Rural Nonfarm Enterprises Diversification, Farm Income and Consumption Expenditure in different agroecological zones of India: Evidence from Longitudinal Farm Households

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ABSTRACT

This paper examines the determinants of livelihood diversification of farm households in rural nonfarm enterprises (NFEs) and its effects on their farm income and consumption expenditure in different agroecological zones in rural India using panel probit analysis (random effect) and propensity score matching (PSM) techniques to account for potential selection bias on panel data from the Indian Human Development Survey (IHDS) conducted in 2005 and 2012. We found diversified farm households are statistically different from undiversified households in terms of number of farm equipment possessed, household size, adult members, land holding, education etc. In addition, by employing panel probit analysis (random effect), we found that NFE diversification decision significantly depends on farm and household characteristics such as dependency ratio, membership of cooperative association, number of loans, land holding and household size etc. The model also indicates that households residing in humid zone are more likely to diversify into NFE activities than those in semi-arid temperates, semi-arid tropics and arid zones. The NFE diversification seems more important for the households at lower end of land distribution. The poor households diversify more towards low-paid, low-return non-farm activities. Small landholdings, low agricultural productivity and surplus labour force the farm households to diversify their income portfolio towards non-farm activities. The

non-farm income sources are accessible to a small proportion of farm households and have un-equalizing effect on income distribution.

Propensity score matching technique was used to access the impact of NFE diversification on farm income and consumption expenditure of farm households. The result reveals that NFE diversification has a significant and positive impact on farm income as well as in consumption expenditure in rural India, and different agroecological zones. In the light of growing urban sprawl, with its positive implications for rural economy by providing closer markets, better transportation services, awareness, and better rural-urban linkages, we recommend rural NFE diversification among farm household as a means of smoothing income and consumption.

Keywords: Rural Nonfarm Enterprises Diversification, Farm Income, Consumption Expenditure, Panel Probit, Propensity Score Matching, Agroecological Zones, India

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1. Introduction:

Poverty remains a major global challenge. Consequently, the first aim of Sustainable Development Goal (SDG) is at eradication of poverty. Between 1990 and 2015, extreme poverty in the developing world declined from 47% to 14% (United Nations, 2015). The 2015 Millennium Development Goals (MDGs) Report points out that much of the advancement towards eradicating extreme poverty was achieved in the year 2000 and beyond (United Nations, 2015). This same period saw the intense advocacy of diversification into nonfarm activities by farm households in rural areas of developing countries (Barrett & Reardon, 2000; Reardon et al., 2006; Barrett et al., 2001; World Bank, 2003; Davis, 2006; Senadza, 2012; Owoo & Naudé, 2014; Senadza, 2014). In theory, literature reveals that "demand-pull" and "distress-push" factors motivate farm households to diversify into nonfarm activities (Davis, 2006). Among such factors considered as "demand-pull" include; higher returns from nonfarm activities, 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, absence of financial services, and inadequate resources (Davis & Pearce, 2000; Barrett et al., 2001). Although Davis (2006) discloses that the distinction between the "demand-pull" and "distress-push" factors is not explicit, he emphasizes the need to distinguish between these factors for effective policy.

In recent years, studies on rural nonfarm enterprises (NFEs) owned by rural households in developing countries have attracted considerable attention in the rural development literature due to increasing inability of the farm sector to provide them with sustainable means of livelihood. Ellis (2000) argues that nonfarm diversification is often a strategy that farm households use to moderate seasonal income variability and minimize the inherent risks associated with agriculture as a result of hostile agroecological factors. The nonfarm enterprise (NFE) sector plays a vital role in enhancing the wellbeing of rural households as it provides them with income diversification opportunities that helps in slowing down rural-urban migration, reducing poverty, and improving food security status (Haggblade *et al*., 2007; Lanjouw, 2007; Ali and Peerlings, 2012).

Despite mounting evidences on the potential contribution of nonfarm activities to economic wellbeing of rural farm households in developing countries, factors influencing their decision to diversify into nonfarm activities are substantially left unexplored, specifically in different agroecological zones (Lanjouw and Lanjouw, 2001; Woldenhanna and Oskam, 2001; Loening *et al*., 2008). Studies on the determinants have not yet taken into consideration the effect of different agroecological zones on diversification in nonfarm activities decision despite their importance to rural entrepreneurship development. Most of the studies (Deininger and Olinto, 2001; Babatunde and Qaim, 2009) focused on only the determinants of household decision to diversify into rural nonfarm activities, which makes it difficult to suggest policies that promote diversification in nonfarm activities as a measure of improving the economic wellbeing of farm households in the different regions.

Moreover, over the last few decades, the development of physical infrastructure has improved urban–rural road connectivity, which also facilitates farm households' engagement in nonfarm activities. Engagement in nonfarm activities is farm households' self-insurance mechanism to increase and stabilize household incomes (Alasia et al. 2009). Several studies analyse the economic impacts of participation in nonfarm employment at the farm household level by evaluating the impacts on farming practices, household expenditure or household incomes (McNally 2002; de Janvry and Sadoulet 2001; Mishra and Sandretto 2001; Goodwin and Mishra 2004; de Janvry, Sadoulet, and Zhu 2005; Chang and Mishra 2008; Owusu, Awudu, and Seini 2011; Akaakohol and Aye 2014; Scharf and Rahut 2014). The findings show that farm households engaging in nonfarm activities tend to enjoy higher household incomes and produce agricultural products more efficiently, suggesting the vital role of nonfarm activities in raising farm households' income and improving farming practices.

In addition, empirical analyses of the importance of farm-nonfarm 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; Jabo et al., 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 and 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. In this respect, the ESR technique is superior to the PSM method. 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 nonfarm 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; Jabo et al., 2014b; Dedehouanou et al., 2015; Osarfo et al., 2016).

