CHAPTER 2

DETERMINANTS AND EFFECTS OF LIVELIHOOD DIVERSIFICATION IN RURAL NON-FARM ENTERPRISES

2. Determinants and Dynamics of Non Farm Enterprises: Longitudinal Evidence from different Agroecological Zones of India

2.1. Introduction

The rural economy is predominantly based on agriculture and other activities related to the agriculture sector. At the same time, research demonstrated that rural household receives a significant proportion of their income from non-farm sources. For instance, Haggblade *et al.* (2007) found that around 30% to 45% of rural income is generated from non-farm activities across developing countries. Reardon *et al.* (1998) find that non-farm income as a share of total income is around 42% for Africa, 32% for Asia, and 40% for Latin America. Davis *et al.* (2007) find evidence that the share of non-farm income is rising over time. At the same time, there was intense advocacy of diversification into non-farm activities by farm households in rural areas of developing countries (Barrett & Reardon, 2000; Barrett *et al.,* 2001; World Bank, 2003; Davis, 2006; Senadza, 2012; 2014; Owoo & Naudé, 2014).

In theory, various studies reveal that "demand-pull" and "distress-push" factors motivate farm households to diversify into non-farm activities (Davis, 2006). The "demand-pull" factors include higher returns from non-farm activities, an appeal of urban life, extra incomes to meet household needs (Davis & Pearce, 2000; Barrett *et al.,* 2001). Distress-push diversification, on the other hand, is triggered by factors such as inadequate farm output, failure of farm input markets, population growth, disasters and shocks, risk reduction, the absence of financial services, and inadequate resources (Davis & Pearce, 2000; Barrett *et al.,* 2001).

In recent years, studies on rural non-farm activities belonging to rural households in developing countries have attracted considerable attention in the rural development literature due to the growing inability of the agricultural sector to provide them with sustainable livelihoods. Ellis (2000) argues that non-farm diversification is often a strategy used by farm households to moderate seasonal income variability and minimize the risks associated with agriculture due to hostile agroecological factors. Under this situation, non-farm activities play a key role in improving the well-being of rural farm households and providing them with

livelihood diversification opportunities that help to curb rural-urban migration, reduce poverty and improve food security (Haggblade *et al.,* 2007; Lanjouw, 2007; Ali & Peerlings, 2012).

In spite of the expanding scope of the potential commitment of non-farm activities to the financial prosperity of rural farm households in developing countries, the factors affecting their choice to diversify into non-farm activities are generously unexplored, especially in various agro-ecological regions (Lanjouw & Lanjouw, 2001; Woldenhanna & Oskam, 2001; Loening *et al.,* 2008). The studies on determinants have not yet mulled over the impact of the distinctive agroecological zones on diversification in the choice of non-farm activities, regardless of their significance for the development of rural non-farm enterprises. The vast majority of the studies (Deininger & Olinto, 2001; Babatunde & Qaim, 2009) concentrated solely on the determinants of household decision to diversify into rural non-farm activities, which makes it difficult to suggest policies that promote diversification in non-farm activities as a measure of improving the economic wellbeing of farm households in the different regions. In addition, empirical studies on the importance of farm and non-farm diversification have been conducted in many rural areas of developing countries. Among these studies, the impact on household food security, agricultural expenditure, and well-being are the most notable (Owusu *et al.,* 2010; Jabo *et al.,* 2014a; 2014b; Shehu & Siddique, 2014; Osarfo *et al.,* 2016). Most of these studies employed econometric techniques which account for selection bias. While Owusu *et al.* (2010); Jabo *et al.* (2014a); Jabo *et al.* (2014b); Shehu & Siddique (2014), and Osarfo *et al.* (2016) employed propensity score matching (PSM) technique, and Dedehouanou *et al.* (2015) utilized endogenous switching regression (ESR) approach. Although the PSM method is relatively widely used in the literature, it does not account for selection bias due to unobservable characteristics of the household. Nonetheless, both methods are known in the literature to yield consistent results. In general, based on the average treatment effect on treated (ATT), which is employed to estimate the participation

effect, participation in non-farm activities by rural farm households is revealed in the literature to positively and significantly affect rural households' food security, agricultural expenditure, and well-being (Owusu *et al.,* 2010; Jabo *et al.,* 2014a; 2014b; Dedehouanou *et al.,* 2015; Osarfo *et al.,* 2016).

Previous studies on the farm and non-farm diversification in India has mainly focused on the rural setting. Table 2.1 presents the percentage share of diversification in non-farm enterprises (NFEs) in different ecological zones of India. The percentage share in the semi-arid temperate zone is lowest (about 10.5%) and highest (about 14.4%) in the humid zone. Even though on a lesser scale, Table 2.1 also indicates that quite a significant proportion of farm households in rural India combine farming with non-farm enterprises in different agroecological zones. Thus, it is important to investigate the motives behind such diversification pattern and what impact it has on household farm income and consumption expenditure.

