

Aryal, Jeetendra Prakash; Rahut, Dil Bahadur; Gartaula, Hom Nath

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## Gendered analysis of food security gaps in rural Nepal

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**ADB Working Paper Series**

**GENDERED ANALYSIS OF FOOD  
SECURITY GAPS IN RURAL NEPAL**

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Jeetendra Prakash Aryal,  
Dil Bahadur Rahut, and  
Hom Nath Gartaula

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Jeetendra Prakash Aryal is a consultant at the Asian Development Bank Institute (ADBI) in Tokyo, Japan. Dil Bahadur Rahut is a senior research fellow at ADBI. Hom Nath Gartaula is a gender and social inclusion specialist at the International Maize and Wheat Improvement Center in New Delhi, India.

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Please contact the authors for information about this paper.

Email: [jeetenaryal@gmail.com](mailto:jeetenaryal@gmail.com), [drahut@adbi.org](mailto:drahut@adbi.org), [h.gartaula@cgiar.org](mailto:h.gartaula@cgiar.org)

Asian Development Bank Institute  
Kasumigaseki Building, 8th Floor  
3-2-5 Kasumigaseki, Chiyoda-ku  
Tokyo 100-6008, Japan

Tel: +81-3-3593-5500  
Fax: +81-3-3593-5571  
URL: [www.adbi.org](http://www.adbi.org)  
E-mail: [info@adbi.org](mailto:info@adbi.org)

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**Abstract**

Gender studies on food security have often focused on the differences between male-headed households (MHHs) and female-headed households (FHHs). Hence, they have mostly ignored the possibility of food security gaps between the different types of FHHs, treating them as homogeneous. Therefore, using nationally representative data from Nepal and applying exogenous switching treatment effect regression models, this study investigated whether food security differences exist between *de facto* FHHs (i.e., households managed by a woman whose husband is physically not present at home owing to work outside) and *de jure* FHHs (i.e., households managed by a single, widowed, or divorced woman). Contrary to the general hypothesis, this study did not find any significant difference in the food security status between MHHs and FHHs. Nevertheless, it found that food security is significantly lower among *de jure* FHHs than among MHHs. More surprising, considering the common belief, is that the food security difference between *de facto* FHHs and *de jure* FHHs is larger than the difference between *de jure* FHHs and MHHs. It is possible to explain these gaps between MHHs and *de jure* FHHs by unobserved heterogeneity effects but not by treatment effects, while both treatment effects (i.e., differences in returns to their assets, such as participation in off-farm income) and unobserved heterogeneity effects explain the differences between *de facto* and *de jure* FHHs. The results have important policy implications, primarily because they reject the general notion that FHHs are less food secure, and strongly recommend a deeper investigation into the heterogeneity among FHHs. This has a crucial implication for designing government policy related to two important Sustainable Development Goals—gender equality and food security.

**Keywords:** gender, food security, gender inequality, exogenous switching treatment regression, rural Nepal

**JEL Classification:** D10, I31, Q18, R20

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## 1. INTRODUCTION

Gender inequality and food insecurity remain among the key development challenges in Nepal as in other developing countries. Among several factors influencing food security, gender inequality is highly interconnected with food security (von Grebmer et al. 2009). Studies in South Asia have shown that gender equality has important implications for food security and efforts to reduce gender inequality and contribute to the fight against hunger (ADB 2013; Aryal, Mottaleb, and Rahut 2019; Clement et al. 2019). In the Nepalese context, we need to consider the intersectional issues of age, caste, and geographical complexity while exploring the association between gender and food security.

The majority of rural households in Nepal rely on the agricultural sector for their livelihood and food security. The agricultural sector contributes one-third of the gross domestic product and employs almost 75% of the total population (CBS 2014). Furthermore, it employs more than 80% of women in the country, indicating gender as a crucial element to consider for understanding the equity dimensions of food security (FAO 2019). As agricultural productivity growth enhances household food security and its impact on food security is stronger among poorer farmers (Morioka and Kondo 2017), land ownership and access to agricultural markets are fundamental to household food security. The average agricultural landholding size is about 0.7 ha in Nepal, and the majority of farmers operate less than 0.5 ha of land, so farm income, in most cases, is not sufficient to achieve household food security (CBS 2014). The limited possibilities in agriculture and the lack of adequate employment generation in the off-farm sectors within Nepal have led to massive out-migration of Nepalese people.

Another crucial issue in the Nepalese economy is its increasing reliance on remittance income from migrant workers. Data show that about 70% of labor migrants are youths; 87% of them are male (Bossavie and Denisova 2018). Nepal is one of the main remittance-receiving countries in the world, constituting about 28% to 32% of the national gross domestic product (ILO 2017). The remittances that households receive from male migrants obviously contribute to household food security, but the phenomenon of male out-migration changes the roles and relationships among the household members, affecting the overall household welfare and the well-being of the individual household members (Kunz 2008; Gartaula, Visser, and Niehof 2012; Kimet et al. 2019; Pandey 2019; Fakir and Abedin 2020). Therefore, while exploring the relationship between gender and food security, the classical comparison between the universal categories of male-versus female-headed households (MHHs vs. FHHs) may not be appropriate. A careful examination of the heterogeneity prevalent among the female heads of households is necessary.

Male out-migration may cause a household labor shortage, resulting in a negative impact on farm production; however, a recent study in Nepal (Kapri and Ghimire 2020) showed that the overall impact of remittances on agricultural productivity is positive, indicating that income effects offset the potential negative effects of household labor migration. The study further revealed that the impact of remittance income on agricultural productivity is higher in lower quantiles than in higher ones, indicating stronger food security impacts of remittances on poorer households. Apart from the changing household labor dynamics and income through remittances, an important aspect of male out-migration is the changing household structure and headship. It transforms gender norms by pushing women to take on new roles in agriculture together with household labor responsibilities and decision making (Maharjan, Bauer,

and Knerr 2012; Lahiri-Dutt and Adhikari 2016; Sugden, Seddon, and Raut 2018; Fakir and Abedin 2020; Spangler and Christie 2020).

Male out-migration brings both challenges and opportunities to women. On the opportunity side, it increases their control over household expenditure, asset ownership, and productive decision-making and gives them freedom of physical mobility (Fakir and Abedin 2020). On the contrary, the challenges involve taking on additional responsibilities, such as ploughing the land and marketing the agricultural products, in which they have less experience (FAO 2019). Another positive note is that women's land ownership has been increasing in recent years in Nepal (FAO 2019). Given this context, the food security of female-headed households with access to remittance income can differ significantly from that of those without such access. Therefore, this study classified FHHs into two categories: *de facto* FHHs (i.e., when the husband has migrated for work) and *de jure* FHHs (i.e., households with a divorced, separated, or widowed, or single FHH).

