Does non-farm income affect food security? Evidence from India

Sumit Mishra[a], Andaleeb Rahman[b]

[a]*Institute for Financial Management & Research (IFMR), Sri City*

[b]*Tata-Cornell Institute (TCI), Dyson School of Applied Economics and Management, Cornell University, Ithaca, NY*

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[a]*Institute for Financial Management & Research (IFMR), Sri City*
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Abstract

Livelihood diversification and greater non-farm income have been considered as useful mechanisms to propel growth, lower rural poverty and augment farm income in the developing countries. Little, however, is known about its implications for nutritional outcomes such as dietary diversity. This article contributes to the literature by investigating whether greater non-farm income helps in improving food consumption patterns and dietary diversity. Using a nationally representative panel data of rural India and an instrumental variable (IV) approach, we investigate this association and find that non-farm income increases expenditure on food products especially non-cereal products, leading to greater household dietary diversity. This has crucial policy implications for nutrition transition and livelihood diversification, further contributing to the existing knowledge on agriculture-nutrition pathways.

Keywords: Rural Nonfarm, Income Diversification, Dietary Diversity
JEL Codes: C33, Q18, O12

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Email addresses: sumit.mishra@ifmr.ac.in (Sumit Mishra), ar687@cornell.edu (Andaleeb Rahman)

1. Introduction

A key feature of the structural transformation of an economy is a gradual reduction in the reliance on agricultural sector, both as a source of income as well as employment. The transition out of agriculture is a combination of the "pull" and "push" factors. Pull factors operate through the productivity growth in agriculture which leads to higher income and households gradually diversify their consumption baskets out of food products towards more of the non-farm goods and services (Haggblade et al., 2010). On the other hand, decreasing returns to land and labor resulting in stagnant farm income could also "push" farmers into pursuing other economic activities when "farming out of poverty" may not be a useful strategy.

Given the uncertainties associated with agricultural incomes, economic opportunities outside of agriculture propels rural growth and leads to a reduction in rural poverty (Barrett et al., 2001b; Ellis, 2007). Diversification into non-farm activities also helps reduce uncertainty in income on account of seasonal variations in crop production and potentially adverse climatic shocks. Movement of capital and labor out of agriculture also facilitates the growth of manufacturing and service sectors, leading to overall economic growth. Empirical evidence on how livelihood diversification and greater non-farm have helped rural income in the developing countries is abundant (Barrett et al., 2001a; Ellis, 2007; Himanshu and Sen, 2013).

Diversification of rural livelihoods into other non-farm activities has potential implications for household food security status (Barrett et al., 2001a; Ellis, 2007; Haggblade et al., 2007). Non-farm income not only augments purchasing power, but also reduces the risk of intra-year food availability (Ellis, 2007). Extant literature has mainly focused on the implication of income diversification into non-farm activities on poverty and growth, but has not accorded sufficient attention to its dietary implications. Non-farm income could affect food security and dietary diversity through multiple pathways. Moving away from agriculture increases reliance on markets for food consumption which exposes households to the vagaries of price fluctuations and potentially undermines their food security. Similarly, non-farm activities could shift resources such as land and labor, previously used to produce food, towards other expenditures. At the same time, higher income increases household access to greater quantity and better variety of food.

Against the above background, this paper is a microeconometric investigation of structural transformation in India and specifically looks into the

relationship between household dietary diversity and income from non-farm sources. The process of structural transformation has been slow in India but it is widely acknowledged that livelihood diversification can enable movement of labor out of agriculture into other activities (Binswanger-Mkhize, 2013; Binswanger-Mkhize et al., 2007). Non-farm activities are a major source of income in rural areas. Income from non-farm sources account for about 35% of total rural income in Africa and around 50% in Asia and Latin America (Haggblade et al., 2010). In India, 88% of the rural households which are primarly engaged in agriculture and allied activities, also undertake additional economic activity in the non-farm sector Chandrasekhar and Mehrotra (2016). The other key feature of demographic change and economic growth in India has been a change in consumption patterns and greater diversification of diets (Pingali, 2006). Households are spending a greater share of expenditure on non-traditional staples, leading to diversification of diets. Dietary diversity as a measure of human development or welfare remains under researched in the Indian case, where the discourse on hunger and food security has been synonymous with poverty. There are subtle differences in what these terms imply for welfare. Poverty levels are a money metric which captures purchasing power. Dietary diversity, on the other hand, tells us about actual consumption and the ability of a household to acquire food, which is essential for human development. Also, while the link between non-farm income and poverty is straightforward, the nature of relationship between non-farm income and dietary diversity is theoretically ambiguous.

Pathways from agriculture to nutrition Kadiyala et al. (2014); Priya et al. (2012); Gillespie and Kadiyala (2011); Kanter et al. (2015), often tend to overlook the importance of non-farm activities for nutrition. This leads to an incomplete map of the agriculture-nutrition association. In this paper, we provide evidence on the role played by income from the non-farm sector for food consumption and dietary diversity. Using a nationally representative panel data for the years 2004-05 and 2011-12 for rural India, we find that increase in non-farm income significantly improves household diets, which is an intermediate pathway to improved nutritional outcomes. Given migration and remittance based livelihoods have become an increasingly important feature of rural livelihoods in India, we also show that remittance income has an important role to play in improving food consumption. Our findings appeal to two separate strands of literature. One of which is the increasing dynamism in the rural economy and changing occupational structure in the last decade. The other body of literature we appeal to is the debate on changing food consumption habits and diets in India. The incremental contribution of this paper is to link the two emerging features of occupation and

dietary change in rural India. Given the slow increase in farm incomes over the last decade, we argue that non-farm income is vital to improving overall food security and better diets. Hence, the agriculture-nutrition pathway needs to recognize the complementarities between non-farm income growth and nutrition.

2. Background

The case of structural transformation in India is atypical. While the share of agricultural sector in overall GDP has declined over time, proportion of people dependent upon agriculture as a source of employment hasn't declined commensurately. (Binswanger-Mkhize, 2013) attributes this to increase in rural population, stagnant manufacturing sector and a slow rate of rural-urban migration. As a result, the rural economy has diversified into the non-farm sector, instead of transitioning towards the manufacturing sector. Between 1983 and 2004, rural non-farm GDP grew at a rate of 7.1%, which is 4.5 percentage points higher than the overall agricultural growth Himanshu and Sen (2011). Rise in rural non-farm output and employment opportunities led to reduction in rural poverty and income inequality (Himanshu and Sen, 2013; Lanjouw and Shariff, 2004; Lanjouw and Murgai, 2009; Janvry and Sadoulet, 2001; Olale and Henson, 2013; Imai et al., 2015; Azam, 2012). Non-farm income sources are specifically crucial for small and marginal farmers in India. According to an estimate by Chand et al. (2011), a quarter of small farmers would fall below poverty line if their non-farm income is not accounted for.

On the nutrition front, there has been a very slow decline in the prevalence of malnutrition in India. Despite stellar economic growth and decline in poverty levels in the last two decades, higher incidence of malnutrition confounds researchers and policymakers alike. India now faces the challenge of "triple burden of malnutrition, where undernutrition co-exists with a rise in obesity and micro-nutrient deficiency (Meenakshi, 2016). Calorie consumption in India on an average, however, has been declining, mainly on account of lower caloric requirements and better health and hygiene environment (Deaton and Drèze, 2009).

In terms of aggregate levels of food security, India is self-sufficient in food production. However, there are concerns about access to food at the household level given widespread disparities in income distribution as well as availability of nutritious food. Recently, National Food Security Act (NFSA), 2013 was enacted in the Indian parliament which mandates 75% of the ru-

ral population and 50% of the rural population to staple grains (rice and wheat) at highly subsidized prices. While ensuring overall food availability is essential for household enhancing food access, improving diets remain a bigger challenge for improving overall nutrition which is a multidimensional concept (Pingali, 2015). While NFSA addresses only of one dimension of food security, there is enough scope for a reconfiguration of food security policies in India Narayanan (2015).

Changes in dietary practices and rise in non-farm income have been a feature of rural India in recent times. Households are diversifying their diets and moving towards non-cereal products such as pulses, milks and other protein rich meat items which are essential for improving diets. Comparison of data over inter-censal period 2001-11 shows that there has been a decline in the share of cultivators overall, while the number of agricultural labor has increased. Similarly, over time, nationally representative data points to a change in the dietary preferences with households moving away from calorie-based staple items to more nutritious food items. These nutritious items are more expensive and there is inequality in its consumption across income classes.

