Food and Nutrition Security Enhancement Project

Impact Evaluation Baseline Report

DIME/World Bank

October 24, 2021

Executive Summary

This report summarizes the findings from the baseline survey for Food and Nutrition Security Enhancement Project (FANSEP) in Nepal. The main findings are:

- Most households in the sample rely on cultivation of crops to meet their nutritional needs, especially cultivation of cereals. Most are smallholder farmers with less than 0.5 hectares of land cultivated on average.
- At the time of the baseline survey, a relatively small proportion of farmers reported membership in farmers groups. If membership does not increase among the target sample, it will be difficult to measure the impact of the program. If 90% of target enrollees join groups, we would be able to detect an impact on household incomes of 20% or more. However, the current reported rate of enrollment among the target population was only 30%. Ensuring that early starter groups have joined groups and are receiving interventions should be a priority.
- The Proxy Means Test scores correctly predicted households with low incomes, and using PMT scores to determine program eligibility was justified to improve beneficiary targeting.
- The timing of when the IE can measure impacts using the most rigorous possible design, depends on when the later starter groups would be phased in. As long as the 40 communities in late starter groups have not been phased into FFS interventions, impacts can be compared using a randomized control design. Given the ongoing recruitment of early starters remains a priority, keeping these 40 communities of late starters until last maximizes the potential for the IE. In the event that delays related to COVID-19 and other constraints prevent the project from reaching the originally planned number of recipients, ensuring that all other communities besides the 40 late starters are reached first would give the most rigorous possible evaluation with the longest possible impact horizon.

Ideally, FANSEP should delay implementation in "late treatment" villages until fall of 2022 to maximize the probability that the IE can detect program impacts in RCT sample before this final set of villages is enrolled in the interventions.

Table 1: PDO Level Results Indicators - Baseline values

Indicator	Definition	Value	Unit
Indicator 2: Increased crop and animal productivity by direct beneficiaries			
Indicator 2a	Food grain	2.5	tons/ha
Indicator 2b	Vegetables	8.5	tons/ha
Indicator 2c	Meat	10.7	KG/animal
	Average goat weight	18.7	KG/animal
	Average poultry weight	2.3	KG/animal
Indicator 2d	Milk	623.7	Liters/animal
Indicator 3: Increased household income (revenue minus cost)			
Indicator 3	Income(revenue minus cost) - All households	232775	NPR/household
Indicator 3a	Income(revenue minus cost) - Female headed households	237506	NPR/household
Indicator 3b	Income(revenue minus cost) - Male headed households	214513	NPR/household
Indicator 4: Improved food security of direct beneficiaries			
Indicator 4	FIES score - all households	−8.6	Score
Indicator 4a	FIES score - Female headed households	−8	Score
Indicator 4b	FIES score - Male headed households	-8.7	Score
	Naive food insecurity score	1.2	Score
Indicator 5: Improved dietary intake			
Indicator 5a	Minimum Dietary Diversity score for pregnant and nursing women	45	Percent
	Minimum Dietary Diversity score for all women aged 15-49	47	Percent
	Minimum Dietary Diversity score for children aged 6 to 24 months old	20	Percent
Indicator 5b	Minimum Acceptable Diet score for children aged 6 to 24 months old	18	Percent
Indicator 8: Climate and Nutrition Smart Technology Adaptation and Dissemination			
Indicator 8	Improved seed replacement rate	20	Percent
Indicator 9: Improving Nutrition Security			
Indicator 9	Household dietary diversity score including nursing mothers and children under two years (1,000 days mother target)	6.9	Number
	Number of food categories consumed by women aged 15-49	7.2	Number
	Number of food categories consumed by children 6-24 months old	4.4	Number

Definition of indicators is given below.
Income values in PDO table are measured through a production-based approach as specified in the Results Framework. This is different from rest of report where total revenue from sale of crops and livestock is included without subtracting production costs.

0.1 PDO Indicator Definitions

0.1.1 Crop Yields

$$Crop\ yield = \frac{Amount\ of\ crop\ produced\ in\ tonnes}{Total\ area\ of\ crop\ in\ hectares}$$

Crop yield is calculated at crop level. For each crop the amount produced is calculated in tonnes (1 ton = 1,000 KG). This amount produced is in the numerator. Farmer reported area of each clot is calculated in hectares and put into the denominator. Crops that were not yet harvested at the time of survey were excluded from yield calculation. Crops that experienced failure due to flood, drought, or animals were included.

0.1.2 Indicator 2a - Food grain

$$\frac{1}{n}\sum_{i=i}^{n} CropYield_i$$

The value for this indicator was calculated by taking the mean of yields for the following crops:

- paddy (N 2564)
- maize (N 3293)
- wheat (N 832)
- millet (N 1765)

Analytical weights will be constructed in the follow up survey rounds, to ensure that any changes to yields are not driven by farmers shifting production from one crop to another.

0.1.3 Indicator 2b - Vegetables

$$\frac{1}{n}\sum_{i=i}^{n} CropYield_i$$

The value for this indicator was calculated by taking the mean of yields for the following crops:

- Tomato
- Cauliflower
- Bitter Gourd
- Cucumber
- Okra
- French Bean
- Long Bean
- Chilli

- Cabbage
- Gardem Pea
- Radish
- Carrot
- Broad Leaf Mustard
- Brinjal

Analytical weights will be constructed in the follow up survey rounds, to ensure that any changes to yields are not driven by farmers shifting production from one crop to another. Fruits and vegetables with less than 30 observations were excluded.

0.1.4 Indicator 2c - Meat

$$\frac{(\frac{1}{n}\sum_{i=i}^{n} ChickenWeight_i) + (\frac{1}{n}\sum_{i=i}^{n} GoatWeight_i)}{2}$$

The value for this indicator was calculating by 1) calculating average live weight of goats regardless of breed and type at sale, 2) calculating average live weight of chickens regardless of breed and type at sale. 3) And finally calculating the mean value of 1) and 2) giving equal weights to both numbers. This allows for beneficairy households to switch from local to improved breeds of animals and experience increases in this indicator, without relying on the average weight of specific breeds and genders to increase.

- Cocks (Local 452) (Improved 131)
- Hens (Local 204) (Improved 77)
- Goat - adult doe (Local 82) (Improved 8)
- Goat - adult buck (Local 463) (Improved 45)
- Goat - female hogget (Local 44) (Improved 2)
- Goat - male hogget (Local 188) (Improved 10)

Importance weights will be constructed in the follow up survey rounds, to ensure that any changes to yields are not driven by farmers shifting production from one crop to another.

0.1.5 Indicator 2d - Milk

$$\frac{(\frac{1}{n}\sum_{i=i}^{n} CowMilk_i) + (\frac{1}{n}\sum_{i=i}^{n} BuffaloMilk_i)}{2}$$

The value for this indicator was calculating by 1) calculating average amount of milk produced per milking cow regardless of breed, 2) calculating average amount of milk produced per milking buffalo regardless of breed. 3) And finally calculating the mean value of 1) and 2) giving equal weights to both numbers. This indicator will increase if more households switch to improved breeds of milking animals or they adopt other livestock technologies that improve the amount of milk produced per animal.

- Adult milking cattle (Local 264) (Improved 76)
- Adult milking buffalo (Local 572) (Improved 63)

0.1.6 Indicator 3 - Household income

$$\frac{1}{n}\sum_{i=i}^{n} IncomeSources_i$$

This indicator was calculated by adding revenue from all sources of the household, additionally the value of household's self-cultivated and self-consumed crops was imputed by multiplying the amount of crop consumed by average sale price of same crop at household/RM/district levels, with preference for data points at lowest available level.

For crop income and livestock income, costs of production such as cost of inputs, labor, veterinary services were subtracted from the total sales revenue of crops and livestock. Net income was winsorized at 1% and 99%, this trims out extreme outliers in positive and negative incomes. The values for this indicator are different from rest of report where only cash revenue is considered.

0.1.7 Indicator 4 - FIES

The approach used to analyze Food Insecurity Experience Scale (FIES) data comes from Item Response Theory (IRT), a branch of statistics that permits the measurement of unobservable traits through analysis of responses to surveys and tests. As food security itself is an inherently unobservable characteristic, such as attitude or intelligence, it can be measured only by examining its observable manifestations. The specific IRT model applied to FIES data is the Rasch model, which is widely used in health, education, and psychology.

The FIES module is a set of 8 yes or no questions (for example, "In the past 12 months, did you worry about not having enough food to eat because of a lack of money or other resources?"). The FIES score can be calculated from these questions in two ways. The simplest would be to sum the number of questions for which the household responds "yes", so that the score is a number between 0 and 8. However, in technical terms, the FIES are meant to capture the continuous variable of underlying food security that can take more than 9 possible values. To summarize the underlying variable properly, the designers of FIES at FAO recommend using a method called a Rasch model. The FAO guidance notes "While other experience-based food security scales have used the raw score (sum of affirmative responses) to classify respondents by the severity of their food insecurity, the resulting prevalence rates are not directly comparable. The methods developed by FAO for the analysis of FIES data, however, are designed to produce measures of food insecurity that are comparable across countries." (FAO, 2021). However, the score computed using the Rasch model can be a negative number.

The Rasch model provides a theoretical base and a set of statistical tools to 1) assess the suitability of a set of survey questions ("items") for constructing a measurement scale and to 2) compare a scale's performance across different populations and survey contexts.

The specific questions included in baseline survey are:

- In the past 12 months, did you worry about not having enough food to eat because of a lack of money or other resources?
- In the past 12 months was there a time when you were unable to eat healthy and nutritious food because of a lack of money or other resources?

- In the past 12 months was there a time when you ate only a few kinds of foods due to a lack of money or other resources?
- In the past 12 months did you have to skip a meal because there was not enough money of other resources to get food?
- In the past 12 months was there a time when you ate less than you thought you should because of a lack of money or other resources?
- In the past 12 months was there a time when your household ran out of food because of a lack of money or resources?
- In the past 12 months was there a time when you were hungry but did not eat because there was not enough money or other resources for food?
- In the past 12 months was there a time when you went without eating for a whole day because of a lack of money or other resources?

The IE team's understanding is that the FIES should be reported using the FAO methodology. While this does make the raw number difficult to understand, the main use of this variable will be the changes in the score from baseline to endline and between treatment and control group interventions are underway. These changes have a simple interpretation as the relative improvement of food security in the treatment group. When data for same households is available from future data collection, Indicator 4 will be calculated as a percentage change in households that have experienced any increase in FIES scores. This will be done as a sample average, meaning that if 5% of households see worse FIES scores at midline, but 15% of households see better FIES scores, then the average improvement in Indicator 4 will be reported as 10%.

A naive food insecurity score was also constructed to give another representation of food insecurity in the sample. The team asked 8 different questions about household's food insecurity to one male and one female respondent in the household. For each responding individual a sum of all positive responses was calculated, then an average naive score was calculated at household level. A detailed discussion on how to interpret the negative coefficient of FIES indicator is in the main body of baseline report.

$$NaiveScore = \frac{1}{n}\sum_{i=i}^{n}(\frac{FemaleResponses_i + MaleResponses_i}{2})$$

0.1.8 Indicator 5a - MDD score for pregnant and nursing women

This indicator is restricted to women who are currently pregnant or nursing children, as stated in the Results Framework. The outcome variable of Minimum Dietary Diversity (MDD),which takes value of 1 if the woman consumed 5 out of 10 food groups specified by FAO within the last 2 of interview:

- grains, white roots and tubers
- pulses
- nuts and seeds
- dairy

- meat, poultry and fish
- eggs
- dark green leafy vegetables
- other vitamin a-rich fruits and vegetables
- other vegetables
- other fruits

The indicator is calculated as a share of women that meet MDD in the numerator, divided by total number of pregnant or nursing women in our sample. This is then multiplied by 100 to get the baseline percentage.

0.1.9 Indicator 5b - MAD score for children aged 6 to 24 months old

This indicator is only calculated for children that are aged over 6 months and under 24 months old. Children aged 24 months and 1 day or above are excluded according to FAO definition. The Minimum Acceptable Diet (MAD) outcome is calculated by combining information on breastfed and non-breastfed children. Outcome takes value of 1 if any of the following conditions are met:

- Child received solid, semi-solid, or soft food yesterday at least 2 times. Child is aged 6-8 months old. Child was breastfed. Child consumed 4 or more food groups.
- Child received solid, semi-solid, or soft food yesterday at least 3 times. Child is aged 9-23 months old. Child was breastfed. Child consumed 4 or more food groups.
- Child received solid, semi-solid, or soft food (including formula, canned milk or yogurt) yesterday at least 4 times. Child is aged 6-23 months old. Child not breastfed. Child consumed 4 or more food groups.

The indicator is calculated as share of children who meet MAD in numerator, divided by total number of children aged 6-23. The final number is multiplied by 100 to get the percentage.

0.1.10 Indicator 8 - Seed Replacement Rate

$$SRR = \frac{Area\ under\ improved\ seed}{Total\ area\ under\ crop} * 100 \tag{1}$$

Area under improved seed is defined as area planted with hybrid or improved seed,which is defined as seed received from Government Agency (PAKC/NARC), Agrovet, or purchased from seed cooperative. Improved seed must be purchased within last 2 years. Area is calculated in hectares in both numerator and denominator. The final indicator is calculated as the average value of SRR across these crops: paddy, maize, wheat.

0.1.11 Indicator 9 - Household dietary diversity score

$$\frac{(\frac{1}{n}\sum_{i=i}^{n} FoodGroupsWomen_i) + (\frac{1}{n}\sum_{i=i}^{n} FoodGroupsChild_i)}{2}$$

We only asked food consumption questions from women aged 15-49, pregnant or nursing women, and children aged 0-23 months old. Therefore this indicator will be calculated as the average number of food categories consumed by women and children in the same household, if the latter exists. Or just the average number of food groups consumed by women aged 15-49 in household if there is no child under 2 years old.

$$\frac{1}{n}\sum_{i=i}^{n} FoodGroupsWomen_i$$

Women's dietary diversity is based on these 14 food groups:

- grains, white roots and tubers
- pulses
- nuts and seeds
- dairy
- meat, poultry and fish
- eggs
- dark green leafy vegetables
- other vitamin a-rich fruits and vegetables
- other vegetables
- other fruits
- insect, snails, and other small protein foods
- oils and fats
- spices, condiments, and seasoning
- other foods and beverages

For children aged 6-23 the following food categories were asked about:

- mother's milk
- grains, roots, and tubers
- legumes, pulses and nuts
- dairy products
- flesh foods (meat, fish, poultry, organs)

- eggs
- vitamin a rich fruits and vegetables
- other fruits and vegetables
- insects, snails, and other small protein foods
- oils and fats
- spices, condiments and seasoning
- other food and beverages

Contents

Chapter 1

Study Design

1.1 Project description

The Food and Nutrition Security Enhancement Project (FANSEP) aims to improve agricultural productivity and nutrition practices of targeted smallholder farmers in Nepal. The project represents a second investment by the Global Agriculture and Food Security Program (GAFSP) in Nepal, following the recently completed Agriculture and Food Security Project (AFSP). FANSEP covers a new set of areas not reached by AFSP and aims to build on the successes made by AFSP, tailoring project interventions to the populations where they are most successful. In contrast to AFSP, smallholder productivity support will be explicitly targeted to poorer households while others will be eligible for more commercially oriented support directed to producer associations.

FANSEP is being implemented in hill and Terai (plains) agro-ecological zones. The project will be implemented over five years (2018-2023) in a total of 16 rural municipalities (Gaupalikas) of eight districts spanning three provinces. These districts are Dhanusa, Mahottari, Siraha, and Saptari from Province 2, Dhading, Dolakha and Sindhupalchowk from Bagmati Province, and Gorkha from Gandaki Province. The project aims to improve the livelihoods of crop and livestock farmers, women engaged in household and kitchen garden production, and pregnant and nursing women.

The project consists of the following complementary components:

(a) Technology Adaptation and Dissemination

(b) Income Generation and Diversification through Market Access and Climate Risk Management

(c) Improving Nutrition Security

(d) Project Management, Communication and Monitoring and Evaluation

Component A focuses on improving productivity and post-harvest management of crops and livestock by promoting introduction of appropriate technologies through improved extension services, including Farmer Field Schools (FFS). In relation to this component, the IE aims to test the overall effectiveness of the project in improving smallholder's income and nutrition as well as comparing types of interventions within the component side by side to measure relative effectiveness.

Component B aims to diversify income generation of targeted smallholders by increasing resilience to climate and natural disaster shocks, improving competitiveness and reducing transaction costs by investing in market infrastructure and building market linkages. This will be achieved through two main avenues: firstly, organizing/strengthening producer groups and enhancing their capacities for leadership, decision-making, risk-management, book keeping, and preparation of simple business plans (among other skills). Second, market linkages will be created through Productive Alliances (PAs) between producer organizations and private agribusiness firms (such as agro-vet, traders, commercial farms, MSMEs). This will involve a sort of "business school" as well as provision of matching grants.

Component C aims to address underlying causes of malnutrition by making the system responsive to these causes and promoting adequate, safe, diversified, and nutrient-rich food. The project will support a set of activities at community and local government level, building on experience from AFSP to strengthen institutional capacity and implement Nutrition Field Schools (NFS) and home nutrition gardens. NFS will follow a theory of behavior change, using skill-based nutrition education over the course of a two-year period per group, including sessions on identification of locally available nutrient-dense foods, cooking demonstrations, food safety, home nutrition gardens, and hygiene education. The target group for the NFS will be existing mothers' groups, the Female Community Health Volunteers (FCHV), 1000 days women, and other influencers/change agents. A complementary package of Information Education and Communication (IEC) materials will be disseminated on various media platforms. The IE will work with the operational team to track FIES and other food security indicators at the household level.

1.2 Research questions

The proposed research questions look to inform project targeting and delivery, and to measure impacts as they relate to the Project Development Outcomes and relevant Results Framework indicators. The most important driver for the questions were priorities from the government perspective and key areas for learning. An additional consideration for the design of the questions was key gaps in the literature, with a view towards informing the larger community of practice within the GAFSP portfolio and across implementing institutions.

Overall Question: **What is the impact of the FANSEP on the most food insecure and vulnerable households in a community?** Additional research questions are:

- Does a Proxy Means Test developed using algorithms based on previous IE data successfully identify and target the most food insecure and/or marginalized households in a community? - *Targeting Effect*
- What extension model and which specific interventions deliver take-up of and changes in agricultural and livestock practices in the most efficient manner? - *Comparative Effect*
- Does an intensive Nutrition Field School in addition to household involvement in component A interventions, have a larger impact on improving dietary diversity and FIES score than receiving one component alone? - *Complementary Effect*

1.3 Data Collection

The baseline data collection was carried out between January and March 2021 by New ERA firm, which also conducted the data collection for AFSP. The New ERA team followed strict health protocols in order to mitigate the spread of COVID-19 and to protect the health of both enumerators and respondents.

The survey team used the SurveyCTO platform to implement the electronic questionnaire and the Field Area Measurement application to do plot tracing in the field. The questionnaire focused on agricultural production and food security, and contained modules on housing, labor, education, health, income and expenditures, assets, and women's empowerment. The questionnaire was designed with inputs from the entire FANSEP project team, including FAO.

The team was able to interview 2024 households, with a replacement rate of 21% [1]. The RCT and RDD sample includes 7 of the 8 districts covered by FANSEP, but the majority of villages sampled were from the Hills geographic zone with additional surveys taken from the 8th district to allow reporting primary indicators from all 8 districts. The decision to focus the IE sample on seven districts was made due to villages in the Terai region having very large populations, and thus making the probability of a randomly sampled household actually being part of a project group in the first phase of the project small. This means that focusing the RCT and RDD on the seven districts with mid-size villages gives the evaluation a better chance of focusing on groups where the full intervention has taken place. The project was still working on enrolling households into farmer groups during the time of the survey. Remaining groups in the early treatment arm will be enrolled by June of 2021.