While previous studies exist on farm-nonfarm diversification in India, they have all focused on the rural setting. Table 1 presents percentage share of diversification in nonfarm enterprises (NFEs) in different ecological zones of India. The percentage share in the semi-arid temperate zone is lowest (about 10.5 percent) and highest (about 14.4 percent) in the humid zone. Even though on a lesser scale, Table 1 indicates that quite a significant proportion of farm households in rural India combine farming with nonfarm 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 1: Livelihood diversification in nonfarm enterprises in different agroecological zones

	Diversified in nonfarm 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]

** Authors calculations based on IHDS – Panel Data*

Note: Values in parentheses ( ) represents row-wise percentage share and values in brackets [ ] represents column-wise percentage share.

To address the current research gaps, this study examines the determinants of livelihood/income diversification of farm households in rural nonfarm enterprises (NFEs) and its effects on farm income and consumption expenditure in different agroecological zones, using a nation-wide panel survey data of same farm households in rural India over the time interval (2005 and 2012). In this study, NFE diversification refers to the allocation of household

production assets to all forms of owned businesses and self-employed economic activities that are undertaken in the nonfarm sector of the rural economy. It is worthy to note that this study is limited to rural farm households that choose – either to specialize in farming or diversify into rural NFEs as a means of sustaining their livelihood. The paper employs panel probit analysis (random effect) to identify the major determining factors for participation decision of farm household in rural NFEs and propensity score matching techniques to assess the impact of NFE diversification on farm income and consumption expenditure. The advantage of matching method over other methods is that it takes care of self-selection bias that exist in the sample by matching diversified and undiversified households that share the same pre-diversification characteristics.

The outcome of this study will contribute to the growing literature on rural development by providing empirical evidence on the contribution of NFE diversification to farm income and consumption expenditure of farm households in different agroecological zones. In addition, the study would be of immense benefit to policy makers, development planners and other stakeholders who seek to promote rural development in Indian communities. As, in best of our knowledge, it is the first study to analyse the determinants of participation in rural nonfarm enterprises and its effect on farm income and consumption expenditure of same farm households in different agroecological zones over the time interval in rural India.

The rest of the paper is organized as follows. The next section provides an extended discussion on NFE diversification in rural India. Section three presents the paper's empirical framework. Section four describes the data sources and the measuring variables used in estimation of determinants of NFE diversification and its effects on household farm income and consumption expenditure. Section five discusses the empirical findings and the last section concludes.

2. NONFARM ENTERPRISE DIVERSIFICATION IN RURAL INDIA

Over the past three decades, Indian agriculture has grown at an annual rate of around 3 per cent. This has helped improve farm incomes and reduce rural poverty (Datt and Ravallion, 1996; Warr, 2003). However, of late, the farm sector has come under stress - the growth therein being decelerated to 2.7 per cent per annum during 1995-96 to 2009-10 from 3.2 per cent per annum during 1980-81 to 1994-95. But, the more worrisome is the continuance of excessive employment pressure on agriculture, despite a significant decline in its share in the national income. The sector engaged 52 per cent of the country's workforce in 2009-10, compared to 69 per cent in 1983, while its share in the gross domestic product (GDP) declined from 40 per cent to 15 per cent during this period. Further, the Indian agriculture is dominated by small

landholdings, and the average size of landholding has shrunk to 1.16 ha in 2010-11 from 1.84 ha in 1980-81. Given these trends, there arises a basic question: how far farm households would survive on such tiny pieces of land? In a recent study, Chand et al. (2011) have reported that if agriculture were to the sole source of income for small landholders, the majority of them would have remained poor.

A number of studies from developing countries have suggested that diversification of rural economy towards nonfarm activities has considerable potential to augment farmers' income and reduce rural poverty (Adams and He, 1995; Adams, 2001; Reardon et al., 1998; 2007; Barrett et al., 2001; Lanjouw, 1999; de Janvry et al., 2005). Diversification towards nonfarm activities overcomes the land constraint to income growth, enables the farmers cope up with the shocks of crop failure and enhances their capacity to invest in productivity-enhancing agricultural inputs and technologies (Collier et al., 1986; Reardon and Taylor, 1996). Further, a growing rural non-farm sector can absorb surplus labour from agriculture, reduce rural-urban migration, narrow down rural-urban disparities and promote farm-nonfarm linkages.

India's rural economy has undergone a gradual shift towards the nonfarm sector with its share in rural income increasing from 35 per cent in 1980-81 to 62 per cent in 2004-05 (GoI, 2010), and in rural employment from 22.3 per cent to 31.5 per cent (Lanjouw and Murgai, 2008). Nonetheless, we do not know much about its distributional impacts. The evidence is scanty and inconclusive. Lanjouw and Shariff (2002) have found the non-farm income to be neither inequality-increasing nor inequality-decreasing. Lanjouw and Stern (1993), on the other hand, had reported a strong un-equalizing effect of non-farm income on rural income inequality. Sen (1994) too had indicated that an increase in nonfarm income can lead to worsening of income distribution due to lower barriers for the rich in transiting from farm to nonfarm sector. The rural nonfarm sector is quite heterogeneous in India, and its distributional consequences are likely to vary depending on whether an income source is accessible to the rich or the poor. Birthal and Singh (1995) had reported that nonfarm wages have an equalizing effect on income distribution, while nonfarm business, salary and transfer incomes have an opposite effect. Lanjouw and Shariff (2002) have observed the distribution of wages to be skewed towards the poor, and salaries towards the rich.

Evidence from other countries is also mixed. Reardon et al. (1998) have reported myriad types of relationship of nonfarm income with landholding size and household income. Adams and He (1995) in Pakistan and Adams (2001) in Egypt have found inverse relationships between

nonfarm income and land ownership as well as household income. The nonfarm income diversification in China has been found to reduce income inequality and poverty (de Janvry et al., 2005). The studies from Rwanda (Dabalen et al., 2004), Jordan (Adams, 2001), Burkina Faso (Reardon and Taylor, 1996) and Tanzania (Collier et al., 1986), on the other hand, have found that non-farm income has un-equalizing effect on income distribution. In a recent study in selected countries of Asia, Africa and Latin America, Davis et al. (2007) have reported unequalizing effect of most non-farm income activities on income distribution.

