencies, let the team leader know about it. The team leader may then assign other team members and if needed change the time and date after consulting with the household to be interviewed.

Using the Survey Schedule Calendar

As an interviewer you should know your fieldwork schedule. The schedule lists the village name, household identification number, a mutually agreed upon date and time for the interview after initial phone contact with the household. The schedule will also have team members for each interview period and location. If you have trouble making an assigned shift (due to sickness or some unexpected emergency), please contact the team leader immediately.

CHAPTER 3: FIELD PROCEDURES

Introduction to the Household

For a successful interview, the first impression of the interviewer is crucial. The interviewer should be professionally dressed and should have a good attitude. What you say at the beginning of the meeting and how you say it is important for the success of the interview. You should greet the household members in a friendly way while introducing yourself. You should ask for the adult member of the household who is scheduled to be interviewed and should explain concisely about the purpose and importance of the survey. Use the “initial contact script” on the survey questionnaire to identify the appropriate respondent in the household. You should convey to respondent that his/her cooperation and participation in the survey is important. It is important

for the interviewer to convey confidence and to be respectful to respondents in order to receive cooperation, participation and attention from the respondent. Therefore try not to appear nervous or unsure.

Bias

Bias is anything that influences the answers you get from the person being interviewed. Interviewers can unknowingly introduce bias into the respondent's answers.

Bias can be introduced through body language, voice inflection, and attitude. If you ask the questions on the survey form exactly as written and stay neutral while visitors give their answers you will be able to collect more accurate data. Avoid commenting on their answers.

You should keep your opinions to yourself, even if asked. If the visitor gets off track and asks your opinion or advice say something like "I'd be glad to talk to you about that after we complete the interview".

Example:

Interviewer: Q40. *Would you say that disease is a major challenge, minor challenge or not a challenge for your off-season tomato production?*

Respondent: *Yes, it is a major challenge. Last year we had late blight problem in my tunnel. Do you think it could be because of the tomato variety I used? I used Laxmi variety instead of the popular Srijana variety. My neighbors think it is because the tunnel does not receive any sunlight, and.....*

Interviewer: *I don't know but I'd be glad to hear about it from you after we complete the interview. For now, let's move on to the next question.*

Interviewer Selection Bias

When there is more than one person in a house, you are to identify the individual that was selected by team leader for the interview. After identifying the respondent, interview should be conducted at a safe distance from other household member so that others do not affect the respondent's answers.

Example:

After introducing yourself, you must explain the importance of the respondent's cooperation and the purpose of the survey. You must emphasize that collected data are confidential in nature. Explaining that the information provided by respondents will remain confidential helps to avoid any fear on part of the respondent. It is not unusual for respondents to be less attentive, or less interested in participating in the survey at the beginning of the interview. Therefore, you must try to increase respondents' attention and interest by paying attention to the rhythm of the survey, tone of questions, pace of the interview, and having knowledge about the questions to be asked in the survey. Reading survey questions in a monotonous fashion with a nervous voice is likely to make the respondents lose interest. You must not give the impression that you consider yourself to be a highly important person. Instead, you must present yourself as an open, friendly and an experienced person. Always avoid any type of aggressive or authoritative behavior, and always be respectful.

Informed Consent

Interviewer must inform respondents that participation in the survey is completely voluntary and confidential. This is called informed consent. Interviewer must read out the consent form (see Appendix A.2 in this manual) to the participants before starting the interview. If the respondent refuses to participate, the interviewer should explain to respondents that their participation is important for the success of the study. If the respondent still refuses to be interviewed, they should not be forced to participate. In that case, interviewer should note the household refusing to participate and move on to the next household selected for the survey.