Table 2.1: Livelihood Diversification in Non-Farm Enterprises in different Agroecological Zones

	Diversified in non-farm enterprises		
Agroecological Zones	No	Yes	Total
	5,561	933	6,494
	(85.63)	(14.37)	(100)
Humid	[30.13]	[35.58]	[30.81]
	4,083	480	4,563
	(89.48)	(10.52)	(100)
Semi-Arid Temperate	[22.12]	[18.31]	[21.65]
	7,597	1,051	8,648
	(87.85)	(12.15)	(100)
Semi-Arid Tropics	[41.16]	[40.08]	[41.03]
	1,215	158	1,373
	(88.49)	(11.51)	(100)
Arid	[6.58]	[6.03]	[6.51]
	18,456	2,622	21,078
	(87.56)	(12.44)	(100)
Total	[100]	[100]	[100]

Source: Authors' calculations based on IHDS – Panel Data (2004-05 and 2011-12)
Note: Values in parentheses ( ) represents row-wise percentage share and values in brackets [ ] represents column-wise percentage share.

Thus, the objectives of the present chapter are (1) to examine the determinants of livelihood diversification of rural farm households in non-farm enterprises and (2) to examine the effects of livelihood diversification of non-farm enterprises on farm income and consumption expenditure in different agroecological zones of India.

To address the current research gaps, the present study uses nationwide panel survey data of rural India over the time interval from 2004-05 to 2011-12. It is worth noting that this study is limited to rural farm households who choose either to specialize or diversify agriculture into rural NFE for their livelihood. The study uses the panel probit analysis (random effect) to identify the determining factors for the decision to participate in rural NFE and propensity score matching technique to assess the impact of diversification of NFEs on farm income and consumption expenditure. The advantage of the matching method compared to other methods is that it occupies the self-selection bias that exists in the sample by matching diversified and non-diversified households that share the same pre-diversification characteristics.

The result of this study will contribute to the growing literature on rural development, providing empirical evidence on the contribution of NFE diversification to farm income and consumption expenditure of farm households in different agroecological zones. Furthermore, the study would be of immense benefit to policymakers, development planners and other stakeholders seeking to promote rural development. As, in best of our knowledge, this study is the first of its kind to analyze the determinants of participation in rural non-farm enterprises and their effect on farm income and consumption expenditure of the same farm households over time in different agroecological zones of India.

The rest of the chapter is organized as follows. The next section (section 2.2) offers a broad discussion on the diversification of NFE in rural India and abroad. The third (section 2.3) presents the empirical framework of the chapter. The fourth (section 2.4) describes the measurement variables used in estimating the determinants of the diversification of NFE and

its effects on the farm income and consumption expenditure. The fifth (section 2.5) discusses the empirical results, and the sixth (section 2.6) concludes the study.

2.2. Livelihood Diversification in Non-Farm Enterprises

Over the last three decades, Indian agriculture has witnessed a declining trend in terms of contribution to GDP, utilization of labor force, land ownership, and income generation to the poor. In this context, Chand *et al.* (2011) stated that if agriculture were the main wellspring of income for small landholders, the majority of them would stay poor.

Several studies have suggested that diversification of the rural economy into non-farm activities has significant potential to increase farmers' income and reduce rural poverty (Adams & He, 1995; Adams, 2001; Reardon *et al.,* 1998; 2007; Barrett *et al.,* 2001; Lanjouw, 1999). Diversification into non-farm activities exceeds the land restriction for revenue growth, allowing farmers to cope with crisis harvests and improves their ability to invest in agricultural inputs and technologies that improve productivity (Collier *et al.,* 1986; Reardon & Taylor, 1996). Furthermore, a non-farm rural sector growth can absorb surplus labor from agriculture, reduce rural-urban migration, reduce disparities between urban and rural areas, and promote links between agriculture and non-agriculture.

India's rural economy saw a gradual shift towards the non-agricultural sector and the share of rural income increased from 35% to 62% and rural employment from 22.3% to 31.5% in 1980-81 and 2004-05 respectively (Lanjouw & Murgai, 2008). However, there is no information about its distributional impacts, and the results are scarce and inconclusive. Lanjouw & Shariff (2002) found that non-farm incomes to be neither inequality-increasing nor inequality-decreasing. On the other hand, Sen (1994) indicated that an increase in non-farm income could lead to a worsening of income distribution due to lower barriers for the rich in the transition from agricultural to non-agricultural. The rural agricultural sector is quite heterogeneous in India, and its distributional consequences are likely to vary depending

on whether a source of income is accessible to the rich or poor. Birthal & Singh (1995) reported that non-farm wages have an equalizing effect on the distribution of income, while non-farm income from enterprises, wages and transfers have the opposite effect.

The trials of the other countries are also mixed. Reardon *et al.* (1998) reported a myriad of types of non-farm income ratios with the size of the property and household income. Adams & He (1995) in Pakistan and Adams (2001) in Egypt have found inverse relationships between non-farm income and land ownership, in addition to household income. Studies of Rwanda (Dabalen *et al.,* 2004), Jordan (Adams, 2001), Burkina Faso (Reardon & Taylor, 1996) and Tanzania (Collier *et al.,* 1986), on the other hand, found that non-farm income has unequalizing effect on income distribution. In a recent study in selected countries in Asia, Africa, and Latin America, Davis *et al.* (2007) reported the unequal effect of most non-farm income activities on income distribution.

However, in countries with surplus labor, such as India, the importance of non-farm income sources for the poor cannot be undermined. From a detailed review, Coppard (2001) concluded that non-farm diversification is important for the landless and small landholders, and can reduce rural poverty, but may be accompanied by a worsening distribution of income due to the differential access of poor and rich to non-farm income sources.