Nevertheless, in the land-scarce, labour-surplus countries like India, the importance of non-farm income sources to the poor cannot be undermined. From an extensive review, Coppard (2001) has concluded that 'nonfarm diversification is important for the landless and small landholders, and a growing non-farm sector can reduce rural poverty, but may be accompanied by worsening income distribution because of differential access of the poor and the rich to nonfarm income sources.'

Stress on Indian agriculture increases because of several reasons, such as continuous fragmentation of landholdings and climate change, there is a serious threat to livelihood based on farming. This is particularly true for small farmers. Growing rural populations and constrained employment opportunities in the nonfarm sector have caused subdivision of landholdings in India to the extent that these cannot provide an adequate livelihood to a majority of farm households. In this context, diversification in rural NFEs can be a possible strategy to improve livelihood. With this view, this study was undertaken to examine farm households' access to NFE diversification, their determinants and effects on farm income and consumption expenditure in different agroecological zones of rural India.

3. Empirical Framework

This section begins with a discussion of rigorous econometric approaches used to analyse factors determining the farm households' decision to engage in NFEs and to evaluate the impacts of such participation on household farm income and consumption expenditure in different agroecological zones of rural India.

3.1 Econometric approaches

(a) Determinants of participation in rural nonfarm enterprises

Following the conventional framework of household choice, a farm household decides to diversify into NFE if nonfarm wage/income is higher than the reservation wage/income from

on-farm work and leisure. This suggests that the likelihood of participating in nonfarm activities is determined by both household socioeconomic characteristics and farm characteristics.

To capture the relationship between these characteristics and farm households' decision to engage in nonfarm activities over time, a panel probit model (random effect) is employed. In this way, we can perform economic analysis and specify models with the data of cross section that are obtained when all operators are considered in an instant of time. Different patterns of behaviour of all farm households together studied in the different temporal moments may thus be assessed.

Probit analysis for panel data can be done by fitting a population-averaged model or a random-effects probit model. There is no procedure for a conditional fixed-effect model, as there does not exist a sufficient statistic allowing the fixed effects to be conditioned out of the likelihood. Though, unconditional fixed-effects probit models can be fit with indicator variables for the panel data. However, unconditional fixed-effects estimates are biased, so we used random effects in our study with the following equation.

$$Pr\ (y_{it} \neq 0 | x_{it}) = \phi\ (x_{it}\ \beta + u_i) \qquad (1)$$

for $i = 1,\ldots,n$ panels, where $t = 1,\ldots,$ n_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 equals 1 for a farm household that engages in at least one nonfarm enterprise and 0 for a farm household that does not engage in any NFE.

(b) Modelling the effects of participation in rural nonfarm 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 nonfarm enterprises may enable farm household to invest in farming activities which may leads 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 nonfarm

engagement on household farm income and consumption expenditure, a commonly used model in the literature on effect evaluation is written as follows:

$$I_{it} = \beta_{it}X_{it} + \Upsilon_{it}D_{it} + \varepsilon_{it} \qquad (2)$$

$$C_{it} = \sigma_{it}Z_{it} + \mu_{it}D_{it} + \nu_{it} \qquad (3)$$

where I and C are the household's farm income and consumption expenditure in equation (2) and (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 Υ and μ are the coefficient capturing the effects of nonfarm participation on the farm income and consumption expenditure.

However, this coefficient may be biased and inconsistent due to the self-selection of farm households into the nonfarm participant group. If, for example, participants are wealthier or live in an area with a high cost of living, their consumption expenditure is higher, irrespective of whether they participate in NFE. In addition, the farm households' nonfarm skills and motivation for diversifying household earnings can also influence both their decisions of whether to participate or not participate in NFE and household consumption expenditure levels. The coefficient on the nonfarm participation dummy (D) would, in this case, also include the effects of these unobserved factors and, thus, produce an overestimate of the effects of participation in NFE. In econometrics, when unobserved effects are correlated with both the regressed (farm income and consumption expenditure) and a regressor (participation in NFE), the coefficient on the latter is inconsistent and biased.

One can use a Heckman selection approach or standard treatment effect model to control for this selection bias. Still, these approaches cannot control for the potential systematic differences between the groups due to the assumption that the consumption functions differ between the participants and nonparticipants by only a constant term (Rao and Qaim 2011). The approach may still yield biased and inconsistent estimates because it cannot control for unobserved factors that potentially affect both the decision of whether to engage in rural nonfarm activities and the outcomes (farm income and consumption expenditure).

The propensity score matching approach is adopted to address the above-mentioned econometric challenges. The method compares the farm income and consumption expenditure of diversified households with that of undiversified households that have similar 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 study, diversified households are farm households that decide to diversify into rural NFEs, while undiversified households are those that rely solely on farming as a means of livelihood.

The propensity score $P(T_{it})$ is defined as the conditional probability of receiving a treatment given observable pre-diversification characteristics of the household, propensity score can be computed as:

$$P(T_{it}) \equiv \text{prob}\,(D_{it} = 1|T_{it}) = E(D_{it}|T_{it});\ P(T_{it}) = F(h(T_{it})$$

where D_{it} is the indicator of diversification in rural NFEs; T_{it} denotes 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 predicted with probit model under the assumption of normal cumulative distribution. The assumption of the conditional independence of the score result extends the use of propensity scores for the computation of the conditional treatment effect.

The predicted propensity scores provide the basis for matching households with the same observable characteristics. Hence, matching requirement has to be satisfied before computing the treatment/diversification effect. Becker and Ichino (2002) suggest that Average Treatment effect on the Treated (ATT) is the parameter of interest in propensity score matching analysis as it shows the actual gain from NFE diversification by comparing the economic wellbeing of diversified households with that of its counterfactual group of households that are closest in terms of their propensity scores. Therefore, ATT can be computed as follows:

$$ATT_{it} = E(T_{it}|1=1) = E(Y_{it}\,(1)|D_{it}=1) - E(Y_{it}\,(0)|D_{it}=1)$$

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 includes nearest neighbour 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 neighbours with similar observed characteristics. For robustness, KM and SM methods are also adopted for the study.