During and After the Interview

As soon as the interview starts, you should keep the following instructions in mind:

- Plan sufficient time for the interview.
- Behave appropriately throughout the interview.
- Avoid providing any information you are not sure of. It is better to seem uninformed, than to give wrong information.
- Avoid any conversation or attitude that could potentially lead to a discussion, argument or confrontation with the respondent. Limit the conversation to the survey topics only.
- While going through the questionnaires, read the questions word by word as written on the survey form. This is because a lot of planning, experience, professional knowledge, psychology, and statistical expertise have been used while formulating the questions and answer choices of each question. In case the respondent does not understand it, read it again. If the respondent still does not understand after reading it for the second time, explain carefully to him/her the meaning of the question taking care not to change in any way the original meaning of the question and not to influence the answer.
- Always try to maintain a consistent mood throughout the interview. If the respondent gets tired or distracted, give the respondent a few minutes break and resume.
- If respondents have trouble answering, you should PAUSE, REPEAT, and PROBE.

Example of some probe techniques:

1. The basic probe: Repeat a question to get the respondent back on track; frequently used when the interviewee is going off-tangent.

2. The explanatory probe: This is used to get a clearer understanding by completing the incomplete statements of the respondent. The interviewer asks questions like, “Can you give an example?” or “Can you explain that?”

3. The focused probe: This is used to get particular understandings about a topic. For example, “What type of...did you use?”

4. The silent probe: The interviewer maintains silence and waits for the respondent to break the silence. This type of technique is generally used when the interviewee is taking lot of time to respond or is hesitant to respond.

5. Drawing out: This is used when the interviewee has stopped and is not responding. The interviewer restates or rephrases the last question or topic (e.g., “So, the question was... What else can you tell me about that?”), which helps the interviewee to start talking again.

6. Giving ideas or suggestions: The interviewer gives suggestions or ideas to think about. For example, “Have you thought about....?”

7. Mirroring or reflecting: The interviewer says what the respondent has just said in his own words. This helps the respondent to think what he or she has just said.

PRACTICE USING DIFFERENT PROBES.

CAREFUL-Things to avoid

Do not show surprise at any answer given by the respondent, either by your facial expressions or the tone of your voice.

Do not skip any question. The ODK is programmed in a way that manual skips are not necessary. Therefore, all the questions displayed on the screen should be answered.

Do not press the respondent in any way while asking questions. *Never assume you know the answer in advance.*

The interview should have questions, answers, moments of silence and breaks. Therefore, give the respondent enough time to think and answer.

Do not offer copies of the questionnaire or any other material to the respondents if they ask for it. Explain to them that you are not authorized to distribute survey materials.

REMEMBER: Once you finish the interview, do not forget to thank all the respondents for their time and cooperation in the survey, before leaving the house.

CHAPTER 4: TECHNOLOGY

Using the Tablet

An android tablet will be provided to you along with a tablet charger and a micro SD card. For the project period, the tablet has been linked with a google account named: nepalsurvey01@gmail.com, which you will not change until the project is completed. The tablet settings have been set by the project manager to meet the survey needs; until the survey is complete, do not change the settings on the tablet or within ODK. *Do not use the tablet for personal use until the project is over.*

The Plan is for enumerators who complete the tasks in a timely and professional way to be able to keep the tablets for personal use. You may do so only after the survey is completed. Since you will be keeping the tablet after the project, it is worth handling the tablet with care.

A fully charged tablet works for about 4-5 hours. This can be problematic because an interview in one household can take up to 2-3 hours in Hamsapur (where both respondents have to be interviewed by the same interviewer). So the tablet needs to be recharged frequently.

Some measures to reduce draining of charge:

- Adjust tablet settings to turn down light, volume, automatic updates etc.
- Switch the tablet off while moving from one house to another.

- ALWAYS carry a portable power bank. Each team leader will be provided 2 portable power banks. Team members will work with respective team leader to make sure the tablet is sufficiently charged to complete at least 5 surveys in a day.

Internet Access [ONLY FOR THE TEAM LEADER]

Each team leader will be provided a portable Internet device (from Nepal Telecom) with 10GB data. The team leaders will be required to learn how to operate the device. At the end of each field day, the team leaders will be responsible for uploading all the filled survey forms to the Internet. The Internet data should be used strictly for the project purpose only. Data needs to be refilled regularly in Nepal Telecom's office in Pokhara. Sometimes, data is consumed by background applications on the tablet that are automatically updated when connected to the Internet. Therefore, automatic updates need to be turned off in order to avoid unnecessary data consumption.