The role of occupational structure for food security in rural India has been recently highlighted by (Chandrasekhar et al., 2016). They find that agricultural workers in India are found to have worse food security indicators as compared to households primarily engaged in cultivation. These findings underscore the challenges for nutritional policy posed by the shifts in occupational patterns. Occupational shifts in India are a reflection of geographical location together with the existing social stratification as operationalized through social groups, educational attainment, assets and land holding patterns. This further confounds its impact on nutrition. The other missing link in the occupation-nutrition association is the role of remittance income as a result of greater out-migration. However, the relationship between remittance based income and household nutrition has been an under-researched topic.

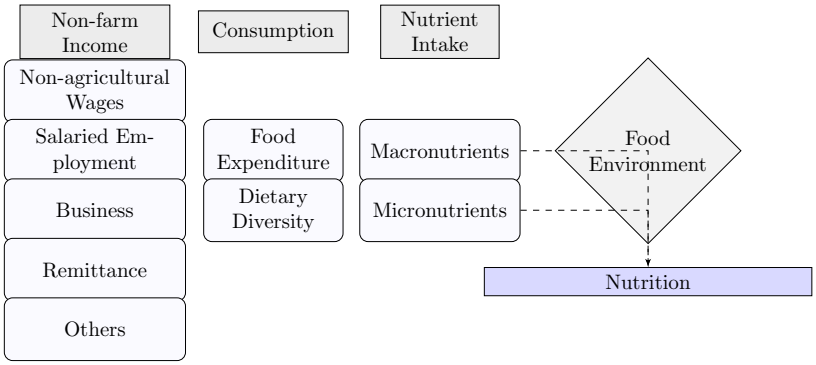
2.1. Link between Non-farm income and dietary diversity

Income diversification towards non-farm activities plays a significant role in maintaining food security levels through smoothing food consumption over time (Ellis, 2007). Results from other countries do suggest that non-farm income has significant implications for food security (Mishra et al., 2015; Mishra and Chang, 2012; Babatunde and Qaim, 2010; Reardon et al., 1992; Ruben and Van Den Berg, 2001). The theoretical pathways from non-farm

income to food security and nutrition could be multiple, but the empirical literature on the link between non-farm income and food security is nascent and only speculates on the potential intermediate mechanisms. Assuming farming as a household enterprise, increase in non-farm income could enable greater investments in agriculture leading to higher income (Chang and Mishra, 2008). Non-farm income could improve food security even for the households who can't invest back in agriculture. It could happen either through inter-temporal food consumption smoothing or by ameliorating food shortage risks in case of unexpected crop failures (Qureshi et al., 2015).

In 1, we provide a schematic representation of the pathway through which non-farm income affects nutrition. Income pathways work directly from earnings to expenditure on food and the diversity of diet through Sen's "wage-labour entitlement" component of food security (Pritchard et al., 2014). Food consumption translates into the amount of calories and nutrients consumed. A more varied diet is expected to be richer in essential micronutrients, while a diet rich in staples like rice or wheat is more likely to increase the consumption of calories. Household food consumption is an intermediate pathway to improved nutritional outocmes. A favorable food environment is essential for better food consumption to result in improved nutritional outcomes. Food environment, here, implies a host of factors such as overall national food availability, market prices, access to clean water and sanitation facilities, and the role of women in the family among others.

Figure 1: Pathway from non-farm income sources to nutrition



For the Indian case, Pritchard et al. (2014) provide an overview of the role of non-farm sector in improving food security in India. They argue that diversification into non-farm activities enables food security given the *de-agrarianisation* of rural areas, stagnant agricultural incomes and rising

food prices. They also highlight the role played by affiliation to certain social group, size of land holdings and educational attainment in the ability of a household to diversify into non-farm incomes. Occupational structure provides useful insight for designing strategies to reduce hunger. Studying rural transformation of Indian agriculture between 1960-2010, (Binswanger-Mkhize, 2013) hypothesise that rise in income from the non-farm sector would lead to reduction in hunger and poverty in the rural areas. The role of occupational structure for food security in rural India has further been highlighted by Chandrasekhar et al. (2016). Using nationally representative surveys, they show that agricultural workers are found to have worse food security indicators as compared to those households primarily engaged in cultivation. This points to the inherent challenges posed by the shifts in occupational patterns for nutrition.

2.1.1. The role of remittance income

An increasingly important feature in India's rural economy with greater non-farm diversification is rise in the share of remittance. Tumbe (2015) shows that remittance-based migrations are a common feature of household which identifying themselves as primarily involved in cultivation. Using a nationally representative household survey with information on the sources of income and consumption expenditure, Tumbe (2011) find that remittance play an instrumental role in household consumption. For the remittance receiving households, income from remittances is used to finance over 40 percent of annual household consumption expenditure. Since expenditure on food comprises a substantial part of the total consumption expenditure, we hypothesize that remittances could also affect expenditure on food and hence have implications for food security. While doing so, we appeal to a separate strand of literature which estimates the impact of mobility on food security through remittances(Adams and Cuecuecha, 2010; Azzarri and Zezza, 2011; de Brauw and Mu, 2011; Karamba et al., 2011; Nguyen and Winters, 2011; Sharma and Chandrasekhar, 2016; Zezza et al., 2011). In a systematic review of 20 such studies, Thow et al. (2016) find some evidence on the positive role of remittance income for greater access to food, intertemporal consumption smoothing and reduction in malnutrition. However, the authors call for further empirical validiation of this association.

3. Data and Summary statistics

We use longitudinal information on nearly 25,000 rural 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 (Desai et al., 2005, 2011). This dataset contains a rich source of information on various socio-economic indicators at the household as well as the individual level. For the rural sample, it also has information on the village level demographic characteristics and phyiscal infrastructure. In this paper, we utilize the household level information on consumption and income indicators. We use the household as well as village level demographic characteristics as our control variables. For our econometric analysis, we also use additional datasets to construct instrumental variables which help us in establishing causal association. First, we use the Population Census 2001 and 2011 data to calculate the share of non-agricultural workers and the share of villages with access to paved road. Second, we use the Defense Meteorological Satellite Program - Operational Linescan System (DMSP-OLS) night-lights data to construct the luminosity variable at the district level.

3.1. Dietary Diversity indicator

The mostly widely used definition of food security is the one agreed upon at the World Food Summit in 1996 which defines food security as the condition when, *"all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life"*. This definition points to the multidimensional nature of food security. It recognizes that for improved nutritional outcomes food access, stability and quality are as important as the overall level of food availability in the country. Such an encompassing conception of food security, however, makes it extremely difficult to measure. As a result, various metrics of food security, as proposed in the literature, have often been found to be inconsistent with each other (Branisa et al., 2011).

Like any other welfare indicator, these indices though theoretically elegant, have their own disadvantages in capturing food security (Tian and Yu, 2015). Here, we focus on the food expenditure patterns and dietary diversity as the measure of food security. We focus on the share of overall food expenditure and the share of various sub-groups within the food basket. Food expenditure shares and dietary diversity indicators are crucial intermediate outcomes in the pathway from agriculture to improved nutritional intake in India (Kadiyala et al., 2014). Acording to Engels law, with improvement in economic status of the household, share of spending on food declines. Similary, according to Bennet's Law, the share of expenditure on staples declines with income.

Dietary diversity is a key component of any health diet and is defined in relation to energy availability as well as the diet quality. From the perspective of developing countries, dietary diversity is essential to understand many facets of malnutrition such as nutritional adequacy (Ruel, 2003). The two most commonly used dietary diversity measures are *Shannon Index* and *Simpson Index*. These measures basically represent a count of the various food items taking into account their relative importance as measured in the diet as measured through respective expenditure shares (w_i). Mathematically, these indices can be calculated as:

Simpson Index = 1 - $\sum_i w_i^2$
Shannon Index = - $\sum_i w_i log(w_i)$

The Simpson Index ranges between zero and one, while Shannon Index can lie within the range between 0 and $log(w_i)$. In case of only one food group within the diet, these indices will equal 0. Shannon Index helps in taking care of the predominance of one group in the diet (for example, cereals) by assigning proportionately lower weights to the groups with higher share of expenditure. To calculate dietary diversity, we have disaggregated overall food expenditure into 8 distinct food groups, namely - cereals, sugar and sugar products, pulses, eggs, fish and meat, edible oil, milk and other dairy products, vegetables and fruits, and all other food items.

3.2. Measuring Non-farm Income

Measurement of non-farm income has been an issue of debate. According to standard definitions, non-farm sector comprises of all economic activities which take place in rural areas with the exception of agriculture, livestock, fishing and hunting (Lanjouw, 2001). Non-farm activities, therefore, consist of a highly heterogeneous portfolio of activities like trading, agro-processing, manufacturing, commercial, and service activities, with their scale of operations varying from large warehousing facilities run by MNCs to part-time self-employment in household based industries or petty trading activities, which may or may not be skill-based (Haggblade et al., 2010).