High frequency checks were conducted on the data on a daily basis. The research team was able to flag outliers in crop production, incomes and omitted data. Audio logs were manually checked when household reported no plots or no livestock. A handful of cases in which enumerators incorrectly skipped the plot or livestock modules were identified. In these cases, those enumerators were required to return to the household to collect the missing data.

1.4 Sample

The study sample has two components, the randomized controlled trial (RCT) and regression discontinuity (RDD). The *RCT sample* contains households from the entire distribution of PMT scores and has villages from 80%, 90% and 100% cutoffs. The 80% cutoff means that all households that are poorer than 80% of all households in FANSEP districts are eligible for support, while 100% cutoff means that every household in that village is eligible. The cutoffs were assigned randomly at the village level. The RCT sample is designed to test whether the different cutoffs affect the types of households that enroll in farmer groups and eventually receive support. There were 109 villages in the RCT sample, with 10 households from each selected for an interview. The RCT villages are also stratified between early and late implementation timelines, similar to the AFSP Impact Evaluation. 40 villages were selected from the late treatment group and 23 early villages were taken from each cutoff. The project will start implementation in the late villages in 2022.

[1] This number includes households which were attempted, but an empty survey was not uploaded. For example, if a village had 15 people in the sampling list, 10 were required to be interviewed but we received a completed survey from households #14, then we assumed households 11-13 were attempted.

The *RDD sample* is designed to give precise estimates of program impact near the eligibility cutoff only, meaning that only households directly below or above the 80% and 90% cutoff are included in the sample. 911 households were selected for the RDD sample from 141 villages, and some of those 141 villages overlap with RCT sample. Only villages that had households near their cutoff were included, so villages with 100% cutoff or late villages were not included in the RDD sample. If the sampled household was not available, the next closest household to cutoff was interviewed as a replacement.

1.5 Next steps

DIME is planning a follow up survey in 2022, one year after this baseline survey. Given the delays in project implementation and baseline survey due to COVID-19, the follow up survey will only be able to show impacts if the project enrolls 90% of eligible households into farmer groups, especially in the *early* villages by Summer of 2021. The beneficiary farmers need time to learn and adopt the new climate smart agricultural and nutrition practices. The midline survey in 2021 is expected to only show the gains in agricultural knowledge, but the adoption of improved practices will only be demonstrable after a longer time period. If the group formation progresses as per the agreed IE plan, then such impacts should be measurable in the endline survey, which is planned for end of 2022 or January 2023.

Currently, the same proportion of eligible households and ineligible households are members of farmer groups, both at 30%. If this trend persists until Summer of 2021, then the sample will not have sufficient power to detect statistically significant impacts in the eligible group, especially in the RDD sample during the follow up survey. The research team plans to conduct short phone interviews with the sample in July and August of 2021 to confirm group enrollment and impact of lockdowns on food security and monsoon paddy and maize planting.

The remainder of this report will present the data from the baseline survey, with special emphasis on Project Development Outcomes (Table 1), agricultural practices of the households, and impacts of COVID-19 around food insecurity.

Chapter 2

Socioeconomic Characteristics

The project conducted over 50,000 beneficiary selection interviews with prospective beneficiaries to date, and proxy means tests were generated by DIME using a Classification and Regression Tree (CART) approach, with the aim of identifying food and nutrition insecure households. The figure 2.1 below shows that the PMT scores are highly correlated with total household revenue from the baseline data. This shows that the proxy means tests, or beneficiary selection surveys, did indeed correctly identify more vulnerable households in the community. In the graph below we considered total cash revenue of the household because it's a better representation of how wealthy a household is, if we used PDO indicator 3 (or total profits of household) then it's possible that a highly commercialized household could incur substantial losses in livestock sales and thus be classified as low-profit in the last year, however given this household's high earning potential it should be classified as high-revenue or wealthy. **In this report we will use household revenue in all graphs and tables, unless specifically stated.**

Figure 2.1: Revenue and PMT scores

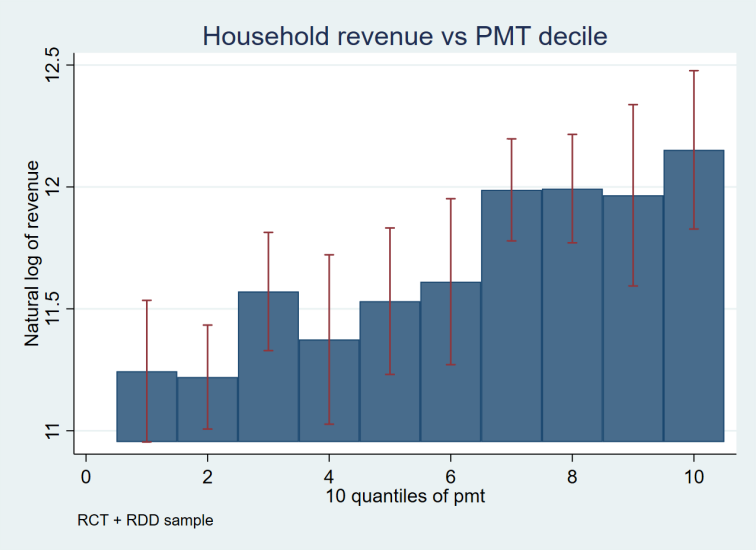
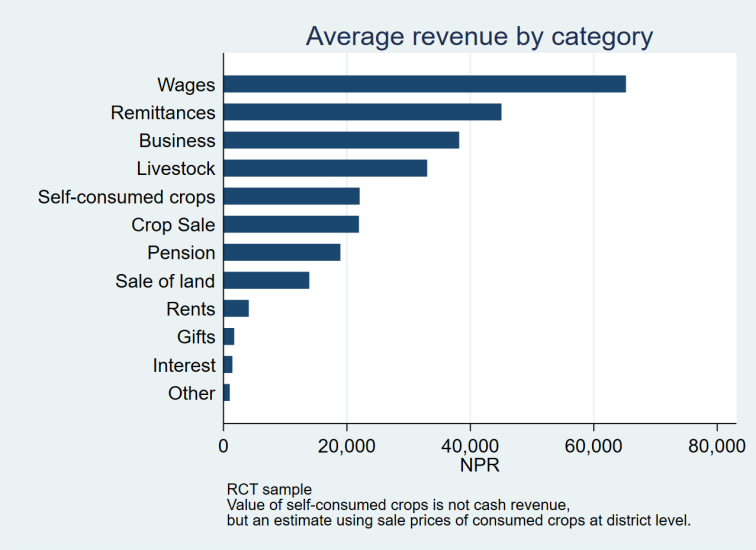


Table 2.1 below shows summary statistics for households in the RCT sample. The households in our sample have an average household cash revenue of 244,429 NPR (2,046 USD) and have on average 5 people per household. This corresponds to a per-capita revenue of 53,910 NPR(451 USD) or less than 1.5 USD per day[1]. It is also worth noting that 1% of surveyed households reported no cash revenue in the last year from farm or non-farm activities. Most of the households in our sample rely on subsistence agriculture to supplement their daily caloric requirements. 73% of households have a kitchen plot and a larger 95% of households had cultivated land in the last 12 months. 14% of households are sharecroppers, which is defined as cultivating crops on other people's land in return for a share of harvested crops. The value of crop that the household grows for their own consumption is not included in total household income.

Figure 2.2: Revenue categories



The most important source of revenue for the surveyed households are wages from labor, as shown in figure 2.2. The questionnaire did not include types of work done by household members. The second most important source of revenue is remittance, however only 27% of households received any money from relatives working outside the household. The third biggest source of revenue is non-agricultural businesses owned by the household. These can range from tea stalls to small sized businesses, so the variance of this variable is large. It is important to highlight that for female-headed households remittances were the most important source of revenue. (Figure 2.5)

All these revenue sources were disrupted to some extent by restrictions imposed by the government as a response to COVID-19. Businesses closures lead to reduced number of days worked in the last year, along with a reduction in revenue from wages and remittances. In 2015, Nepal Rastra Bank estimated that average monthly revenue in rural areas was 27,511 NPR, or 330,132 annually. This is slightly higher than our estimate of 244,429 NPR for the

[1]This finding was checked against Nepal Rastra estimate of per capita and total household income in rural households from 2015.

Table 2.1: Descriptive statistics - RCT sample

Variable	(1) RCT Mean/SE
Household size	5.00
	(0.07)
Total household revenue	244429.82
	(11022.50)
Value of self consumed crops	22047.05
	(672.91)
Per capita revenue - NPR	53910.12
	(2374.57)
No revenue reported - share	0.01
	(0.00)
PDO indicator 3: HH Income	232775.16
	(10481.92)
Farm profit	22066.28
	(1962.05)
Off-farm profit	188661.83
	(10132.49)
Has kitchen garden - share	0.73
	(0.01)
Has cultivated land - share	0.95
	(0.01)
Did sharecropping - share	0.14
	(0.01)
Has remittances - share	0.27
	(0.01)
N	1113

Notes: Median value of annual household revenue was: 132000 NPR. Total household revenue only accounts cash revenue, so it does not include value of self consumed crops.

baseline of FANSEP or the average household revenue in AFSP endline survey respondents (296,045 NPR). In AFSP endline data the average labor force participant worked 9.7 months out of the last 12 months. For the FANSEP sample, it was only 7 months.

Farm revenue is an important contributor to total household revenue, at 23% of total cash revenue. Figure 2.2 shows that revenue from livestock was higher than revenue from crop sales. The total estimated value of crops that households produced and consumed is similar in magnitude to total revenue from sale of crops. The former was calculated as

amount of crops consumed by household multiplied by median price of each crop at district level. This does not mean that each individual household consumed half of its crops and sells the other half. Rather, the households diverge into three groups:

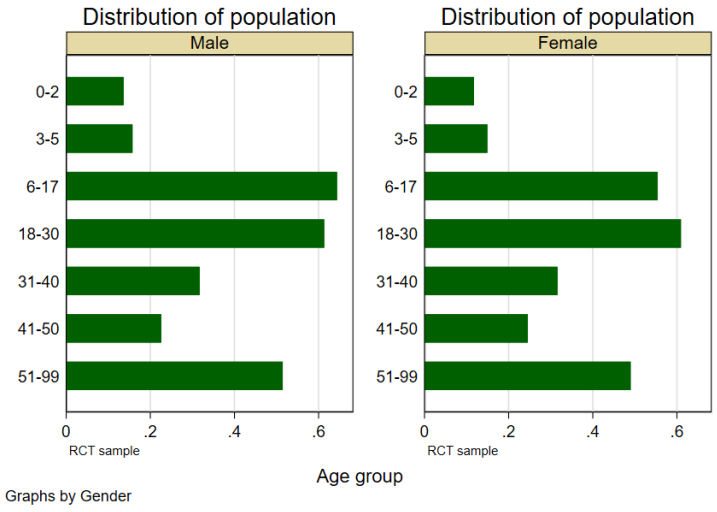
- Subsistence farmers who cultivate cereals for their household's own consumption.
- Commercialized farmers who cultivate high value crops like tomatoes and beans.
- Commercialized farmers who cultivate improved or hybrid varieties of cereal crops, who sell their production as seed.

FANSEP is designed to increase the value that households derive from cultivated and consumed crops, as well as cash revenue from sales of cultivated crops. It is interesting to note that labor wages are the largest source of revenue for male-headed households, while remittances are the largest revenue source for female-headed households, followed by wages. This represents the contribution of male household members who travel abroad or within Nepal for work and send part of their wages back to their families.

Another difference between male and female headed households is the importance of crop sales, which are the 5th largest source of revenue in male-headed households but drops to 7th place in female-headed households. The average value of crop sales, livestock and business are lower in female-headed households, when compared to male-headed households.[2]

2.1 Household composition

Figure 2.3: Household composition by age group and gender



[2]Given that multiple unobserved factors inform the household members' decision to migrate for work, this comparison should not be interpreted as a causal impact of the gender of household head on earnings potential of the household.

The population breakdown by age is given in figure 2.3. It shows that most people in the RCT households fell into 3 age groups ():

- 6-17 year old children
- 18-30 year old young adults
- and 51-99 year old older adults.

There were slightly fewer male children in 0-2 age group, which is expected as newborn children have slightly higher probability of being male, but male children also have higher infant mortality rates compared to newborn girls. There were more male children in 6-17 year age group, compared to female children. No gender imbalance was observed in other age groups.

Figure 2.4: Male household head

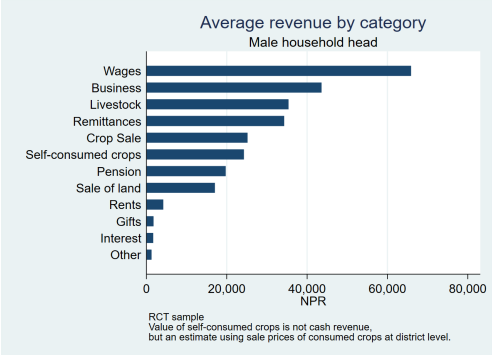
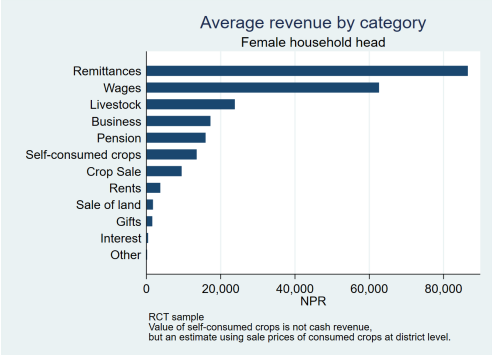


Figure 2.5: Female household head



2.2 Household head characteristics

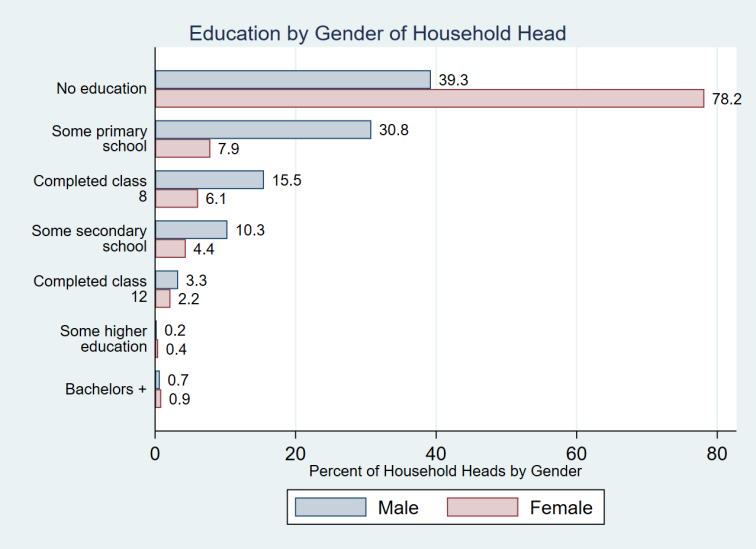
In Nepal, the caste of the household is often correlated with food insecurity and poverty. "Lower" caste households can also have lower probability of receiving agricultural extension support and may be less prepared for external shocks such as climate change or Covid-19. Characteristics of the household head are tabulated in the table 6.1 in the Appendix. Significant differences were observed between households in the Hill and Terai districts, with the former being more likely to be of "lower" caste and on average having household heads with lower levels of formal education. The average age of household head was higher in the Hill district households at 51 years old, compared to 46 in Terai households. (Table 6.1)

Over 65% of households in Terai and 70% of households in Hill districts had outstanding loans in the last 12 months, but the share of households with any formal savings accounts was much higher in Hill districts at 57% compared to 21% in Terai. This suggests that the respondent households have limited access to formal savings accounts in banks and cooperatives in the Terai and could pose as a barrier to enrollment into farmer groups. This lack of access to financial institutions is correlated with lower financial literacy and extensive use of informal money lenders. Lack of access to formal financial institutions is often a prohibitive barrier to access agricultural subsidies, especially via matching grants that require the recipient farmer group to access credit from a commercial bank in order

to raise the *match* amount. The probability of owning a mobile phone in the household high, suggesting that re-interviewing the same respondents for the follow up surveys will be successful.

The probability that the household had a pregnant woman was the same in both Terai and Hill districts, however the numbers of children aged 0-2 and 0-5 are significantly higher in Terai, suggesting that there will be a greater demand for FANSEP's Component C in the Terai. 20% of households in Hill villages have a female household head, compared to 22% of households in the Terai. The education of the household head is also skewed for female household heads, 77% of whom had no formal education, while only 39% of male household heads had no formal education. (Figure 2.6) This highlights the need to tailor the extension training modules to better serve women with no formal education, and increase the usage of field practice and demonstrations.

Figure 2.6: Education of Household Head



2.3 Baseline balance

2.3.1 Regression Discontinuity Design - RDD

In the households sampled for the Regression Discontinuity design, baseline balance was tested for the same set of PDO indicators described in the previous section. The placebo test results in table **??** of Appendix indicate that both eligible and ineligible households near the cutoff are balanced on all PDO level indicators at baseline.

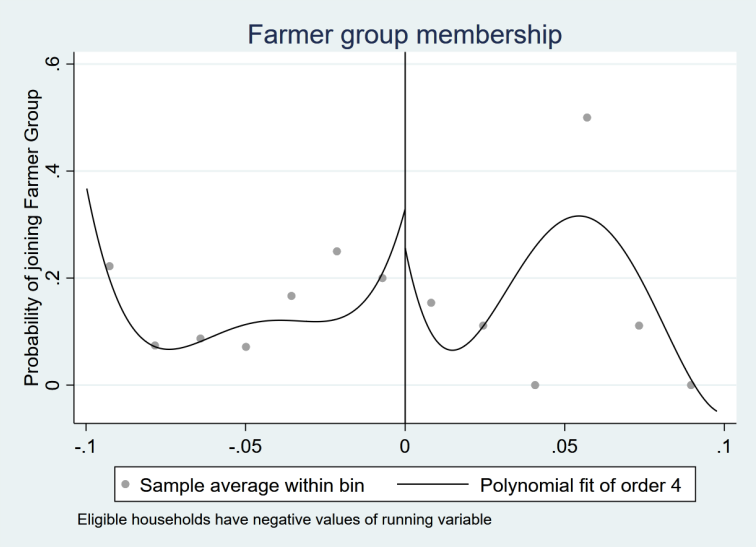
The figure 2.7 shows the probability that household is enrolled into farmer groups right at the cutoff. The households to the left of 0 are eligible for FANSEP support and those to the right are not eligible. The line shows no discontinuity or "jump" at the cutoff, which suggests that both eligible and ineligible households have the same probability of being in a FANSEP farmer group. This is problematic for the impact evaluation as group formation

already started in November 2020 and the baseline survey took place in February 2021. Using PMT data from one year ago, both types of households had 9% chance of being in a group at the cutoff. This finding that the same share of ineligible households joined groups as eligible, is problematic for detecting project impacts.

The power calculations conducted using PMT score data and AFSP baseline revenue suggest that the RDD sample used has 67% power to detect a 20% increase in total household revenue resulting from FANSEP. This power calculation was conducted with assumption of perfect compliance to group enrollment plan. Therefore if too many ineligible households join groups, or not enough eligible households join groups, then our power calculations will not be relevant.