4. Data sources and Variables:

4.1 Sources of Data

We used longitudinal household information on 21,078 rural farm households for our analysis. The data comes from two waves (2004-05 and 2011-12) of the nationally representative India Human Development Survey (IHDS) carried out by the University of Maryland, USA and the National Council of Applied Economics Research (NCAER), New Delhi. IHDS-I is a nationally representative survey of 41,554 households conducted in 2004-2005, while IHDS – II has re-interviewed 83% of the original households as well as split households residing within the village and an additional sample of 2134 households. The final sample size for IHDS-II is 42,152 households. These households are spread across 33 states and union territories, 384 districts, 1420 villages and 1042 urban blocks located in 276 towns and cities.

This dataset contains a rich source of information on various socio-economic indicators at the household as well as individual level. For the rural sample, it also has information on the basic demographic characteristics of the villages in addition to the presence of physical infrastructure. In this paper, we utilize the household level information on consumption and income indicators. We use the household as well as farm level characteristics as our control variables. For our analysis, we also use additional datasets, which help us in establishing causal association. In addition, we used the Census 2001 and 2011 data to calculate the share of district with access to paved road.

To assess the climate impacts, we used district-level data on climate variables (temperature and rainfall) for the respective years. The district-wise data on temperature and rainfall were extracted from 1 x 1 degree high-resolution daily gridded data available from the Indian Metrological Department, Government of India. The daily data were converted into monthly averages. Many studies have used averages of temperature and rainfall during different quarters of the year on the monthly means for January, April, July, and October as representative of the respective quarters. But, there is a possibility of high correlation between quarterly temperature and cumulative rainfall for India's two main crop growing periods, viz., *kharif* (June to September) and *rabi* (October to February), which are less correlated than the quarterly or monthly averages.

The data were scrutinized for errors and outliers. There were a number of households that had no access to land, owned or leased, but had reported income from cultivation. Some households had also reported unusually low or high income from cultivation which was not in relation to their landholding size. These observations were excluded from the analysis.

4.2 Measurement Variables:

The dependent variable in the selection equation (equation 1) is a binary variable for participation in rural NFE. It equals 1 for a farm household that engages in at least one rural nonfarm enterprise and 0 for a farm household that does not engage in any rural nonfarm enterprise. The dependent variable in the outcome equations (equations 2 and 3) are household farm income and consumption expenditure. The explanatory variables consist of household characteristics, farm characteristics, memberships, availability of roads in the district and agroecological risks. These variables are summarized in Table 2. Household characteristics include religion, caste, household size, household and adult dependency ratios, household head's education level. Education level is an indicator of human capital; those with a high education level would have more job opportunities. Additionally, well-educated individuals would have easier access to a large amount of information and be able to build networks in the community better (Azam, Imai, and Gaiha 2012). Hence, the education level would stimulate the farm households' participation in NFE, as found by Lanjouw and Shariff (2004) and de Janvry, Sadoulet, and Zhu (2005).

Dependency ratios are used to capture life cycle effects on participation in NFE and household farm income and consumption expenditure. These dependency ratios deal with household members over the age of 64 years and under the age of 15 years to capture the effects of dependents on the likelihood of engaging in NFE, household farm income and consumption expenditure. The number of dependents can produce mixed effects on the farm households' nonfarm engagement (Shi, Heerink, and Qu 2007). On the one hand, with more dependents in a farm household, high household incomes are needed to satisfy consumption and other necessary expenditures, stimulating household income diversification. On the other hand, the farm households with more dependents need to spend more time taking care of these dependents, reducing the time available for nonfarm activities. However, older members may help care for children, possibly allowing the parents to engage in either on-farm or nonfarm employment. Nevertheless, more dependents in a household would reduce household consumption per capita if the household enjoyed low household earnings.

Landholding in hectares is used to capture the effects of farm characteristics. The landholding variable is employed instead of a cultivated land area variable because the latter has a higher potential for endogeneity, although land markets in rural India are inactive, as argued by Azam, Imai, and Gaiha (2012). Labor employed on larger farms is less flexible, and households holding a larger area of land are likely to be discouraged from engaging in nonfarm employment (Benjamin 1994; Mishra and Goodwin 1997). Landholding would therefore have negative effects on nonfarm participation; however, it is difficult to hypothesize about the effects on household consumption due to the potentially mixed effects.

A categorical variable for agroecological zones caused by excessive rainfall and/or flood, drought, rot, birds/other insects and/or rodents is used to capture the effects of agroecological risks. Farmers reported yield quantity loss from such agroecological factors from the previous year to the time of interview. Because some farmers produced multiple crops, the use of aggregate quantities of damaged crops to capture such effects is impracticable. Moreover, due to the availability of information on temperature and rainfall at district levels, the study constructs the agroecological zones dummy, with the value equal to 1 if a farm household belongs to particular type (humid, semi-arid temperate, semi-arid tropics and arid) of agroecological zone and 0 if the farm household did not belong to that particular agroecological zone. Because the risks negatively affect agricultural returns, they would affect the farm households' decision regarding on-farm and nonfarm activities and household welfare in terms of food consumption (Kaur et al. 2011).

The availability of roads in the district is used as the identification instrument in the model because availability of roads in the district can facilitate traveling back and forth between home and workplaces and connect rural economies to the entire economy of India. This creates nonfarm employment opportunities for the farm households and, thus, likely motivates farm households to engage in nonfarm employment.

Note that we have used the concept of diversification as farm household participation in rural nonfarm enterprises. In reality, there are many other dimensions of diversification. Farm households can diversify their activities as well as their crops. The choices made by the farm households ultimately depend on subjective assessment of the risk-return trade-offs. The capacity to bear risk is lower for small farmers and thus riskiness of nonfarm enterprises is likely to be an important consideration for them.