Non-agricultural incomes in the rural areas has been synonymously used with terms like "off-farm", "non-agricultural", or "non-traditional" sources of income (Barrett et al., 2001a). Based upon the existing literature Barrett et al. (2001a); Pritchard et al. (2014); Chambers and Conway (1992), we classify sources of rural income into categories based upon location and nature of work. Remittances comprise the only form of income which is not earned within the local economy. We do away with the distinction between

the "off-farm" and the "non-farm" income and define all non-agricultural activity as "non-farm" occupation.

3.3. Descriptive Statistics

Table 1 represents the distribution of different income-sources for the survey years.[1] We can see that the share of farm income has declined between 2004-05 and 2011-2012. The share of non-agricultural wages, government benefits, and remittances has increased during the same period; income from regular salary has, however, declined. It is worth noting here that the share of income from remittances has more than doubled during the period. In Figure 2, we draw kernel density curves which shows that average food expenditure for those who report non-farm work is higher than for those who do not report non-farm employment, and that households which receive remittance income have higher food bills than those who do not receive any remittance. To further look at the relationship between food security and non-farm income sources, we plot logarithm of non-farm income and remittance income versus food consumption and dietary diversity in figure 3. We can see that there is a positive association between non-farm income and food expenditure, non-farm income and dietary diversity, and between remittance income and food expenditure. However, we do not find any association between remittance and dietary diversity indicator (Shannon Index, in this case). These initial non-parametric findings motivate us to investigate further into the nature of these associations using parametric regressions in the following section.

4. Empirical Strategy and Results

We estimate a panel regression model, where different measures of food security are our outcome of interest while non-farm income is our main explanatory variable. We use panel data framework because of two reasons (Baltagi, 2013). First, we want to control for household level heterogeneity; non-farm income may be systematically correlated with some unobservables. Secondly, we want to track how change in non-farm income is related to change in households dietary pattern. The panel regression model is of the following form:

$$Y_{it} = \alpha_i + \beta_1 NFI_{it} + \sum \beta_k X_{kit} + u_{it}$$

[1]NREGS stands from National Rural Employment Guarantee Scheme. This is a social security measure under which every rural household is guaranteed 100 days of employment. This became a law and got implemented across India in 2006. For the same reason, the 2004-05 survey reports no income from NREGS.

where Y_{it} is the outcome variable, NFI_{it} is the non-farm income, X_{kit} are the set of household level socio-economic controls. We control for several observable household characteristics including caste, religion, educational attainment, household size, access to the PDS[2], primary income source, ration card type, access to household amenities (toilet, water, electricity), and land owned in our regression models. Household-level time-invariant unobservable characteristics have been accounted for by α_i.

We are interested in estimating β_1 which is the effect of non-farm income on the outcome variable. It is likely that households which have higher non-farm income are also the ones who are already consuming better food which could lead to potential endogeneity. Using a panel data regression model may not entirely take care of this endogeniety. More food secure households are more likely to engage in non-farm activities and this could lead, in turn, to a more diverse diet. This simultaneity may be compounded if the non-farm income and the measures of food security are correlated with some unobservable factors. Therefore, our estimated effects of non-farm income on household food security may be biased. Hence, we use an instrumental variable (IV) approach to circumvent this problem.

4.1. Choice of Instrumental Variable

The IV approach is useful to avoid the potential endogeneity of non-farm income and food security outcomes. Here, food security and income from non-farm sources could be influenced by other household characteristics which is not captured in the survey data. Unobserved heterogeneity could therefore lead to measurement errors and bias our estimated coefficients on β_1 (Khandker et al., 2010). In the IV approach, we need to find an instrument z which is correlated with changes the variable (here, NFI_{it}), but not with the outcome variable. Put simply, we need a variable to instrument for NFI_{it} which does not affect Y_{it} directly, but through its effect on NFI_{it}. Here, we use a number of instruments to circumvent this potential endogeneity. We use the share of villages with paved road in the district, district-level share of non-farm workers, and median night-lights at the district level as instruments for non-farm income.

Our choice of IVs are informed by the existing literature which has established that improved road-access in villages are considered to be important

[2]Public Distribution System (PDS) is a targeted food based assistance program in India.

pathways to escape poverty (Khandker et al., 2009). This is based upon the premise that increased market access and reduced transportation costs reduce barriers to engage in non-farm activities (Binswanger et al., 1993; Fafchamps and Shilpi, 2003). In particular, Jacoby and Minten (2009) show that reduction in transport costs is associated with increase in household welfare mainly through positive non-farm income effects. More specifically, for the Indian case, Asher and Novosad (2017) empirically establish how road access has led to greater participation in non-farm activities leading to structural transformation in rural India. Using the IHDS data, Lei et al. (2017) have also show that access to roads positively influence participation in non-agricultural work in the villages. Aggarwal (2015) shows that villages which were connected to roads under the *Pradhan Mantri Gram Sadak Yojana* (PMGSY) saw an observable shift in occupational structure. Most notably, women in the age-group 14-20 shifted to occupations like animal rearing, tailoring and textile manufacturing.

Our other instruments – district level share of non-farm workers, and median night-lights – for non-farm income are also in line with the existing literature that looks into the effect of non-farm activities on various outcomes including food security. For instance, Pfeiffer et al. (2009); Kilic et al. (2009) employ the *municipio* (district) level share of non-agri employment as an instrument for off-farm income. Table A6 reports the list of instruments used in the existing literature on non-farm income. In addition to non-farm employment share, we also use the district-level median night-lights. Night-lights are considered to be excellent proxy of economic activity, even at the local level at which economic output figures are hardly available (Henderson et al., 2012; Donaldson et al., 2016; Michalopoulos and Papaioannou, 2013). In particular, given that a large proportion of non-farm workforce in India is employed in the informal setup, night-lights data also reflects the informality in Indian economy more accurately than other available measures like the GDP.

4.2. Results

4.2.1. Association between different Non-farm income sources on dietary diversity

We first provide indicative evidence on the correlation between different non-farm income sources and different measures of food security. The idea here is fairly simple: we want to understand the strength of association between a household's primary source of income and its food security status. In order to do so, we estimate panel regression for each of the outcome variables on all the non-farm income sources. The results are presented in Table

A3. We find that income from regular employment and entrepreneurship has greater impact on dietary diversity, expenditure on non-cereals and animal protein based items . This is consistent with the findings by Imai et al. (2015) who show that the reduction in economic vulnerability from non-farm income is much higher for those in skill based employment. These results are also in line with the existing evidence from other countries. Babatunde and Qaim (2010) find that greater non-farm income in Nigeria leads to greater calorie intake and better diet quality. Similarly, Zereyesus et al. (2017) show that non-farm work plays an important role in mitigating the risk of food poverty among the poorest of the households in northern Ghana.

4.2.2. Panel Regression

We first run a panel regression with the logarithm of non-farm income as the main explanatory variable. Table 2 presents the results of the panel regression[3]. We can glean from this table that non-farm income is positively associated with food consumption expenditure, dietary diversity, expenditure on egg, fish and meat, and the ratio of expenditure on non-cereals to cereals; non-farm income is negatively related to the share of expenditure on food consumption. Households with higher education level spend lesser on overall food, more on cereals, and have greater dietary diversity. Households that report salaried work as their primary occupation spend less on food as well as on cereals; those with access to flush toilets spend more on proteins (egg, fish, and meat) and these households have greater dietary diversity as against those which do not have access to toilets.

Our results are robust to different specifications where we start with a sparse model with just our main explanatory variable and add more variables in subsequent specifications. These results could be biased because of feedback effects that run from non-farm income to food security and back to participation in non-farm activities. Therefore, we need instruments to correct for the bias.