A scenario in which farmer group enrollment stays at current levels for both eligible and ineligible group will not allow us to detect significant project impacts, even if eligible farmer revenue were to double by the next survey. However if 90% of eligible households join a farmer group by summer of 2021, then the RDD sample still has sufficient power to detect a 20% increase in total household revenue resulting from FANSEP support.

Figure 2.7: Farmer group membership at baseline - RDD



2.3.2 Randomized Controlled Trial - RCT

The Randomized Controlled Trial sample consisted of 109 villages, with 10 households from each village. [3] 40 of those villages were randomly selected to be in the "late treatment" schedule. The FANSEP project team agreed to delay implementation in these 40 villages until at least fall of 2022. The project conducted PMT surveys in 542 villages, out of which 100 were selected into "late treatment", and remaining 442 villages were selected into early

[3]Dhanusha households are not part of study RCT sample, but are included in this report to tabulate findings at cluster and district level. Dhanusha households are not included in the study RCT sample because the surveyed village has more than 130 households and is less likely to have each member of village receive treatment from project during the follow up survey rounds.

treatment. Therefore the project has 44,402 eligible households in the early villages, and this number should be sufficient to reach implementation targets. Thus, delaying implementation in just 40 "late treatment" villages should not impose undue constraints on project implementation plans.

Table 2.2 shows that households in "early" villages had slightly higher total household cash revenue than households in "late" villages, by about 22,773 NPR. This difference is not statistically significant. Other important variables, such as probability of sharecropping, receiving remittances and being low caste household were balanced between "early" and "late" villages. The only 3 variables with statistically significant differences were gender of household heads, number of children under 2 and value of self-consumed crops. "Early" villages had higher value of self-consumed crops, a higher number of children under 2, and were less likely to be headed by a female compared to "late" villages. The research team will need to control for these characteristics in endline regressions, because the F-test of joint significance was significant.

Based on findings of the AFSP impact evaluation, staggering the treatment schedule is sufficient to produce detectable impacts on households. Therefore it is important that "late" villages do not start farmer group formation until at least November 2022. We have a better chance of detecting impacts when comparing households with FANSEP support to those without FANSEP support, rather than comparing treated households with itself before FANSEP support.

Table 2.2: Baseline balance RCT

Variable	(1) early Mean/SE	(2) late Mean/SE	T-test Difference (1)-(2)
Household size	4.97	5.07	-0.10
	(0.09)	(0.11)	
Total household revenue	252614.45	229840.71	22773.74
	(15651.74)	(12732.22)	
Value of self consumed crops	23254.46	19894.84	3359.61**
	(897.86)	(963.87)	
Per capita revenue - NPR	56335.57	49586.75	6748.82
	(3349.47)	(2822.62)	
No revenue reported - share	0.01	0.01	0.00
	(0.00)	(0.00)	
PDO indicator 3: HH Income	241398.54	217403.99	23994.54
	(14922.17)	(11950.80)	
Farm profit	22398.91	21473.37	925.54
	(2443.23)	(3296.06)	
Off-farm profit	195745.17	176035.78	19709.38
	(14419.00)	(11585.43)	
Has kitchen garden - share	0.74	0.73	0.00
	(0.02)	(0.02)	
Has cultivated land - share	0.95	0.95	0.01
	(0.01)	(0.01)	
Did sharecropping - share	0.14	0.14	-0.00
	(0.01)	(0.02)	
Has remittances - share	0.26	0.29	-0.03
	(0.02)	(0.02)	
Household head is low caste	0.61	0.61	-0.00
	(0.02)	(0.02)	
Household head age	50.03	50.46	-0.43
	(0.55)	(0.76)	
Household head is female	0.18	0.24	-0.06**
	(0.01)	(0.02)	
Household has loans	0.70	0.68	0.03
	(0.02)	(0.02)	
Household has savings	0.51	0.47	0.04
	(0.02)	(0.02)	
# children 0 - 2 years old	0.28	0.20	0.07**
	(0.02)	(0.02)	
N	713	400	
F-test of joint significance (F-stat)			1.65**
F-test, number of observations			1113

Notes: Total household revenue only accounts cash revenue, so it does not include value of self consumed crops.

Chapter 3

Agriculture

3.1 Land ownership

Most households surveyed at baseline represent smallholder farmers who rely on their crop cultivation for a significant share of their nutritional needs. Table 3.1 shows that 95% of households in the RCT sample had cultivated land, and the average household had 3 cultivated plots totally 0.41 hectares. Only 11% of households in the sample were renting out land, and the average area rented out was 0.36 hectares. A significant share of households (32%) reported owning fallow land, which suggests that agricultural interventions that provide inputs and training should succeed in increasing area under cultivation and agricultural revenues of beneficiary farmers.

The majority of farmers (73%) reported cultivating crops on a *kitchen garden* plot near their house. The average number of crops grown on these *kitchen garden* plots is 7 and over 82% of farmers that did have kitchen gardens applied inputs such as chemical fertilizer, pesticides or micro nutrients.

3.1.1 Plot details

The average plot of a household, defined as a contiguous area of land that does not merge with other land cultivated by same household, has a size of 0.13 hectares. Of that area, an average of 0.12 hectares is planted in the summer, suggesting that almost all available land is utilized in the summer season, when monsoon rains provide the necessary water for cultivation of paddy. The average size of plots cultivated in winter and spring is half of total area, suggesting that only some plots are cultivated in the winter and spring seasons. The combined annual total area cultivated for each plot is 0.25 on average, which corresponds to a cropping intensity of 186%. (Table 6.4)

Most of the cultivated plots are owned by the household (81%) and only 8% of the plots are sharecropped. The average area of owned and sharecropped plots was similar at 0.12 and 0.15 hectares, respectively. Out of the average plot size of 0.13 hectares only 0.06 hectares are irrigated in any of the three seasons. (Table 6.4) The utilization of chemical fertilizer was high, with 69% of all plots having fertilizer applied in at least one season. The usage of pesticides was low with only 17% of plots being sprayed with pesticides. Access to irrigation was also low, with only 39% of plots being irrigated in at least one season.

Table 3.1: Land information at household level

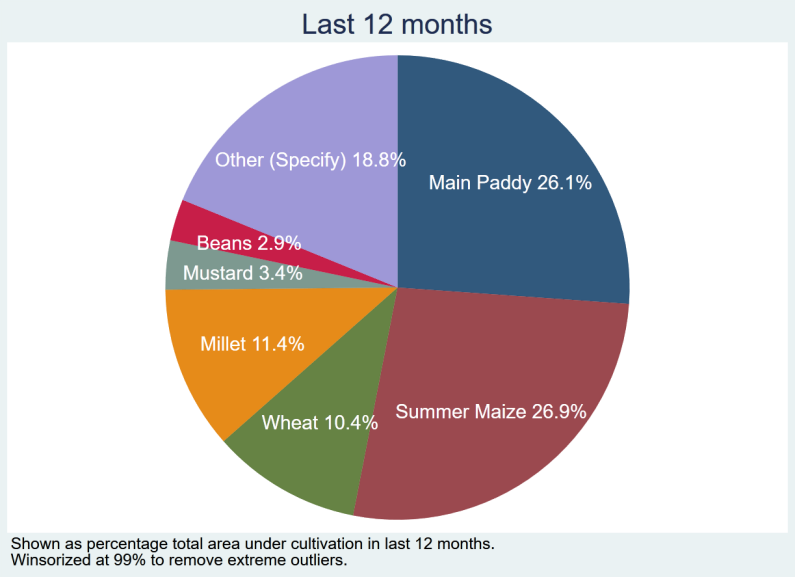
Variable	N	(1) 1 Mean/SE
Share of households cultivating land	1113	0.95 (0.01)
# of cultivated plots	1113	2.96 (0.06)
Area under cultvation in hectares	1059	0.41 (0.01)
Share of households renting out land	1113	0.11 (0.01)
# of rented out plots	1090	0.11 (0.01)
Area rented out in hectares	123	0.36 (0.05)
Share of households with fallow land	1113	0.32 (0.01)
Area of fallow land in hectares	357	0.20 (0.01)
Share of households with kitchen gardens	1113	0.73 (0.01)
# of crops in kitchen garden	818	7.06 (0.13)
Share of households using inputs on kitchen gardens	818	0.82 (0.01)

3.1.2 Crop cultivation

Figure 3.1 shows that the most common crops cultivated, as measured by total area planted, were summer maize and main paddy. The next most cultivated crops were wheat and millet. When the total area planted was broken down by season, as shown in figures 6.3 - 6.5, each of the three seasons was dominated by only one or two crops. In the summer, 55% of the total planted area was cultivated with main paddy, followed by 24% of total area cultivated with millet. In the winter season the two most common crops were wheat and mustard, while in the spring households only grew summer maize.

The current cropping intensity of the household stands at 186% (Table 6.4). To understand potential constraints to households' full utilization of their cultivatable land, we will look at the current baseline agricultural knowledge, use of agricultural technologies, and participation in farmer groups.

Figure 3.1: Crop cultivation by area



The cropping pattern differs by geological zone, with Terai households planting paddy in the summer and wheat and lentil in the winter. Very few households in Terai planted any crops in the spring season, mostly due to lack of irrigation facilities. (Table 6.5) In the Hill districts by comparison, households cultivated paddy or millet in monsoon season. This was usually followed by wheat, potato or mustard in the winter season. In the spring season, maize was the most common crop for Hill districts. (Table 6.6)

3.1.3 Crop allocation

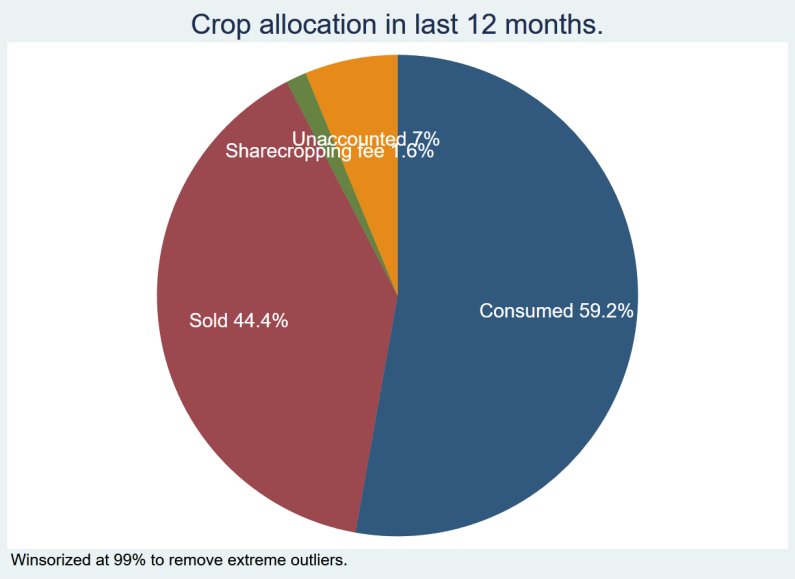
Figure 3.2 shows how crops are distributed after harvest. Most of the value of the crop, defined as the amount consumed by the household multiplied by median cost of each crop at district level, is consumed by the household itself. Only about 42% of the harvest is sold for cash. This figure considers all crops in the sample and is prone to a few outlier households that grow cash crops such as tomatoes.

The 4 most cultivated crops in RCT sample [1] are cereals such as paddy, maize, wheat, and millet. Figure 3.3 shows that an average main paddy crop produces a harvest with an economic value of 7,600 NPR (64 USD), most of which was consumed by the household. Most of the remaining cereal crops were also consumed by the household. The only two crops for which a larger share was sold than self-consumed are tomatoes and beans. The average harvest of tomatoes is over 40,000 NPR. However, only 125 out of 1113 RCT households grew tomatoes.

When the same figure was calculated using area-adjusted crop values (Figure 3.4), then most crops grown generated around 50,000 NPR per hectare planted, including paddy, maize, and millet. It is important to note that lentils, wheat and mustard produced much less value per hectare planted compared to paddy and maize. This could be driven by the

[1] As defined by total area planted under each crop and sorted from largest to smallest total area planted.

Figure 3.2: Total crop allocation by household



different geographic areas, where wheat is planted as the main staple cereal crop. Potatoes and black gram produced significantly higher value per area planted than cereals.

Figure 6.2 shows that households in the Hill villages cultivated a different crop rotation than households in Terai villages. The hill villages grew maize and millet as the main cereal crops, with a subgroup of households cultivating paddy. Meanwhile, households in the Terai used a paddy-wheat-fallow pattern.

These figures indicate that cereals are a major source of household consumption, suggesting the potential for FANSEP beneficiary farmers to improve the yields of those crops so that they can sell the excess grain they produce. Another pathway for households to improve their livelihood is to start cultivating tomatoes, potatoes, and beans, which are already cultivated as cash crops by some farmers. This would require the households to pro-

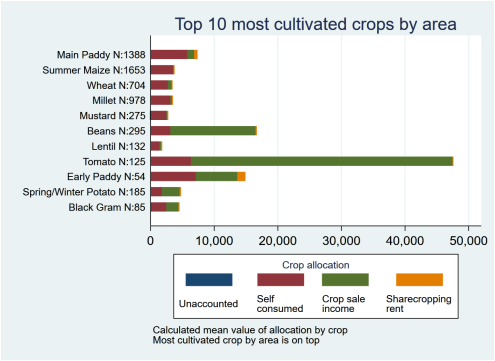


Figure 3.3: Crop level estimation

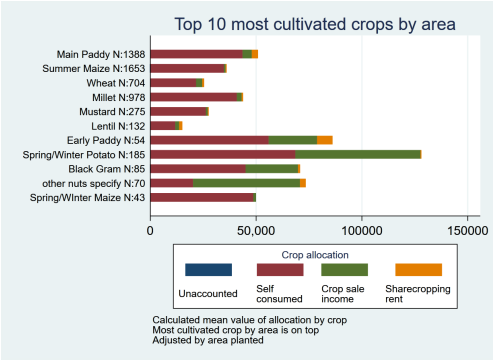


Figure 3.4: Crop level-area adjusted

cure or receive additional inputs like seeds, tomato tunnels, and training on cultivating new crops. Farmers would also need access to markets, cold storage facilities, and transportation to sell these crops.

3.2 Agricultural knowledge

To test the baseline knowledge of farmers, 22 questions were developed by DIME with input from the project team's crop and livestock experts. The questions are designed to test the knowledge around climate smart practices for crop cultivation, such as proper use of inputs, soil quality and seed varieties. A portion of the questions relate to animal husbandry.

One question was included to test whether farmers are primed to give any response to a dummy question. The question asked about potential benefits of burning crops. Figure 3.6 below shows that more than 60% of surveyed farmers reported that burning crops enriches the soil. These views are held in absence of any evidence in agricultural literature. The enumerators were not told which of the answer options was correct in the knowledge quizzes, to help ensure they would not be able to guide the respondents. After data collection each quiz was graded and assigned a knowledge z-score.

Figure 3.5 shows the relationship between measured agricultural knowledge and proxy means test (PMT) scores. Poorer households performed worse on questions about crop cultivation than households in the top 20% of PMT scores. This reflects that wealthier households in the village are likely to have better knowledge about agriculture and often hold leadership positions in farmer groups and cooperatives. Therefore, it may not be feasible to exclude the wealthiest 20% of households from being active members of farmer groups.

Figure 3.5: Agricultural knowledge across enterprise distribution

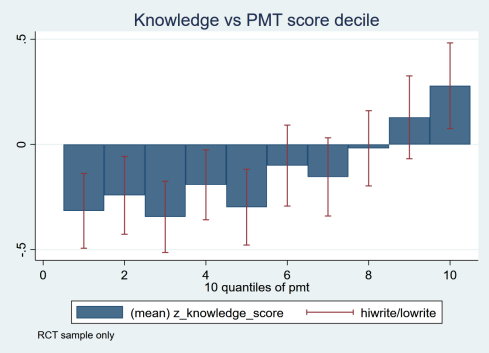
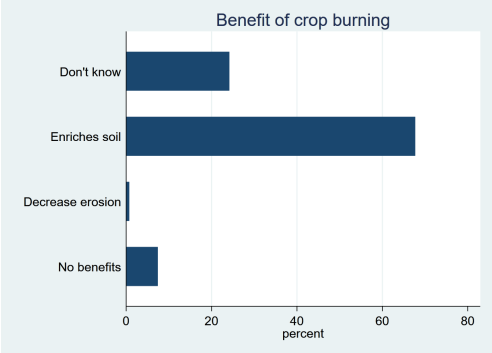


Figure 3.6: Question about benefits of crop burning



To see if any other household characteristics affect the agricultural knowledge of a household, we tabulated the mean z-scores by gender of household head. Figure 3.7 below shows that households with female household heads scored lower on the agricultural knowledge quiz compared to male-headed households. Upon closer examination, however, this drop in scores is attributable to *Brahmin/Chettri* caste female household heads having lower scores compared to their male counterparts.

Regression discontinuity graphs of agricultural knowledge z-scores do not show any significant *jump* at the cutoff (Figure 3.9). This suggests that households just below and above

Figure 3.7: Crop knowledge - by gender

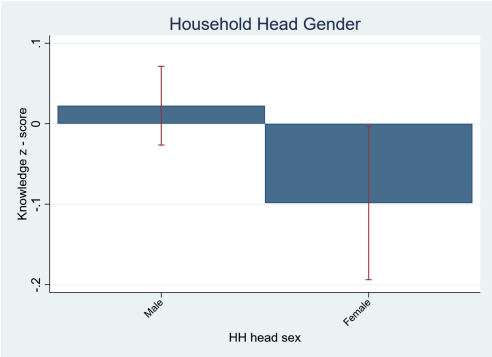
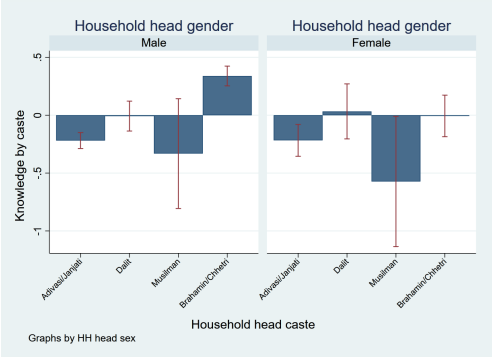


Figure 3.8: Crop knowledge - by caste and gender



the cutoff have the same level of agricultural knowledge. Therefore any changes to this at endline will be fully attributable to the FANSEP intervention. At the midline survey we hope to see discontinuity presented in figure 3.10. The latter figure was created by simulating a 1 standard deviation increase in agricultural knowledge z-scores for eligible farmers.