Stress in Indian agriculture increases due to continued fragmentation of land and climate change which is a serious threat to livelihood based on agriculture. This is especially true for small farmers. The growth of rural populations and limited employment opportunities in the non-farm sector has led to the subdivision of land ownership in India to the extent that they cannot provide sufficient living means to the majority of farm households. In this context, diversification into rural NFE may be a possible strategy to improve livelihoods. With this vision, this study was conducted to examine the access of farm households to diversifying NFE, its determinants and effects on farm income and consumer expenditure in different agroecological zones of rural India.

2.3. Empirical Framework

This section presents the econometric approaches used to dissect the variables that decide the choice of rural farm household to partake in NFEs and to evaluate the effect of this participation on farm income and consumption expenditure in different agro-ecological zones of rural India.

2.3.1. Determinants of Participation in Rural Non-Farm Enterprises

Following the conventional framework of household choice, a farm household decides to diversify into the rural NFE if the non-farm income is higher than the reserve income from on-farm work and leisure. This suggests that the probability of participating in non-farm activities is determined by the farm characteristics as well the socio-economic characteristics of farm households.

To capture the relationship between these characteristics and the decision of farm households to engage in non-farm activities over time, a probit panel model (random effect) is used. In this way, we can perform economic analyses and specify models with transversal data obtained when all operators are considered at a time. Different patterns of behavior of all farm households can be assessed together at different times.

The probit analysis for panel data can be performed by inserting a population-averaged model or a probit random effects model. There is no procedure for a conditional model of fixed effects, as there are not enough statistics to allow fixed effects to be conditioned out of the likelihood. However, unconditioned fixed effect probit models can be adapted to the panel data indicator variables. However, the estimates of unconditional fixed effects are partial, so we used random effects in our study with the following Equation (2.1).

$$Pr\,(y_{it} \neq 0 / x_{it}) = \phi\,(x_{it}\beta + u_i) \qquad (2.1)$$

for $i = 1,\ldots,n$ panels, where $t = 1,\ldots,$ u_i, v_i are i.i.d., $N(0, \sigma^2_u)$, and ϕ is the standard normal cumulative distribution function. Y_{it} is the probability of a farm household participates in

rural NFE in addition to its primary farm work (also known as the latent variable). It is equivalent to 1 for a farm household that participates in at least one non-farm enterprise and 0 for a farm household that does not participate in any NFE.

2.3.2. Modelling the Effects of Participation in Rural Non-Farm Enterprises on Household Farm Income and Consumption Expenditure

According to the standard agricultural household model, a farm household allocates labor and consumption levels by maximizing the utility subject to cash and production technology constraints because it generates additional income. Participation in rural NFE is very likely to determine farm income because additional income received from non-farm enterprises may enable farm household to invest in farming activities which may lead to increase their farm income and directly or indirectly their consumption expenditure. This study hypothesizes that participation in NFE exerts positive effects on household farm income and consumption expenditure because it increases household earnings. To assess the effects of non-farm engagement on household farm income and consumption expenditure, a commonly used model in the literature on effect evaluation is written as follows:

$$I_{it} = \beta_{it} X_{it} + \gamma_{it} D_{it} + \varepsilon_{it} \qquad (2.2)$$

$$C_{it} = \sigma_{it} Z_{it} + \mu_{it} D_{it} + \nu_{it} \qquad (2.3)$$

where I and C are the household's farm income and consumption expenditure in Equation (2.2) and (2.3) respectively; X and Z includes household and farm characteristics and other factors, which are expected to affect the farm income and consumption expenditure respectively; D is a dummy for participation in NFE; and γ and μ are the coefficient capturing the effects of non-farm participation on the farm income and consumption expenditure. Nonetheless, this coefficient can be biased and inconsistent because of the self-selection of farm households in the gathering of non-farm participant group. Heckman choice approach or a standard treatment impact model can be utilized to control this selection bias. All things

being equal, these methodologies cannot control conceivable foundational contrasts between groups because of the assumption that consumption function varies amongst participants and non-participants for a consistent term (Rao & Qaim 2011). The approach can, in any case, produce mutilated and conflicting evaluations since it cannot control unobserved factors that can influence both the choice to participate in the rural non-farm enterprises and the outcomes (farm income and consumption expenditure).

The propensity score matching approach is adopted to address the above-mentioned econometric difficulties. The strategy analyses farm income and consumption expenditure of diversified households with that of undiversified households that have comparable and observable characteristics. Propensity score matching is commonly used for non-experimental impact studies. This is because it is known to account for selection bias. It achieves this by simply employing matching algorithms to match treatment and control units on the basis of similar propensity scores (Rubin, 2001). In this examination, diversified households are farm households that choose to diversify into rural NFEs, while undiversified households are those that depend only on farming for their livelihood.

The propensity score P (T_{it}) is given the observable pre-diversification characteristics of the household, the propensity score can be calculated as:

$$P(T_{it}) \equiv prob\,(D_{it} = 1 / T_{it}) = E(D_{it} / T_{it});\ P(T_{it}) = F(h(T_{it}) \qquad (2.4)$$

where D_{it} is the indicator of diversification in rural NFEs; T_{it} demonstrates a vector of pre-diversification characteristics of farm household$_i$; E is the expectation operator; and $F(.)$ represents normal cumulative distribution frequency. The propensity score was anticipated with the probit model under the presumption of normal cumulative distribution. The supposition of conditional independence of the score result expands the utilization of propensity scores for the computation of the conditional treatment effect.