4.2.3. Panel IV Regression

As discussed in the previous section, we choose three different instruments to address the endogeneity issue in the OLS estimates. We find that all our chosen instruments validate the OLS results. Table 4 shows the results of the

[3] *lnfoodexp*: Log food expenditure, *foodexpShr*: Share of food expenditure in total monthly per-capita expenditure (MPCE), *lncrlexp*: Log cereal expenditure, *nccExp*: Ratio of expenditure on non-cereals to expenditure on cereals, *lnefmexp*: Logarithm of expenditure on egg, fish and meat, *DD*: Shannon Index of dietary diversity.

panel IV regression with share of villages with paved road as the instrument, Table A1 with share of non-agricultural workers as instrument, Table A2 with median night-time lights as instrument. When we use district-wise share of non-agricultural workers, we find that for a 10% rise in non-farm income for a household in our sample, we find a 3% increase in spending on food items, 0.1% increase in the dietary diversity measure, 4.2% rise in the expenditure spent on egg-fish-meat. Our instrument is also positively associated with the ratio of expenditure on non-cereal to the corresponding expenditure on cereals. We find that non-farm income is negatively associated with the share of food expenditure. All the other instruments yield similar results. Our results show that livelihood diversification in rural India, by the virtue of augmenting income, eases household's budget constraints, leading to greater consumption of food (spending on nutritious food items like egg, fish, and meat increases, in particular) and more diverse diet pattern. Our results also present evidence that spending pattern in rural India is moving away from cereals because of greater employment opportunities outside of agriculture.

4.2.4. Validity of Instrument

The validity of an instrument rests on two conditions, viz, relevance and exogeneity. For the former to be fulfilled, the variation in the endogenous explanatory variable must be explained by the instrument. For the latter, the chosen instrument must be orthogonal to the outcome variable of interest. While we had already provided theoretical explanation for the exogeneity of the instruments, we focus on the relevance of the instruments in this section. In order to do so, we provide the first stage estimates for each of our chosen instruments in Table A4. The first stage F-statistics for different instruments are also found to be well above the cut-off F-statistic of 10 (Staiger and Stock, 1997) indicating that the chosen instruments are relevant and explain the variation in non-farm income.

4.2.5. Remittances and Dietary Diversity

We also explore whether income from remittances affects food security in rural India. First, we run a set of panel regressions with income from remittances as the main explanatory variable. Table 4 presents the results. We find that remittance income, controlling for household characteristics, is positively associated with different food security indicators; households with higher remittance income spend more on food items, non-cereals relative to cereals, protein rich food items (egg, fish, and meat) and have greater dietary diversity. However, as argued above, the relationship is not causal because of endogeneity issue which renders our panel estimates biased. We identify the relationship by using an instrument for remittances. We use the

status of outmigrants in the survey villages as an instrument.[4] We argue that out-migration from the village would affect remittance income and the household food security status is influenced via the income received through remittances. The first stage estimates are presented in Table A5 which confirm that the chosen instrument is a relevant one.

Table 5 shows the results for our instrument variable exercise. We find that income from remittances leads to greater spending on food. We also document that households with greater remittance income spend more on non-cereal food items relative to cereals, and also on eggs, fish, and meat. However, we find that remittance income does not have any statistically significant effect on dietary diversity measures. All other variables have expected signs. More educated households enjoy better food security indicators including dietary diversity. Similarly, households with flush toilets and electricity have greater dietary diversity. Households which report agricultural labour as their primary income source have lower dietary diversity, and those who engage primarily in non-agricultural labour have greater dietary diversity.

4.3. Robustness Checks

4.3.1. Omitted Variable Bias

While we control for time-invariant effects through the panel data, we cannot be sure about eliminating all potential omitted variable biases. In panel data, we assume that changes in food security measures over time are uncorrelated with changes in non-farm income. If this assumption doesn't hold and some unobservable shift in non-farm income is correlated with food-security indicators, omitted variable bias may still pose a threat to our estimates. We, therefore, use the method proposed by Oster (2016) to understand the influence of omitted variable bias. The method tracks changes in two variables: β and R^2. Since we do not know what true β would be, Oster (2016) suggests that β could be derived from the following parameters: $(\tilde{\beta}, \dot{\beta}, \tilde{R^2}, \dot{R^2})$. $\tilde{\beta}$ comes from the regression with full set of control, $\dot{\beta}$ is the estimate from the regression without any controls, $\tilde{R^2}$ and $\dot{R^2}$ are the corresponding R^2 for the two regressions. Oster (2016) defines two additional parameters which determine the consistent estimator for the effect of non-farm income on food-security indicators- δ and R_{max}. δ is the degree of proportionality for the relationship between non-farm income and observables and the relationship

[4]Village schedule of the survey instrument collects information on whether the village has an inflow or outflow of workers.

between non-farm income and unobservables. R_{max} is the $R-$squared of a hypothetical regression which would account for all unobservables. We need to make assumptions about these two parameters. First, we assume that $\delta \in [-1, 1]$. With $\delta = 1$, unobservables are as important as observable effects on food-security and the effects are in the same direction. $\delta = -1$ would mean that the effects of unobservables and that of observables move in opposite directions. It could be possible that $\delta > 1$. We estimate $\hat{\delta}$ which is the value of δ for which the effect of non-farm income on food-security indicators would be zero.

Similarly, R_{max} is not known, but reasonable assumptions can be made regarding this parameter. Oster (2016) argues that a useful bound for R_{max} is given by $R_{max} = min\{2.2\tilde{R^2}, 1\}$. $R-$squares are typically low for fixed-effects panel data models. Therefore, we use the bound as $min\{1.5\tilde{R^2}, 1\}$.

5. Discussion and Conclusion

The pace of structural transformation in India which includes occupational and dietary transition has been actively debated in the policy as well as academic circles. Contribution of the non-farm sector to total income and employment is expected to increase further with time as a part of the transition of India's economy. Although diversification into non-farm employment has always been an integral part of rural livelihood strategy, the extent of diversification increases as the country goes through structural transformation and the share of agricultural output declines. Recent experience suggests that non-farm income is increasingly important for India's rural economy. Farming not being a remunerative enough option has led to calls for further diversification into non-farm activities. Since 2011, farm income has grown at around 1 percent leading to acute agrarian distress (Chand et al., 2015). Indian farmers are going through a phase of crisis where income from cultivation has not kept pace with rise in input costs which has affected their profiitability. In the wake of such a sluggish pace of growth of income from cultivation, the government of India has called for doubling farmer's income by 2022. However, this has been criticized by many in the policy circles as "impossible and unrealistic".[5] Chandrasekhar and Mehrotra (2016) have shown that income from cultivation alone will be inadequate for increasing farmer's income. Hence, policy should aim at increasing income from other non-farm sources to reduce vulneerability among farm households.

[5]See http://indianexpress.com/article/india/india-news-india/farm-incomes-dreaming-to-double-2939405/.

Household access to food is clearly a function of income. Greater non-farm income through diversification of economic activities have played a significant role in ensuring access to food in India during the time during which cultivation has not been remunerative enough. In this paper, we have shown that non-farm income and remittance income have a positive impact on various food security indicators. Increased spending on rural connectivity in last two decades has opened new employment opportunities outside of agriculture for rural households helping them diversify their spending on various food items. Using a large-scale national survey, this paper provides an estimate of the effect of non-farm activity on food security in rural India. We empirically establish that non-farm opportunities do help households spend more on better quality of food, thereby diversifying their diets. Remittance, which has increased significantly as a source of household income, has also helped in maintaining household food security.

However, this does not mean that agriculture or farming sector can be left on its own and expect people to transition out of agriculture for improved welfare outcomes. Barrett et al. (2001a) argues that the classifying activities as "non-farm" often leads agricultural researchers and rural policy institutions considering them outside of their "mandate". For substantial rural progress, the non-farm sector can not be overlooked. Agarwal and Agrawal (2016) has shown that non-farm employment mainly benefits those involves in the skilled or regular jobs which are not available in plenty in India. Most farmers end up being in agriculture on account of lower occupational mobility despite their dislike for farming.

Non-farm employment in rural India has also been found to be distress-driven since the portfolio of activities which comprise the non-farm sector often comprises of small economic enterprises which might be of subsistence in character (Jatav and Sen, 2013). Cultivation or self-employment in agriculture is generally assumed to be the most prestigious and wealthy economic activity. Greater share of the non-farm economy could also represents symptoms of a weak rural economy as a result of greater share of casual laborers without access to formal jobs and eroded asset base. Placing our results in that context, one could cast doubts on the positive welfare effect on food security, which we find in this paper. In response to that, we would like to assert that our findings should be taken in the context of changing nature of rural occupation and their association with diets. This paper does not aim to answer the long-term welfare impacts of the occupational or dietary transitions in India, both of which could be answered only retrospectively sometime later in the future. The modest contribution of this paper is to ex-

plain the relationship between of the these transition, which opens up further avenues of research on explaining the pathways between agricultural sector transformation, dietary change and its nutritional impact. We highlight the need for more research for a better understanding of the processes which could explain greater diversification into the non-farm sector. This adds to the challenge for the Indian policymakers who face a precarious challenge of farming remunerative but also creating an enabling environment where non-farm economic activities are accessible to a wider rural population which are at a disadvantage on account of lacking in education, skills, social networks, and financial capital.