Figure 3.9: Crop knowledge - baseline (real data)

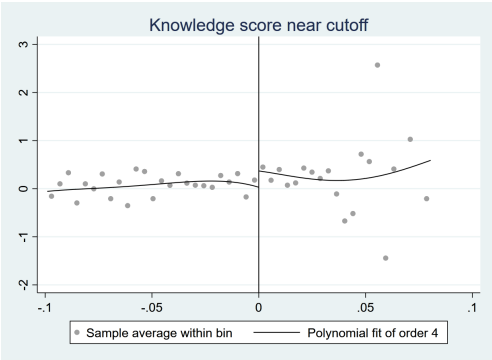


Figure 3.10: Crop knowledge - potential (not real data)

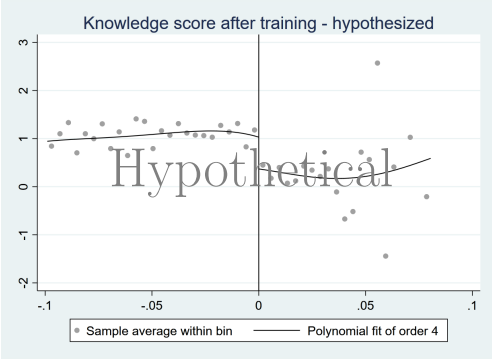
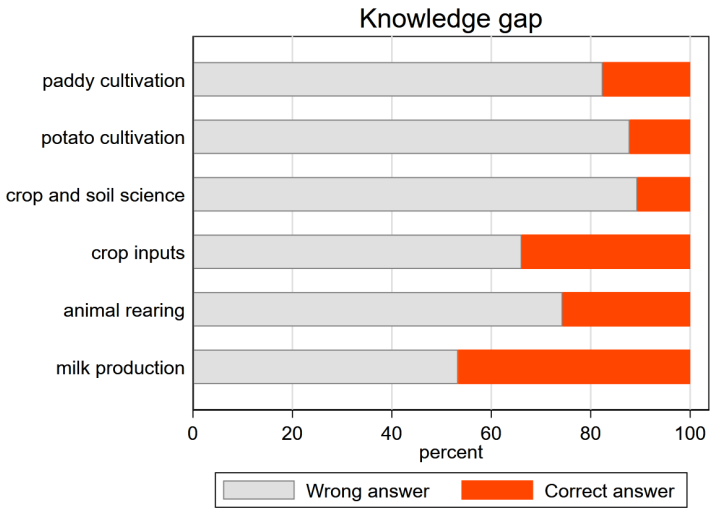


Figure 3.10 is the potential result of FANSEP eligible farmers answering on average 3 more questions correctly compared to answers they provided at baseline. The magnitude of knowledge increase depends on quality of farmer group training provided by FANSEP cluster staff, and the ability of farmers to comprehend and apply the new knowledge. It is important to conduct the follow up survey immediately after the beneficiary farmers are trained in fall season of 2021, to maximize the probability that farmers correctly recall the training. This data can be better supplemented by monitoring data that tracks knowledge of group members throughout the intervention.

Figure 3.11 illustrates the topics that respondents answered correctly versus incorrectly. The largest gaps in knowledge were for questions related to paddy cultivation, potato cultivation and soil science. The knowledge gap was smallest for milk production questions, where 46% of respondents gave a correct answer. It is also possible that questions varied by

Figure 3.11: Knowledge gap



difficulty across different topics. Because of this, it is better to rely on the knowledge z-scores when assessing whether farmers are gaining knowledge from FANSEP training sessions.

3.3 Crop cultivation technologies

The only technologies on which households spent a significant amount of money are use of tractors and power tillers. The likely explanation for this is that the cost of hiring machines was lower than hiring laborers to do the same work. Additionally, since most cereal crops produced are consumed by households themselves and not sold, there is less incentive to increase yields of cereals crops.

Figure 3.13 shows that most of the households that applied pesticides used masks during application and washed their hands with soap after each application. However, given that a large scale effort was made in the last year to improve use of face coverings and hand washing due to COVID-19 pandemic, clear attribution is not possible. Usage of boots and aprons was low with less than 4% of households that used pesticides reporting using the above mentioned protective equipment.

3.4 Farmer groups and extension support

Farmer group participation was low at the time of the beneficiary selection survey, with only 9% of households self-reporting being an active member of a farmer group. At the baseline survey this increased to 30% for both eligible and ineligible households in the RDD sample. Farmer group membership is important as it allows households to receive government support such as subsidized costs for inputs and extension training. Additionally, there are benefits to collective action such as knowledge transfers and ability to organize tasks.

Figure 3.12: Spending on crop technology

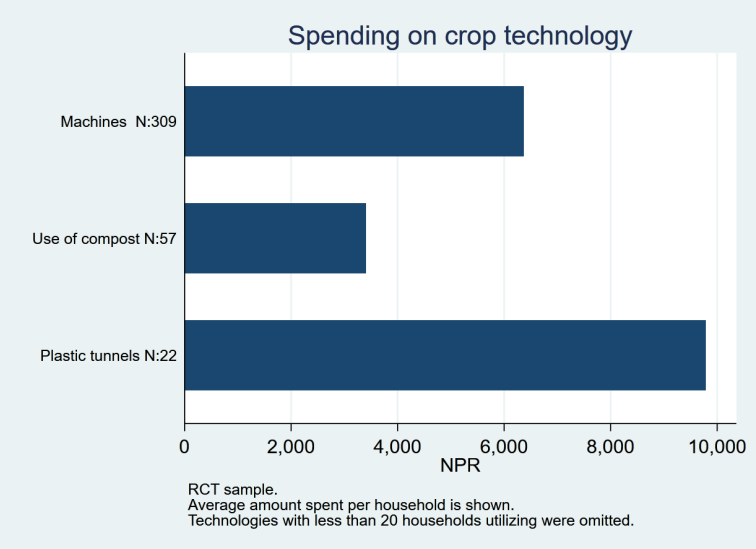
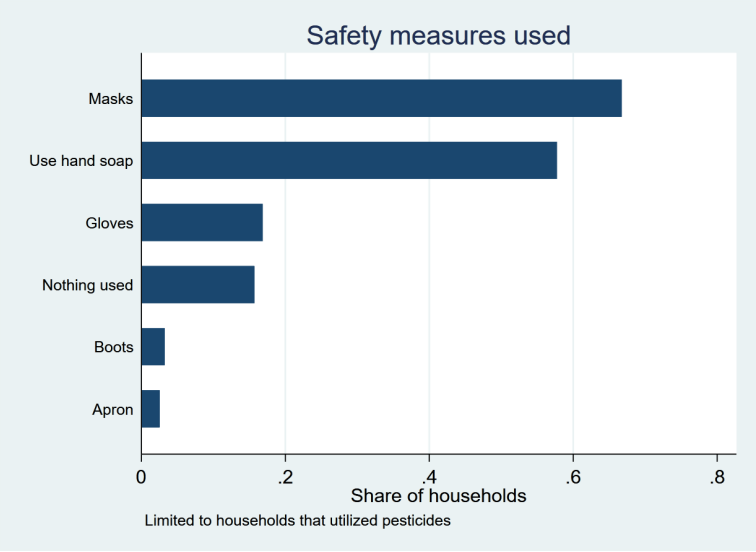


Figure 3.13: Pesticide safety methods used



16% of households in RCT sample reported receiving any agricultural support at baseline, including 5% of households that reported receiving support from FANSEP. This support was limited to distribution of rice and lentil seeds as a response to COVID-19 induced lockdown measures. A quarter of respondents reported receiving seeds from an Agricultural Knowledge Center (AKC) in the last 6 months.

The types of groups involvement reported at baseline was not limited to farmer groups. Many households reported being members of water user groups and forestry groups, which

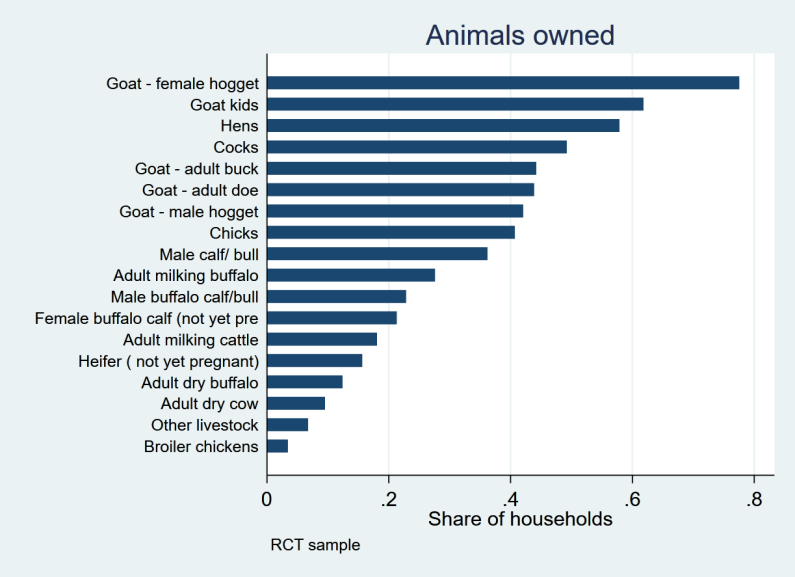
included about a quarter of baseline respondents. 19% of households belonged to health mothers groups and 18% of households belonged to a microfinance group. (Table 6.2)

3.5 Livestock

Almost all households (96%) owned at least one type of animal in the last 12 months, excluding pets. The most common types of animal owned by the households were goats and chickens. Table 6.9 shows that 77% of households in the RCT sample owned a female hogget goat, followed by 61% of households owning a kid goat. About half of households owned an adult doe or buck. For households that did own goats,the average number of goats owned was 3 got adult doe/bucks and 2 for female hoggets.

Ownership of larger animals was less likely than goats, with 18% of households owning an adult milking cow and 27% of households owned an adult milking buffalo. Increasing the share of households that own milking cows and buffaloes is key to improving nutritional status of household members, especially children. The actual number of large animals owned was low, so if the household did own cows or buffalo, on average they only had 1 large animal.

Figure 3.14: Animal ownership



The ownership of chickens varied by type of chicken, more than half of households owned hens (58%), and the average number of hens per household was 5. However ownership of broiler chickens was much lower, with only 3% of households owning broiler chickens. These are usually owned by wealthier households that own chicken coops, with the average number of broiler chickens per household at 370. Therefore it's important for the project to separate commercial chicken producers from eligible beneficiary households, that own only a handful of chickens per household.

3.5.1 Goats

Detailed descriptive statistics for different domestic animals are provided in the Appendix. Table 6.10 shows that most of the goats owned by households were of local Khari breed, followed by Terai or unknown breeds. Most households owned 2 or fewer goats of each type. As expected, disease mortality of goats was highest for younger goats, such as kids and hoggets (9% - 11% mortality). The income from sale of adult bucks was the highest, with households earning on average 27,285 NPR (233 USD). The average household income from sale of meat was also highest for adult bucks, followed by male hoggets.

3.5.2 Cows

Ownership of cows was significantly lower than goats, with most households only owning one adult milking cow or one heifer. (Table 6.12) The disease mortality of cows was half of that of goats, between 5.5 and 6.4% annually. The income from sale of animals is significantly lower, due to cultural aversion to consumption of beef in Nepal. The average household income from sale of milk was 25,883 NPR (221 USD), with average amount of milk sold in household with milking cows was 125.7 liters. This gives an average sale price of 207 NPR per liter. Each adult milking cow was producing an average of 478.3 liters per year.[2](Table 6.13)

3.5.3 Buffalo

Data on buffalo ownership was similar to cows, with most households that own a buffalo only owning a single adult milking buffalo or a male buffalo. (Table 6.14) The probability that the buffalo was improved breed was low, thus most households own a local breed buffalo. Disease mortality of buffalo was even lower than cows, suggesting that buffaloes are better adapted to the Terai and Hill climates of Nepal. Income from the sale of buffaloes was significantly higher than cows, because buffalo meat is consumed in Nepal. The households that owned buffaloes earned on average 65,717 NPR (563 USD) from sale of animals as a whole. (Table 6.15) Buffaloes also produced a significant amount of milk, with each household producing around 758.3 liters per year if they owned an adult milking buffalo. Out of that amount 487.7 liters were consumed by household. Not all households that milked adult buffalo sold their milk, but the ones that did sold around 252.7 liters on average per year per household and received 33,702.2 NPR per year from milk sales. The per animal productivity of adult milking buffalo was 697 liters per animal in last year in our sample. This value is on the higher end of MOAD estimates for survey districts, which range from 466 liters per animal in Terai (Mahottari) to 656 liters per animal in Hills (Dhadhing).

3.5.4 Chickens

The number of chickens owned by households was much higher, since it is a small animal to raise, with lower associated feed and veterinary costs. The ownership of improved breeds of chickens was almost non-existent with only less than 1% of all chickens in baseline dataset being the improved New Hampshire breed. (Table 6.16) The average number of chickens owned and sold by household was significantly skewed by presence of a few households that

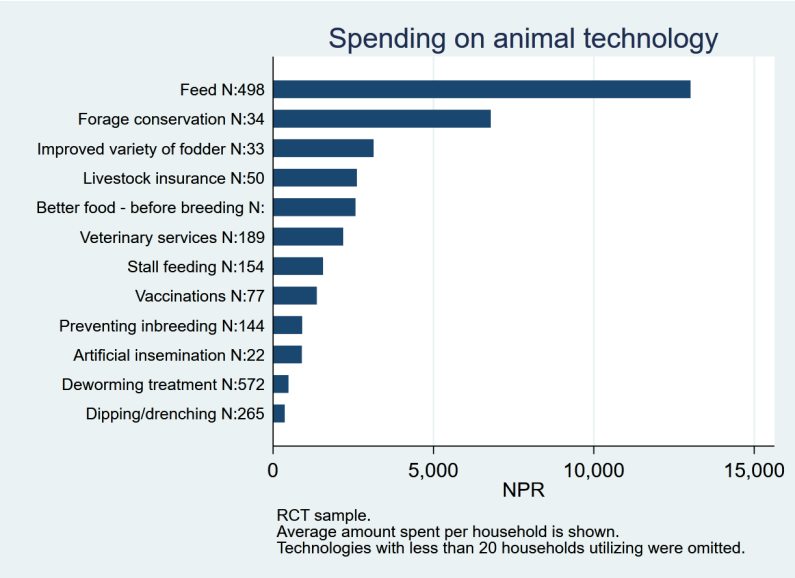
[2]In 7 households, the household used to own milking cows in the last 12 months, but they either sold the milking cows at the time of interview or those cows had died due to disease. That is why they are no longer producing milk.

were commercial chicken farmers, defined as owning more than 1000 chickens. Thus the average income from sale of cocks was 3,771 NPR (30 USD), while the income from selling Broiler chickens was 153,808 NPR (1318 USD). The average age of chickens at date of sale was 7.6 months old. (Table 6.17) The households with hens produced on average 66.7 eggs[3] per year and out of that number 40.4 eggs were consumed by household. Not all households sold their eggs, but those that did received 1,609 NPR on average. According to MOAD data[4], chickens in our survey districts produced between 112-143 eggs per laying hen, this is much higher than baseline data, where each hen produces on average 27.7 eggs per hen in a year.

3.5.5 Livestock technologies

Figure 3.15 shows baseline spending on different types of animal technology, limited to households with animals. The most common expense was deworming treatment and the average amount spent was 480 NPR per year. The second most common expense was purchase of improved feed, which cost the household 13,152 NPR for all animals in the last year. The third and fourth most common expenses were veterinary services and dropping/drenching to treat diseases.

Figure 3.15: Spending on animal technology



Most respondents said that no one helped them implement these animal-related technologies, with a small fraction of respondents reporting government extension agents and agrovets as providing advice or service. (Table 3.14). 8% of respondents said they received advice about animal technologies from farmer groups or cooperatives. Table 6.17 shows that animal vaccinations were mostly given to adult milking buffalo and goats.

[3]Comments from the project team note that some both local and crossbred hens were included into "egg laying hens" category, this the productivity of hens could be higher than local hens alone.
[4]Statistical Information ON Nepalese Agriculture 2075/76 (2018/19)

Chapter 4

Nutrition and Food Security

Dietary diversity data was collected for a mother and a child in each household (when present). The share of women aged 15-49 that meet Minimum Dietary Diversity (MDD) is 47% (N 815). When restricted only to pregnant women or mothers of children less than 24 months, the share that meet MDD is 45% (N 173). Only 18% of children aged 6-24 months meet the Minimum Acceptable Diet (MAD). If we compute a household dietary diversity score at the household level, defined as average between the number of food groups consumed by children and number of food groups consumed by women in same household, then the average household consumed 6.9 food groups. It is important to note that women consumed more food groups (7.2 food groups) than children (4.4 food groups) on average. Most households only had women aged 15-49 but no children under 2, therefore the average between these two variables does not lie in the midpoint of two averages.

4.1 Mother's nutrition

Enumerators asked respondents to describe what they ate in the last 24 hours (unless the last day was unusual, in which case they were asked what they consumed during the day before). This section describes food consumption of women by category of food. All women ate spices, seasoning and grains, including rice. However the consumption of dairy products and proteins was low. Only half of sampled women in the Terai consumed dairy products, and less than half in the Hill districts. The consumption of meat was reversed with 35% of women in Hill districts consuming meat, while only 14% of women in Terai consumed meat during the recall period. While consumption of pulses and other vegetables was high in both Hills and Terai districts, the consumption of important food categories like eggs, nuts and fruits was significantly lower than recommended levels.

4.2 Children's nutrition

A similar set of questions was asked about different food categories that a child under 2 years old consumed in the last day. The figure 4.4 shows that children in Hill districts on average consumed food from slightly more categories than children in the Terai. The most common food category given to children was mother's milk, followed by rice, seasoning, and

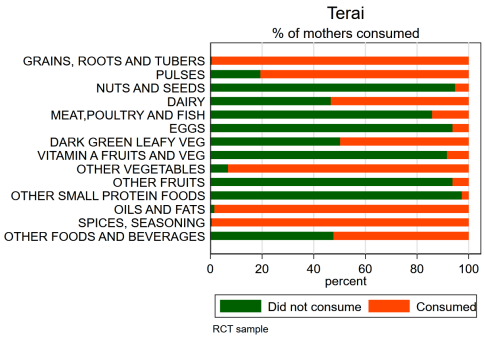


Figure 4.1: Food consumption - Terai

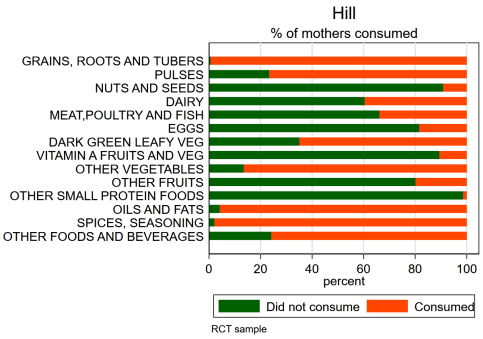


Figure 4.2: Food consumption - Terai

oil. The overall share of children who consumed other important food categories was low, especially dairy products, protein, fruits, and vegetables.

This explains why only 18% of children in the baseline RCT sample meet the Minimum Acceptable Diet(MAD) criteria set by WHO. The 7 broad food categories that contribute to MAD are the following:

- Grains
- Legumes
- Meat
- Eggs
- Vitamin A foods
- Other vegetables
- Dairy

Children must consume at least 4 food categories in the past day to meet the MAD criteria. The figures 4.4 and 4.3 below represent the overall share of children who consumed each category. At the individual level each child consumed food from an average of 2 of the above food categories, in addition to mother's milk.