Automatic updates can be turned off using the following steps:

- Open the Play Store app.
- Tap the slide-out menu button in the upper left corner, as denoted by three horizontal lines, then tap *Settings*.
- On the settings screen, tap *Auto-update apps*.
- On the next screen, you'll be able to choose whether you want to allow apps to automatically receive updates over Wi-Fi, whether you want to allow apps to update at any time, or whether you want to manually install all updates.
- To turn off auto-updates altogether, go ahead and tap "Do not auto-update apps."

Conducting the survey using the tablet

This survey uses a data collection tool called "Open Data Kit" which allows us to collect interviews on mobile devices, and send completed surveys to an online server for downloading onto a computer later. Enumerators do not need to worry about this, but it is here for your information.

The survey form is loaded onto the tablets using an app called "ODK Collect." Once the forms are filled, they are saved for uploading to an online server, where they can be later downloaded for analysis.

Filling in Blank Forms

To begin a new interview, open the app called "ODK Collect" on the home screen of the tablet.

Once the ODK Collect is opened, you will see "Main Menu." From the main menu, click "Fill Blank Form", and select the form you wish to fill in. The process of filling in a form is fairly straightforward. You can swipe or click arrow keys to navigate backward and forward between questions. You can also navigate to a specific question by clicking the "Go To Prompt" icon on the top bar. After filling all the answers, click the "Save" icon on the top bar of the questionnaire. You may click the "Save" button throughout the interview. After completing the survey form, you will have to "Mark the form as finalized" before saving and exiting. Once the form is saved, you will be directed to the "Main Menu" where you can choose to fill blank form for a new interview in another household.

All your finalized forms can be viewed by clicking “Send Finalized Form” in the Main Menu. You may not be able to send filled forms unless it has been marked finalized, so be careful to mark completed forms as finalized.

Uploading Data

Once team members hand over the tablet to the Team Leader at the end of each field day, team leaders should select the option to send forms to the server once connected to a Wi-Fi network. To be more careful, team leaders should double-check each night ensuring that all forms have been uploaded. Also Team leaders need to back up data onto the Micro SD card at the end of each field day.

Portable Power Bank and Multiplug

Individual interviewers are responsible to ensure that their tablets are sufficiently charged throughout the survey period. For this purpose, each team leader will be given two portable power banks and one multiplug, which the team members may use during the project period.

Paper survey If the tablet runs out of battery or crashes unexpectedly, complete the survey on paper. You should carry at least 4 hard copies of questionnaires to use complete the survey on paper if needed. Do not distribute the paper copies.

CHAPTER 5: HOUSEHOLD QUESTIONNAIRE

Definition of key terms and concepts

It is important for interviewers to know the definition of terms that will be used in the interview form. It is your responsibility to make sure you understand what each term means so that you can clarify any questions respondents may have during the interview process. Given below are the definitions of some of the terms used in this survey.

1. Household

A household is made up of a person or a group of related persons that live in the same house, has one adult male or adult female as the head of the household, shares the same kitchen, and is considered as one unit. Not all related persons living in the same house form one household, if they have separate cooking arrangements. This is true particularly in joint families where there are more than two adult males or adult females as household heads. Therefore, it is essential to thoroughly probe respondents so that there is no confusion about what a household means in the context of this survey. Following guidelines can be followed to accurately define a household:

- Generally, a household consists of an adult (older than 18 years) male, his wife (adult female), their children, and sometimes other relatives living under the same roof and eating in the same kitchen. This type of household is considered as a *dual-headed household*.
- Sometimes, one of the adult members may be absent due to migration, divorce/separation, death, and unmarried status. In this case, the household is considered as a *single-headed household*. If the male adult is absent, it should be considered as a female-headed household. If the female adult is absent, it is to be considered as a male-headed household.