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26-27/The{_}Stunted{_}Structural{_}Transformation{_}of{_}the{_}Indian{_}Econom
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Figure 2: Kernel density estimates for food expenditure

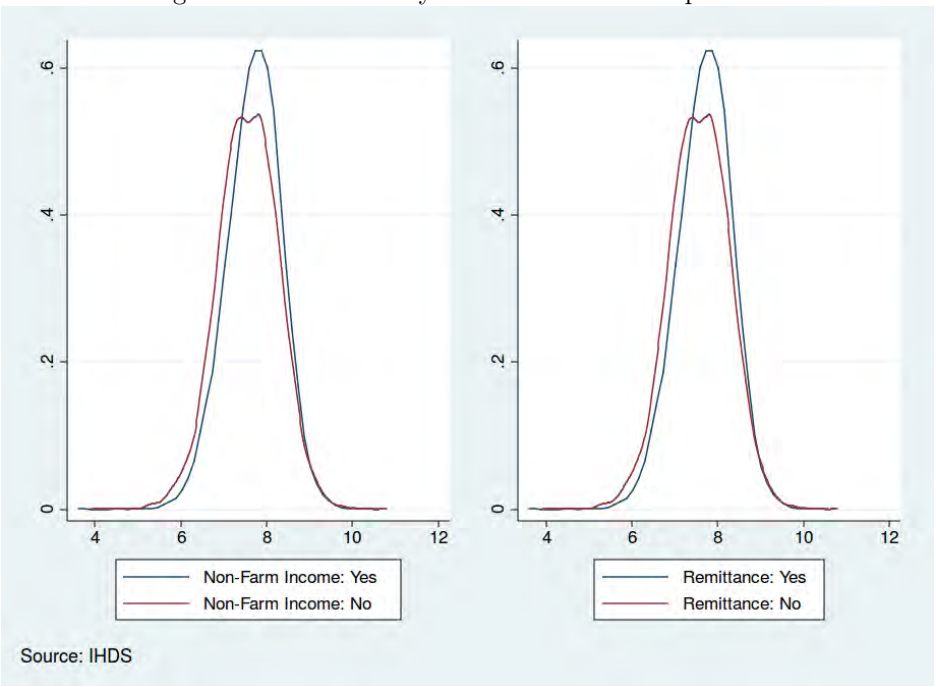

Figure 3: Non-parametric associations: Food security and Non-farm Income

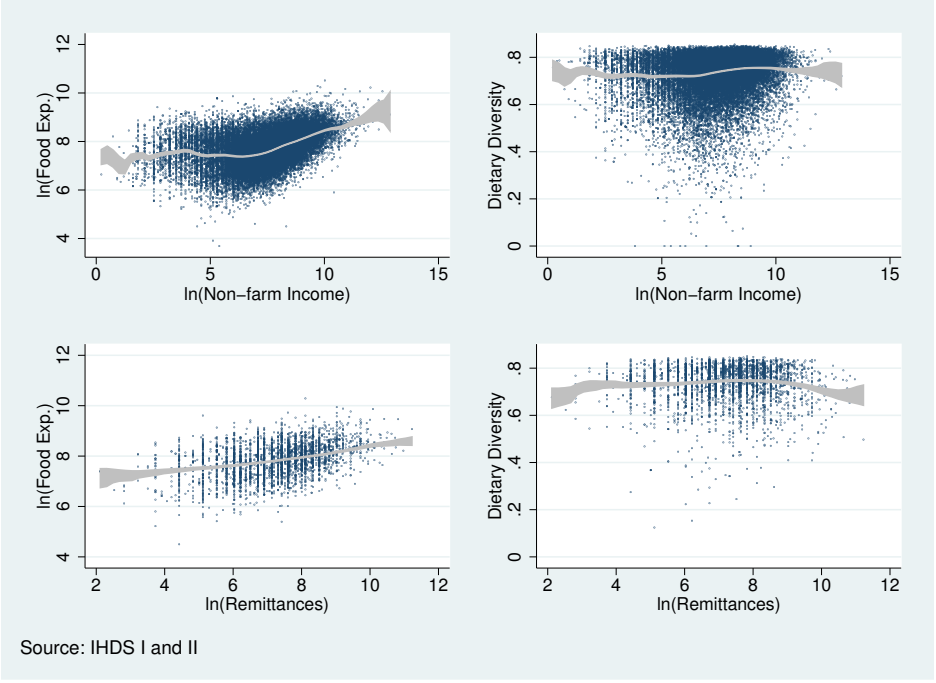

Table 1: Share of Income From Various Sources: 2004-05 & 2011-12

Income Source	**2004-05**	**2011-12**
Cultivation	29%	25%
Agricultural Wages	13%	11%
Livestock	7%	4%
Agricultural Property	1%	2%
NREGS	-	2%
Salary	18%	16%
Non-agricultural Wages	13%	16%
Business Enterprise	12%	11%
Government Benefit	1%	2%
Remittance	3%	8%
Others	4%	4%

Table 2: Panel Regression: Non-Farm Income & Food Security

	Food Expenditure	Share Food Expenditure	Cereal Expenditure	Non-Cereal to Cereal Expenditure	Egg-Fish-Meat Expenditure	Dietary Diversity
Log Non-farm Income	0.047***	−0.002***	0.029***	0.004***	0.059***	0.003***
	(0.004)	(0.001)	(0.001)	(0.001)	(0.006)	(0.000)
Highest edu	0.028***	−0.002***	0.017***	0.002***	0.037***	0.001***
	(0.001)	(0.000)	(0.001)	(0.000)	(0.004)	(0.000)
MPCE	0.000***	−0.000***	0.000***	0.000***	0.000***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Kids	0.058***	−0.001	0.092***	−0.011***	0.036***	−0.003***
	(0.003)	(0.001)	(0.002)	(0.001)	(0.007)	(0.000)
PDS	0.177***	−0.028***	−0.117***	0.082***	0.378***	0.040***
	(0.019)	(0.005)	(0.011)	(0.008)	(0.044)	(0.004)
Primary Income Source						
Ag labour	−0.057**	0.009	0.018	−0.021***	−0.088*	−0.007
	(0.022)	(0.006)	(0.015)	(0.006)	(0.037)	(0.004)
Non-ag labour	−0.019	−0.002	−0.007	−0.004	0.007	0.007*
	(0.020)	(0.005)	(0.015)	(0.006)	(0.041)	(0.003)
Salaried	−0.072***	−0.020***	−0.084***	0.008	−0.104*	0.003
	(0.020)	(0.005)	(0.019)	(0.006)	(0.052)	(0.004)
Other	−0.092***	−0.002	−0.104***	0.007	−0.109*	−0.001
	(0.020)	(0.005)	(0.016)	(0.005)	(0.045)	(0.003)
Ration Card						
BPL	−0.099***	0.017**	0.096***	−0.053***	−0.174**	−0.012**
	(0.024)	(0.006)	(0.018)	(0.007)	(0.054)	(0.004)
APL	−0.006	0.022**	0.188***	−0.053***	−0.086	−0.003
	(0.025)	(0.007)	(0.020)	(0.009)	(0.063)	(0.005)
Toilet Facility						
Traditional	0.192***	0.008	0.102***	0.015	0.068	0.003
	(0.030)	(0.006)	(0.014)	(0.010)	(0.075)	(0.003)
Flush	0.222***	−0.003	0.159***	0.008	0.261***	0.011***
	(0.024)	(0.004)	(0.013)	(0.005)	(0.050)	(0.003)
Electricity	0.277***	−0.029***	0.142***	0.035***	0.433***	0.024***
	(0.020)	(0.005)	(0.012)	(0.007)	(0.040)	(0.003)
Land Class						
0.01-0.4	0.092***	−0.015**	0.082***	−0.001	0.041	−0.000
	(0.023)	(0.005)	(0.016)	(0.006)	(0.042)	(0.003)
0.4-1.0	0.072***	−0.011	0.088***	−0.008	0.051	−0.003
	(0.021)	(0.006)	(0.016)	(0.005)	(0.047)	(0.003)
1.0-2.0	0.024	−0.014*	0.038	−0.004	−0.031	−0.007
	(0.024)	(0.006)	(0.019)	(0.007)	(0.055)	(0.004)
2.0-4.0	−0.036	−0.013	−0.059*	0.010	−0.065	−0.003
	(0.032)	(0.007)	(0.025)	(0.007)	(0.088)	(0.004)
4.0-10.0	−0.009	−0.007	−0.042	0.013	0.125	0.002
	(0.041)	(0.009)	(0.033)	(0.012)	(0.118)	(0.007)
10+	−0.109	−0.050*	−0.249***	0.046**	0.287	0.017
	(0.089)	(0.021)	(0.060)	(0.018)	(0.262)	(0.013)
N	42327	42327	42245	42241	24026	42327
R^2	0.421	0.202	0.229	0.164	0.305	0.109

Robust standard errors clustered at the district-level in parentheses.
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
Omitted groups: *Primary Income Source:* Cultivator. *Ration Card Type:* AAY. *Toilet:* No Toilet. *Land Class:* 0-0.01 hectares.
MPCE refers to Monthly per capita expenditure.