Table 2: Description and Measurement of Variables

Variables	Measurement/Definition
Treatment Variable	
• diversification in nonfarm enterprises	1 if either the household head or any member of the household diversified into nonfarm enterprises, 0 otherwise.
• **Outcome Variables**	
• log farm income	natural log of total income received from cultivation in Indian rupees
• log consumption	natural log of total consumption expenditure of household in Indian rupees
• **Independent Variables**	
• farm equipment	total number of farm equipment a farm household possessed
• religion	1 = hindu; 2 = muslim; 3 = all other religions
• caste	1 = general; 2 = other backward castes; 3 = schedule castes; 4 = schedule tribes
• hh size	total number of household members
• hh size square	square of hh size
• 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
• no of adults	Total number of adult members in the household
• total livestocks	Total number of livestocks
• land holding	Household land possessed in hectare
• road density	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
• education square	Square of education
• 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

5. Empirical Analysis

This section starts with a description of summary statistics of main variables used in the analysis and a descriptive statistical analysis of the differences between farm households who diversify in rural nonfarm enterprises and those who do not. The section ends by presenting the econometric analysis results.

5.1 Descriptive statistics analysis

Table 3 summarizes the statistics of variables used in the econometric analysis. The table demonstrates that, on average, approximately 12.5% of the farm households diversify into rural NFE, and approximately 89% of the farm households are Hindus, while approximately 41% and 28% of the farm household belongs to general and obc category of caste respectively. India's social system is quite heterogenous and is stratified based on caste. The scheduled caste (sc) and scheduled tribe (st) households are considered to be less-endowed with land and other resources. Such households comprised close to one-third of the total farm households in the sample, and are expected to be engaged more in nonfarm activities. Moreover, approximately 30% and 41% farm households are in humid and semi-arid tropics regions respectively, while about 75% farm households are marginal or small who possessed less than 2 hectares of land.

Table 3 also presents general differences between the NFE participants and nonparticipants. The summary statistics in the table indicate some remarkable differences between participants and nonparticipants, which are confirmed by simple statistical tests of differences in means. There is 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. Land has emerged as an important factor in farm households' decision to diversify their livelihood in NFE. On average, approximately 1.67 hectares of land holding possessed by the nonparticipants households, while approximately 1.87 hectare of land holding is possessed by the participant households. If land-lease market is flexible, farm households may adjust their resources by leasing-in or leasing-out land. The low productivity of land may push farm households towards nonfarm activities. The heads of nonfarm participant households completed, on average, a nine-year formal education, while the heads of nonparticipant households completed, on average, a seven-year formal education. This result shows that those households headed by a better-educated person are more likely to engage in NFE. The lack of access to external finances can impede investment in farm as well as nonfarm activities that require high start-up capital or even operational expenses (Barrett, et al., 2001). Hence, to start a new nonfarm business requires high start-up capital. The access to external finance eases the liquidity constraint, and we have included a continuous variable for farm households' access to farm and nonfarm credits. Close to 49 percent farm households in the sample had accessed credit for agricultural purposes, and about 4 percent for nonfarm business activities. There is also a significant difference in relation to district road availability, with approximately 664 road density of the nonfarm participant households and 629 road density of the nonparticipant

households living in a district. This finding reveals that households that live in a district with road density are more likely to participate in NFE. With an average consumption expenditure of 79,800 Indian rupees, the nonfarm participant households' consumption expenditure is significant higher that the nonparticipant households, with an average of 55,122 Indian rupees. Similarly, farm income of participant households' (112805 Indian rupees) is significantly higher than nonparticipant households' (79794 Indian rupees). This result suggests that the nonfarm participant households are likely to enjoy higher levels of farm income and consumption expenditure that the nonparticipant households.

Tables 3: Descriptive statistics of variables and characteristics of participants and nonparticipants in nonfarm enterprises

Explanatory Variable	Full Sample	Sub-samples		
	Mean (SE) (n = 21,078)	Mean (SE) U (n = 18,456)	Mean (SE) D (n = 2,622)	Mean Difference (t-test)
Farm Income	84004.98 (1405.424)	79794.20 (4293.640)	112805.60 (1480.972)	-33011.41***
Consumption expenditure	58192.36 (659.818)	55122.16 (670.896)	79800.84 (2373.163)	-24678.67***
Farm Equipment	1.611 (0.016)	1.590 (0.016)	1.759 (0.061)	-0.169***
Hindu	0.887 (0.002)	0.889 (0.002)	0.873 (0.006)	0.015**
Muslim	0.064 (0.002)	0.061 (0.002)	0.082 (0.005)	-0.021***
Other Religions	0.049 (0.001)	0.050 (0.002)	0.045 (0.004)	0.006
General	0.417 (0.003)	0.418 (0.004)	0.414 (0.010)	0.004
OBC	0.278 (0.003)	0.271 (0.003)	0.323 (0.009)	-0.052***
SC	0.113 (0.002)	0.113 (0.002)	0.113 (0.006)	0.001
ST	0.192 (0.003)	0.198 (0.003)	0.150 (0.007)	0.047***
HH Size	6.019 (0.022)	5.901 (0.023)	6.847 (0.071)	-0.946***
HH Size Square	46.596 (0.442)	44.662 (0.451)	60.206 (1.567)	-15.544***
Adult Members	3.147 (0.010)	3.074 (0.011)	3.662 (0.036)	-0.588***
Dependency Ratio	37.733 (0.208)	38.196 (0.227)	34.477 (0.479)	3.719***
Adult Dependency Ratio	72.992 (0.409)	73.740 (0.442)	67.727 (1.058)	6.013***
Livestock	5.264 (0.050)	5.262 (0.053)	5.282 (0.155)	-0.021
Land Holding	1.692 (0.020)	1.666 (0.020)	1.871 (0.082)	-0.205***
Road Density	632.960 (3.128)	628.585 (3.321)	663.757 (9.245)	-35.172***
Education	7.566 (0.033)	7.345 (0.035)	9.129 (0.091)	-1.784***
Education Square	79.936 (0.488)	76.360 (0.509)	105.115 (1.503)	-28.755***
Number of Loans	2.013 (0.021)	1.970 (0.022)	2.314 (0.064)	-0.344***
SHG	0.148 (0.002)	0.147 (0.003)	0.155 (0.007)	-0.008
Credit Savings	0.095 (0.002)	0.095 (0.002)	0.097 (0.006)	-0.003
Cooperative	0.079 (0.002)	0.071 (0.002)	0.134 (0.007)	-0.063***