The predicted propensity scores give the premise to match households with the same observable characteristics. In this manner, the matching requirement must be fulfilled before computing the treatment/diversification impact. Becker & Ichino (2002) recommend that the average treatment effect on the treated (ATT) is the parameter of interest in the analysis of the correspondence of the propensity score, as it shows the real gain of NFE diversification by comparing the outcome variables of diversified households with that of their counterfactual group of households that are closer in terms of propensity scores. Therefore, ATT can be calculated as follows:

$$ATT_{it} = E(T_{it}/1=1) = E(Y_{it}(1)/D_{it}=1) - E(Y_{it}(0)/D_{it}=1) \qquad (2.5)$$

where $E(Y_{it}(1)/D_{it} = 1)$ denotes the expected outcome (farm income and consumption expenditure) of diversified household; and $E(Y_{it}(0)|D_{it} = 1)$ represents the counterfactual farm income and consumption expenditure of undiversified household, which indicates the probable farm income and consumption expenditure outcome of a diversified household if he/she had not diversified into rural NFE.

Studies reveal a number of matching algorithms to match treated and untreated units based on the propensity scores. These include nearest neighbor matching (NNM), radius matching (RM), and kernel matching (KM) methods, stratification matching (SM) and Mahalanobis matching (MM) methods etc. The NNM method is used to match diversified farm households with their closest undiversified neighbors with similar observed characteristics. For robustness, KM and SM methods are also adopted for the study.

2.4. Measurement of Variables

The dependent variable in the selection equation (Equation [2.1]) is a binary variable for participation in the rural NFE. It is equivalent to 1 for a farm household that participates in at least one rural non-farm enterprise and 0 for a farm household that does not participate in any rural non-farm enterprise. The dependent variable in the outcome equations (Equations [2.2] and [2.3]) are household farm income and consumption expenditure. The

independent variables comprise of household and farm characteristics, memberships, road density, and agroecological risks. These factors are presented in Table 2.2. The household characteristics include religion, caste, family size, dependency ratios, household heads' education level. The level of education is an indicator of human capital; those with a high level of education would have more job opportunities. Furthermore, educated people would have easier access to a great deal of information and would be able to build networks in the better community (Azam *et al.,* 2012). Therefore, the level of education would stimulate the participation of farm households in the NFE, as noted by Lanjouw & Shariff (2004).

Dependency ratios are used to capture the effects of the life cycle on participation in NFE and household farm income and consumption expenditure. These dependency ratios refer to household members over the age of 64 and under 15 years of age to capture the effects of dependents on the likelihood of participating in the NFE. The number of dependents can produce mixed effects in the non-farm commitment of farm households (Shi *et al.,* 2007). On the one hand, with more dependents in a farm household, a high household income is needed to meet consumption and other necessary expenses, stimulating the diversification of household income. On the other hand, farm households with more dependents must spend more time caring for these dependents, reducing the time available for non-farm activities. However, older members can help take care of children, possibly allowing parents to participate in the farm or non-farm activities. However, more dependents in a household would reduce per capita household consumption if the household enjoyed the low household income.

Land ownership in hectares is used to capture the effects of farm characteristics. The land holding variable is used in place of a variable area of farmland because the latter has a greater potential for endogeneity, although the land markets of rural India are inactive, as claimed by Azam *et al.* (2012). Workers employed on larger farms are less flexible, and households with a larger area risk being discouraged from participating in non-farm activities

(Benjamin, 1994; Mishra & Goodwin, 1997). So, land ownership would have negative effects on non-farm participation; however, it is difficult to hypothesize the effects on household consumption due to the potentially conflicting effects.

A categorical variable for agroecological zones caused by excessive rains and/or floods, drought, rot, birds/other insects and/or rodents is used to capture the effects of agroecological risks. The farmers reported the loss of yield of the aforesaid agroecological factors compared to the previous year up to the time of the interview. Because some farmers produce multiple crops, the use of aggregate amounts of damaged crops to capture such effects is not practical. Moreover, thanks to the availability of information on temperature and precipitation at the district level, the study is based fictitious agroecological zones, with the value of 1 if a farm household belongs to a particular type (humid, semi-arid temperate, semi-arid tropics and arid) of the agroecological zone and 0 if the agricultural family did not belong to that particular agro-ecological zone. Because the risks that adversely affect agricultural yields, influence the decision of farm households on agricultural and non-agricultural activities and the welfare of household in terms of food consumption (Kaur *et al.,* 2010).

The availability of roads in the district is used as an identification tool in the model because the availability of roads in the district can facilitate the return journey between home and workplace and connect rural economies with the entire economy from India. This creates non-farm employment opportunities for farm households and, therefore, it is likely to motivate farm households to participate in non-farm enterprises.

Remember that we have used the concept of diversification as the participation of farm households in non-farm rural enterprises. In reality, there are many other dimensions of diversification. Farm households can diversify their activities and crops. The decisions made by farm households ultimately depend on the subjective assessment of the advantages and disadvantages of the risk. The ability to take risks is lower for small farmers and, as a result, the risk of non-farm enterprises is likely to be an important consideration for them.