Table 3: Non-farm Income & Food Security(IV: Share of Villages with Paved Road)

	(1) Food Expenditure	(2) Share Food Expenditure	(3) Cereal Expenditure	(4) Non-Cereal to Cereal Expenditure	(5) Egg-Fish-Meat Expenditure	(6) Dietary Diversity
Log Non-farm Income	0.393***	−0.059	0.024	0.112*	0.397**	0.076*
	(0.107)	(0.035)	(0.083)	(0.050)	(0.132)	(0.037)
MPCE	0.000	−0.000	0.000**	−0.000	0.000	−0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Kids	0.049***	0.000	0.093***	−0.014***	0.037***	−0.005**
	(0.007)	(0.002)	(0.004)	(0.002)	(0.011)	(0.002)
PDS	−0.051	0.011	−0.112	0.010	0.133	−0.008
	(0.075)	(0.023)	(0.060)	(0.034)	(0.113)	(0.024)
Primary Income Source						
Ag-labour	0.212*	−0.035	0.016	0.063	0.142	0.049
	(0.088)	(0.027)	(0.067)	(0.039)	(0.108)	(0.029)
Non-ag labour	−0.603***	0.093	0.002	−0.185*	−0.548*	−0.116
	(0.179)	(0.058)	(0.141)	(0.084)	(0.216)	(0.062)
Salaried	−0.781***	0.093	−0.082	−0.209*	−0.789**	−0.145
	(0.217)	(0.070)	(0.167)	(0.101)	(0.267)	(0.075)
Other	−0.780***	0.110	−0.095	−0.208*	−0.776**	−0.146*
	(0.211)	(0.069)	(0.164)	(0.099)	(0.260)	(0.074)
Ration Card						
BPL	0.096	−0.014	0.096	0.007	−0.063	0.029
	(0.065)	(0.020)	(0.054)	(0.029)	(0.075)	(0.021)
APL	0.138*	−0.002	0.187***	−0.010	−0.017	0.027
	(0.056)	(0.016)	(0.047)	(0.024)	(0.084)	(0.018)
Toilet Facility						
Traditional	0.012	0.038	0.104*	−0.041	−0.001	−0.034
	(0.075)	(0.020)	(0.050)	(0.030)	(0.104)	(0.021)
Flush	0.028	0.029	0.157**	−0.051	0.127	−0.028
	(0.069)	(0.019)	(0.049)	(0.029)	(0.078)	(0.021)
Electricity	−0.046	0.023	0.142	−0.063	0.113	−0.041
	(0.099)	(0.032)	(0.077)	(0.045)	(0.133)	(0.034)
Land Class						
0.01-0.4	0.081*	−0.014	0.075***	−0.001	0.029	−0.001
	(0.036)	(0.008)	(0.021)	(0.012)	(0.058)	(0.008)
0.4-1.0	0.175**	−0.028*	0.080**	0.028	0.104	0.020
	(0.058)	(0.014)	(0.031)	(0.022)	(0.072)	(0.015)
1.0-2.0	0.214*	−0.044*	0.038	0.056	0.004	0.033
	(0.085)	(0.022)	(0.048)	(0.034)	(0.078)	(0.024)
2.0-4.0	0.196	−0.051	−0.068	0.085*	−0.089	0.045
	(0.107)	(0.026)	(0.064)	(0.042)	(0.123)	(0.031)
4.0-10.0	0.318*	−0.060	−0.047	0.118*	0.268	0.071
	(0.141)	(0.037)	(0.090)	(0.058)	(0.252)	(0.043)
10+	0.224	−0.104*	−0.257*	0.154	0.265	0.087
	(0.217)	(0.044)	(0.124)	(0.081)	(0.502)	(0.060)
N	36302	36302	36150	36146	16446	36302

Robust standard errors clustered at the district-level in parentheses.
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
Omitted groups: *Primary Income Source:* Cultivator. *Ration Card Type:* AAY. *Toilet:* No Toilet. *Land Class:* 0-0.01 hectares.
MPCE refers to Monthly per capita expenditure.

Table 4: Panel Regression: Remittances and Food Security

	Food Expenditure	Share Food Expenditure	Cereal Expenditure	Non-Cereal to Cereal Expenditure	Egg-Fish-Meat Expenditure	Dietary Diversity
Log Remittance Income	0.025***	−0.002*	0.009**	0.004***	0.028***	0.002***
	(0.003)	(0.001)	(0.003)	(0.001)	(0.005)	(0.000)
Highest Edu	0.035***	−0.002***	0.021***	0.003***	0.046***	0.002***
	(0.002)	(0.000)	(0.002)	(0.000)	(0.004)	(0.000)
MPCE	0.000***	−0.000***	0.000***	0.000***	0.000***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Kids	0.061***	−0.001	0.093***	−0.010***	0.038***	−0.003***
	(0.003)	(0.001)	(0.003)	(0.001)	(0.007)	(0.000)
PDS	0.195***	−0.029***	−0.102***	0.082***	0.406***	0.040***
	(0.020)	(0.005)	(0.024)	(0.008)	(0.044)	(0.004)
Primary Income Source						
Ag labour	−0.087***	0.010	−0.001	−0.023***	−0.120**	−0.008*
	(0.024)	(0.006)	(0.023)	(0.006)	(0.039)	(0.004)
Non-ag labour	0.064**	−0.006	0.043	0.003	0.109*	0.012**
	(0.022)	(0.005)	(0.023)	(0.006)	(0.042)	(0.004)
Salaried	0.019	−0.024***	−0.027	0.015*	0.007	0.008*
	(0.023)	(0.005)	(0.023)	(0.006)	(0.052)	(0.004)
Other	−0.011	−0.006	−0.050*	0.012*	−0.004	0.003
	(0.022)	(0.005)	(0.021)	(0.005)	(0.045)	(0.003)
Ration Card						
BPL	−0.120***	0.017**	0.082**	−0.054***	−0.191***	−0.013**
	(0.025)	(0.006)	(0.031)	(0.007)	(0.056)	(0.004)
APL	−0.026	0.022***	0.176***	−0.055***	−0.103	−0.004
	(0.027)	(0.007)	(0.034)	(0.009)	(0.065)	(0.005)
Toilet Facility						
Traditional	0.206***	0.008	0.114***	0.015	0.074	0.003
	(0.030)	(0.006)	(0.026)	(0.010)	(0.076)	(0.003)
Flush	0.242***	−0.004	0.173***	0.009	0.275***	0.012***
	(0.025)	(0.004)	(0.023)	(0.005)	(0.052)	(0.003)
Electricity	0.309***	−0.030***	0.165***	0.036***	0.476***	0.026***
	(0.021)	(0.005)	(0.021)	(0.007)	(0.041)	(0.003)
Land Class						
0.04-0.1	0.092***	−0.015**	0.083***	−0.002	0.042	−0.000
	(0.024)	(0.005)	(0.023)	(0.006)	(0.044)	(0.003)
0.1-0.4	0.060**	−0.010	0.080***	−0.009	0.043	−0.004
	(0.022)	(0.006)	(0.020)	(0.005)	(0.049)	(0.003)
0.4-1.0	0.001	−0.013*	0.024	−0.005	−0.036	−0.008*
	(0.026)	(0.006)	(0.025)	(0.007)	(0.060)	(0.004)
1.0-2.0	−0.062	−0.012	−0.076*	0.008	−0.065	−0.005
	(0.033)	(0.007)	(0.031)	(0.007)	(0.091)	(0.004)
2.0-4.0	−0.051	−0.005	−0.068	0.010	0.091	−0.000
	(0.044)	(0.009)	(0.047)	(0.012)	(0.113)	(0.007)
4.0-10.0	−0.149	−0.049*	−0.275**	0.044*	0.264	0.015
	(0.092)	(0.021)	(0.100)	(0.017)	(0.246)	(0.012)
N	42327	42327	42245	42241	24026	42327
R^2	0.386	0.201	0.213	0.163	0.280	0.105

Robust standard errors clustered at the district-level in parentheses.
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
Omitted groups: *Primary Income Source:* Cultivator. *Ration Card Type:* AAY. *Toilet:* No Toilet. *Land Class:* 0-0.01 hectares.
MPCE refers to Monthly per capita expenditure.