Marginal Farmers	0.490 (0.003)	0.496 (0.004)	0.446 (0.010)	0.051***
Small Farmers	0.233 (0.003)	0.224 (0.003)	0.292 (0.009)	-0.067***
Medium Farmers	0.168 (0.003)	0.171 (0.003)	0.150 (0.007)	0.021***
Large Farmers	0.109 (0.002)	0.108 (0.002)	0.112 (0.006)	-0.004
Humid	0.308 (0.003)	0.301 (0.003)	0.356 (0.009)	-0.055***
Semi-Arid Temperates	0.216 (0.003)	0.221 (0.003)	0.183 (0.008)	0.038***
Semi-Arid Tropics	0.410 (0.003)	0.412 (0.004)	0.401 (0.010)	0.011
Arid	0.065 (0.002)	0.066 (0.002)	0.060 (0.005)	0.006

Source: IHDS-Panel Survey conducted by NCEAR and University of Maryland in 2005-2012.
****, ** and * denotes statistical significance at 1%, 5% and 10% levels respectively.*

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 properly evaluate the effects of participation in NFE on farm income and consumption expenditure, as outlined in section 3, a propensity score matching technique is used. The farm income and consumption expenditure equations are jointly estimated with the selection equation explaining farm households' engagement in NFE.

(a) Determinants of participation in nonfarm enterprises

Table 4 presents the results of panel probit analysis to examine the determining factors of participation of farm households in rural nonfarm enterprises in different agroecological zones and size of land holding. The first column presents the independently estimate results of a panel probit for full sample, while the column 2 to column 5 presents the results of the panel probit models of different agroecological zones, similarly column 6 to column 9 represent the panel probit results for different type of farmer categories (based on their land holding). The likelihood of participating in NFE is significantly dependent on the farm income, household size, and number of adult members in the household etc. Farm households with more adult members in the household are very likely to engage in NFE. The results are consistent with the above descriptive statistics analysis and with the findings of other studies like (Lanjouw and Shariff 2004; de Janvry, Sadoulet, and Zhu 2005; Akaakohol and Aye 2014). This is plausible because more adult members can help farm households better adjust to nonfarm labour market requirements. Additionally, the coefficient of household size is significantly positive, revealing that large farm households are very likely to engage in NFE, which may be associated with their requirement of additional income to fulfil their needs. Similarly, the coefficient of education is significantly negatively, revealing that education is negatively affecting the decision of farm households for participation in NFE, which may be associated with their lesser

education obtained, as on average, only 7.5 years of formal education is obtained by the household head and education doesn't affect positively before a certain level. Yet, the coefficient of education-squared term is significantly positive, suggesting that as the head obtains more education, s/he gains more knowledge and has growing employment opportunities but that s/he starts to gradually get the opportunities after turning a certain level of education.

The coefficient of household dependency ratio is significantly negative, suggesting that the farm households with more child (aged upto 14 years) and older members (over the age of 64 years) are more likely to be discouraged from participating in NFE. This is because farmers may face a deficiency in labour force when some family members age and, thus, are more likely to lose nonfarm job opportunities. Land holding has a significantly negative correlation with participation in NFE, demonstrating that the farm households owning larger land are more likely to prefer on-farm work to diversifying into NFE. Labour employed on larger farms is not flexible; thus, larger landholding is very likely to reduce an individuals' likelihood of engaging nonfarm activities (Benjamin 1994; Mishra and Goodwin 1997). The availability of roads in the district has a significantly positive correlation with participation in NFE. Road density can help facilitate the ability to travel back and forth between home and workplace and create nonfarm employment opportunities for active farmers, likely inducing farm households to engage in nonfarm employment.

Membership of SHG and cooperative association are very important factors influencing diversification decision in NFE. This indicates the importance of membership of associations in overcoming the entry barriers associated with NFE diversification. Associations such as cooperatives provide loans, financial assistance and information to their members, thereby encouraging households' participation in nonfarm entrepreneurial activities. The result shows that households residing in semi-arid temperates, semi-arid tropics and arid regions are less likely to diversify into NFE than those living in humid region of rural India. The result of type of farmer 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 indicating the importance of formal credit to the development of NFE in rural areas. In support of this finding, Abdulia and Crolerees, (2001) reveal that nonexistence of an effective formal credit market is one of the factors that affected development of NFE activities in developing countries.

Diversification by marginal and small farmers toward rural nonfarm enterprises that can raise farm incomes significantly has always been in question because of several reasons such as diseconomies of scale and lack of access to inputs such as capital and information etc. We present evidence that in rural India diversification toward rural nonfarm enterprises exhibits a pro-smallholder (rather than anti-smallholder) bias. The smallholders however play a proportionally larger role than in large farmers. These patterns are consistent with simple comparative advantage-based production choices. Even with small landholdings if labor endowments are high, such farm households diversify toward nonfarm enterprises. The results are robust to several tests on specification including those related to self-selection.