Table 2.2: Description and Measurement of Principal Variables

Variables	Measurement/Definition
Dependent Variable	
• Livelihood diversification in non-farm enterprises	1 if any member of the household engaged in non-farm enterprises, 0 otherwise.
Independent Variables	
• log farm income	natural log of total income received from cultivation in Indian rupees (INR)
• farm equipment	number of farm equipment possessed
• religion	1 = hindu; 2 = muslim; 3 = all other religions
• caste	1 = general; 2 = other backward castes (obc); 3 = schedule castes (sc); 4 = schedule tribes (st)
• hh size	number of household members
• hh dependency ratio	{child (aged upto 14) + elder (aged more than 65) / number of family member} * 100
• adult dependency ratio	{child (aged upto 14) + elder (aged more than 65) / number of adult family member} * 100
• livestock	number of livestocks
• landholding	household land possessed in hectares
• road density	the ratio of the length of the district's total road network to the district's land area.
• education	years of formal education of household head
• no of loans	number of loans taken from formal or informal institutions
• shg membership	1 = yes; 0 = otherwise
• credit savings membership	1 = yes; 0 = otherwise
• cooperative membership	1 = yes; 0 = otherwise
• type of farmers	1 = marginal (land holding<1 hectare); 2 = small (1< land holding < 2); 3 = medium (2 < land holding < 4); 4 = large (land holding > 4)
• agroecological zones	1 = humid; 2 = semi-arid temperates; 3 = semi-arid tropics; 4 = arid

2.5. Empirical Analysis

This section begins with a description of the summary statistics of the fundamental factors utilized in the analysis and a descriptive statistical analysis of the differences between farm households that are diversified into non-farm rural enterprises and those that do not. The section ends presenting the results of the econometric analysis.

2.5.1. Descriptive Statistics Analysis

Table 2.3 presents the summary statistics of the factors utilized in the empirical analysis. The table shows that, on an average, around 12.5% of farm households are diversifying in rural NFEs and around 89% of farm households are Hindu, while around 41% and 28% of farm household have a place with the class of General and OBC category of caste respectively. The Indian social framework is very heterogeneous and stratified by caste. The scheduled caste (SC) and the scheduled tribe (ST) households are viewed as less-endowed with land and different assets. These households represented about 33% of total farm household in the sample and ought to be more associated with non-farm activities. Moreover, approximately 30% and 41% of farm households are in humid and semi-arid tropics regions respectively, while about 75% of farm households are marginal or small who possessed less than 2 hectares of land.

Table 2.3 also shows a significant difference between the farm households that participate in NFE and those that do not in terms of the possessing farm equipment, household size, and their dependency ratios etc. The land is an important factor in farm households' decision to diversify their livelihood in NFE. On an average, approximately 1.67 hectares of landholding possessed by the undiversified farm households, while approximately 1.87 hectares of land holding is possessed by the diversified farm households.

The analysis also demonstrates that on an average the heads of diversified household completed nine years of formal education whereas the heads of undiversified households completed seven years of formal education. This shows that an educated person will take part

in the NFE. Further, absence or lack of access to external financing may impede investment in farm and non-farm activities in terms of high starting capital or even operational costs (Barrett *et al.,* 2001). Our result confirms that about 49% of the sample farm households have access to credit for agricultural purposes while only 4% for non-farm enterprise activities. Further, a similar difference with respect to the availability of district road is also observed from the sample. The road density of the diversified households is around 664 against 629 road density of the undiversified households living in a district. This finding reveals that households with high road density are more likely to participate in NFE. Further, the consumption expenditure of Indian rupees (INR) 79,800 for participants in non-farm enterprises which is significantly higher than that of non-participant households, with an average of INR 55,122. Similarly, farm income of participant of non-farm enterprises is significantly higher than non-participants.

Table 2.3: Descriptive Statistics of Principal Variables

Explanatory Variable	Full Sample	Sub-samples		
	Mean (n = 21,078)	Undiversified Mean (n = 18,456)	Diversified Mean (n = 2,622)	Mean Difference (t-test)
farm income	84004.98	79794.20	112805.60	-33011.41***
consumption expenditure	58192.36	55122.16	79800.84	-24678.67***
farm equipment	1.611	1.590	1.759	-0.169***
Religion:				
Hindu	0.887	0.889	0.873	0.015**
muslim	0.064	0.061	0.082	-0.021***
other religions	0.049	0.050	0.045	0.006
Caste:				
general	0.417	0.418	0.414	0.004
Obc	0.278	0.271	0.323	-0.052***
Sc	0.113	0.113	0.113	0.001
St	0.192	0.198	0.150	0.047***
hh size	6.019	5.901	6.847	-0.946***
dependency ratio	37.733	38.196	34.477	3.719***
adult dependency ratio	72.992	73.740	67.727	6.013***
livestock	5.264	5.262	5.282	-0.021
land holding	1.692	1.666	1.871	-0.205***
road density	632.960	628.585	663.757	-35.172***
education	7.566	7.345	9.129	-1.784***