4.3 Food insecurity

Food insecurity was measured using the Household Food Insecurity Experience Scale(FIES) constructed by the Food and Agriculture Organization (FAO). The standard questionnaire consists of 8 questions which were administered to one male and one female respondent in each household. 43% of female respondents and 42% of male respondents said yes to at least one of the food insecurity questions. In cases where both male and female responded they gave similar responses in only 67% of cases, which suggests that household knowledge and perception of food insecurity differs between male and female household members. A RASCH model was used to predict food insecurity scores for the baseline sample. Table 4.1

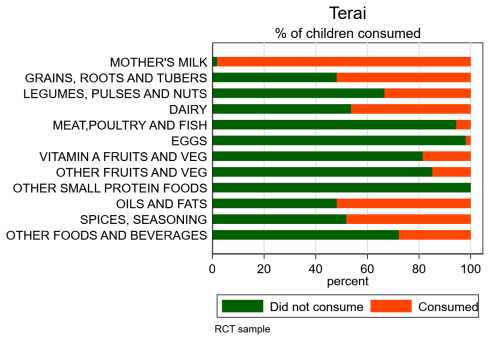


Figure 4.3: Food consumption - Terai

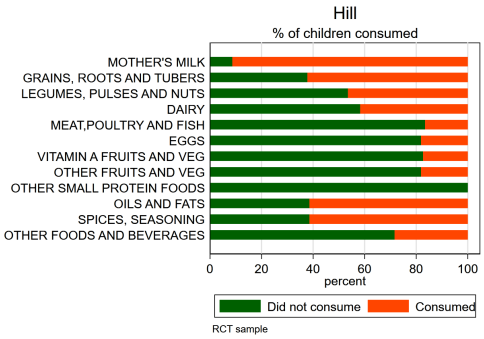


Figure 4.4: Food consumption - Hill

Figure 4.5: Male headed households

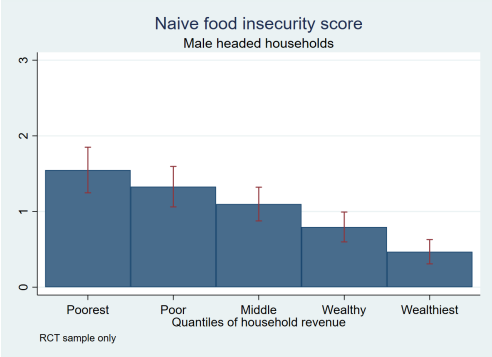
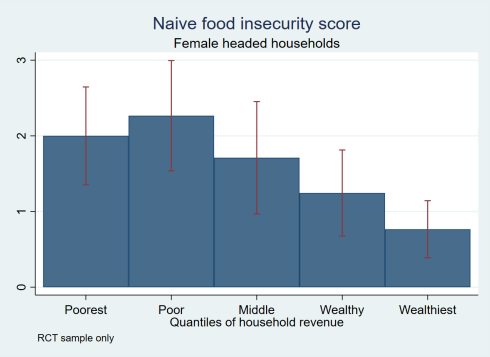


Figure 4.6: Female headed households



below shows that households in early and late starter villages had the same prevalence of food insecurity.

To understand if the gender of household head has any effect on prevalence of food insecurity, we constructed a naive food insecurity score, which simply counted to how many food insecurity questions the household responded with an affirmative answer. The results in figure4.5 and 4.6 show that on average households in bottom 20% of cash revenue strata had the highest affirmative responses, suggesting that poorest households experience the most food insecurity. This inequality was even starker when we divided the sample into male and female headed households, with the latter responding "yes" to 2 food insecurity questions on average.

The relationship between FIES and naive food insecurity score is presented in figure 4.7. The lower FIES scores are generally associated with less food insecurity. Households that answered "no" to all food insecurity questions were given a value of -10 in FIES scores. The sample mean of -8.6 falls within the "Mild" food insecurity category. This was calculated using the mean value at baseline and standard deviations (SD). Households with FIES scores above -6.2 are considered to be "Moderately" food insecure, which is defined as households 2 SD above the mean. The remaining households which had FIES scores above -3.9 are considered to be in "Severe" food insecurity category. These definitions were created at the request of the project team, and may not be utilized in economics literature.

Figure 4.7: FIES Explanation

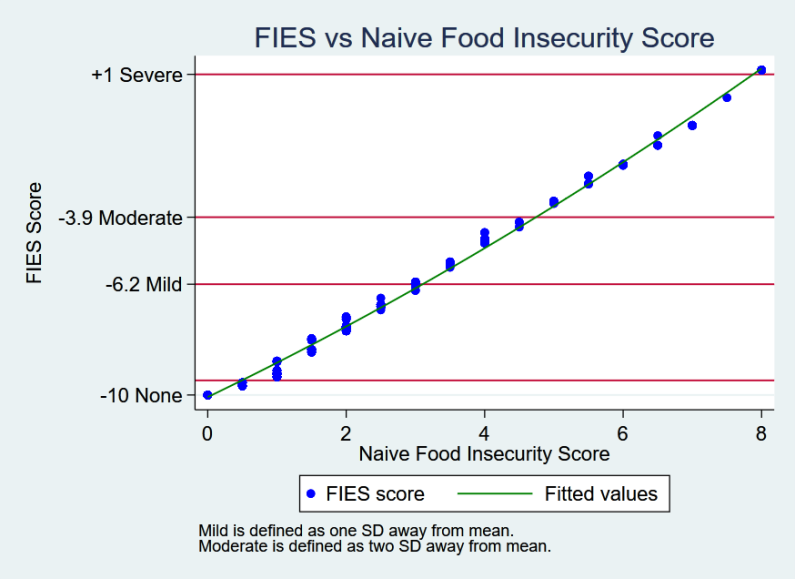


Figure 4.8: FIES Categorization

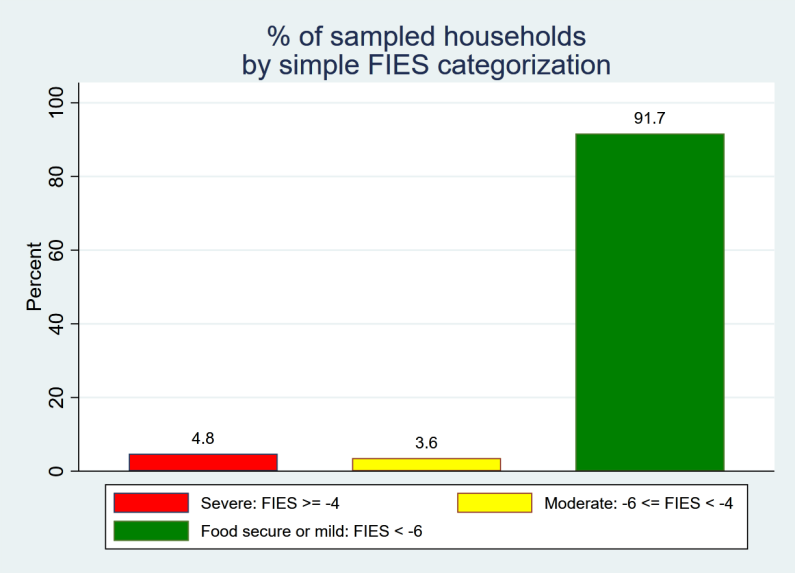


Figure 4.8 shows that 91.7% of sampled households fell into the "Food secure or mild" food insecurity categorization. Only 3.6% and 4.8% of households fell into the "Moderate" or "Severe" food insecurity categorization.

Table 4.1: Food insecurity

Variable	N	(1) early Mean/SE	N	(2) late Mean/SE	T-test Difference (1)-(2)
Atleast one category of food insecurity-women	681	0.43	388	0.44	-0.02
		(0.02)		(0.03)	
Atleast one category of food insecurity-men	538	0.41	301	0.44	-0.04
		(0.02)		(0.03)	
Naive food security score - Male hh head	582	1.02	302	1.10	-0.08
		(0.07)		(0.10)	
Naive food security score - Female hh head	131	1.41	98	1.84	-0.43
		(0.17)		(0.24)	
Predicted Food Insecurity score - Woman	677	-8.70	387	-8.49	-0.21
		(0.09)		(0.13)	
Predicted Food Insecurity score - Man	536	-8.76	300	-8.65	-0.11
		(0.10)		(0.13)	

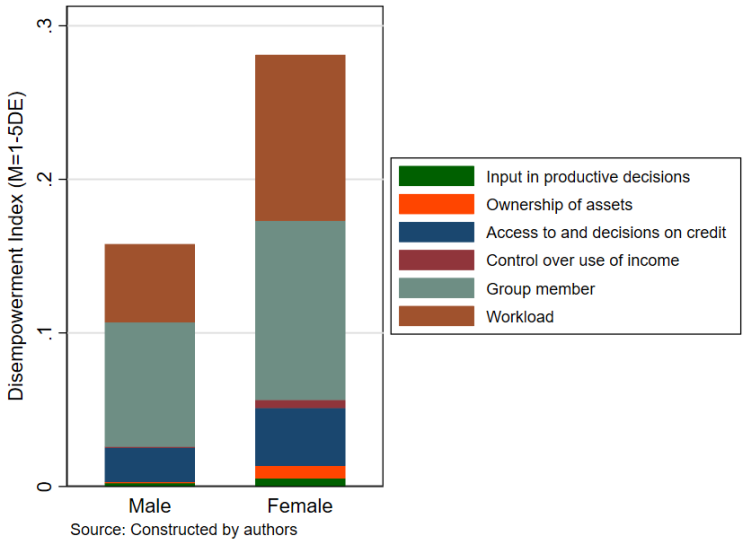
Chapter 5

Women's Empowerment Module

5.1 Empowerment in agriculture

Women's empowerment in agriculture index was calculated using the WEIA-A module from the International Food Policy Research Institute (IFPRI). This module includes information about the role women play in decision-making in the household across a range of topics, including household expenditure and decisions about agriculture. The figure 5.1 below shows that, on average, women are more dis-empowered than men. The two major contributors to women's dis empowerment were excessive workload and lack of group membership. Group membership looked at whether the man and women were members of any types of community groups. The list of groups included water users associations, microfinance groups, or women's' groups.

Figure 5.1: Contribution of Each Indicator to Dis-empowerment for Women and Men in Nepal



Source: Constructed by authors

5.2 Time use

The amount of work conducted by women compared to men is presented in this section. Both male and female respondents were asked to fill out a 24 hour time calendar for the last completed day. The time use was captured in increments of 15 minutes. Figures 5.2 and 5.3 show the total amount of time each group spent in one of the three broad categories of activities. Overall this shows that women spend a larger share of their time working compared to men. Men spend more hours on personal time, especially during mid-day and evening.

Figure 5.2: Total time allocation - females

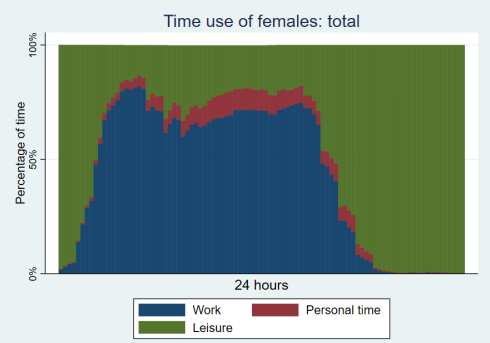


Figure 5.3: Total time allocation - males

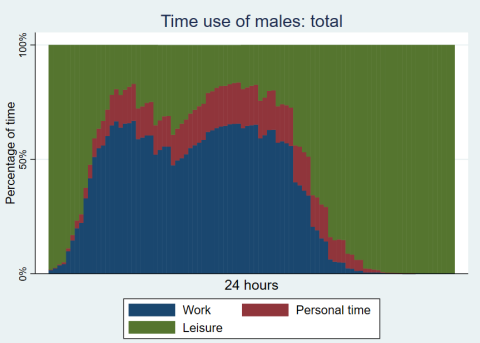
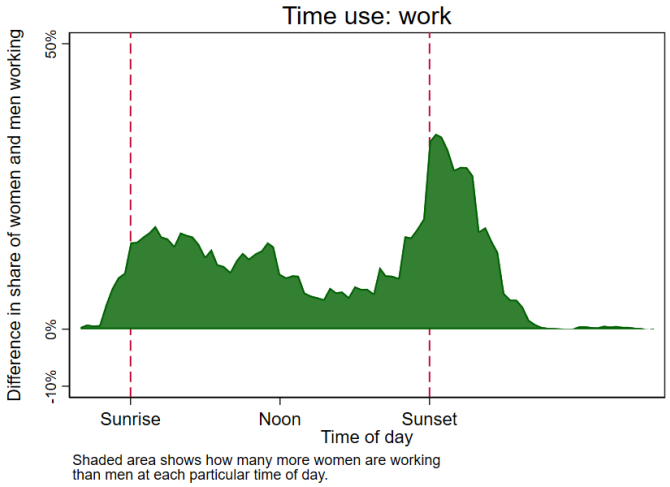


Figure 5.4 shows the gender gap in time use, meaning positive values show what extra percentage of women are conducting work over men. For example, a +10% at noon suggests that 10% more women are working than men at noon. The overall pattern in this gap-graph suggests that women do disproportionately more work after sunrise and after sunset.

Figure 5.4: Gap in time use



This inequality is driven by time spent cooking food, as shown in figure 5.5. Women see a sharp jump in the share of time spent cooking after sunrise and sunset, while men do not spend any significant time cooking. A higher share of men start farm work at sunrise than women, but this share becomes equal in the afternoon until sunset. At sunset the share of women who spending time cooking increases while for men there is not change.

Figure 5.5: Time spent working - females

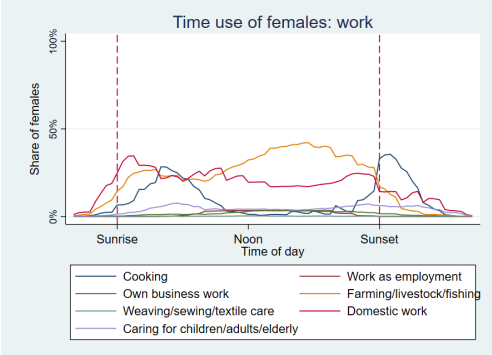
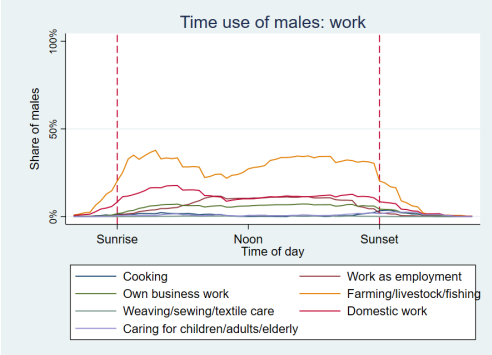


Figure 5.6: Time spent working - males



Chapter 6

Appendix

6.1 Tables

Table 6.1: Household head characteristics - RCT sample

Variable	(1) Hill Mean/SE	(2) Terai Mean/SE
Household head is low caste	0.66	0.38
	(0.02)	(0.03)
Household head is from religious minority	0.07	0.07
	(0.01)	(0.02)
HH head age	51.12	46.15
	(0.50)	(0.92)
Household head is female	0.20	0.22
	(0.01)	(0.03)
HH head education	1.94	2.17
	(0.04)	(0.10)
House has cement roof	0.13	0.17
	(0.01)	(0.03)
Household has loans	0.70	0.65
	(0.02)	(0.03)
Household has savings	0.57	0.21
	(0.02)	(0.03)
Household has mobile phone	0.96	1.00
	(0.01)	(0.00)
Household has pregnant woman	0.04	0.03
	(0.01)	(0.01)
# children 0 - 2 years old	0.21	0.40
	(0.02)	(0.05)
# children 0 - 5 years old	0.48	0.88
	(0.02)	(0.08)
N	903	210

Notes: Adivasi/Janjati and Dalit were included into lower caste variable

Table 6.2: Farmer group membership and extension support

	(1) RCT		(2) RDD-Eligible		(3) RDD-Ineligible	
Variable	N	Mean/SE	N	Mean/SE	N	Mean/SE
Farmer group membership - PMT	1090	0.09	612	0.11	299	0.09
		(0.01)		(0.01)		(0.02)
Farmer group membership - current	1113	0.22	612	0.31	299	0.30
		(0.01)		(0.02)		(0.03)
HH received any support - current	1113	0.16	612	0.14	299	0.14
		(0.01)		(0.01)		(0.02)
Household received support from fansep in last 2 years	1113	0.05	612	0.03	299	0.03
		(0.01)		(0.01)		(0.01)
HH received seeds from AKC in last 6 months	1113	0.25	612	0.30	299	0.28
		(0.01)		(0.02)		(0.03)
HH received chicks from AKC in last 6 months	1113	0.01	612	0.02	299	0.01
		(0.00)		(0.01)		(0.01)
Household is member of water use group	1113	0.25	612	0.32	299	0.35
		(0.01)		(0.02)		(0.03)
Household is member of forest group	1113	0.23	612	0.33	299	0.34
		(0.01)		(0.02)		(0.03)
Household is member of credit or micro-finance group	1113	0.18	612	0.19	299	0.19
		(0.01)		(0.02)		(0.02)
Household is member of self-help group	1113	0.08	612	0.06	299	0.08
		(0.01)		(0.01)		(0.02)
Household is member of civic or charitable group	1113	0.03	612	0.03	299	0.06
		(0.01)		(0.01)		(0.01)
Household is member of religious group	1113	0.07	612	0.08	299	0.08
		(0.01)		(0.01)		(0.02)
Household is member of mother health group	1113	0.19	612	0.21	299	0.24
		(0.01)		(0.02)		(0.02)
Household is member of other group	1113	0.03	612	0.03	299	0.03
		(0.01)		(0.01)		(0.01)

Notes: AKC - Agriculture Knowledge Center

Table 6.3: Baseline balance PDO indicators - RCT sample

Variable	N	(1) early Mean/SE	N	(2) late Mean/SE	T-test Difference (1)-(2)
Indicator 2 Grains	665	2.53	367	2.46	0.07
		(0.06)		(0.08)	
Indicator 2 Vegetables	234	8.06	104	9.37	-1.31
		(0.85)		(1.39)	
Weight of goats	241	18.87	127	18.44	0.43
		(0.61)		(0.76)	
Weight of chickens	225	2.26	133	2.26	-0.00
		(0.09)		(0.10)	
Liters of milk per animal	279	657.28	156	563.56	93.72*
		(32.56)		(45.31)	
Indicator 3	713	241398.54	400	217403.99	23994.54
		(14922.17)		(11950.80)	
Indicator 3 - female HH	582	249541.81	302	214310.99	35230.82
		(17686.62)		(14014.80)	
Indicator 3 - male HH	131	205220.00	98	226935.48	-21715.48
		(20351.93)		(22768.72)	
FIES score	710	-8.68	398	-8.43	-0.25*
		(0.08)		(0.13)	
FIES score - female HH	130	-8.30	98	-7.70	-0.60
		(0.23)		(0.33)	
FIES score - male HH	580	-8.76	300	-8.67	-0.09
		(0.09)		(0.13)	
Naive food insecurity score	713	1.09	400	1.28	-0.19*
		(0.06)		(0.09)	
MDD - women	116	0.44	57	0.46	-0.02
		(0.05)		(0.07)	
MAD - child	113	0.21	60	0.13	0.08
		(0.04)		(0.04)	
Indicator 8	666	0.21	368	0.20	0.01
		(0.01)		(0.02)	
Indicator 9	516	6.83	299	6.94	-0.11
		(0.08)		(0.10)	

Notes: The value displayed for t-tests are the differences in the means across the groups. ***, **, and * indicate significance at the 1, 5, and 10 percent critical level.

6.1.1 Plot and crop tables

Table 6.4: Plot level information

Variable	N	(1) 1 Mean/SE
Average plot area - hectares	3229	0.13 (0.00)
Area planted in summer - hectares	3229	0.12 (0.00)
Area planted in winter - hectares	3229	0.06 (0.00)
Area planted in spring - hectares	3229	0.07 (0.00)
Total area planted annually - hectares	3229	0.25 (0.00)
Cropping intensity as percentage	3229	186.13 (0.96)
Share of plots owned	3229	0.81 (0.01)
Area owned - hectares	2626	0.12 (0.00)
Share of plots sharecropped	3229	0.08 (0.00)
Area sharecropped - hectares	258	0.15 (0.01)
Share of land with fertilizer	3229	0.69 (0.01)
Area with fertilizer applied - hectares	3229	0.19 (0.00)
Share of land with pesticide	3229	0.17 (0.01)
Area with pesticide applied - hectares	3229	0.06 (0.00)
Share of plots with irrigation	3229	0.39 (0.01)
Area under irrigation - hectares	3229	0.06 (0.00)

Notes: Farmer self reported plot sizes are reported. The value displayed for t-tests are the differences in the means across the groups. ***, **, and * indicate significance at the 1, 5, and 10 percent critical level.