- In joint families where there are *two or more generations* of related people living together (e.g., grandparents, their married children and their families), it is important to distinguish if this is a one or multiple household. If they all share the same kitchen, it is considered as a single household. If they have separate cooking arrangements, they should be considered as multiple households.

2. Head of household

Head of household is the adult member of household who manages household activities and takes the decisions as well as responsibility in all household related matters. A household head can be either male or female.

3. Income sources

Income sources are the different ways/means through which a household acquires money.

4. Farm activities and farm decisions

This involves all activities and decisions related to farming operations carried out by the household.

5. Survey respondents

There are four types of respondents in our survey. They are defined and identified as follows:

Primary Respondent (Only in Rupa-7)

A primary respondent is typically the adult member of a dual-headed household who is *knowledgeable about household's income sources, farm activities and farm decisions*. It can be either the male head or the female head of the household. *In multiple generation families where there are more than one adult male or one adult female, the person (male or female) that is most knowledgeable about income sources, farm activities and farm decisions will be considered as the primary respondent.*

Secondary Respondent (Only in Rupa-7)

The secondary respondent is usually the *spouse of the primary respondent* in a dual-headed household. If the gender of the primary respondent is male, the secondary respondent is always female and vice versa.

Solo respondent (Only in Rupa-7)

A solo respondent is the only adult head in a single headed household. The solo respondent can be either female or male.

Household head (In Rupa-2 and Rupa-4) [Not the same as defined in 2.]

Unlike in Rupa-7, where two interviews will be conducted per household - therefore requiring primary and secondary respondents- only one interview will be conducted in each household in Rupa-2 and Rupa-4. In this case, the adult member who is *knowledgeable about household's income sources, farm activities and farm decisions* will be considered as household head. This can be either male or female. In households with multiple generations (eg. grandparents, son and his family) family members may report the senior most adult (father-in-law or mother-in-law) as the household head. In this case, it is important to explicitly mention and select the adult member who is knowledgeable about income sources, farm activities and farm decisions as our survey

respondent. So the in-laws may not necessarily become household head in the context of our survey if they do not have knowledge about household's income sources, farm activities and farm decisions. In single headed households in Rupa-2 and Rupa-4, the adult head of the household is defined as the household head and should be selected as the respondent.

6. Cereal crops

Includes crops like rice, wheat, maize, millet etc.

7. Vegetable crops

Includes vegetable crops like tomatoes, cabbage, cauliflower, potato, cucumber, gourds etc.

8. Fruit crops

Includes fruit crops like apple, orange, banana, guava etc.

9. Cash crops

Includes crops like turmeric, cardamom etc.

10. Off-season tomato

Includes tomatoes grown in rainy season inside plastic tunnel

11. Plastic tunnel

It is a tunnel made of plastic and used to grow off-season tomato.

12. Improved FYM (Farm Yard Manure)

Improved Farm Yard Manure is prepared by covering the manure with a shed in order to prevent nutrient loss through evaporation.

13. Improved shed

When the floor of the shed is cemented or is designed to prevent leaking of cattle urine so that the urine can be collected and used as fertilizer or pesticide, the shed is said to be improved shed.

14. Drip irrigation

15. Rain water harvesting tank

16. Hybrid and open pollinated crop varieties

18. Livestock refers to animals such as cattle, buffalo, goat, pig, poultry etc.

19. Main source of drinking water

Drinking water source refers to the place from which households draw water for drinking and cooking foods for household members. Water source may differ from place to place and by seasons. In this survey, main source of drinking water refers to the *source from where most of the time water is collected*. Water source may or may not be within house's own premise and it may be private or public. Some of the common drinking water sources are:

Tap/ pipe: When water is collected from piped line made up of either metal or polythene, then the source is considered as tap/piped line. The piped water could be distributed either from Department of Water Supply and Sewerage (DWSS), District Development Committee (DDC), Village Development Committee (VDC) or from some other private organizations like NGOs or INGOs. Here tap includes both private tap within house's compound, or a public tap located in different places across the study area.