Table 5: Panel IV Regression: Remittances & Food Security (IV: Share of out-migrants)

	Food Expenditure	Share Food Expenditure	Cereal Expenditure	Non-Cereal to Cereal Expenditure	Egg-Fish-Meat Expenditure	Dietary Diversity
Log Remittance Income	0.534**	−0.009	0.227+	0.059*	0.500+	−0.001
	(0.169)	(0.023)	(0.125)	(0.027)	(0.290)	(0.017)
Highest Edu	0.052***	−0.002*	0.028***	0.004***	0.054***	0.002*
	(0.007)	(0.001)	(0.005)	(0.001)	(0.007)	(0.001)
MPCE	0.000*	−0.000***	0.000*	0.000	0.000+	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Kids	0.098***	−0.002	0.110***	−0.006**	0.077**	−0.003*
	(0.013)	(0.002)	(0.010)	(0.002)	(0.025)	(0.001)
PDS	−0.034	−0.026*	−0.200**	0.057***	0.201	0.042***
	(0.086)	(0.012)	(0.066)	(0.015)	(0.140)	(0.008)
Primary Income Source						
Ag labour	0.007	0.009	0.040	−0.013	−0.039	−0.009*
	(0.049)	(0.007)	(0.034)	(0.009)	(0.077)	(0.004)
Non-ag labour	0.159**	−0.007	0.084*	0.014	0.185*	0.011**
	(0.050)	(0.006)	(0.035)	(0.009)	(0.081)	(0.004)
Salary	−0.046	−0.023***	−0.054	0.008	−0.096	0.009+
	(0.062)	(0.007)	(0.036)	(0.009)	(0.119)	(0.005)
Other	−0.259**	−0.002	−0.155*	−0.015	−0.225	0.005
	(0.096)	(0.012)	(0.066)	(0.014)	(0.147)	(0.009)
Ration Card						
BPL	−0.034	0.016*	0.119**	−0.045***	−0.149*	−0.013**
	(0.052)	(0.007)	(0.039)	(0.010)	(0.075)	(0.004)
APL	−0.018	0.022***	0.179***	−0.054***	−0.148	−0.004
	(0.052)	(0.007)	(0.038)	(0.010)	(0.097)	(0.005)
Toilet Facility						
Traditional	−0.010	0.011	0.022	−0.009	−0.056	0.005
	(0.094)	(0.010)	(0.063)	(0.016)	(0.132)	(0.008)
Flush	0.084	−0.001	0.106*	−0.008	0.089	0.013*
	(0.070)	(0.007)	(0.049)	(0.010)	(0.128)	(0.006)
Electricity	0.086	−0.027*	0.070	0.012	0.258+	0.027***
	(0.082)	(0.011)	(0.061)	(0.012)	(0.141)	(0.008)
Land Class						
0.01-0.4	0.052	−0.015**	0.067*	−0.006	0.045	0.000
	(0.046)	(0.006)	(0.027)	(0.008)	(0.064)	(0.004)
0.4-1.0	0.072	−0.011+	0.087**	−0.007	0.050	−0.004
	(0.044)	(0.006)	(0.028)	(0.006)	(0.076)	(0.003)
1.0-2.0	0.011	−0.013*	0.029	−0.004	−0.084	−0.008*
	(0.049)	(0.006)	(0.031)	(0.008)	(0.085)	(0.004)
2.0-4.0	−0.031	−0.012	−0.062	0.012	−0.137	−0.005
	(0.072)	(0.007)	(0.044)	(0.010)	(0.130)	(0.005)
4.0-10.0	−0.055	−0.005	−0.069	0.010	−0.116	−0.000
	(0.095)	(0.009)	(0.064)	(0.014)	(0.203)	(0.006)
10.0+	−0.094	−0.049**	−0.250*	0.050+	−0.240	0.014
	(0.178)	(0.019)	(0.112)	(0.027)	(0.679)	(0.012)
N	37456	37456	37304	37300	17022	37456

Robust standard errors clustered at the district-level in parentheses.
+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
Omitted groups: *Primary Income Source:* Cultivator. *Ration Card Type:* AAY. *Toilet:* No Toilet. *Land Class:* 0-0.01 hectares.
MPCE refers to Monthly per capita expenditure.

Table A1: Non-farm Income & Food Security (IV: Share of non-agri workers)

	Food Expenditure	Share Food Expenditure	Cereal Expenditure	Non-Cereal to Cereal Expenditure	Egg-Fish-Meat Expenditure	Dietary Diversity
Log Non-Farm Income	0.316***	−0.014*	0.188***	0.029***	0.456***	0.015***
	(0.033)	(0.006)	(0.028)	(0.008)	(0.072)	(0.003)
Highest edu	−0.005	−0.000	−0.002	−0.001	−0.018	−0.000
	(0.005)	(0.001)	(0.004)	(0.001)	(0.011)	(0.000)
MPCE	0.000***	−0.000***	0.000***	0.000	0.000*	−0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Kids	0.051***	−0.001	0.088***	−0.011***	0.039***	−0.003***
	(0.005)	(0.001)	(0.004)	(0.001)	(0.012)	(0.000)
PDS	0.004	−0.021**	−0.220***	0.065***	0.102	0.031***
	(0.036)	(0.006)	(0.031)	(0.010)	(0.091)	(0.005)
Primary Income Source						
Ag-labour	0.141***	0.000	0.136***	−0.002	0.162*	0.003
	(0.042)	(0.008)	(0.034)	(0.009)	(0.076)	(0.005)
Non-ag labour	−0.472***	0.019	−0.274***	−0.047***	−0.647***	−0.014*
	(0.063)	(0.011)	(0.053)	(0.014)	(0.134)	(0.007)
Salaried	−0.619***	0.005	−0.406***	−0.044**	−0.893***	−0.022**
	(0.078)	(0.013)	(0.065)	(0.016)	(0.171)	(0.008)
Other	−0.630***	0.022	−0.422***	−0.045**	−0.905***	−0.026***
	(0.074)	(0.012)	(0.062)	(0.016)	(0.161)	(0.008)
Ration Card						
BPL	0.051	0.010	0.185***	−0.039***	−0.041	−0.005
	(0.033)	(0.006)	(0.033)	(0.008)	(0.074)	(0.005)
APL	0.108**	0.016*	0.254***	−0.043***	0.007	0.002
	(0.036)	(0.007)	(0.036)	(0.009)	(0.089)	(0.006)
Toilet						
Traditional	0.049	0.015*	0.018	0.001	−0.021	−0.004
	(0.045)	(0.006)	(0.033)	(0.011)	(0.102)	(0.004)
Flush	0.067*	0.004	0.066*	−0.007	0.098	0.004
	(0.033)	(0.005)	(0.026)	(0.007)	(0.065)	(0.004)
Electricity	0.031	−0.018*	−0.003	0.011	0.052	0.013**
	(0.042)	(0.007)	(0.034)	(0.011)	(0.095)	(0.005)
Land Class						
0.01-0.4	0.080**	−0.015**	0.076**	−0.002	0.036	−0.001
	(0.029)	(0.006)	(0.025)	(0.006)	(0.063)	(0.004)
0.4-1.0	0.147***	−0.014*	0.134***	−0.001	0.111	0.000
	(0.035)	(0.006)	(0.026)	(0.006)	(0.073)	(0.003)
1.0-2.0	0.155***	−0.020**	0.117**	0.009	−0.017	−0.001
	(0.044)	(0.007)	(0.036)	(0.008)	(0.083)	(0.004)
2.0-4.0	0.126*	−0.020*	0.038	0.026**	−0.095	0.004
	(0.059)	(0.008)	(0.044)	(0.010)	(0.134)	(0.005)
4.0-10.0	0.231**	−0.018	0.103	0.037*	0.271	0.013
	(0.078)	(0.011)	(0.063)	(0.015)	(0.264)	(0.009)
10+	0.134	−0.061**	−0.102	0.070**	0.237	0.028
	(0.153)	(0.020)	(0.108)	(0.024)	(0.543)	(0.018)
N	37456	37456	37304	37300	17022	37456

Robust standard errors clustered at the district-level in parentheses.
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
Omitted groups: *Primary Income Source:* Cultivator. *Ration Card Type:* AAY. *Toilet:* No Toilet. *Land Class:* 0-0.01 hectares.
MPCE refers to Monthly per capita expenditure.