Table 6.5: Crops grown by season: Terai

	No.
Crops planted in summer:	
Main Paddy	665
Red Gram	3
Bamboo	9
other trees specify	3
Mango	31
Total	711
Crops planted in winter:	
Wheat	329
Spring/Winter Potato	44
Lentil	130
other nuts specify	41
Mustard	44
Total	588
Crops planted in spring:	
Early Paddy	7
Green Gram	21
Beans	2
Spinach /Leafy greens	2
Green Onion	2
Total	34
N	34

Source: Only show 5 most common crops in each season for Terai households

Table 6.6: Crops grown by season: Hills

	No.
Crops planted in summer:	
Main Paddy	715
Summer Maize	89
Millet	969
Black Gram	80
Beans	180
Total	2,033
Crops planted in winter:	
Wheat	357
Spring/Winter Potato	139
Summer Potato	29
Mustard	222
Cauliflower	33
Total	780
Crops planted in spring:	
Early Paddy	46
Spring/WInter Maize	35
Summer Maize	1,561
Summer Potato	66
Beans	88
Total	1,796
N	1,796

Source: Only show 5 most common crops in each season for Hill households

Table 6.7: Seed replacement rate: early vs late villages - RCT sample

		(1) early		(2) late	T-test Difference
Variable	N	Mean/SE	N	Mean/SE	(1)-(2)
Seed Replacement Rate: paddy	438	0.29	259	0.30	-0.01
		(0.02)		(0.03)	
Seed Replacement Rate: maize	529	0.18	276	0.13	0.05*
		(0.02)		(0.02)	
Seed Replacement Rate: wheat	232	0.15	135	0.25	-0.10**
		(0.02)		(0.04)	
Seed Replacement Rate: potato	154	0.11	78	0.10	0.01
		(0.03)		(0.03)	
F-test of joint significance (F-stat)					1.59
F-test, number of observations					50

Notes: Low number of observations in F-test is due to few households cultivating all 4 crops.

Table 6.8: Seed replacement rate: eligible vs not eligible households - RDD sample

Variable	(1) Ineligible N	(1) Ineligible Mean/SE	(2) Eligible N	(2) Eligible Mean/SE	T-test Difference (1)-(2)
Seed Replacement Rate: paddy	177	0.29	295	0.29	-0.00
		(0.03)		(0.02)	
Seed Replacement Rate: maize	228	0.20	377	0.16	0.03
		(0.03)		(0.02)	
Seed Replacement Rate: wheat	75	0.13	136	0.14	-0.01
		(0.04)		(0.03)	
Seed Replacement Rate: potato	68	0.16	131	0.13	0.03
		(0.04)		(0.03)	
F-test of joint significance (F-stat)					0.60
F-test, number of observations					32

Notes: Using bandwidth suggested by rdrobust command on paddy SRR.

6.1.2 Livestock descriptive tables

Table 6.9: Livestock ownership and number owned

Animal type	Percent of households that owns this animal - %	If yes, average number owned	Total
Adult milking cattle	18	1	15
Adult dry cow	10	1	9
Heifer	15	1	13
Male calf/ bull	36	2	27
Adult milking buffalo	27	1	21
Adult dry buffalo	12	1	11
Female buffalo calf	21	1	18
Male buffalo calf/bull	23	1	19
Goat - adult doe	43	3	31
Goat - adult buck	43	3	31
Goat - female hogget	77	3	45
Goat - male hogget	42	2	30
Goat kids	61	3	39
Cocks	49	6	35
Hens	58	5	38
Broiler chickens	3	370	16
Chicks	41	14	33
Other livestock	7	7	7

Source: Average value calculated conditional on ownership of animal.

Table 6.10: Goat descriptive statistics

	Goat types					
	Goat - adult doe No.	**Goat - adult buck** No.	**Goat - female hogget** No.	**Goat - male hogget** No.	**Goat kids** No.	**Total** No.
Number owned in last 12 months						
1	173	138	216	186	152	865
2	122	133	216	126	208	805
3	74	72	158	73	110	487
4	43	42	101	32	83	301
5+	67	95	163	51	128	504
Total	479	480	854	468	681	2,962
Number sold in last 12 months						
0	403	378	761	360	634	2,536
1	40	47	56	62	20	225
2	16	35	19	19	18	107
3	12	12	9	14	4	51
4	4	6	6	6	2	24
5+	4	2	2	7	3	18
Total	479	480	853	468	681	2,961
Goat local breed						
Khari	301	278	481	291	386	1,737
Sinhal	34	32	81	40	62	249
Tarai	32	71	119	14	90	326
Unknown	79	68	128	87	100	462
Total	446	449	809	432	638	2,774
Improved breed						
Boer	11	11	8	9	17	56
Jamunapari	24	24	39	25	23	135
Saanen	1	1	1	0	0	3
Total	36	36	48	34	40	194
Animal produced meat						
No	420	238	827	359	672	2,516
Yes	59	242	27	109	9	446
Total	479	480	854	468	681	2,962
Animal produced milk						
No	479	480	854	468	681	2,962
Total	479	480	854	468	681	2,962
N	479	480	854	468	681	2,962

Source: RCT sample only: 1113 households

Table 6.11: Goat means statistics

Variable	Goat types					Total
	Goat - adult doe	**Goat - adult buck**	**Goat - female hogget**	**Goat - male hogget**	**Goat kids**	
Number owned in last 12 months	2.4	2.6	2.7	2.2	2.7	2.6
Number lost to disease in last 12 months	0.3	0.2	0.4	0.4	0.5	0.4
Goat mortality: Percent	9.3	5.4	9.0	11.5	11.0	9.3
Number sold in last 12 months	0.3	0.4	0.2	0.4	0.1	0.3
Income from sale of goats in last 12 months	8,411.9	27,285.3	13,083.7	15,662.6	6,134.8	15,565.5
Number purchased in last 12 months	0.2	0.4	0.1	0.1	0.0	0.1
Total cost of purchased goats in NPR	8,017.0	42,179.5	15,055.4	12,903.3	6,006.7	20,430.9
Quantity of meat produced: KG	16.4	50.6	18.4	19.6	11.6	35.9
Quantity of meat consumed: KG	6.0	11.5	7.6	9.5	7.1	10.0
Quantity of meat given away: KG	0.4	0.5	0.0	1.1	0.8	0.6
Quantity of meat sold: KG	13.9	55.7	14.3	18.1	9.3	39.0
Income from meat sale: NPR	7,304.5	38,857.0	4,970.6	14,141.5	4,850.0	27,001.0
Age of goat at sale in months	9.3	14.9	45.1	11.7	8.4	15.0
Weight of goat at sale in KG	8.8	22.4	13.7	15.1	7.1	18.0

Source: RCT sample only

Table 6.12: Cow descriptive statistics

	Cow types				
	Adult milking cattle	**Adult dry cow**	**Heifer**	**Male calf/ bull**	**Total**
	No.	No.	No.	No.	No.
Number owned in last 12 months					
1	173	76	137	83	469
2	17	24	27	236	304
3	6	4	5	51	66
4	1	1	1	23	26
5+	1	1	0	9	11
Total	198	106	170	402	876
Number sold in last 12 months					
0	175	99	154	340	768
1	22	5	15	31	73
2	1	2	0	31	34
Total	198	106	169	402	875
Improved breed					
Haryana	0	0	0	1	1
Jersey	31	7	19	17	74
Total	31	7	19	18	75
Animal produced milk					
No	7	106	113		
Yes	191	0	191		
Total	198	106	304		
N	198	106	304		

Source: RCT sample only: 1113 households

Table 6.13: Cow means statistics

Variable	Cow types				Total
	Adult milking cattle	**Adult dry cow**	**Heifer**	**Male calf/ bull**	
Number owned in last 12 months	1.2	1.4	1.2	2.1	1.6
Number lost to disease in last 12 months	0.1	0.1	0.1	0.1	0.1
Cow mortality: Percent	6.4	5.8	6.2	5.5	5.9
Number sold in last 12 months	0.1	0.1	0.1	0.2	0.2
Income from sale of cow in last 12 months	14,456.6	6,857.3	2,666.7	18,504.9	14,652.4
Number purchased in last 12 months	0.1	0.0	0.1	0.2	0.1
Total cost of purchased cow in NPR	27,468.8	3,800.2	3,529.0	21,821.1	19,931.8
Quantity of milk produced: liters	512.5				512.5
Quantity of milk consumed: liters	375.0				375.0
Quantity of milk given away: liters	5.0				5.0
Quantity of milk sold: liters	125.7				125.7
Income from milk sale: NPR	25,883.4				25,883.4
Milk produced per cow: Liters	478.3				478.3

Source: RCT sample only

Table 6.14: Buffalo descriptive statistics

	Buffalo types				
	Adult milking buffalo	**Adult dry buffalo**	**Female buffalo calf**	**Male buffalo calf/bull**	**Total**
	No.	No.	No.	No.	No.
Number owned in last 12 months					
1	274	111	195	200	780
2	20	25	32	43	120
3	3	1	3	7	14
4	3	0	1	2	6
5+	0	0	4	1	5
Total	300	137	235	253	925
Number sold in last 12 months					
0	254	103	199	209	765
1	43	32	30	41	146
2	2	2	4	2	10
3	0	0	0	1	1
4	1	0	0	0	1
5+	0	0	2	0	2
Total	300	137	235	253	925
Improved breed					
Murrah	12	1	12	9	34
Total	12	1	12	9	34
Animal produced milk					
No	12	137	253	402	
Yes	288	0	0	288	
Total	300	137	253	690	
N	300	137	253	690	

Source: RCT sample only: 1113 households

Table 6.15: Buffalo means statistics

Variable	Buffalo types				Total
	Adult milking buffalo	Adult dry buffalo	Female buffalo calf	Male buffalo calf/bull	
Number owned in last 12 months	1.1	1.2	1.2	1.3	1.2
Number lost to disease in last 12 months	0.0	0.0	0.0	0.0	0.0
Buffalo mortality: Percent	1.3	0.7	2.8	3.4	2.2
Number sold in last 12 months	0.2	0.3	0.2	0.2	0.2
Income from sale of buffalo in last 12 months	65,717.4	37,911.8	29,416.7	25,465.9	40,571.9
Number purchased in last 12 months	0.1	0.1	0.2	0.3	0.2
Total cost of purchased buffalo in NPR	92,034.5	34,571.5	31,187.5	37,214.3	48,181.5
Quantity of milk produced: liters	758.3				758.3
Quantity of milk consumed: liters	487.7				487.7
Quantity of milk given away: liters	16.7				16.7
Quantity of milk sold: liters	252.7				252.7
Income from milk sale: NPR	33,702.2				33,702.2
Quantity of meat produced: KG	382.5	98.3		135.3	144.0
Quantity of meat consumed: KG	202.5	0.0		3.2	17.1
Quantity of meat given away: KG	0.0	0.0		2.0	1.3
Quantity of meat sold: KG	180.0	98.3		130.2	125.6
Income from meat sale: NPR		36,571.4		48,777.8	45,360.0
Milk produced per buffalo: Liters	697.0				697.0

Source: RCT sample only

Table 6.16: Chicken descriptive statistics

	Chicken types				
	Cocks	**Hens**	**Broiler chickens**	**Chicks**	**Total**
	No.	No.	No.	No.	No.
Number owned in last 12 months					
1	75	102	1	1	179
2	90	158	0	15	263
3	64	97	1	14	176
4	70	74	1	29	174
5+	249	213	35	394	891
Total	548	644	38	453	1,683
Number sold in last 12 months					
0	455	589	10	435	1,489
1	30	19	1	1	51
2	21	11	0	3	35
3	11	9	1	3	24
4	10	5	0	4	19
5+	21	11	26	7	65
Total	548	644	38	453	1,683
Improved breed					
New_Hampshire	1	5	6	1	13
Total	1	5	6	1	13
Poultry produced meat					
No	235	473	708		
Yes	313	171	484		
Total	548	644	1,192		
Poultry produced eggs					
No	548	162	710		
Yes	0	482	482		
Total	548	644	1,192		
N	548	644	1,192		

Source: RCT sample only: 1113 households

Table 6.17: Chicken means statistics

Variable	Chicken types				Total
	Cocks	**Hens**	**Broiler chickens**	**Chicks**	
Number owned in last 12 months	3.6	3.2	4.8	4.8	3.8
Number lost to disease in last 12 months	1.2	0.9	80.2	6.3	4.2
Chicken mortality: Percent	16.5	15.2	23.1	36.6	21.5
Number sold in last 12 months	0.5	0.2	3.5	0.1	0.4
Income from sale of chicken in last 12 months	3,771.0	3,440.2	153,808.2	1,223.3	25,095.7
Number purchased in last 12 months	1.7	1.0	197.8	2.2	6.0
Total cost of purchased chickens in NPR	3,778.7	1,651.9	41,329.7	1,989.6	6,137.7
Quantity of egg produced		66.7			66.7
Quantity of egg consumed		40.4			40.4
Quantity of egg given away		1.2			1.2
Quantity of egg sold		2.6			2.6
Income from egg sale: NPR		1,609.4			1,609.4
Quantity of meat produced: KG	10.6	7.9			9.6
Quantity of meat consumed: KG	6.1	5.2			5.8
Quantity of meat given away: KG	1.5	0.5			1.2
Quantity of meat sold: KG	13.8	15.0			14.1
Income from meat sale: NPR	7,792.8	5,602.0			7,226.3
Age of chicken at sale in months	7.6	7.7			7.6
Weight of chicken at sale in KG	2.4	2.1			2.3

Source: RCT sample only

Table 6.18: Animal service and technology descriptive statistics

	No.
Animal service or technology	
Artificial insemination	21
Colostrum feeding for infants	640
Construction of improved shed	81
Deworming/internal parasite treatment	596
Dipping practices for external parasites	276
Feed (including compounded/concentrated feed, oilseed cakes, wheat bran, rice polish, corn flour etc)	920
Feed animals improved variety of fodder and tree fodder	359
Feeding more nutritious feed 1-2 months before breeding	220
Feeding more nutritious food during breeding season	34
Feeding with Urea Molasses Mineral Blocks (UMMB)	4
Forage conservation (for dry season or lack of food)	380
Hired labor to assist with the management/care of livestock	6
Livestock insurance	51
Preventing inbreeding	261
Stall feeding	574
Use of clean milk production techniques	55
Vaccination against infectious diseases (ex PPR goats, Foot and Mouth disease, Ranikhet chickens)	141
Veterinary services	201
Total	4,820
Who helped implement technology or service	
Farmer group or cooperative meetings	63
Government extension agents	133
Agrovets or other private sector entity	135
No one helped me	4,489
Total	4,820
Source of knowledge: Farmer group or cooperative meetings	
No	4,445
Yes	375
Total	4,820
Source of knowledge: Government extension agents	
No	4,639
Yes	181
Total	4,820
Source of knowledge: Agrovets or other private sector entity	
No	4,449
Yes	371
Total	4,820
Source of knowledge: Media	
No	4,794
Yes	26
Total	4,820
Source of knowledge: Not from elsewhere- my own knowledge	
No	767
Yes	4,053
Total	4,820
Source of knowledge: Don't know	
No	4,818
Yes	2
Total	4,820
N	4,820

Source: RCT sample only: 1113 households

Table 6.19: Animal service and technology used on what animals?

Service	Adult milking cattle	Adult dry cow	Heifer	Male calf/ bull	Adult milking buffalo	Adult dry buffalo	Female buffalo calf	Male buffalo calf/bull	Goat - adult doe	Total
Hired labor	11	1	1	0	6	2	0	0	1	22
Feed	7	1	46	57	10	2	80	81	43	327
Vaccination	15	7	8	14	17	13	17	14	31	136
Veterinary services	58	15	24	84	117	45	51	80	248	722
Livestock insurance	21	2	6	22	47	17	31	31	119	296
Deworming	178	89	138	345	273	120	189	211	413	1,956
Stall feeding	72	34	59	130	116	44	90	91	202	838
Dipping/drenching: parasites	41	0	1	0	68	1	0	2	13	126
Artificial insemination	1	0	0	0	1	0	0	0	0	2
Improved shed	0	0	0	1	2	2	2	2	3	12
Improved fodder	87	39	73	165	130	60	111	118	121	904
UMMB	0	0	0	0	2	2	4	2	1	11
Clean milk production	12	1	0	3	15	3	3	1	6	44
Forage conservation	35	3	3	0	58	5	5	0	34	143
Colostrum feeding	97	40	82	153	188	82	145	146	198	1,131
Food : breeding season	21	0	0	0	39	0	0	2	0	62
Food : before breeding	5	1	0	12	16	5	10	8	42	99
Preventing inbreeding	31	6	4	25	42	3	11	13	28	163

Service	Goat - adult buck	Goat - female hogget	Goat - male hogget	Goat kids	Cocks	Hens	Broiler chickens	Chicks	Other livestock	Total
Hired labor	0	1	1	0	0	0	0	0	0	2
Feed	11	37	43	512	0	0	0	0	2	605
Vaccination	29	44	31	25	4	4	0	3	1	141
Veterinary services	272	447	222	104	26	26	3	4	4	1,108
Livestock insurance	128	214	123	108	17	18	1	4	1	614
Deworming	383	711	407	458	315	356	23	227	56	2,936
Stall feeding	172	317	196	193	0	0	0	0	1	879
Dipping/drenching: parasites	1	205	1	3	0	0	0	0	1	211
Artificial insemination	1	5	29	0	0	0	0	0	0	35
Improved shed	4	3	2	0	0	0	0	0	0	9
Improved fodder	111	186	116	97	1	0	0	0	0	511
UMMB	2	2	1	2	0	0	1	0	1	9
Clean milk production	3	35	3	1	0	0	0	0	1	43
Forage conservation	1	234	2	4	0	1	0	0	2	244
Colostrum feeding	215	344	171	195	37	46	7	33	14	1,062
Food : before breeding	49	98	38	17	5	5	5	0	2	219
Preventing inbreeding	34	104	38	19	11	11	3	6	1	227

Table 6.20: Cost of animal service and technology

Animal service or technology	**Mean** NPR
Artificial insemination	861
Colostrum feeding for infants	0
Construction of improved shed	8,316
Deworming/internal parasite treatment	465
Dipping practices for external parasites	350
Feed (including compounded/concentrated feed, oilseed cakes, wheat bran, rice polish, corn flour etc)	7,013
Feed animals improved variety of fodder and tree fodder	286
Feeding more nutritious feed 1-2 months before breeding	297
Feeding more nutritious food during breeding season	621
Feeding with Urea Molasses Mineral Blocks (UMMB)	1,938
Forage conservation (for dry season or lack of food)	607
Hired labor to assist with the management/care of livestock	75,417
Livestock insurance	2,615
Preventing inbreeding	501
Stall feeding	416
Use of clean milk production techniques	55
Vaccination against infectious diseases (ex PPR goats, Foot and Mouth disease, Ranikhet chickens)	755
Veterinary services	1,955

Source: RCT sample only

6.1.3 Cluster dis-aggregation

We did not specifically sample with aim of calculating Gaupalika/cluster level results, which would have required a much larger survey budget. That's why we can't present dis-aggregation at Gaupalika level. The sample is designed to detect impacts of the project across all sampled households, not Gaupalika-wise. We do however report primary measures such as crop-productivity for the sub-sample taken from each district as a compromise to be able to have as much geographic dis-aggregation as possible. We will therefore have to report baseline status for districts grouping RMs together rather than an individual report per district. It is important to further note that the IE sample has to over-sample communities with at least 20 members and fewer than 130 to ensure that farmers groups in the treatment group were not too delayed in formation. While we can weight the sample of larger villages, the number of households included in large villages was smaller than planned due to COVID-related travel restrictions at the start of baseline data collection. Caution should be taken therefore in extrapolating results to the largest villages, as the sample is best understood as representative of mid-sized communities in the project areas. Additionally for some outcome variables did not have a sufficient number of reporting observations to report a value. For example, for child Minimum Acceptable Diet, some clusters did not have children aged 0-2 in our sample, and some specific crops were not cultivated frequently enough to report yields for every crop. Thus we cannot report on all PDO outcomes at cluster level.