Tube well/ hand pump: If ground water is drawn by using Tube-well, Borehole, Jet pump etc and used for drinking and cooking foods for household members, then the source is defined as Tube-well.

Covered (/uncovered) well/ kuwa: Here, the source of drinking water is either from well or Kuwa whether covered or not. It is also known as dug-well. (note: kuwa is the local term for well.)

Spout: This refers to water source from spout, pandhero or stone tap. (note: pandhero is the local term for spout/stone tap.)

Others: This includes all other water sources not listed above. It could be river/ stream etc.

20. Source of lightening in household

It refers to the main source of lighting fuels used by the households. The common sources of lighting fuel are kerosene, electricity and bio-gas. It should be noted that in many areas of the country (especially in rural sites), Nepal Electricity Corporation has not succeeded in providing electricity to majority of the households. However, rural households are getting benefit from electricity provided by Micro-hydro Power and in some extent from Solar System. Hence, these households should also be considered as using electricity as source of lighting facility although Nepal Electricity Corporation has not yet reached these communities.

21. Toilet facilities in household

If households possess their own toilets that could be within the house or boundary of the house then such households are considered as households having toilet facilities. If the households do not have their own toilet and household members use either public toilets or open places then such households are considered as households having no toilet facilities. Toilet facility is categorized into two groups as modern with flush system and ordinary. If it is possible to clean human excreta by pouring water (either using machine or manually) and is connected to drainage or septic tank, then the toilet is said to be modern with flush system. On the other hand, if it is not possible to clean human excreta by pouring water and is not connected to sewage or septic tank, then the toilet is said to be ordinary.

Filling the Questionnaire

There are different elements in the questionnaire:

Question: It should be read exactly as it is written to the respondent. Each question has a unique numeric ID.

Instructions for Interviewer: are written in *italic* letters in the question's part of each question. The actual question to read to the respondent is in normal case. For example, there may be instructions like "DO NOT PROMPT" in which case the interviewer should keep this in mind and avoid giving answer prompts to respondents.

Skip patterns: The skip patterns are programmed in the ODK. Therefore, no questions should be skipped.

Question types: Most of the questions in the questionnaire are closed ended. However, there are some open-ended questions too.

In close-ended questions, the possible answers are coded and they appear as a list of alternatives just after the question.

For the open ended question, read only the text of the question and then write down the answer exactly as given by the respondent on a hard paper with a pen. Do not forget to write the household ID and the question number while writing down response to open ended questions.

APPENDIX C.1: SCREENING QUESTIONS {FOR TEAM LEADERS}:

The questionnaire includes all questions used in the surveys in three villages in eastern Kaski District. There will be four (4) types of respondents-three (3) types of respondents in Rupa-7 (Hamsapur) and one (1) type of respondent in Rupa-2 (Thumki) and Rupa-4 (Siddha).

Groups 1, 2, and 3

For Rupa-7 (Hamsapur)

When both male and female household heads are present

- Group 1: Primary respondent –the primary respondent can be either male or female depending on which of the male and female household heads is identified as being “*knowledgeable about household income (i.e. sources/size) and household farm activities and decisions.*”
-
- Group 2: Secondary respondent –the secondary respondent will be the female or male household head who is the counterpart of the primary respondent.

When there is only one head of household present

- Group 3: Solo respondent – when there is only a female head of household or a male head of household presently living in the household, that individual will be the household’s solo respondent (e.g., in case of migration, the household head living at the house/farm will be that household’s solo respondent).

Group 4

For Rupa-2 and Rupa-4

Household head/respondent – The respondent can be either male or female depending on which of the male and female household heads is identified as being “*knowledgeable about household income (i.e. sources/size) and household farm activities and decisions.*” Only one respondent per household will be interviewed, although other household members may assist with specific answers to income, property, and other responses to survey questions.

Four pathways through the questions (i.e., skip patterns) from the “full questionnaire” will be designed for use with the four types of possible respondents.