The main objective of this study was to examine the gendered food security gap in rural Nepal. We first determined whether there are significant food security gaps between MHHs and FHHs, and then we investigated whether food security gaps exist between *de facto* and *de jure* FHHs. Acknowledging the possible interaction effects of explanatory variables, we applied the exogenous switching treatment effect regression (ESTER) method instead of using the pooled regression method with a gender dummy variable. Additionally, ESTER provides a way to disentangle diverse types of inequality and helps to provide a better explanation for the gendered food security gap (Kassie et al. 2015; Aryal, Mottaleb, and Rahut 2019). In our case, a large sample size helped us to estimate the econometric models without worrying about micronumerosity (Goldberger 1964, 1991).

## 2. GENDER AND FOOD SECURITY ISSUES IN NEPAL

The decreasing trend of the Global Gender Gap Index (GGGI), together with the sub-indices in the areas of health and survival, educational attainment, economic participation and opportunity, and political empowerment, shows that Nepal has made significant progress in closing the gender gap and approaching gender equality (Table 1). However, looking at the same numbers in relation to other countries in the world, there is still much to undertake to realize a real change. In other words, Nepal is making progress, but considerable work is still necessary to close the gender gap.

It is evident that, in the past two decades, Nepal has undergone a significant political transformation from a closed, autocratic monarchy into an open, liberal, multi-party, federal state. The increasing access to information and state and non-state interventions to include women in political, economic, and development processes have increased their exposure to the outside world. Their traditional gender functions of being a housewife and fulfilling a reproductive role have enlarged to include participating in the productive economy by expanding their involvement in the household and agricultural decision-making and contributing to the overall household food security (Upretiet al. 2018; Kimet al. 2019). Women in Nepal make all the decisions when their husbands are absent while participating in joint decision-making even when their husbands are present (Holmelin 2019).

**Table 1: Nepal's Achievement in the Global Gender Gap Index (GGGI) over Time (2006–2020)**

Year	The Global Gender Gap Index Rankings by Sub-index									
	Global Gender Gap Index		Health and Survival		Educational Attainment		Economic Participation and Opportunity		Political Empowerment	
	Score (0–1)	Rank	Score (0–1)	Rank	Score (0–1)	Rank	Score (0–1)	Rank	Score (0–1)	Rank
2020	0.680	101	0.966	131	0.895	133	0.632	101	0.227	59
2018	0.671	105	0.966	128	0.926	123	0.608	110	0.185	66
2012	0.6026	123	0.9612	111	0.7632	128	0.4874	120	0.1989	37
2006	0.5477	111	0.9531	111	0.7336	109	0.4654	100	0.0392	102

## Notes:

1. Authors' compilation from the Global Gender Gap Reports (Hausmann et al. 2006, 2012; World Economic Forum 2018, 2020).
2. A high score (closer to 1) indicates an improvement in the gender gap situation.
3. The scores and ranks are relative to other nations included in the comparisons. Therefore, in some cases, the rank of a nation in the Global Gender Gap Index can change even if there is no change in its score. Details on the methodology for calculating the score and ranking are available from World Economic Forum (2020).

The interface of gender and food security is complex as gender cuts across all the four dimensions of food security: availability, access, utilization, and stability (FAO 2006). The availability and accessibility depend on access to and control over productive resources, income, and employment, while utilization is subject to people's health or the cleanliness of the surrounding environment (hygiene, sanitation, etc.), and stability refers to temporal aspects of all the other three dimensions. The concept of food security entered the academic discussion in the 1970s, when the Food Conference that took place in 1974 defined food security as access to enough food for all people at all times to live an active and healthy life (Maxwell and Smith 1992). The idea of food availability was a precursor to food security at that time.

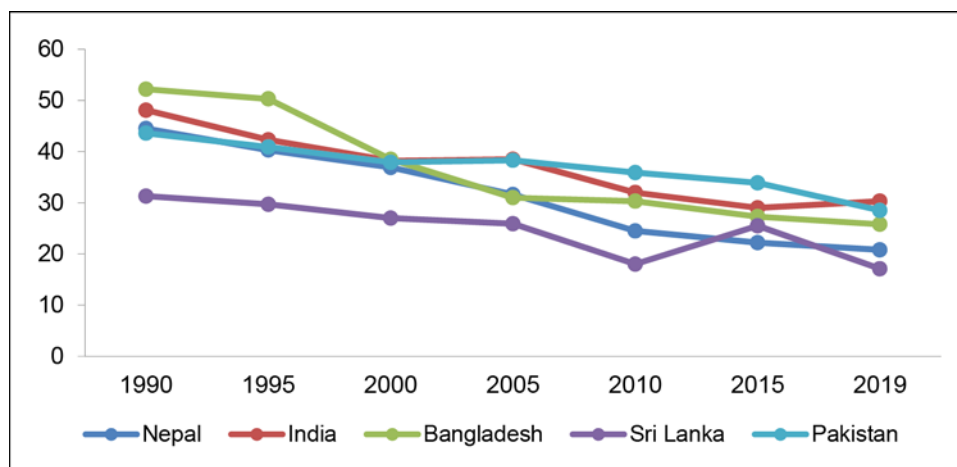
Common to all these four pillars of food security is the emphasis on the availability of and access to food, which people can acquire either from their own production or through purchase, exchange, borrowing, or receiving gifts of food. The seminal work of Amartya Sen (1981) shifted the then-existing emphasis on the adequacy of food supplies to an emphasis on the capability of individuals to access food through entitlements. The individual difference in the capability and entitlements is where gender and food security interconnect, which means that having enough food available for a household does not necessarily guarantee secure access to food for the men and women in a household. To reiterate this perspective, Rao (2020) asserted that food security is hard to achieve without gender equality.

While Nepalese agriculture plays an important role in the domestic food supply, it also generates income for 70% and employment for 66% of Nepalese households, contributing 28% of the country's gross domestic product (Adhikari 2015). Between 1997 and 2017, Nepal's population increased by 24%, from 22.5 to 28.0 million. This expanded population created a huge demand for food in a situation of relatively low yield growth rates of cereals and food distributional challenges, which resulted in the importing of major cereals, like rice (0.54 million tons, worth USD 232 million), wheat (0.14 million tons, worth USD 38 million), and maize (0.35 million tons, worth USD 91 million) in 2017 (FAOSTAT 2019).