Table 6.21: Income by cluster

	Cluster ID				
Income source:	**Cluster 1** NPR	**Cluster 2** NPR	**Cluster 3** NPR	**Cluster 4** NPR	**Total** NPR
Livestock Profit	27838	17696	8516	8922	20845
Crop Sale Profit + Self-consumed	36461	10552	5459	12276	23269
Business	33828	35374	33655	60931	38172
Rents	4287	4759	247	3798	4092
Sale of land	10345	25009	5479	7000	13893
Remittances	42110	23241	90849	79181	45041
Interest	1140	1019	0	3903	1426
Pension	23557	18905	8441	7973	18946
Gifts	1799	2636	219	239	1719
Other	244	2845	164	283	1015
Wages	52726	81989	70637	70984	65202
Indicator 3	233859	222130	223639	255174	232775

Source: Cluster 1: Gorkha and Dhading Cluster 2: Sindhupalchowk and Dolakha Cluster 3: Mahottari and Dhanusha Cluster 4: Siraha and Saptari

Table 6.22: PDO indicators by cluster

Income source:	Cluster ID				Total
	Cluster 1	**Cluster 2**	**Cluster 3**	**Cluster 4**	
	Value	Value	Value	Value	Value
Indicator 3	233859.1	222129.5	223638.7	255174.3	232775.2
Indicator 3 - female HH	235223.1	232287.9	216100.6	261959.3	237505.9
Indicator 3 - male HH	227326.1	190901.8	235753.5	218535.0	214513.1
FIES score	-8.5	-9.3	-8.0	-7.7	-8.6
FIES score - female HH	-8.3	-9.0	-7.6	-4.5	-8.0
FIES score - male HH	-8.5	-9.4	-8.2	-8.3	-8.7
Naive food insecurity score	1.2	0.6	1.6	1.8	1.2
MDD - women	0.5	0.7	0.3	0.3	0.4
MAD - child	0.2	0.2	0.2	0.1	0.2
Indicator 9	7.0	7.2	6.0	6.3	6.9

Source: Cluster 1: Gorkha and Dhading Cluster 2: Sindhupalchowk and Dolakha Cluster 3: Mahottari and Dhanusha Cluster 4: Siraha and Saptari

6.2 Graphs

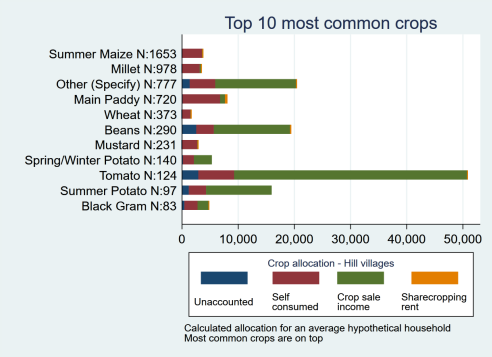


Figure 6.1: Hill villages

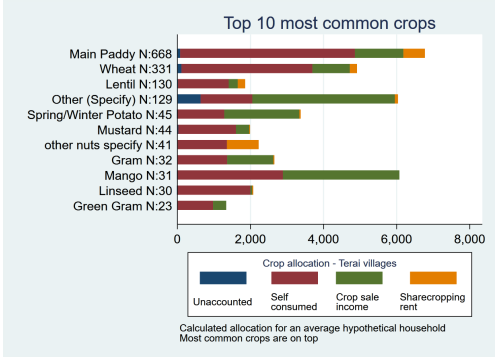


Figure 6.2: Terai villages

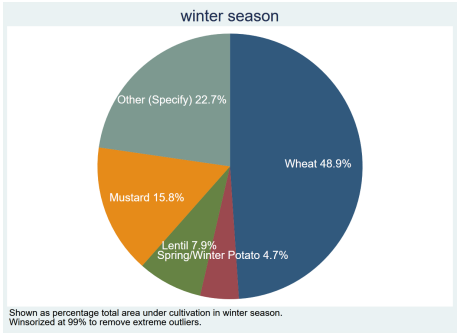


Figure 6.3: Winter 2019
Share of total area planted

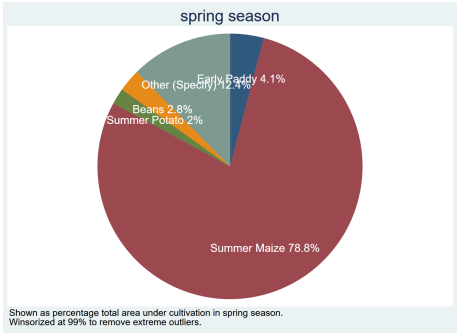


Figure 6.4: Spring 2020
Share of total area planted

Figure 6.5: Summer 2020
Share of total area planted

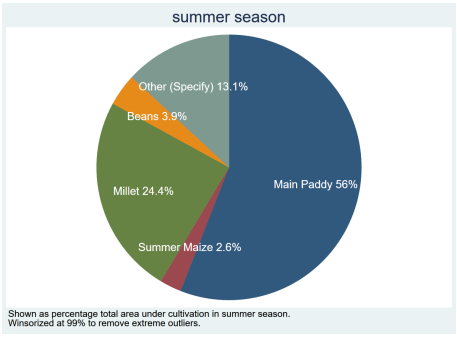


Figure 6.6: Crop knowledge - 80% cutoff villages

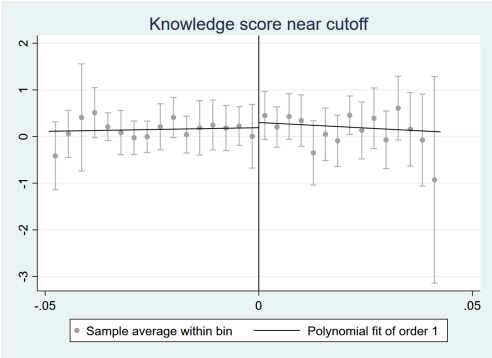


Figure 6.7: Crop knowledge - 90% cutoff villages

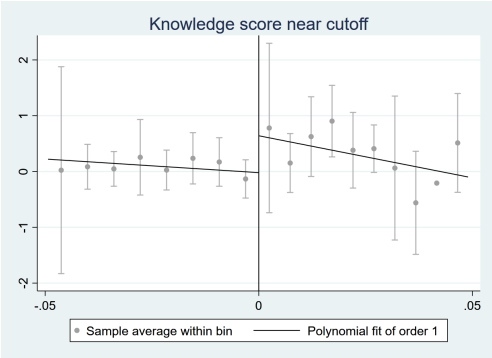


Figure 6.8: Personal time - females

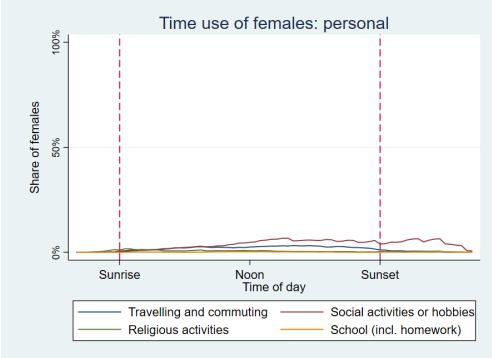


Figure 6.9: Personal time - males

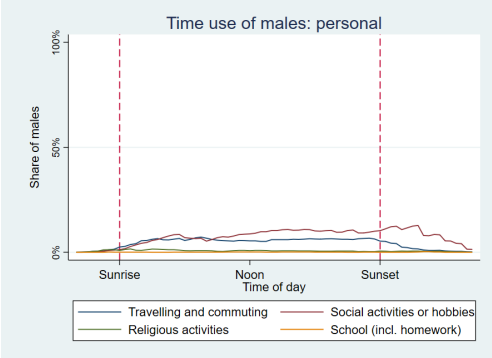


Figure 6.10: Leisure time - females

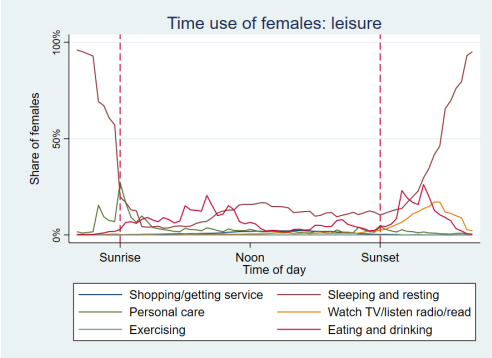
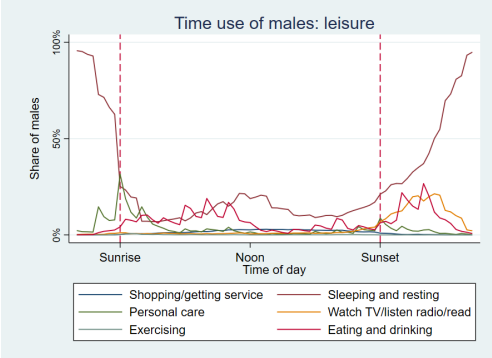
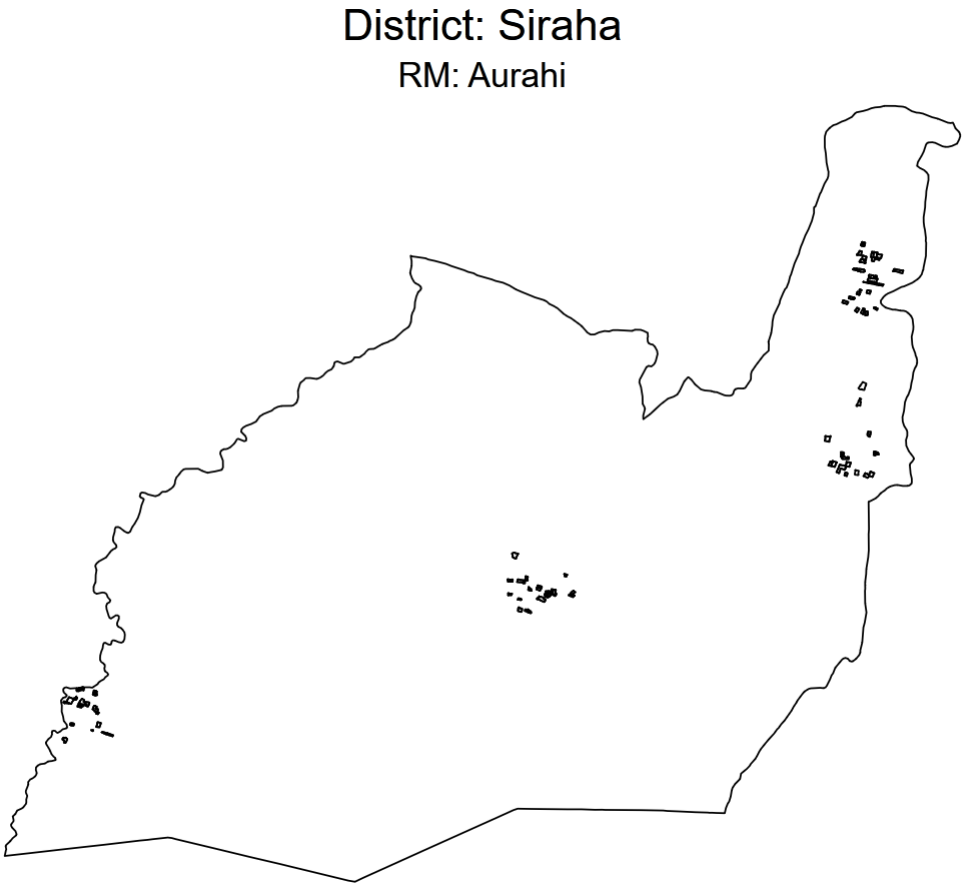


Figure 6.11: Leisure time - males



6.3 Maps of plots

The following maps show the outliers of individual farmer's plots, which were traced using the Android tablets. The area estimated from these plot traces were compared with farmer's self reported areas for same plots.