Explanatory Variable	Full Sample	Sub-samples		
	Mean (n = 21,078)	Undiversified Mean (n = 18,456)	Diversified Mean (n = 2,622)	Mean Difference (t-test)
number of loans	2.013	1.970	2.314	-0.344***
Membership:				
Shg	0.148	0.147	0.155	-0.008
credit savings	0.095	0.095	0.097	-0.003
cooperative	0.079	0.071	0.134	-0.063***
Land Class:				
marginal farmers	0.490	0.496	0.446	0.051***
small farmers	0.233	0.224	0.292	-0.067***
medium farmers	0.168	0.171	0.150	0.021***
large farmers	0.109	0.108	0.112	-0.004
Agroecological Zones:				
Humid	0.308	0.301	0.356	-0.055***
semi-arid temperates	0.216	0.221	0.183	0.038***
semi-arid tropics	0.410	0.412	0.401	0.011
Arid	0.065	0.066	0.060	0.006

****, ** and * denotes statistical significance at 1%, 5% and 10% levels respectively.*

2.5.2. Econometrics Analysis

The descriptive analysis indicated significant differences in farm income, consumption expenditure, farm and household characteristics between NFE diversified and undiversified farm households. However, to assess correctly the effects of participation in NFE on farm income and consumption expenditure, as described in section 2.3, a propensity score matching technique is used in the present study. The farm income and consumption expenditure equations are estimated together with the selection equation which explains the farm households' participation in NFEs.

2.5.2.1. Determinants of Participation in Non-Farm Enterprises

Table 2.4 shows the results of panel probit analysis to examine the determining factors of participation of farm households in rural non-farm enterprises in different agroecological zones and the size of landholding. The first column shows the separately estimate results of a panel probit for the full sample, while column [2] to column [5] shows the results of the panel probit models of different agroecological zones. Further, column [6]

to column [9] represents the panel probit results for the different type of farmer categories with respect to their land holding. The result shows that the likelihood of participating in NFE is significantly dependent on the farm income, household size, and a number of adult members in the household. Farm households with more adult members in the household are very likely to engage in NFE. The results are consistent with the descriptive statistics and also with the findings of (Lanjouw & Shariff 2004). This is due to the fact that more adult members can help farm households adjustable to non-farm labor market requirements. Additionally, the coefficient of household size is significantly positive, revealing that large farm households are very likely to engage in NFE. This is because the farm households are associated with their requirement of additional income to fulfill their basic needs.

The coefficient of household dependency ratio is significantly negative, suggesting that the farm households with a greater number of young child (aged up to 14 years) and a greater number of elder members (over the age of 64 years) are more likely to be discouraged from participating in NFE. This is due to the fact that farm households may encounter a shortage of free labor hours when some family members get older and/or young children at home, therefore, more likely to lose non-farm labor opportunities. Landholding has a significantly negative correlation with participation in NFE, which shows that the farm households with larger land are more likely to prefer work on farms rather than to diversify into NFE. Labor employed on larger farms is not flexible and therefore, larger land holdings are very likely to reduce the likelihood of an individual performing non-farm activities (Benjamin, 1994; Mishra & Goodwin, 1997). The availability of roads in the district has a significantly positive correlation with participation in the NFE. Road density can help to facilitate the possibility of moving back and forth between home and workplace and create income generation opportunities in the non-farm sector for active farm households, which is likely to induce farm households to participate in non-farm uses.

Membership of SHG and cooperative association is very important factors influencing diversification decision in NFE as well. Farm households having membership in various formal and informal financial institutions get involved in more non-farm enterprise activities. Further, the result shows that households residing in semi-arid temperate, semi-arid tropics and arid regions are less likely to diversify into NFE than those living in the humid region of rural India. The result with respect to land holding shows that medium and large farmers are less like to diversify as compared to marginal farmers. The coefficient of access to formal credit is positive and significant, which indicates the importance of formal credit for the development of NFE in rural areas. In support of this finding, Abdulai & Crolerees (2001) reveal that the lack of an effective formal credit market is one of the factors that has influenced the development of NFE's activities in developing countries.

The diversification by small and marginal farmers towards non-farm rural enterprises that can significantly increase farm income has always been questioned in the literature. This is due to reasons such as diseconomies of scale and lack of access to factors such as capital and information etc. The statistical evidence shows that positive diversification towards non-farm rural enterprises for small owners rather than anti-smallholder. However, small farmers play a proportionally larger role than large farmers. These patterns are consistent with simple comparative advantage-based production choices. Even with small landholdings with high labor endowments, such as farm households diversify toward non-farm enterprises. The results are robust to several tests on specification including those related to self-selection.

Table 2.4: Determinants of Livelihood Diversification of Farm Households in Rural Non-Farm Enterprises