In the past decades, the Global Hunger Index (GHI)<sup>1</sup> has decreased across South Asian countries. Comparing Nepal's GHI with those of India, Bangladesh, Pakistan, and Sri Lanka, Nepal's situation is better than that of many of its neighbors, appearing second after Sri Lanka (Figure 1). Even though the number of hungry people has decreased over the years, the achievement is not satisfactory in the global comparison as well as considering the gender, social, and regional inequalities prevalent in the country. In the 2019 GHI, Nepal ranked 73rd out of 117 qualifying countries. With a score of 20.8, Nepal suffers from a level of hunger that is "serious."

**Figure 1: Status of Nepal and its Neighboring Countries in the Global Hunger Index**



Notes:

1. The Global Hunger Index (GHI) score incorporates four major indicators: undernourishment, child wasting, child stunting, and child mortality. A low GHI score (i.e., closer to 0) refers to a better situation. It is possible to categorize GHI scores into five major groups as follows: low (less than or equal to 9.9), moderate (10.0 to 19.9), serious (20.0 to 34.9), alarming (35.0 to 49.9), and extremely alarming (more than 50.0).
2. In 2019, Nepal, with a GHI score of 20.8, ranked 73rd out of 117 countries. It thus suffers from a level of hunger that is serious.
3. For details, see [www.globalhungerindex.org](http://www.globalhungerindex.org).

### 3. DATA AND SAMPLING

The study relied on cross-sectional pooled data that the Central Bureau of Statistics (CBS), Nepal, collected through the Nepal Living Standard Surveys (NLSSs) I, II, and III, which was conducted in 1994, 2004, and 2011, respectively. These surveys followed the Living Standard Measurement Survey (LSMS) approach that the World Bank developed. To select a nationally representative sample, these surveys employed a two-stage stratified sampling method. In the first stage, they selected the smallest administrative units (i.e., wards in Nepal) by applying the probability proportional to size (PPS) method within each of four ecological strata: mountains, hills (urban), hills (rural), and *terai*. Within each ward, the survey sampled 12 households (or 16 households per ward in the Far-Western Region), resulting in a total cross-sectional sample size of 5,988 in 2011. Of the 5,988 sampled households, 3,900 were rural households.

<sup>1</sup> The Global Hunger Index (GHI) is based on four indicators: undernourishment, child wasting, child stunting, and child mortality. The GHI allocates scores using a 0–100-point GHI Severity Scale, where 0 is the best score (no hunger) and 100 is the worst (for more details, visit <https://www.globalhungerindex.org/about.html>).

The development of the sampling frame for NLSS-III used the Nepal Living Force Survey (NLFS-II) of 2008 and the Nepal Population Census of 2001.

NLSS II, which took place in 2004, pursued a similar approach, and the data came from a cross-sectional sample of 4,008 households, of which 1164 were urban households, and 2,748 were rural households. NLSS I, in 1994, used a similar sampling approach and the 1991 population census as the sampling frame; it surveyed a total of 3,373 households from 73 districts against the planned survey of 3,388 households.

## 4. EMPIRICAL FRAMEWORK

Of the several available measures of food security, we adopted a subjective food security measure in which a household subjectively assesses its overall status with regard to its food security. In developing countries, this approach is closer to reality as income- and expenditure-based methods are less reliable in their contexts (Deaton 1997; Kassie, Ndiritu, and Stage 2014; Kassie et al. 2015). In our case, we classified households as food-secure HHs and food-insecure HHs; hence, our variable of interest is binary. In assessing the association between the gender of the household head and the household food security status, we had to choose between two major methodological alternatives to apply. The first method was pooled regression (PR) with a binary gender variable, and the second was exogenous switching treatment effect regression (ESTER). As the interaction effects of gender and other sets of covariates can vary and have different impacts on food security, we applied the ESTER method. The PR method assumes that the set of covariates has the same impact on both male- and female-headed households and thus fails to identify the possible interactions between the gender and the explanatory variables (Kassie, Ndiritu, and Stage 2014; Kassie et al. 2015; Aryal, Mottaleb, and Rahut 2019). Hence, the PR method only presents the intercept effect, also called the parallel shift effect or the homogeneous slope hypothesis, which remains the same, notwithstanding the changing values of other covariates that affect food security.

Before applying the ESTER method, we tested the homogeneous slope hypothesis by applying the Chow test. The test results confirmed the rejection of the homogeneous slope hypothesis at the 0.1% level of significance [ $\chi^2(23) = 102.21^{***}$ ,  $p = 0.000$ ] and indicated the importance of considering interaction effects across genders through the use of the ESTER method. Hence, in our case, first, we present two separate equations for MHHs and FHHs as follows:

$$\begin{cases} y_m = x_m \beta_m + u_m & \text{if } g = 1 \text{ for male-headed households (MHHs)} \\ y_f = x_f \beta_f + u_f & \text{if } g = 0 \text{ for female-headed households (FHHs)} \end{cases} \quad [1]$$

Equation (1) contains two separate binary probit models—one for MHHs and the other for FHHs. The subscripts  $m$  and  $f$  denote MHHs and FHHs, respectively. The variable  $y$  refers to the food security outcomes for each category of HHs, depending on the subscripts.  $x$  is the vector of explanatory variables;  $\beta$  is the coefficient vector expressing how male- and female-headed HHs respond to the explanatory variables, and  $u$  is a stochastic error term.

To assess the role of gender in food security for each category of households, we estimated the counterfactual food security status of each category. The counterfactual indicates the food security status of one category (say FHHs) if the returns (coefficients) to their explanatory variables are the same as the coefficients of the other category (say MHHs). This approach offers a way to compare the expected food security status under the actual and counterfactual cases and helps us to disentangle the effects of gender on food security. We estimated the actual food security status of both categories from our data following Carter and Milon (2005) and Kassie et al. (2015). We computed the actual and counterfactual expected food security status of each category of HHs:

$$E(y_m | g = 1) = x_m \beta_m \quad [1a]$$

$$E(y_f | g = 0) = x_f \beta_f \quad [1b]$$

$$E(y_f | g = 1) = x_m \beta_f \quad [1c]$$

$$E(y_m | g = 0) = x_f \beta_m \quad [1d]$$

where  $E$  is the expectation operator. Equations (1a) and (1b) represent the food security status for MHHs and FHHs that we actually observed in the sample, respectively, while equations (1c) and (1d) are their respective counterfactual expected food security status (see Table 2). The use of these conditional expectations, combined with the consideration of the gender variable as a treatment variable, allowed us to calculate the causal effects of gender on food security as follows.