{1}= Primary respondent questionnaire (Rupa-7)

{2}= Secondary respondent questionnaire (Rupa-7)

{3}= Solo respondent questionnaire (Rupa-7)

{4}= Household Head questionnaire in Rupa-2 and Rupa-4 (one questionnaire per household)

INITIAL (TELEPHONIC) CONTACT {FOR TEAM LEADERS}

[Seeking one respondent per HHD, e.g., Rupa-2 and Rupa-4]

Hello! May I please speak with [household head's name]? Hi, my name is [Bineeta Gurung/enumerator name]. I am a [graduate student at/research assistant working with] Michigan State University, USA.

We are conducting research on livelihoods and development initiatives in the Kaski district. Your household has been scientifically selected to be part of the study. Before we move forward, we'd like to make sure we have the right person from your household for our study.

PS-Q1: *Are you a household head aged 18 or older?*

If needed: *A head of household is the member of household who manages household activities and takes the decisions as well as responsibility in all household related matters (CBS, 2011). A household head can be either male or female.*

Yes [continue PS-Q2]

No [continue PS-Q1a]

PS-Q1a: *Is there a household head aged 18 or older at your house?*

Yes If yes, then Q1b: *Who is that?[name, gender]*

Q1c: *Can we speak with [him/her]?*

[go to Q1 with new person/arrange follow-up]

No If no, then thank them and conclude initial contact.

PS-Q2: *Are you knowledgeable about your household's farm activities?*

If needed: *Farm activities include all activities and decisions related to farming that are carried out by the household.*

Yes [continue PS-Q3]

No [continue PS-Q2b]

PS-Q2b: *Who in your household is knowledgeable about your household's farm activities?*

PS-Q2c: *Can I speak with [him/her]?*

[go to Q1 with new person / arrange follow-up]

PS-Q3: *Are you knowledgeable about your household's income sources?*

If needed: *Income sources are the different ways through which a household acquires money.*

Yes [continue PS-Q4]

No [continue PS-Q3b]

PS-Q3b: *Who in your household is knowledgeable about your household's income sources?*

PS-Q3c: *Can they join you for part of our visit if we arrange to meet at a convenient time/place for you?*

Yes [continue PS-Q4]

No [continue PS-Q3d]

PS-Q3d: *Can speak with [him/her]?*

[go to Q1 with new person/ arrange follow-up]

Thank you. We would like to arrange for a convenient time for me or one of our colleagues to visit your home/farm to ask you some survey questions.

PS-Q4: *When and where would be time for [you/him/her] to meet with us?*

_____ [when]

_____ [where], Please confirm home/farm address

Ending the call after agreeing to meet and deciding a suitable date, time and place (most likely the respondent's house)

Thank you for your time. I look forward to meeting you on (date) at (time). Till then if you have any question about this survey, please feel free to contact me at (phone number).

If refused

I understand. Thank you for your help and please accept our apologies for disturbing you. . If you change your mind and decide to participate in this survey, please let us know. You can reach us at [phone number].

INITIAL (TELEPHONIC) CONTACT {FOR TEAM LEADER}

[seeking both male and female respondent per HHD-Rupa-7 (Hamsapur)]

Hello! May I please speak with (household head's name)? Hi, my name is [Bineeta Gurung/name]. I am a [graduate student at/research assistant working with] Michigan State University, USA.

We are conducting research on livelihoods and development initiatives in the Kaski district. Your household has been scientifically selected to be part of the study. Before we move forward, we'd like to make sure we have the right people from your household for our study.

PS-Q1: *Are you a household head aged 18 or older?*

If needed: *A head of household is the member of household who manages household activities and takes the decisions as well as responsibility in all household related matters (CBS, 2011). A household head can be either male or female.*

Yes [continue PS-Q1d]

No [continue PS-Q1a]

PS-Q1a: *Is there a household head aged 18 or older at your house?*

Yes If yes, then Q1b: *Who is that?*

Q1c: *Can we speak with [him/her]?*

[go to Q1 with new person / arrange follow-up]

No If no, then thank them and conclude initial contact.