	Full Sample	Humid	Semi-Arid Temperate	Semi-Arid Tropics	Arid	Marginal	Small	Medium	Large
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent Variable = Livelihood diversification in Rural Non-farm Enterprise									
log farm income	0.286***	0.258***	0.355***	0.309***	0.127	0.283***	0.504***	0.261***	0.115*
farm equipment	-0.009	-0.015	-0.041*	0.013	0.004	-0.044*	-0.056	0.031	0.010
Religion									
muslim	0.292***	0.028	0.660***	0.426**	-0.486	0.226**	0.267	0.237	0.567*
other religions	-0.204*	-0.160	-0.583*	-0.003	-0.014	-0.097	-0.274	-0.309	-0.391
Caste									
OBC	0.158***	0.273***	0.045	0.010	0.318*	0.082	0.295*	0.192	0.199
SC	0.274***	0.357***	-0.325	0.337***	0.318	-0.002	0.541**	0.875***	0.459*
ST	-0.163***	-0.192*	-0.110	-0.119	-0.103	-0.262***	-0.147	0.079	-0.052
hh size	0.033*	0.044	-0.014	0.055	0.048	0.067	0.048	-0.009	0.002
hh dependency ratio	-0.003*	-0.007**	0.003	-0.0005	-0.007	0.0004	-0.011**	0.00007	-0.0005
adult dependency ratio	0.0004	-0.0003	-0.001	0.001	0.004*	-0.002**	0.004**	0.001	0.002
livestocks	-0.008**	0.001	-0.032***	-0.007	-0.002	0.002	-0.022*	-0.002	-0.013*
road density	0.011*	0.015*	0.031	0.010	0.008	0.016**	0.007	0.007	0.045**
education	0.032**	0.113***	0.016	0.017	0.073	0.021	0.065*	0.029	0.030
loans	0.025***	0.033**	0.035**	0.015	0.045*	0.025**	0.041**	-0.002	0.033**
shg membership	0.048	-0.296***	0.630***	0.212**	-0.073	0.120	-0.088	0.077	0.171
credit savings membership	-0.197**	-0.025	-0.051	-0.288**	-0.692*	-0.151	-0.408*	-0.025	-0.137
cooperative membership	0.383***	0.823***	0.274*	0.226**	0.297	0.183*	0.819***	0.159	0.287*
Land Class									
small	0.075	0.227*	-0.138	0.144*	0.078				
medium	-0.281***	-0.388*	-0.506***	-0.029	0.157				
large	-0.564***	-0.289	-0.706***	-0.266*	-0.140				

	Full Sample	Humid	Semi-Arid Temperate	Semi-Arid Tropics	Arid	Marginal	Small	Medium	Large
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent Variable = Livelihood diversification in Rural Non-farm Enterprise									
Agroecological Zones									
semi-arid temperates	-0.383***					-0.183**	-0.876***	-0.311*	-0.130
semi-arid tropics	-0.205***					-0.190**	-0.436***	0.247*	-0.027
arid	-0.314***					-0.346**	-0.732**	0.183	-0.021
_cons	-3.977***	-3.793***	-4.774***	-4.478***	-3.300***	-3.474***	-6.087***	-5.343***	-3.118***
lnsig2u	-0.389**	-0.083	-1.176*	-0.715**	-1.707	-1.273**	0.842**	-0.350	-2.800
sigma_u	0.823	0.959	0.555	0.699	0.426	0.529	1.523	0.839	0.246
rho	0.404	0.479	0.236	0.328	0.153	0.219	0.699	0.413	0.057
N	16545	5100	3857	6492	1096	7698	4076	3082	1689

Note: *Significance level of the difference: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$*
Robust standard errors clustered at the district-level in parentheses.
Omitted groups: *Religion:* hindu. *Caste:* general. *Land Class:* marginal. *Agro-ecological Zones:* humid.

2.5.2.2. Effects of Participation in Non-Farm Enterprises on Farm Income and Consumption Expenditure of Farm Households in Different Agro-ecological Zones

To account for the effects of heterogeneous treatment in estimating the relationship between treatment and outcome variables, we implemented the propensity score matching (PSM) to obtain the average treatment effects on the treated (ATT). In PSM, we include a large set of covariates. The set of variables that meet the technical requirements of the common support and the balance properties are considered. The estimates of the propensity of diversified and non-diversified farm households within a common support region was used to balance the observed distribution of covariates between the two groups in order to ensure that households with the same covariates have the same probability as to select in assessing the impact of diversification in the NFE on farm income and consumption expenditure of farm households in rural India and in various agro-ecological zones.

Table 2.5: Impact of Livelihood Diversification on Farm Income and Household Consumption

	Matching Algorithms	Number of Treated Units	Number of Control Units	ATT	Standard Error	T-Statistics
Nearest Neighbour	**Farm Income**					
	Full Sample	2088	1875	12736.90	18910.66	2.67
	Humid	789	550	14647.41	7380.40	1.99
	Semi-Arid Temperates	402	337	41772.16	8513.29	4.91
	Semi-Arid Tropics	782	637	30958.95	9467.84	3.27
	Arid	115	99	2283.18	29082.15	0.08
	Marginal	881	704	9475.69	16991.63	0.56
	Small	670	420	18649.06	7581.39	2.46
	Medium	347	293	31008.08	9451.39	3.28
	Large	196	169	49127.52	64595.03	0.76
	Consumption					
	Full Sample	2077	1659	16562.17	3567.55	4.64
	Humid	785	572	17782.31	10642.52	1.67
	Semi-Arid Temperates	401	357	11768.98	14132.74	0.83
	Semi-Arid Tropics	776	700	12132.80	8237.89	1.47
	Arid	115	95	-967.59	9591.14	0.10
	Marginal	876	739	10673.79	6528.96	1.64
	Small	667	442	41528.38	20362.20	2.04
	Medium	345	336	20271.34	11768.81	1.72