If MHHs' characteristics had the same returns (coefficients) as FHHs' characteristics, then we can determine the effect of gender on MHHs' food security (MHHsFS) as the difference between equation (1a) and equation (1c) as follows:

$$MHHsFS = E(y_m | g = 1) - E(y_f | g = 1) = x_m (\beta_m - \beta_f) \quad [2]$$

Analogously, we can state the effect of gender on FHHs' food security (FHHsFS)—if their characteristics had the same returns (coefficients) as FHHs' characteristics—as the difference between equation (1d) and equation (1b):

$$FHHsFS = E(y_m | g = 0) - E(y_f | g = 0) = x_f (\beta_m - \beta_f) \quad [3]$$

The MHHsFS and FHHsFS parameters give the expected food security status of a randomly chosen household from the MHHs and FHHs, respectively. Equations (2) and (3) represent the average treatment effects on the treated and untreated, respectively, in the impact evaluation literature and the coefficient effects in the literature on wage decomposition.

**Table 2: Treatment and Heterogeneity Effects**

Categories of Households	Male-Headed Households (MHHs)	Female-Headed Households (FHHs)	Treatment Effects
MHHs	a) $E(y_m G=1)$	c) $E(y_f G=1)$	$MHHsCA = (a - c)$
FHHs	d) $E(y_m G=0)$	b) $E(y_f G=0)$	$FHHsCA = (d - b)$
Base heterogeneity effects	$BHE_m = (a - d)$	$BHE_f = (c - d)$	

## Notes:

1. Cells a) and b) denote the actual food security status that is observable in the sample of MHHs and FHHs, respectively; cells c) and d) refer to the counterfactual food security status of these two types of households, which we estimated based on the conditional expectation in the model.
2.  $G=1$  refers to male-headed households;  $G=0$  refers to female-headed households.
3.  $y_m$  = the food security status indicator for MHHs.  $y_f$  = the food security status indicator for FHHs.
4.  $BHE_m$  and  $BHE_f$  are the differences in the food security status between the MHHs and the FHHs, respectively, that their unobserved characteristics cause.  $MHHsCA$  and  $FHHsCA$  denote the expected food security status effects of gender for those randomly chosen households from the MHHs and FHHs, respectively.

In many cases, MHHs and FHHs may not have the same food security status, despite having the same observed characteristics and the same returns to their respective observed characteristics. MHHs may be innately more food secure than FHHs irrespective of their observed characteristics due to other endogenous causes of food security (such as differences in access to credit and input markets and off-farm income-generating activities). Alternatively, some types of FHHs in Nepal (say *de facto* FHHs) may be more food secure due to their greater access to remittance income. It is possible to explain such a difference through the base heterogeneity effects (Carter and Milon 2005; Kassie et al. 2015), which we can obtain using the following expressions:

$$BH_m = E(y_m|g=1) - E(y_m|g=0) \quad [5]$$

$$BH_f = E(y_f|g=1) - E(y_f|g=0) \quad [6]$$

Following a similar procedure, this study examined the differences between MHHs and *de facto* FHHs, between MHHs and *de jure* FHHs, and further between *de jure* FHHs and *de facto* FHHs.

## 5. RESULTS AND DISCUSSION

### 5.1 Descriptive Statistics

Table 3 provides the descriptive statistics of the variables that we used in this paper by the gender of the head. The results show that 67% of the MHHs and 68% of the FHHs are food secure, which means that over 30% of the rural families are food insecure. Such a high level of food insecurity is a cause of concern for policymakers in Nepal. Further, 63% of the *de jure* female-headed households (*de jure* FHHs) are food secure compared with 71% of the *de facto* female-headed households (*de facto* FHHs). Finally, we can infer that *de jure* FHHs are the most food-secure households.

**Table 3: Socio-economic Characteristics of Male- and Female-Headed Households (De Jure/De Facto) in Rural Nepal**

Description of Variables	MHHs		FHHs		De Jure FHHs		De Facto FHHs	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
<b>Outcome variables</b>								
HH food security status (1=foodsecure; 0=foodinsecure)	0.67	0.47	0.68	0.47	0.63	0.48	0.71	0.45
<b>Explanatory variables</b>								
<i>HH characteristic variables</i>								
<i>Demographics</i>								
Age of HH head in years	46.87	14.08	41.99	14.25	52.77	13.94	35.67	10.00
Household size	5.66	2.62	3.84	1.86	3.35	2.01	4.13	1.71
Children under 15 years old	2.38	1.80	1.88	1.45	1.27	1.38	2.24	1.37
HH members over 65 years old	0.30	0.57	0.18	0.42	0.24	0.44	0.14	0.40
<i>Human capital</i>								
HH head can read and write	0.50	0.50	0.22	0.42	0.09	0.29	0.30	0.46
Years of education of HH head	2.89	4.05	1.23	2.85	0.52	1.99	1.65	3.17
Below primary education	0.14	0.35	0.07	0.26	0.04	0.19	0.09	0.28
Primary education	0.18	0.38	0.08	0.28	0.03	0.16	0.12	0.32
Secondary education	0.08	0.27	0.04	0.19	0.02	0.12	0.05	0.22
Higher secondary education	0.02	0.14	0.01	0.08	0.00	0.07	0.01	0.09
University education	0.01	0.12	0.00	0.03	0.00	0.04	0.00	0.03
<b>Economic asset variables</b>								
Livestock assets (in TLU)	2.57	2.32	1.63	1.54	1.69	1.75	1.60	1.41
Dry land (Bari) owned (in ha)	0.43	1.83	0.24	1.37	0.21	0.90	0.25	1.58
Low land (Khet) owned (in ha)	1.18	5.99	0.32	2.20	0.40	2.25	0.27	2.16
At least one member participated in non-farm income-generating activities (self)	0.28	0.45	0.16	0.37	0.19	0.39	0.15	0.36
At least one member participated in non-farm income-generating activities (wage)	0.45	0.50	0.22	0.42	0.22	0.42	0.22	0.42
Total remittances (in Nepalese rupees per year)	22,632	595,334	39,712	88,855	15,353	47,790	53,950	103,117
Owens a private car	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00
Owens a television	0.18	0.39	0.21	0.41	0.13	0.34	0.25	0.43
Household asset index	0.21	0.18	0.19	0.19	0.15	0.17	0.22	0.19
<i>Food consumption expenditure</i>								
Per capita consumption expenditure of first quintile	0.19	0.39	0.17	0.37	0.15	0.36	0.18	0.38
Per capita consumption expenditure of second quintile	0.20	0.40	0.17	0.37	0.15	0.36	0.17	0.38
Per capita consumption expenditure of third quintile	0.22	0.41	0.22	0.41	0.21	0.41	0.22	0.41
Per capita consumption expenditure of fourth quintile	0.22	0.41	0.23	0.42	0.25	0.43	0.22	0.42
Per capita consumption expenditure of fifth quintile	0.17	0.36	0.22	0.41	0.23	0.42	0.21	0.41
<i>Access to market and other public utilities</i>								
Distance to market in minutes	104.39	103.75	99.27	105.57	107.04	122.99	94.71	93.61
Distance to health care center in minutes	56.18	76.06	52.69	69.28	58.24	87.02	49.44	56.11
Distance to primary school in minutes	19.87	41.52	17.78	19.61	18.55	19.88	17.33	19.44
Distance to local village market in minutes	37.93	71.24	30.64	70.66	32.88	91.35	29.33	55.02
<i>Geographical regions</i>								
Mountainous region dummy (1)	0.13	0.33	0.10	0.30	0.14	0.34	0.08	0.27
Hilly region dummy (1)	0.43	0.50	0.52	0.50	0.55	0.50	0.51	0.50
Terai region dummy (1)	0.45	0.50	0.38	0.49	0.32	0.47	0.41	0.49
<i>Time (survey year dummies)</i>								
Year dummy for 1993	0.31	0.46	0.18	0.39	0.24	0.43	0.15	0.35
Year dummy for 2003	0.30	0.46	0.28	0.45	0.33	0.47	0.25	0.43
Year dummy for 2011	0.39	0.49	0.54	0.50	0.43	0.50	0.61	0.49
Total number of observations	7,369		1,936		716		1,220	