PS-Q1d: *Is there another household head of your family?*

a. Yes [continue PS-Q1e]

PS-Q1e: *Who is that? [name, gender]*

PS-Q1f: *Are they aged 18 or older?*

Yes

No

PS-Q1g: *Do they currently live at this house?*

Yes [continue PS-Q2]

No [continue PS-Q1h]

PS-Q1h: *Where do they currently live?*

a. Pokhara

b. Kathmandu

c. Outside Nepal

d. Other [?] [go to PS-Q2]

b. No [go to PS-Q2]

PS-Q2: *Are you knowledgeable about your household's farm activities?*

If needed: *Farm activities include all activities and decisions related to farming that are carried out by the household.*

Yes [continue PS-Q3]

No [continue PS-Q2b]

PS-Q2b: *Who in your household is knowledgeable about your household's farm activities?*

PS-Q3: *Are you knowledgeable about your household's income sources?*

If needed: *Income sources are the different ways through which a household acquires money.*

Yes [continue PS-Q4]

No [continue PS-Q3b]

PS-Q3b: *Who in your household is knowledgeable about your household's income sources?*

Thank you. We would like to arrange for a convenient time for one of our research assistants to visit your home/farm to ask you [both] some question for our research project.

PS-Q4: *When and where would be time for [you/him/her] to meet with us?*

_____ [when]

_____ [where], Please confirm home/farm address

Ending the call after agreeing to meet and deciding a suitable date, time and place (most likely the respondent's house)

Thank you for your time. I look forward to meeting you on (date) at (time). Till then if you have any question about this survey, please feel free to contact me at (phone number).

If refused

I understand.

Soft refusal

I appreciate that but this is an important study and we really would appreciate your help. We really need your help.

Hard refusals

Thank you for your help and please accept our apologies for disturbing you. If you change your mind and decide to participate in this survey, please let us know. You can reach us at [phone number].

INITIAL IN-PERSON CONTACT

Date: { _____ }

Time: { _____ }

Enumerator ID: { _____ }

Household ID: { _____ }

Respondent Gender: { }

GPS Coordinates: { }

Rupa: { 2 , 4 , 7 }

In-Person Initial Contact – Hamsapur (Rupa-7)

Hello, my name is [Bineeta Gurung/enumerator's name]. I am a [graduate student at/research assistant working with] Michigan State University, USA.

Verify that R from initial telephone is R in –person. If not, then....

Q0:

Were [either of] you contacted by someone from our team about today's interview?

Yes

[continue with PS-Q2]

No

[continue including PS-Q1]

We are conducting research project on livelihoods and development initiatives in the Kaski district. Your household has been scientifically selected to be part of the study. Before we move forward, we'd like to make sure we have the right people from your household for our study.

PS-Q1: *Are you a household head aged 18 or older?* [have a definition available of household head]

Yes [continue PS-Q1d]

No [continue PS-Q1a]

PS-Q1a: *Is there a household head aged 18 or older at your house?*

Yes If yes, then

Q1b: *Who is that?*

Q1c: *Can we speak with [him/her]?*

[restart @ Q1 / arrange follow-up]

No If no, then thank them and conclude initial contact.

PS-Q1d: *Is there another household head of your family?*

a. Yes [continue PS-Q1e]

PS-Q1e: *Who is that? [name, gender]*

PS-Q1f: *Are they aged 18 or older?*

Yes [continue]

No [go to XXXX]

PS-Q1g: *Do they currently live at this house?*

Yes [continue PS-Q2]

No [continue PS-Q1h]

PS-Q1h: *Where do they currently live?*

a. Pokhara

b. Kathmandu

c. Outside Nepal

d. Other [?] [go to PSQ2]

b. No [go to PS-Q2]

PS-Q2: *Are you knowledgeable about your household's farm activities?*

If needed: *Farm activities include all activities and decisions related to farming that are carried out by the household.*

Yes [continue PS-Q3]

No [continue PS-Q2b]