	Matching Algorithms	Number of Treated Units	Number of Control Units	ATT	Standard Error	T-Statistics
	Large	195	172	107.07	16943.67	0.01
Kernal Matching Method	**Farm Income**					
	Full Sample	2088	14996	15517.77	3945.56	3.93
	Humid	789	4338	29498.33	19195.49	1.54
	Semi-Arid Temperates	402	3533	25981.97	16768.28	1.55
	Semi-Arid Tropics	782	5939	32518.55	6340.33	5.13
	Arid	115	1013	44898.74	34581.74	1.30
	Marginal	881	7045	21084.60	4434.88	4.75
	Small	670	3545	5187.86	9377.12	0.55
	Medium	347	2816	29966.13	9355.11	3.20
	Large	196	1594	22142.70	26036.69	0.85
	Consumption					
	Full Sample	2077	14462	8550.6	1607.42	5.32
	Humid	785	4251	2134.8	4168.70	0.51
	Semi-Arid Temperates	401	3383	17351.6	5614.64	3.09
	Semi-Arid Tropics	776	5704	5500.2	5770.42	0.95
	Arid	115	959	15873.5	18220.95	0.87
	Marginal	876	6821	18796.3	2902.79	6.48
	Small	667	3405	19201.8	6099.34	3.15
	Medium	345	2717	17300.6	10430.05	1.66
	Large	195	1527	15368.6	5375.29	2.86
Stratification Matching	**Farm Income**					
	Full Sample	2088	14996	12196.86	6860.10	1.78
	Humid	789	4338	6450.40	10469.62	0.62
	Semi-Arid Temperates	401	3534	22724.81	11127.03	2.04
	Semi-Arid Tropics	781	5940	23386.30	7905.73	2.96
	Arid	114	1014	31570.84	34066.07	0.93
	Marginal	881	7045	7530.33	8061.72	0.93
	Small	670	3545	8645.08	9412.59	0.92
	Medium	346	2817	22535.47	5302.05	4.25
	Large	196	1594	11697.75	35361.11	0.33
	Consumption					
	Full Sample	2077	14462	3304.26	3270.39	1.01
	Humid	781	4255	9753.11	5416.61	1.80
	Semi-Arid Temperates	398	3386	10614.90	9537.66	1.11
	Semi-Arid Tropics	776	5704	2422.16	4665.28	0.52
	Arid	112	962	4135.51	17012.65	0.24
	Marginal	876	6821	12864.28	2604.78	4.94
	Small	667	3405	20812.53	4368.70	4.76
	Medium	344	2718	12566.49	6162.69	2.04
	Large	195	1527	5456.65	14583.06	0.37

For the present purpose nearest neighbor matching, kernel matching and stratification matching techniques were used to assess the impact of NFE diversification on farm income and consumption expenditure. The results presented in Table 2.5 indicates that NFE diversification has a positive significant impact on farm income as well as consumption expenditure of farm households in rural India. Specifically, the estimates of the average treatment effect on the treated group (ATT) show that farm households that diversified into NFE have on average more farm income and consumption expenditure of INR 12736.90 and INR 15517.77 Indian rupees respectively than those that have not diversified into NFE. This shows that diversified households are financially more secured than undiversified households. This implies that the increased household income from diversification assist in the significant improvement of farming practices results in more farm income and more consumption expenditure experienced by farm households. Therefore, non-farm diversification tends to play a vital role in raising farm income and improving consumption expenditure of farm households in rural India. This result is consistent with the finding of Ali & Peerlings (2012) who uses a similar approach to investigate the effect of participation in NFE activities on farm household economic wellbeing in Ethiopia.

Sensitivity analysis is performed using kernel gaussian and stratification matching techniques to check if our nearest neighbor matching results are robust to other matching methods. The results of all three methods presented in Table 2.5 confirms that our nearest neighbor matching results are quite robust and is not sensitive to other matching techniques. However, the nearest neighbor outcomes are slightly different than that of other techniques in some cases.

2.6. Concluding Remarks

This chapter examines the determinants of livelihood diversification in non-farm enterprises (NFE) among the farm households and its effects on their farm income and consumption expenditure in different agroecological zones. The panel probit result (random effect) shows that decision of livelihood diversification in NFE is determined by household head characteristics, household endowments, community-level characteristics, and farm characteristics. Farm income, consumption, household size, dependency ratio, number of adults, number of livestock, educational attainment of the individual household heads and cooperative membership are found to have a significant impact on rural NFE diversification decision. Household size as one of the endowments of the rural household has a significant positive impact on NFEs activities. Similarly, road density at the district level has an important influence on NFE diversification. The results also indicate that households residing humid zone are more likely to diversify into NFEs than their counterparts in semi-arid temperate, semi-arid tropics and arid zones. Another result of this study is that rural farm households that have access to self-help groups and cooperative associations have managed to overcome the barriers associated with entry into NFE activities. This is an interesting finding that has not received much attention in previous studies and describes the importance of social networks and loans in promoting NFE activities in different agroecological zones of rural India.

The second part of the study employs the propensity score matching technique to assess the impacts of NFE diversification on farm income and consumption expenditure of the farm households. The result shows that NFE diversification has a positive significant impact on the farm income as well as the consumption expenditure. This finding is consistent with the widely held view in the literature that income from NFE activities plays a vital role to smoothen household consumption expenditure and in improving the economic wellbeing of household status.

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