The average years of schooling for MHHs, FHHs, *de jure* FHHs, and *de facto* FHHs are 2.89, 1.23, 0.52, and 1.65 years, respectively, indicating that *de jure* FHHs have the lowest level of schooling. Similarly, 50.2% of the rural MHHs are literate, while only 22.3% of the FHHs are illiterate. Furthermore, only 9% of the *de jure* FHHs are literate, while 30% of the *de facto* FHHs are literate. Generally, the percentages of MHHs with different levels of education (below primary, primary, secondary, higher secondary, and university) are higher than those of FHHs. Similarly, the percentages of *de facto* FHHs with different levels of education (below primary, primary, secondary, higher secondary, and university) are higher than those of *de jure* FHHs. In reality, the percentage of households declines sharply with an increase in the education level irrespective of the gender of the head. Among the three categories of households, *de jure* FHHs are predominately illiterate or have a low education level, implying their limited capacity to take advantage of opportunities.

The rural household heads are middle-aged individuals, the average age being 47 and 42 years for MHHs and FHHs and 53 and 36 years for *de jure* FHHs and *de facto* FHHs, reflecting that the results for *de facto* FHHs encompass out-migration of male household members for better opportunities. Interestingly, the numbers of family members, children under 15 years old, and members over 65 years old are higher in MHHs than in FHHs.

On average, MHHs have greater ownership of assets, such as livestock assets, dry land ownership, and low land ownership, than FHHs, *de jure* FHHs, and *de facto* FHHs. MHHs own 2.6 units of livestock assets, 0.53 hectares of dry land, and 1.2 hectares of low land, while FHHs own 1.6 livestock assets (TLU), 0.24 hectares of dry land, and 0.32 hectares of low land.

A stark and significant difference is apparent in the participation of non-farm livelihood activities. As expected, approximately 28% of MHHs are engaged in non-agricultural self-employment, while only 16.3% of FHHs are engaged in non-farm self-employment. The figure for participation in non-farm wage employment for MHHs is 45.2% compared with 22.1% for FHHs. On average, MHHs receive lower remittances (NPR 22,632) than FHHs (NPR 39,712). In rural Nepal, male household members migrate to urban areas and other countries for employment and remit back home. Hence, it is obvious that FHHs receive higher remittances. However, on further disaggregating FHHs into *de jure* and *de facto* FHHs, we found that *de facto* FHHs receive NPR 53,950 against NPR 15,353 for *de jure* FHHs. This further reflects that *de facto* FHHs receive higher remittances owing to the male out-migration.

In rural Nepal, only 0.3% of MHHs and no female-headed households own a private car. In contrast, 20.1% of FHHs and 18.2% of male-headed households own a television. The household asset index for MHHs is 0.21, while it is 0.19 for FHHs. Similarly, *de jure* FHHs have lower asset ownership than *de facto* FHHs. The percentage of MHHs declines across the per capita consumption quintiles, while the percentage of FHHs increases across the per capita consumption quintiles. However, within FHHs, the results show that the percentage of *de jure* FHHs declines across the per capita consumption quintiles, while the percentage of *de facto* FHHs increases across the per capita consumption quintiles.

As measured using the distance to a market and public utilities, access to market and public utility services shows that FHHs have better access than MHHs. The distances to a market, a health center, a primary school, and a local market for FHHs are 99.3, 52.7, 17.8, and 30.6 minutes compared with 104.4, 56.2, 19.9, and 37.9 minutes for MHHs. Further, we found that *de facto* FHHs have much better access than *de jure* FHHs. The spatial distribution of the sampled households shows a small proportion of

households in the mountainous region. The results show that 52% of FHHs are in the hilly region and 38% are in the Terai region, while 43% of MHHs are in the hilly region and 45% are in the Terai region.