Table 4: Determinants of Livelihood Diversification of Farm Households in Rural Nonfarm 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 Nonfarm Business									
log farm income	0.286***	0.258***	0.355***	0.309***	0.127	0.283***	0.504***	0.261***	0.115*
	(12.68)	(6.18)	(7.13)	(8.94)	(1.69)	(9.07)	(6.51)	(4.62)	(2.32)
log consumption	-0.0931***	-0.0707**	-0.0507	-0.116***	-0.0561	-0.0724***	-0.224***	-0.0308	-0.0840*
	(-7.45)	(-3.11)	(-1.82)	(-5.95)	(-1.12)	(-4.41)	(-5.49)	(-0.97)	(-2.25)
farm equipment	-0.00908	-0.0152	-0.0405*	0.0125	0.00362	-0.0444*	-0.0559	0.0308	0.00967
	(-1.11)	(-0.77)	(-2.01)	(1.13)	(0.14)	(-2.48)	(-1.81)	(1.91)	(0.77)
hindu	omitted	omitted	omitted	omitted	omitted	omitted	omitted	omitted	omitted
muslim	0.292***	0.0283	0.660***	0.426**	-0.486	0.226**	0.267	0.237	0.567*
	(3.99)	(0.24)	(5.11)	(2.62)	(-1.07)	(2.70)	(1.27)	(1.13)	(2.37)
other religions	-0.204*	-0.160	-0.583*	-0.00260	-0.0138	-0.0968	-0.274	-0.309	-0.391
	(-2.30)	(-0.98)	(-2.51)	(-0.01)	(-0.07)	(-0.80)	(-1.11)	(-1.53)	(-1.88)
general	omitted	omitted	omitted	omitted	omitted	omitted	omitted	omitted	omitted
obc	0.158***	0.273***	0.0448	0.0101	0.318*	0.0824	0.295*	0.192	0.199
	(3.66)	(3.37)	(0.54)	(0.14)	(1.99)	(1.48)	(2.40)	(1.63)	(1.63)
sc	0.274***	0.357***	-0.325	0.337***	0.318	-0.00244	0.541**	0.875***	0.459*
	(4.77)	(3.41)	(-1.91)	(3.96)	(1.47)	(-0.03)	(3.21)	(5.45)	(2.38)
st	-0.163***	-0.192*	-0.110	-0.119	-0.103	-0.262***	-0.147	0.0792	-0.0522
	(-3.41)	(-2.02)	(-1.05)	(-1.72)	(-0.57)	(-3.91)	(-1.12)	(0.71)	(-0.43)
hh size	0.0333*	0.0441	-0.0143	0.0554	0.0478	0.0668	0.0476	-0.00903	0.00242
	(2.04)	(1.24)	(-0.43)	(1.93)	(1.00)	(1.87)	(0.98)	(-0.22)	(0.07)
hh size square	-0.0000331	-0.000395	0.00339**	-0.00103	-0.00143	-0.00136	0.000177	0.00277	0.000182
	(-0.05)	(-0.26)	(2.59)	(-0.83)	(-0.93)	(-0.68)	(0.09)	(1.78)	(0.18)
hh dependency ratio	-0.00257*	-0.00682**	0.00277	-0.000505	-0.00653	0.000481	-0.0108**	0.0000713	-0.000519
	(-2.19)	(-2.89)	(1.32)	(-0.28)	(-1.44)	(0.35)	(-2.92)	(0.02)	(-0.16)
adult dependency ratio	0.000408	-0.000352	-0.00133	0.00131	0.00398*	-0.00211**	0.00483**	0.00125	0.00218

	(0.70)	(-0.30)	(-1.36)	(1.33)	(2.05)	(-2.77)	(2.75)	(0.86)	(1.51)
no of adults	0.0840***	0.172***	0.00880	0.0116	0.106	0.00199	0.235***	0.0546	0.0588*
	(5.23)	(5.54)	(0.28)	(0.46)	(1.90)	(0.08)	(4.79)	(1.40)	(1.99)
total livestocks	-0.00751**	0.00107	-0.0315***	-0.00721	-0.00243	0.00183	-0.0223*	-0.00218	-0.0133*
	(-2.64)	(0.22)	(-3.35)	(-1.71)	(-0.29)	(0.44)	(-2.13)	(-0.37)	(-2.03)
land holding	-0.000613	-0.0838	0.0185*	-0.0265	-0.0246	-0.387***	0.00374	0.0508	0.00580
	(-0.09)	(-1.07)	(2.33)	(-1.80)	(-0.99)	(-4.47)	(0.02)	(0.64)	(1.00)
road density	0.000105*	0.000152*	0.000314	0.000104	0.0000754	0.000161**	0.0000762	0.0000738	0.000454**
	(-2.37)	(-2.47)	(-1.58)	(1.19)	(-0.21)	(-3.23)	(-0.55)	(-0.57)	(2.71)
education	-0.0323**	-0.113***	-0.0163	0.0165	0.0733	-0.0214	-0.0654*	0.0285	0.0296
	(-2.78)	(-5.12)	(-0.70)	(0.89)	(1.76)	(-1.47)	(-1.97)	(0.89)	(0.69)
education square	0.00446***	0.00832***	0.00356*	0.00217	-0.00337	0.00275**	0.00869***	0.00102	0.00210
	(5.99)	(5.75)	(2.48)	(1.86)	(-1.25)	(2.75)	(3.99)	(0.54)	(0.95)
no of loans	0.0253***	0.0333**	0.0345**	0.0145	0.0446*	0.0251**	0.0407**	-0.00180	0.0332**
	(4.65)	(2.96)	(3.03)	(1.83)	(2.12)	(3.18)	(2.87)	(-0.13)	(2.67)
shg membership	0.0475	-0.296***	0.630***	0.212**	-0.0731	0.120	-0.0880	0.0768	0.171
	(0.93)	(-3.35)	(4.22)	(2.94)	(-0.23)	(1.86)	(-0.60)	(0.57)	(1.28)
credit savings membership	-0.197**	-0.0250	-0.0510	-0.288**	-0.692*	-0.151	-0.408*	-0.0255	-0.137
	(-3.08)	(-0.22)	(-0.30)	(-3.20)	(-2.17)	(-1.74)	(-2.27)	(-0.17)	(-0.92)
cooperative membership	0.383***	0.823***	0.274*	0.226**	0.297	0.183*	0.819***	0.159	0.287*
	(6.87)	(6.37)	(2.00)	(3.19)	(1.14)	(1.97)	(5.43)	(1.28)	(2.33)
marginal	omitted	omitted	omitted	omitted	omitted				
small	0.0753	0.227*	-0.138	0.144*	0.0775				
	(1.76)	(2.18)	(-1.63)	(2.13)	(0.45)				
medium	-0.281***	-0.388*	-0.506***	-0.0285	0.157				
	(-5.31)	(-2.10)	(-4.36)	(-0.36)	(0.89)				
large	-0.564***	-0.289	-0.706***	-0.266*	-0.140				
	(-6.68)	(-0.70)	(-4.46)	(-2.03)	(-0.55)				
humid	omitted					omitted	omitted	omitted	omitted
semi-arid temperates	-0.383***					-0.183**	-0.876***	-0.311*	-0.130
	(-7.19)					(-2.92)	(-5.15)	(-2.12)	(-0.72)