PS-Q2b: *Who in your household is knowledgeable about your household's farm activities?*

a) Male head of household

b) Female head of household

PS-Q3: *Are you knowledgeable about your household's income sources?*

If needed: *Income sources are the different ways through which a household acquires money.*

Yes [continue PS-Q4]

No [continue PS-Q3b]

PS-Q3b: *Who in your household is knowledgeable about your household's income sources?* _____

Go to Informed Consent

In-Person Initial Contact – Rupa-2, Rupa-4

Q0: *Were you contacted by someone from our team about today's interview?*

Yes [continue with PS-Q1]

No

We are conducting research project on livelihoods and development initiatives in the Kaski district. Your household has been scientifically selected to be part of the study. Before we move forward, we'd like to make sure we have the right people from your household for our study. [continue to PS-Q1]

PS-Q1: *Are you a household head aged 18 or older?* [have a definition available of household head]

Yes [continue PS-Q1d]

No [continue PS-Q1a]

PS-Q1a: *Is there a household head aged 18 or older at your house?*

Yes If yes, then Q1b: *Who is that?*

Q1c: *Can we speak with [him/her]?*

[restart @ Q1 / arrange follow-up]

No If no, then thank them and conclude initial contact.

PS-Q1d: *Is there another household head of your family?*

a. Yes [continue PS-Q1e]

PS-Q1e: *Who is that? [name, gender]*

PS-Q1f: *Are they aged 18 or older?*

Yes [continue]

No [go to XXXX]

PS-Q1g: *Do they currently live at this house?*

Yes [continue PS-Q2]

No [continue PS-Q1h]

PS-Q1h: *Where do they currently live?*

a. Pokhara

b. Kathmandu

- c. Outside Nepal
- d. Other [?] [go to PSQ2]

b. No [go to PS-Q2]

PS-Q2: *Are you knowledgeable about your household's farm activities?*

[have a definition available of
farm activities]

- Yes [continue PS-Q3]
- No [continue PS-Q2b]

PS-Q2b: *Who in your household is knowledgeable about your household's farm activities?*

- a) Male head of household
 - b) Female head of household
-

PS-Q3: *Are you knowledgeable about your household's income sources?*

[have a definition
available of income
sources]

- Yes [continue to Informed Consent]
- No [continue PS-Q3b]

PS-Q3b: *Who in your household has the most knowledge about household income sources?*

- a) Male head of household
- b) Female head of household

Go to Informed Consent

APPENDIX C.2: INFORMED CONSENT

{TO BE USED BEFORE SURVEY BEGINS}

Before we go any further, I'd like to follow the university's research protocol and go over a few things with you.

You are being asked to voluntarily participate in a research study of agricultural practices and livelihoods in Nepal. The findings of this study will help form the basis for policy recommendations regarding livelihood-related development initiatives in Nepal.

If you agree to participate, I will ask you some questions about agricultural practices, agricultural technologies, and livelihood approaches. I will also ask you some questions regarding your household and farm, farmer organizations, and the community.

The interview will take approximately one and a half hour of your time. You should know that your identity and responses to questions will be kept confidential and your privacy will be protected to the maximum extent. All reports and publications resulting from this interview will be written and shared using pseudonyms and code numbers, not names or addresses. Only the researchers will have access to your responses and the data will be stored on a secure, password-protected computer and in offices at Michigan State University with no identifying information linking them to you.

Your participation is voluntary and you may choose not to participate at all, refuse to answer certain questions, or stop the interview at any time without any consequences. It is also important for you to know that there are no right or wrong answers.

If you have any questions or concerns regarding your participation in this study, you may contact the researchers whose contact information is on the sheet I am handing you [hand Information Sheet to respondent]. If you feel your rights have been violated or you are dissatisfied with any aspect of the study, please contact Michigan State University's Human Research Protection Program using the contact information on the Information Sheet.

IC-Q1: Do you have any questions?

Yes [if yes, answer questions and then proceed]

No

You indicate your voluntary agreement to participate in this study by beginning the interview with me.

IC-Q2: May I begin?

Yes [proceed]

No [thank and end].