**Table 4: Difference in Socio-economic Characteristics by the Gender of the Household Head in Rural Nepal**

Description of Variables	Diff. MHHs and FHHs	Diff. MHHs and <i>de Jure</i> FHHs	Diff. MHHs and <i>de Facto</i> FHHs	Diff. <i>de Jure</i> FHHs and <i>de Facto</i> FHHs
HH food security status (1=foodsecure; 0=foodinsecure)	-0.008	0.044**	-0.039***	-0.083***
<i>Demographics</i>				
Age of HH head in years	4.872***	-5.902***	11.195***	17.097***
Household size	1.818***	2.306***	1.532***	-0.774***
Children under 15 years old	0.502***	1.116***	0.141***	-0.975***
HH members over 65 years old	0.118***	0.057***	0.153***	0.096***
<i>Human capital</i>				
HH head can read and write	0.279***	0.408***	0.203***	-0.205***
Years of education of HH head	1.658***	2.374***	1.238***	-1.136***
Below primary education	0.069***	0.1***	0.049***	-0.051***
Primary education	0.096***	0.153***	0.063***	-0.09***
Secondary education	0.044***	0.066***	0.032***	-0.034***
Higher secondary education	0.012***	0.015***	0.011***	-0.004
University education	0.013***	0.0126***	0.013***	0.001
<i>Economic assets</i>				
Livestock assets (in TLU)	0.939***	0.884***	0.974***	0.09
Dry land (Bari) owned (in ha)	0.19***	0.215***	0.176***	-0.039
Low land (Khet) owned (in ha)	0.858***	0.781***	0.903***	0.122
At least one member participated in non-farm income-generating activities (self)	0.115***	0.087***	0.129***	0.042**
At least one member participated in non-farm income-generating activities (wage)	0.231***	0.229***	0.231***	0.002
Total remittance (in Nepalese rupees per year)	-17,080	7,279	-31,318*	-38,597***
Owns a private car	0.003**	0.003	0.003*	0.00
Owns a television	-0.025**	0.048***	-0.068***	-0.116***
Household asset index	0.017***	0.061***	-0.009	-0.07
<i>Food consumption expenditure</i>				
Per capita consumption expenditure of first quintile	0.025**	0.041***	0.015	-0.026
Per capita consumption expenditure of second quintile	0.036***	0.048***	0.029**	-0.019
Per capita consumption expenditure of third quintile	0.002	0.007	-0.001	-0.008
Per capita consumption expenditure of fourth quintile	-0.015	-0.034**	-0.003	0.031
Per capita consumption expenditure of fifth quintile	-0.05***	-0.064***	-0.042***	0.022
<i>Access to market and other public utilities</i>				
Distance to market in minutes	5.117*	-2.656	9.677***	12.333**
Distance to health care center in minutes	3.488*	-2.058	6.742***	8.8***
Distance to primary school in minutes	2.085**	1.321	2.534**	1.213
Distance to local village market in minutes	7.286***	5.044*	8.602***	3.558
<i>Geographical region</i>				
Mountainous region dummy (1)	0.025***	-0.01	0.046***	0.056***
Hilly region dummy (1)	-0.096***	-0.121***	-0.081***	0.04*
Terai region dummy (1)	0.071***	0.132***	0.035**	-0.097***
<i>Time (survey year dummies)</i>				
Year dummy for 1993	0.132***	0.071***	0.167***	0.096***
Year dummy for 2003	0.02*	-0.033*	0.052***	0.085***
Year dummy for 2011	-0.153***	-0.039**	-0.22***	-0.181***

The difference in food security status between male- and female-headed households is insignificant, indicating that there is no difference between male- and female-headed households as far as food security is concerned (see Table 4). We found a significant and positive difference between MHHs and *de jure* FHHs, while the difference between MHHs and *de facto* FHHs is negative, demonstrating that MHHs are more food secure than *de jure* FHHs and less food secure than *de facto* FHHs. Further, the results show that *de jure* FHHs are less food secure than *de facto* FHHs.

The age of the head of MHHs is higher than that of FHHs and *de facto* FHHs. However, the age of *de jure* FHHs is higher than that of MHHs and *de facto* FHHs. This may be due to the fact that *de jure* FHHs generally result from the death of the husband or divorce. The difference in household size between MHHs and FHHs and between MHHs and *de facto* FHHs is positive and significant, while that between *de jure* FHHs and *de facto* FHHs is negative and significant. This indicates that households are larger for MHHs than for FHHs, and further analysis showed that *de facto* FHHs have a larger household than *de facto* FHHs.

The difference in education/literacy between MHHs and FHHs is positive and significant at the 1% level. We found a significant and positive difference between MHHs and *de jure* FHHs and *de facto* FHHs. On further examination, the results show that the difference between *de jure* FHHs and *de facto* FHHs is negative and significant, demonstrating that *de jure* FHHs are less educated than *de facto* FHHs.

The difference in livestock assets and land owned in hectares between MHHs and FHHs, *de jure* FHHs, and *de facto* FHHs is positive and significant at the 1% level of significance, indicating that MHHs have more income-generating agricultural assets. The difference in participation in waged and self-employment in non-farm activities between MHHs and FHHs, *de jure* FHHs, and *de facto* FHHs is positive and significant at the 1% level. Further, the difference between *de jure* FHHs and *de facto* FHHs is positive and significant, indicating that, due to the need to make ends meet, *de jure* FHHs engage in self non-farm livelihood activities.

The difference in the remittances that households receive per year between MHHs and FHHs and between MHHs and *de jure* FHHs is insignificant, while the difference between MHHs and *de facto* FHHs is significant at the 10% level of significance and that between *de jure* FHHs and *de facto* FHHs is negative and significant at the 1% level.

The car ownership difference between MHHs and FHHs and between MHHs and *de facto* FHHs is significant, indicating that MHHs are wealthier than FHHs. The household asset index also reflects that MHHs are better off than FHHs, particularly *de jure* FHHs. However, television ownership shows that MHHs have more televisions than *de jure* FHHs and fewer televisions than *de facto* FHHs. The difference in the consumption quintile shows that FHHs are better off than MHHs.

Access to facilities is an important measure of households' welfare and their ability to improve their livelihood. The difference in the distance to facilities in minutes between MHHs and FHHs, between MHHs and *de jure* FHHs, and between *de jure* FHHs and *de facto* FHHs is positive and significant, highlighting the fact that *de facto* FHHs have better access to facilities such as markets, schools, and health care centers than MHHs and *de jure* FHHs.