semi-arid tropics	-0.205***					-0.190**	-0.436***	0.247*	-0.0273
	(-4.60)					(-3.29)	(-3.47)	(2.21)	(-0.18)
arid	-0.314***					-0.346**	-0.732**	0.183	-0.0210
	(-3.79)					(-2.64)	(-2.99)	(1.08)	(-0.11)
_cons	-3.977***	-3.793***	-4.774***	-4.478***	-3.300***	-3.474***	-6.087***	-5.343***	-3.118***
	(-17.34)	(-9.04)	(-9.25)	(-12.22)	(-4.08)	(-10.89)	(-7.05)	(-7.13)	(-5.11)
lnsig2u	-0.389**	-0.0827	-1.176*	-0.715**	-1.707	-1.273**	0.842**	-0.350	-2.800
	(-2.78)	(-0.37)	(-2.40)	(-2.84)	(-1.22)	(-2.89)	(2.99)	(-0.75)	(-1.02)
sigma_u	0.823066	0.959494	0.555458	0.699418	0.425924	0.529178	1.523244	0.839273	0.246544
rho	0.403853	0.479337	0.235786	0.328492	0.153554	0.218768	0.69882	0.413276	0.057301
N	16545	5100	3857	6492	1096	7698	4076	3082	1689

t statistics in parentheses

" *** p<0.001, ** p<0.01, * p<0.05"

(b) Effects of participation in nonfarm enterprises on farm income and consumption expenditure of farm households in different agroecological zones

To account for the heterogeneous treatment effects in estimating the relationship between treatment and outcome variables, we implement propensity score matching to get the average treatment effects on the treated (ATT). In PSM, we include an extensive set of covariates. The set of variables that satisfy the technical requirements of common support and balancing properties are taken into consideration. The propensity score estimates of the diversified and undiversified farm households within a region of common support were used to balance the observed distribution of the covariates across the two groups in order to ensure that households with the same covariates have equal chance of being selected in assessing the impact of diversification in NFE on farm income and consumption expenditure of farm household in rural India and different agroecological zones.

Table 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
	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

Nearest neighbour 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 6 indicates that NFE diversification has a positive significant impact on farm income as well as consumption expenditure of farm households. 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 12736.90 Indian rupees and 15517.77 Indian rupees respectively than those that have not diversified into NFE, which shows that diversified households are more secured than undiversified households. This implies that the increased household income from NFE diversification assist in significant improvement in farming practices, hence, more farm income and more consumption expenditure experienced by the diversified farm households. Therefore, NFE diversification tends to play a vital role in raising farm income and improving consumption expenditure of the farm households. This result is consistent with the finding of Ali and 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 neighbour matching results are robust to other matching methods. The results of all three methods are presented in Table 6 confirms that our nearest neighbour matching results are quite robust and is not sensitive to other matching techniques. However, the nearest neighbour outcomes are slightly different than that of other techniques in some cases.

6. Conclusion:

This study uses the nationally representative panel survey data of same rural farm households from Indian Human Development Survey (IHDS) conducted in 2005 and 2012 to examine the determinants of NFE diversification 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 NFE diversification decision 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 livestocks, educational attainment of the individual household heads and cooperative membership are found to have significant impact on rural NFE diversification decision. Household size as one of the endowments of rural household has a significant positive impact on NFEs activities. Similarly, road density at the district level have an important influence on NFE diversification. The results also indicate that households residing humid zone is more likely to diversify into NFEs than their counterparts in semi-arid temperates, semi-arid tropics and arid zones. Another finding of this study of is that rural households having access to SHGs and cooperative associations have managed to overcome the barriers associated with entry into NFE activities. This is an interesting finding which has not been given much attention in previous studies and portrays the importance of social networking and loans in promoting NFE activities in different agroecological zones of rural India.

The second part of the study employs 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 economic wellbeing of household status.

Given the roles that rural NFE diversification can play in improving the farm income, consumption expenditure, hence, the economic wellbeing of farm households, it is obvious that agriculture alone cannot bring the rapid changes needed in lifting households out of poverty and food shortage in rural areas of India, especially in the different agroecological zones because of their diversify characteristics. Thus, policies seeking to address grassroot issues like income, consumption, poverty and food insecurity in these zones should go beyond just food production measures. They should also consider enhancing the ability of farm households to

diversify into rural NFE activities. Hence, this can be facilitated by increasing households' access to formal credit by introducing rural banking scheme with simple collateral requirement. Associations such as cooperatives, women associations and business associations should be encouraged among the rural households as they promote NFE activities. Rural households should also be equipped with basic formal education by introducing programs such as free basic education and adult education in rural areas. The significance of district or village level infrastructures suggest that the role of government in providing the necessary infrastructures to rural communities is essential in promoting NFE diversification in rural India. Although we find that NFE diversification has positive effects on farm income and consumption expenditure of the farm households, we cannot conclude whether it is the poor or the non-poor that benefits from NFE diversification. Thus, further research is still needed to fill this gap.

At the policy level, to promote the rural nonfarm economy, special attention should be paid to programs that enhance agribusiness, small-scale industry development, education and training, agricultural markets and agricultural public sector investment targeted at rural localities. The industrial development should focus on input-intensive technologies that enhance not only productivity but also agricultural marketing. The development of the rural nonfarm sector requires public investment in rural infrastructure, such as roads and bridges, telecommunications, education, energy and water. The government may also directly promote the sector by designing programs that provide credit, training and necessary inputs to rural households.

In addition to government participation, the development of the nonfarm sector requires the participation of private firms and not-for-profit organizations to strengthen rural small-scale industries through entrepreneurial skills training and other necessary services to small private manufacturing units (IFAD 2011). In general, policies to promote the development of the rural nonfarm sector should be formulated at three levels. At the national level, policies should focus on a friendly business environment. At the regional level, the focus should be on the provision of physical and social infrastructure that facilitates the connectivity of economic activities. Finally, at the local level, the emphasis should be on training, migration facilitation and public transportation, which motivate households to engage in nonfarm activities (IFAD 2011).

Finally, further studies should obtain accurate data on different types of nonfarm employment by the operator and spouse and analyse their effects on rural farm households' food and non-food (monthly and annually) consumption.

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