Table A2: Non-farm Income & Food Security (IV: Night-time lights)

	Food Expenditure	Share Food Expenditure	Cereal Expenditure	Non-Cereal to Cereal Expenditure	Egg-Fish-Meat Expenditure	Dietary Diversity
Log Non-farm Income	0.297***	−0.012	0.202***	0.018**	0.421***	0.008***
	(0.038)	(0.007)	(0.028)	(0.005)	(0.035)	(0.002)
Highest edu	−0.003	−0.001	−0.004	0.000	−0.013	0.001
	(0.005)	(0.001)	(0.004)	(0.001)	(0.007)	(0.000)
MPCE	0.000***	−0.000***	0.000**	0.000**	0.000**	−0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Kids	0.052***	−0.001	0.088***	−0.011***	0.039***	−0.003***
	(0.005)	(0.001)	(0.004)	(0.001)	(0.011)	(0.000)
PDS	0.016	−0.022***	−0.229***	0.072***	0.126	0.036***
	(0.038)	(0.006)	(0.033)	(0.009)	(0.073)	(0.004)
Primary Income Source						
Ag-labour	0.127**	0.002	0.146***	−0.011	0.140*	−0.002
	(0.045)	(0.007)	(0.035)	(0.007)	(0.062)	(0.004)
Non-ag labour	−0.440***	0.015	−0.298***	−0.028*	−0.589***	−0.003
	(0.072)	(0.012)	(0.054)	(0.011)	(0.077)	(0.005)
Salaried	−0.581***	−0.000	−0.434***	−0.021	−0.824***	−0.009
	(0.087)	(0.015)	(0.064)	(0.012)	(0.103)	(0.006)
Other	−0.593***	0.017	−0.451***	−0.022	−0.835***	−0.013*
	(0.083)	(0.013)	(0.061)	(0.012)	(0.090)	(0.005)
Ration Card						
BPL	0.041	0.011	0.193***	−0.045***	−0.053	−0.009*
	(0.036)	(0.007)	(0.035)	(0.008)	(0.072)	(0.004)
APL	0.100**	0.017*	0.260***	−0.048***	−0.001	−0.001
	(0.038)	(0.007)	(0.038)	(0.009)	(0.087)	(0.005)
Toilet Facility						
Traditional	0.059	0.014*	0.010	0.007	−0.013	−0.000
	(0.046)	(0.007)	(0.035)	(0.010)	(0.099)	(0.004)
Flush	0.078*	0.003	0.058*	−0.000	0.112	0.008**
	(0.035)	(0.005)	(0.027)	(0.006)	(0.063)	(0.003)
Electricity	0.048	−0.020**	−0.015	0.022**	0.086	0.019***
	(0.044)	(0.007)	(0.037)	(0.008)	(0.067)	(0.004)
Land Class						
0.01-0.4	0.080**	−0.015**	0.076**	−0.002	0.037	−0.000
	(0.028)	(0.005)	(0.026)	(0.006)	(0.060)	(0.003)
0.4-1.0	0.142***	−0.014*	0.138***	−0.004	0.106	−0.001
	(0.032)	(0.006)	(0.027)	(0.005)	(0.068)	(0.003)
1.0-2.0	0.146***	−0.019**	0.124***	0.003	−0.019	−0.004
	(0.043)	(0.007)	(0.037)	(0.007)	(0.078)	(0.003)
2.0-4.0	0.115*	−0.019*	0.046	0.019*	−0.092	0.000
	(0.057)	(0.009)	(0.048)	(0.008)	(0.126)	(0.005)
4.0-10.0	0.215**	−0.016	0.116	0.026	0.258	0.007
	(0.075)	(0.011)	(0.066)	(0.013)	(0.250)	(0.007)
10+	0.118	−0.059**	−0.089	0.060**	0.241	0.022
	(0.138)	(0.020)	(0.109)	(0.020)	(0.516)	(0.015)
N	37456	37456	37304	37300	17022	37456

Robust standard errors clustered at the district-level in parentheses.
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
Omitted groups: *Primary Income Source:* Cultivator. *Ration Card Type:* AAY. *Toilet:* No Toilet. *Land Class:* 0-0.01 hectares.
MPCE refers to Monthly per capita expenditure.

Table A3: Panel Regression: Different Sources of Income & Food Security

	Food Expenditure	Share Food Expenditure	Cereal Expenditure	Non-Cereal to Cereal Expenditure	Egg-Fish-Meat Expenditure	Dietary Diversity
Log Salary	0.114***	−0.008*	0.062***	0.012**	0.177***	0.009***
	(0.010)	(0.003)	(0.013)	(0.004)	(0.022)	(0.002)
Log Business	0.122***	−0.009**	0.071***	0.011***	0.173***	0.012***
	(0.010)	(0.003)	(0.010)	(0.003)	(0.019)	(0.002)
Non-ag Wage	0.086***	0.003	0.054***	0.006*	0.101***	0.005***
	(0.007)	(0.002)	(0.008)	(0.002)	(0.017)	(0.001)
Govt Benefit	0.065***	−0.004*	0.037***	0.007***	0.140***	0.004**
	(0.010)	(0.002)	(0.011)	(0.002)	(0.016)	(0.001)
Log Remittance Income	0.053***	0.001	0.049***	−0.003	0.077**	0.000
	(0.010)	(0.003)	(0.013)	(0.004)	(0.023)	(0.002)
Log Other Income	0.055**	0.002	0.048**	0.001	0.052	0.004*
	(0.018)	(0.003)	(0.016)	(0.003)	(0.034)	(0.002)
N	42327	42327	42245	42241	24026	42327
R^2	0.466	0.208	0.247	0.173	0.343	0.124

Household-level controls include highest education level in the household, MPCE, number of kids, access to PDS, primary income source, ration card type, access to toilet, access to electricity, land-class.

Robust standard errors clustered at the district-level in parentheses.

$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A4: First-stage estimates: Non-Farm Income and Instruments

	(1)	(2)	(3)	(4)	(5)	(6)
Share village with roads	-0.0486^{***}	-0.0486^{***}	-0.0481^{***}	-0.0435^{***}	-0.0481^{***}	-0.0486^{***}
	(-6.00)	(-6.00)	(-5.94)	(-3.76)	(-5.94)	(-6.00)
F-statistics	20.41	20.41	20.31	13.75	20.32	20.41
Share non-agri	15.37^{***}	15.37^{***}	15.32^{***}	15.40^{***}	15.31^{***}	15.37^{***}
	(24.11)	(24.11)	(23.96)	(16.45)	(23.95)	(24.11)
F-statistics	581.2	581.2	574.3	270.7	573.5	581.2
Nightlights	40.71^{***}	40.71^{***}	40.62^{***}	93.00^{***}	40.61^{***}	40.71^{***}
	(24.39)	(24.39)	(24.31)	(24.46)	(24.31)	(24.39)
F-statistics	594.7	594.7	591.2	598.2	590.7	594.7

Household-level controls include highest education level in the household, MPCE, number of kids, access to PDS, primary income source, ration card type, access to toilet, access to electricity, land-class.
t statistics in parentheses.
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A5: First-stage estimates: Remittance Income

	(1)	(2)	(3)	(4)	(5)	(6)
outMigrantVill	0.234^{***}	0.234^{***}	0.239^{***}	0.228^{***}	0.239^{***}	0.234^{***}
	(6.66)	(6.66)	(6.78)	(4.46)	(6.78)	(6.66)
F-statistics	44.30	44.30	45.98	19.87	46.01	44.30

outMigrantVill: Share of out-migrants in the village.
t statistics in parentheses.
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A6: Instruments Used in the Literature

Paper	**Country**	**Variable Instrumented**	**Instruments**
Pfeiffer et al, Agricultural Economics 2009	Mexico	Off-farm income	distance from the municipio to the US border using the rail network. parents of hh head or the spouse were migrants (correlated with remittances) parents of hh head or the spouse were migrants (correlated with remittances)
Oseni and Winters, Agricultural Economics 2009	Nigeria	Non-farm participation; Household migration network	Literacy in English
Killic et al, 2009	Albanai	Non-farm participation	Knowledge of any foreign language Share of district non-farm employment
Babatunde and Qaim, Food Policy 2010	Nigeria	Off-farm income	household assets; access to electricity; tapped water; tarred road; distance to market
Imai et al, Journal of Asian Economics 2015	Viet Nam, India	Non-farm participation	hh average of predicted wage of female members
Mishra et al, Agricultural Economics 2015	Bangladesh	Total income	agri wage rate at the district; non-agri wage rate at the district level; share of hh with elasticity; rainfall and maximum diversity; distance from Dhaka