**Table 5: Factors Affecting the Food Security Status of MHHs, *de Jure* FHHs, and *de Facto* FHHs in Rural Nepal**

Explanatory Variables	MHHs	<i>De Jure</i> FHHs	<i>De Facto</i> FHHs
<i>Demographics</i>			
Ln(age)	0.073 (0.064)	0.247 (0.254)	-0.110 (0.182)
Household size	0.037*** (0.014)	-0.018 (0.058)	0.073 (0.052)
Children under 15 years old	-0.037* (0.019)	0.002 (0.078)	-0.051 (0.063)
HH members over 65 years old	0.025 (0.033)	-0.057 (0.145)	-0.297*** (0.114)
Years of schooling of household head	0.034*** (0.005)	0.075* (0.041)	0.053*** (0.019)
Livestock assets (in TLU)	0.051*** (0.009)	0.146*** (0.041)	0.053 (0.037)
Low land (Khet) owned (in ha)	0.071*** (0.007)	0.057** (0.025)	0.095*** (0.023)
Low land (Bari) owned (in ha)	0.017** (0.008)	0.030 (0.029)	0.064** (0.025)
Log (remittances received)	0.002 (0.003)	0.002 (0.008)	0.020*** (0.008)
Asset index	0.968*** (0.114)	1.099*** (0.404)	0.705** (0.288)
Per capita consumption expenditure of second quintile	0.287*** (0.051)	0.620*** (0.193)	0.227* (0.133)
Per capita consumption expenditure of third quintile	0.431*** (0.053)	0.729*** (0.188)	0.542*** (0.137)
Per capita consumption expenditure of fourth quintile	0.650*** (0.058)	0.803*** (0.196)	0.874*** (0.149)
Per capita consumption expenditure of fifth quintile	0.769*** (0.069)	1.376*** (0.226)	1.319*** (0.188)
Self-employed in agriculture	0.039 (0.068)	0.064 (0.172)	-0.192 (0.147)
Log of distance to market in minutes	0.002 (0.011)	-0.049 (0.042)	-0.008 (0.029)
Log of distance to health center in minutes	-0.037*** (0.010)	-0.031 (0.036)	0.020 (0.020)
Log of distance to primary school in minutes	-0.014 (0.009)	-0.001 (0.027)	-0.020 (0.019)
Log of distance to market in minutes	-0.013*** (0.005)	-0.024 (0.015)	0.030** (0.012)
Hills (base category is mountains)	0.242*** (0.052)	-0.070 (0.165)	0.068 (0.160)
Terai (base category is mountains)	0.468*** (0.060)	0.167 (0.197)	0.054 (0.176)
Year 2003 (base year is 1993)	0.454*** (0.043)	0.387*** (0.147)	0.585*** (0.140)
Year 2011 (base year is 1993)	1.196*** (0.060)	1.347*** (0.196)	1.463*** (0.174)
Constant	-1.118*** (0.267)	-1.770* (1.054)	-0.162 (0.706)
Pseudo R-squared	0.195	0.223	0.235
Number of observations	7,639	716	1,220

Note: The food security status of *de facto* FHHs is better than that of MHHs and *de jure* FHHs. When we classified households based on the gender of the household head, we found that there is no statistically significant difference in food security status between MHHs and FHHs. When we classified FHHs into two groups, that is, *de facto* and *de jure*, we found that *de facto* FHHs are more food secure than both MHHs and *de jure* FHHs. One major reason for this result could be off-farm income, particularly the remittance income that *de facto* FHHs receive as their husbands are away from home to earn off-farm income.

## 5.2 Determinants of Household Food Security

Table 5 below shows the factors affecting the food security status of MHHs, *de jure* FHHs, and *de facto* FHHs in rural Nepal. The household size coefficient is positive and significant, and children under 15 years of age are negative and significant for MHHs for food security. This indicates that households with a large number of family members are more secure, while households with more children are less secure. In the case of *de facto* FHHs, households with elderly family members are more likely to be food insecure. The years of schooling of the household heads are positive and significant for MHHs, *de jure* FHHs, and *de facto* FHHs in rural Nepal, highlighting education as an important driver of food security in Nepal irrespective of the gender of the household head.

As livestock is an important asset of Nepal's rural households, the results show that MHHs and *de jure* FHHs with more livestock assets are more likely to be food secure. The coefficient of the ownership of low land (Khet) (in hectares) is positive and highly significant, which indicates the importance of land ownership for food security. Generally, low land (Khet) is used for the cultivation of paddy, which is the staple cereal of Nepal; hence, low land (Khet) is crucial for food security. The ownership of sloped land (Bari) (in hectares) is positive and significant only for MHHs and *de facto* FHHs. The coefficient of the asset index is positive and significant, indicating the crucial role of wealth in ensuring food security in rural Nepal. Similarly, the per capita consumption expenditure quintile coefficients for the second, third, fourth, and fifth quintiles are positive and significant compared with the first quintile for all three categories of household MHHs, *de jure* FHHs, and *de facto* FHHs.

As expected, the remittance coefficient is positive and significant at the 1% level of significance only for *de facto* FHHs. Male migration for employment to urban areas and foreign countries is the important reason for *de facto* FHHs in rural Nepal. MHHs in hilly areas and the Terai region are more secure than households in the mountainous region. Finally, rural households were more secure in 2003 and 2011 than they were in 1994.

## 5.3 Heterogeneous and Treatment Effects

The results of exogenous switching treatment effect regression (Table 6) reveal remarkable gender differences in the food security status across the three categories of households (i.e., MHHs, *de facto* FHHs, and *de jure* FHHs) under study. The households under study exhibit differences in both treatment effects and base heterogeneity effects.

Cells (a) and (b) of Table 6 (section A) show the actual food security status of MHHs and *de jure* FHHs, while cells (c) and (d) of Table 6 (section A) present their counterfactual food security status. The treatment effects (Table 6 section A) are very marginal and not significant between MHHs and *de jure* FHHs in rural Nepal. This means that the differences in food security status between MHHs and *de jure* FHHs are not explained by the differences in the returns to their observed characteristics and resources. In other words, the food security status of *de jure* FHHs would not have changed significantly even if they had had the same observed resources and characteristics as MHHs. This result does not corroborate the findings of Aryal, Mottaleb, and Rahut (2019) in their study on Bhutan. Section A (Table 6) shows that the base heterogeneity effects are highly significant between MHHs and *de jure* FHHs, implying that unobserved heterogeneity rather than treatment effects explain the differences in their food security status. This means that even controlling for the

observed differences between MHHs and *de jure* FHHs would not eliminate the differences in food security status. This unobserved heterogeneity might be due to some typical types of social discrimination that *de jure* FHHs face in society, leading to inherent differences between MHHs and *de jure* FHHs. However, this study cannot dig further into this issue due to the absence of data on these social and psychological variables. Therefore, future research on gender differences needs to apply a more experimental approach to examine these unobservable and inherent factors causing gender differences.