District: Siraha

RM: Bariyarpatti

District: Saptari

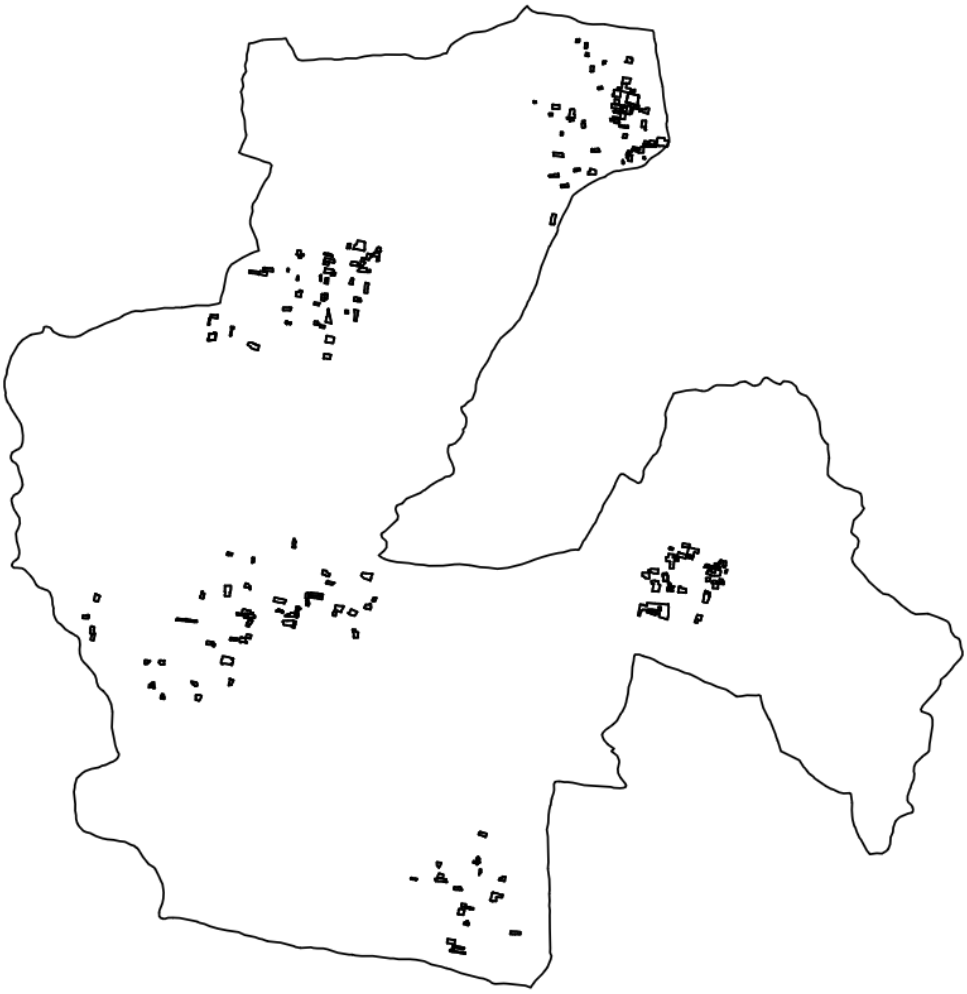
RM: Rajgadh

District: Dhading

RM: Benighat Rorang

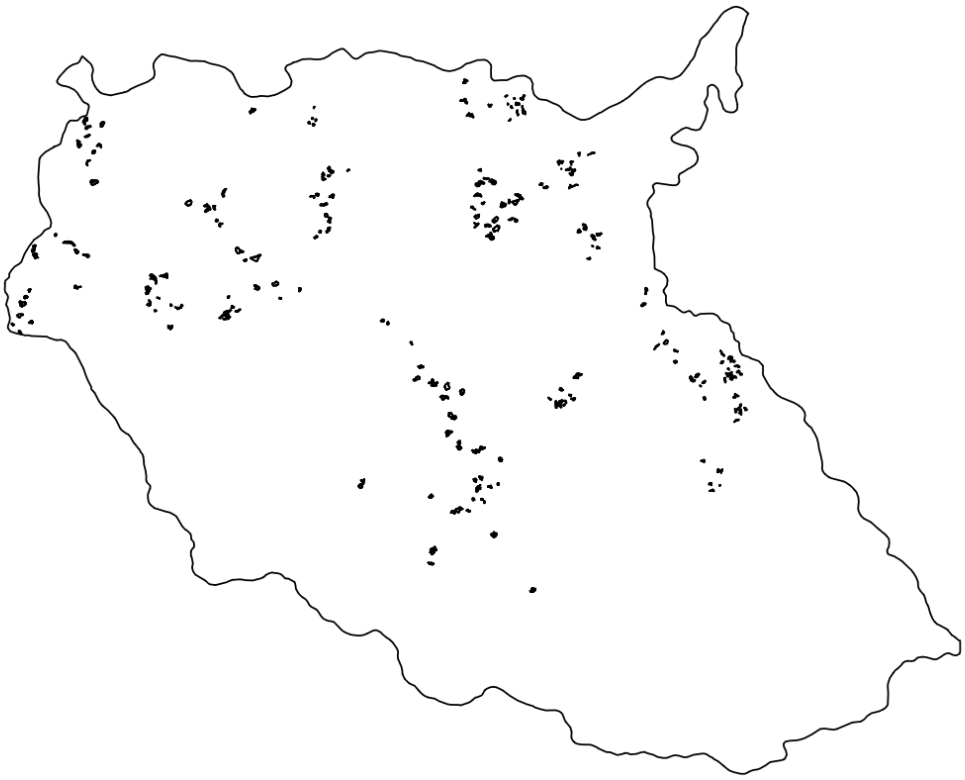
District: Saptari

RM: Bishnupur



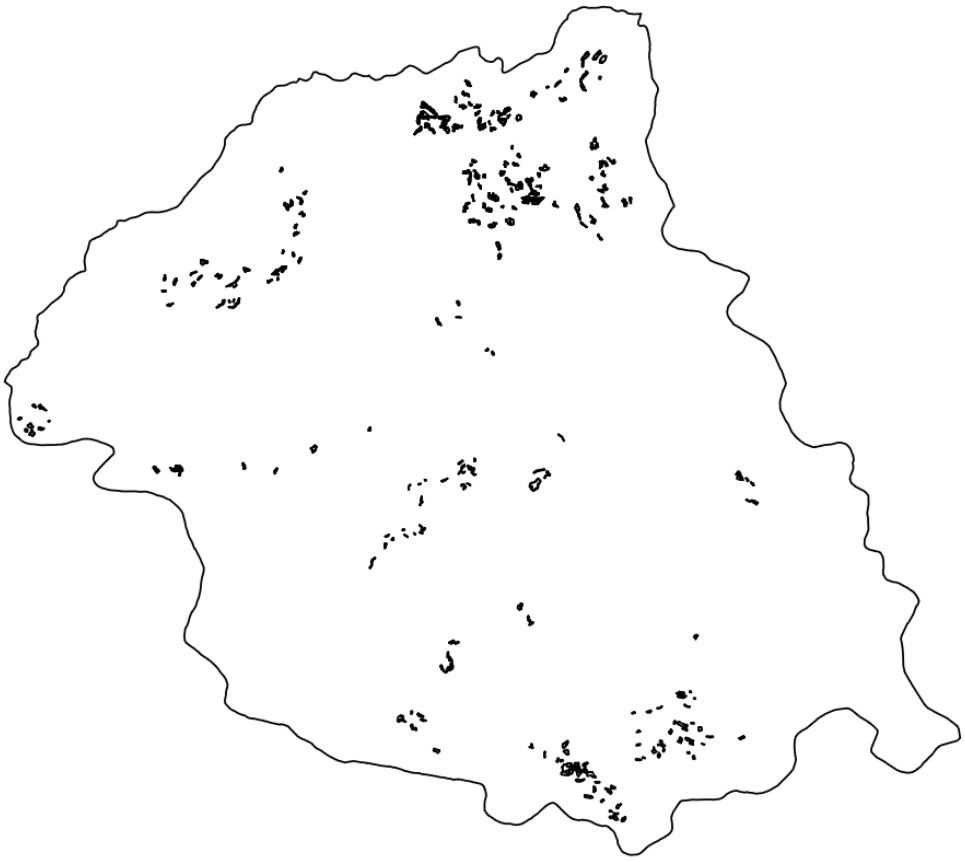
District: Dhading

RM: Gajuri



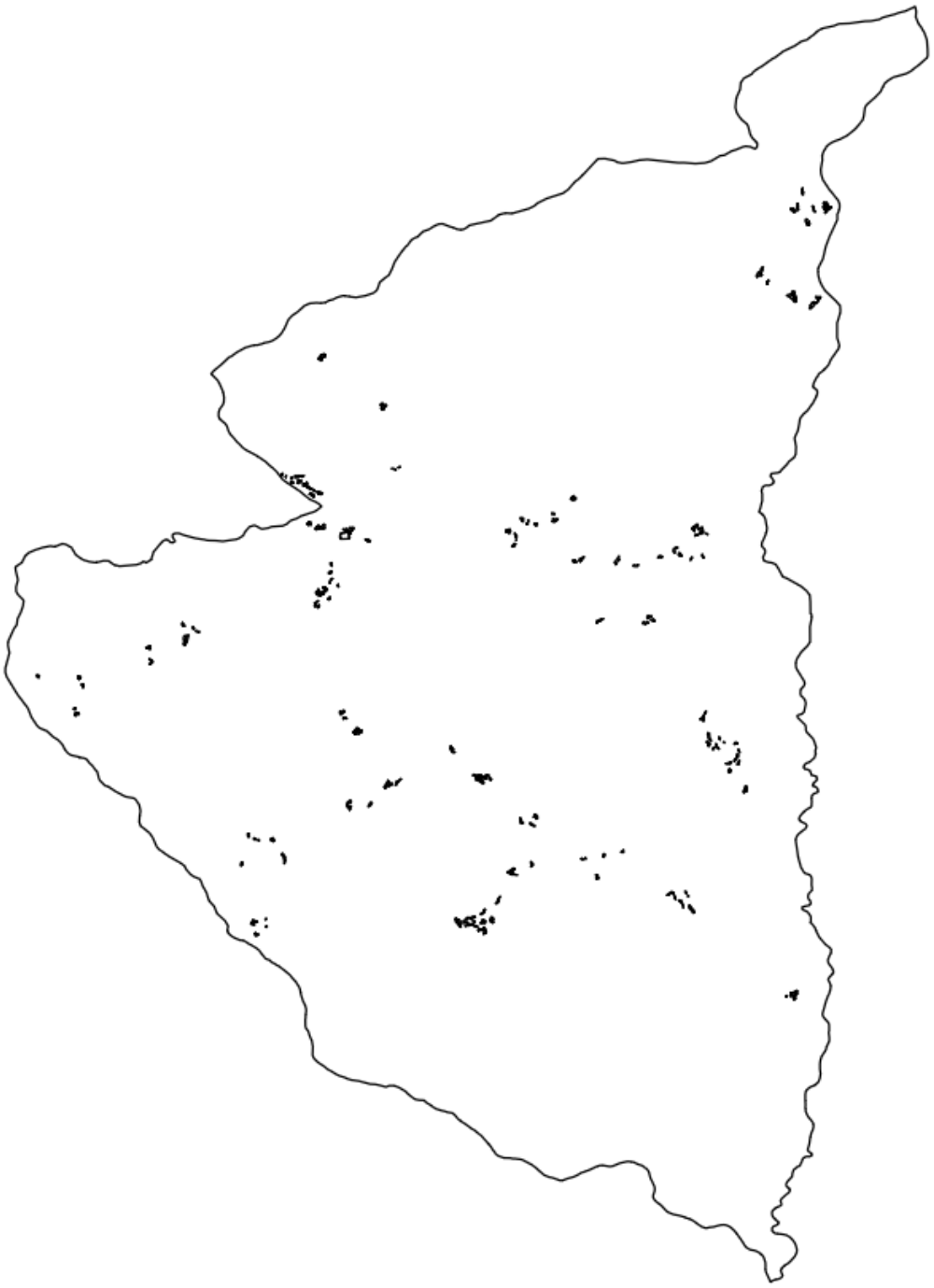
District: Gorkha

RM: Gandaki



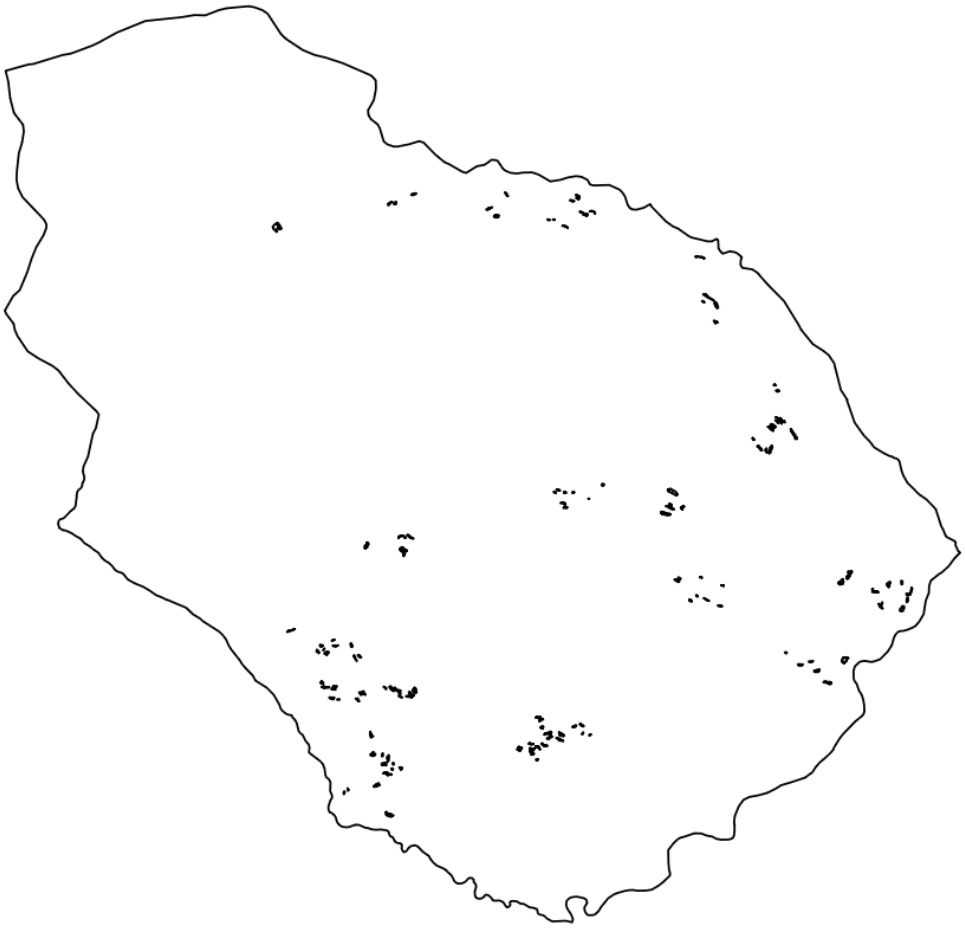
District: Sindhupalchok

RM: Indrawati



District: Dolakha

RM: Kalinchok



District: Sindhupalchok

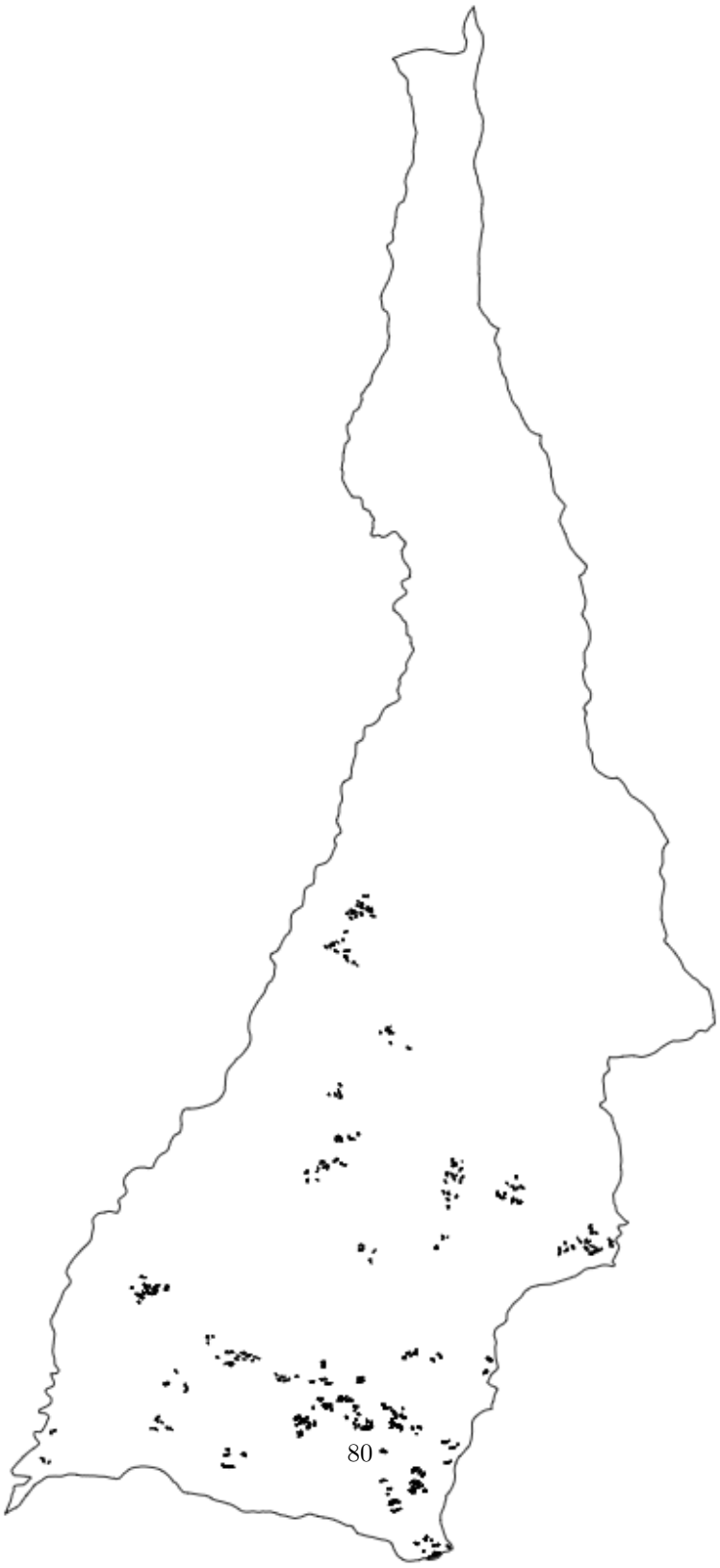
RM: Lisangkhu Pakhar

District: Mahottari

RM: Pipra

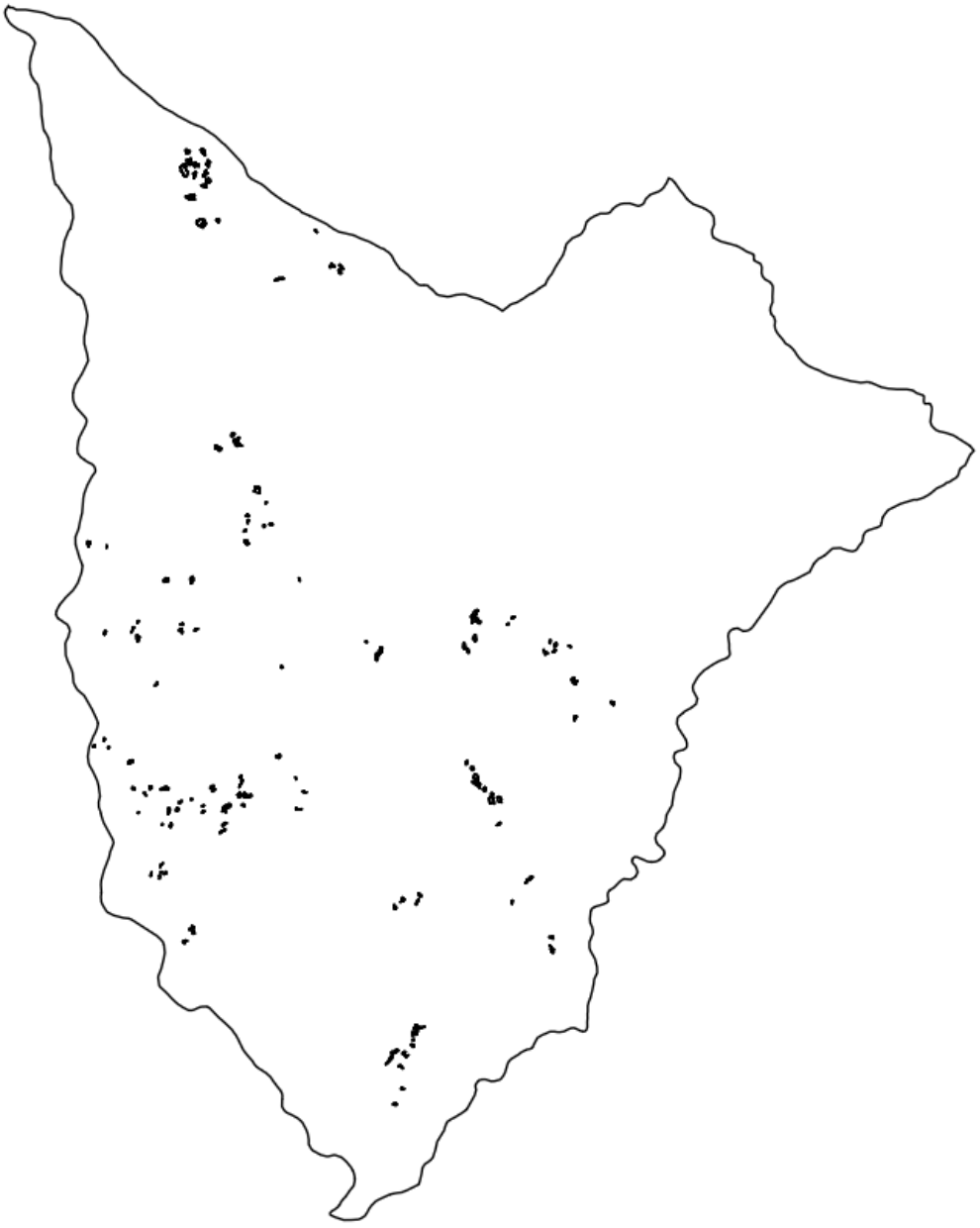
District: Gorkha

RM: Barpak Sulikot



District: Dolakha

RM: Tamakoshi



6.4 Literature review

The literature on rural livelihoods programs in South Asia mostly suggests that these interventions can alleviate poverty and improve welfare but suggests that targeting interventions to the populations who benefit the most is an important element in success. One of the core goals of FANSEP is to find ways to fundamentally alter the productive capacity of farmers through both transfer of materials and capacity building. One component of this program is the transfer of livestock assets to targeted households. Janzen et al (2018) [1] study a livestock transfer intervention that includes formation of livelihoods groups, technical training, and nutrition programming, and find that after 1.5 years, participants show higher financial inclusion and women's empowerment, but no higher income, food security, or household expenditure than comparable households in a randomized control group. While the per-beneficiary costs in the intervention they study are lower than those in other productive asset or cash transfer programs, the question arises why this intervention, which is similar to GAFSP interventions, did not show improvements on income or poverty during the study period.

In addition to the transfer of assets, FANSEP will also work with farmers on a number of complimentary interventions through Farmer Field Schools. Bannerjee et al (2015) [2] study a program including a productive asset grant plus training, coaching, financial inter-mediation, and small cash grants across six countries. In all six, they find through a randomized control trial that that incomes increase. In five of the six, including India (the most closely related context to Nepal in the study), in contrast to Janzen et al (2018) [1], they find that consumption increases relative to the control group.

A distinct feature of FANSEP relative to AFSP is to target the program to the most vulnerable households within the community. Bandiera et al (2017) [3] suggest starting poverty status of households can be instrumental in mediating how these interventions affect household welfare. They study the labor choices of women in rural Bangladesh through a large randomized control trial of livestock transfer and training program, and find that heterogeneous responses by different households to the intervention explain why the same intervention could sometimes lead to sustained improvements in income but not always. In their context, labor markets are clearly segmented. The relatively wealthy women are able to buy assets such as livestock that earn relatively high returns. Poorer women who cannot access such assets are trapped in low return agricultural labor. When the poorer women were offered an animal and trained on how to take care of it, they were able to move out of the low return labor equilibrium. These findings suggest not only that interventions structured like the one proposed by FANSEP can be effective, but that targeting is important to maximize returns from these investments. Assets transferred to those who are already well-off enough to purchase them will not change the income growth trajectory for those households. In contrast transferring productive assets and skills to the households trapped in the low return equilibrium do. This finding suggests that a targeted intervention could have greater impacts than one that allows for universal enrollment.

The most closely related study was Christian et al (forthcoming) which focused on the impact of the Agriculture and Food Security Project, which consisted of a suite of farmer-group interventions through a Farmer Field School (FFS) program. Program communities experienced an 18% increase in total income relative to control communities. Livestock income was the primary channel through which farmers realized these gains, relative to more modest impacts on crop income through the improved seeds interventions. This is an encouraging result, but crucially, the first phase AFSP project was not targeted. Any

farmers who lived in the intervention communities and were interested in participating were eligible. Therefore relative to the first AFSP evaluation, this IE will test whether targeting by focusing on relatively disadvantaged households leads to greater benefits for FANSEP households and allow for testing the effectiveness of the project within the same community. The Christian et al study also found that while the AFSP was successful at increasing income of participating farmers, the food security gains in the control group were just as large as in the treated group. However, both groups experienced large gains. The hypothesis by DIME was that the behavioral change interventions implemented by AFSP were designed to improve food security starting at a low level of food security, and other interventions may be more effective at accelerating the nutrition transition seemingly underway in Nepal. The FANSEP project is taking account of these findings by trying new approaches for improving food security such as Nutrition Field School. The IE of FANSEP will test whether these interventions lead to larger differential gains in food security than the approaches pursued by AFSP.

Bibliography

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[2] Abhijit Banerjee, Dean Karlan, and Jonathan Zinman. *Six Randomized Evaluations of Microcredit:Introduction and Further Steps*. American Economic Journal: Applied Economics 2015, 7(1): 1–21. 2015.

[3] Oriana Bandiera, Robin Burgess, Narayan Das, Selim Gulesci, Imran Rasul and Munshi Sulaiman. *Labor markets and poverty in village economies*. Quarterly Journal of Economics, 132 (2). pp. 811-870. 2017.