**Table 6: Treatment and Heterogeneous Effects  
Based on Conditional Expectations**

<b>Section A: Male-Headed Households (MHHs) versus <i>de Jure</i> FHHs</b>			
<b>Household Type</b>	<b>Household Type</b>		<b>Treatment Effect</b>
	<b>MHHs</b>	<b><i>De jure</i> FHHs</b>	
MHHs	a) 0.665	c) 0.671	-0.006 <sup>ns</sup> (0.0041)
<i>De jure</i> FHHs	d) 0.629	b) 0.630	-0.0019 <sup>ns</sup> (0.0124)
Heterogeneous effects	0.037 <sup>***</sup> (0.0105)	0.041 <sup>***</sup> (0.0088)	
<b>Section B: Male-Headed Households (MHHs) versus <i>de Facto</i> FHHs</b>			
<b>Household Type</b>	<b>Household Type</b>		<b>Treatment Effect</b>
	<b>MHHs</b>	<b><i>De facto</i> FHHs</b>	
MHHs	a) 0.646	c) 0.671	-0.026 <sup>***</sup> (0.0040)
<i>De facto</i> FHHs	d) 0.709	b) 0.695	-0.014 <sup>ns</sup> (0.0091)
Heterogeneous effects	-0.064 <sup>***</sup> (0.0079)	-0.023 <sup>***</sup> (0.0069)	
<b>Section C: <i>De Facto</i> FHHs versus <i>De Jure</i> FHHs</b>			
<b>Household Type</b>	<b>Household Type</b>		<b>Treatment Effect</b>
	<b><i>De facto</i> FHHs</b>	<b><i>De jure</i> FHHs</b>	
<i>De facto</i> FHHs	a) 0.709	c) 0.612	0.098 <sup>***</sup> (0.0113)
<i>De jure</i> FHHs	d) 0.678	b) 0.628	0.049 <sup>***</sup> (0.0119)
Heterogeneous effects	0.031 <sup>***</sup> (0.0099)	0.017 <sup>ns</sup> (0.0113)	

Note: Values in parentheses are standard errors. ns means not significant, and \*\*\* refers to significance at the 99% level of confidence.

Table 6 (section B) presents the actual (cells “a” and “b”) and counterfactual (cells “c” and “d”) food security status of MHHs and *de facto* FHHs. Contrary to the general hypothesis, the treatment effects are negative and significant, indicating that the returns to the resources of *de facto* FHHs are, on average, higher than those of MHHs. This finding contradicts Aryal, Mottaleb, and Rahut’s (2019) finding for Bhutan and Kassie et al. (2015) finding for Malawi. However, it resembles the ground realities of Nepal, where the majority of rural men (almost 87% of total migrant labor are men) have migrated for their job (Bossavie and Denisova 2018). As a result, remittances have increased households’ capacity to purchase food and exerted an overall positive effect (Kapri and Ghimire 2020). This has changed the situation in that food production at the household level is no longer a major determinant of food security for many households in rural Nepal, which has crucial implications for the policy-making body that deals with gender inequality, food security, and agriculture in Nepal.

In the case of MHHs and *de facto* FHHs (section B Table 6), the base heterogeneity effects are also negative and significant. This implies that not all FHHs are relatively asset poor as compared with MHHs. It also means that unobserved heterogeneity does not always have negative impacts on the food security status of FHHs, as many other

researchers have assumed (Quisumbing, Haddad, and Peña2001; Kassie, Ndiritu, and Stage2014; Kassie et al. 2015). The perception of Nepalese society regarding the out-migration of labor for remittance earnings may explain this result. The social setting in rural Nepal is such that households that receive remittance income are becoming better off over time, and these households are increasingly able to access food markets as the expectation is that they have payback capacity. This shows that not only gender status but also households' capacity to bargain affect returns to assets; thus, gender interacts with other observed and unobserved characteristics of households, such as the quality of the land owned, expected income, family background, and so on.

Table 6 (section C) provides another very interesting aspect with regard to gender and food security. It shows that significantly positive treatment effects exist, indicating that, if the observed characteristics and resources of *de jure* FHHs receive the same level of return as those of *de facto* FHHs, the food security status of the former will improve by 9.8%. In addition, there are significant base heterogeneity effects, which indicate that several unobserved heterogeneity effects exist between *de facto* and *de jure* FHHs. These findings provide further lessons on how the heterogeneity among FHHs can lead to the inequality in food security status among them; thus, policymakers need to acknowledge this heterogeneity to address food security issues properly.

## 6. CONCLUSION AND POLICY IMPLICATIONS

Food insecurity is a major problem that smallholder farmers face in developing countries. According to the United Nations (<https://www.un.org/en/global-issues/food>), about 690 million people (8.9% of the world population) are hungry, and most of them are dependent on agriculture and live in the rural areas of sub-Saharan Africa and South Asia. Furthermore, the United Nations estimated that “2 billion people in the world did not have regular access to safe, nutritious and sufficient food in 2019.”

Although agriculture is the source of livelihood for the majority of Nepalese households in rural areas, food insecurity is prevalent in rural Nepal due to its rugged topography, low level of soil fertility, and lack of access to farm inputs. The out-migration of labor from rural Nepal to urban centers and other neighboring and Gulf countries for employment has resulted in a shortage of labor in the agricultural sector, which is mostly dominated by women. In the light of this rising food insecurity dominated by women, this paper aimed to understand the food insecurity gaps and drivers of food security in rural Nepal using large nationally representative datasets covering the last three decades (1993/94, 2003/04, and 2010/11). The paper recognized that female-headed households (FHHs) are heterogeneous and investigated whether food security differences exist between *de facto* FHHs and *de jure* FHHs (i.e., households managed by a single, widowed, or divorced woman).

Unlike other studies, this research concluded that there is no significant difference in the food security status between MHHs and FHHs. However, on further dissecting FHHs, we found that food security is significantly lower among *de jure* FHHs than among MHHs. Further, the food security difference between *de facto* FHHs and *de jure* FHHs is larger than the difference between *de jure* FHHs and MHHs. We can explain these gaps between MHHs and *de jure* FHHs through unobserved heterogeneity effects but not through treatment effects, while it is possible to explain the differences between *de facto* and *de jure* FHHs through both treatment effects (i.e., differences in the returns to their assets, such as participation in off-farm income) and unobserved heterogeneity effects. The most noteworthy point is that the difference in food security

between *de facto* and *de jure* FHHs is also significant, implying that having a male household member, even if he is not present at home, makes a difference to households' food security status. There are two possible reasons: firstly, *de facto* FHHs receive remittance income from migrant male household members, making them food secure compared with *de jure* FHHs; secondly, *de jure* FHHs are overburdened as they have to carry out all the activities to manage the household. The results also show that the gender of the household head (MHHs, FHHs, *de jure* FHHs, and *de facto* FHHs), economic status, land ownership, and education significantly influence food security for rural households in Nepal.

The results have important policy implications for achieving two important Sustainable Development Goals—gender equality and food security—primarily because they reject the general notion that FHHs are less food secure and strongly recommend a deeper investigation into the heterogeneity among FHHs. The agricultural policy, which aims to enhance food security and reduce gender inequality, should target *de jure* FHHs by augmenting their productivity through investments in training, ensuring market access, easing liquidity, and providing subsidies to fill the asset gap.

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