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

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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.

Acknowledgment:

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#481



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 (29). 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 (10, 25). Diversification into non-farm activities also help 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 (9, 25, 31).

Diversification of rural livelihoods into other non-farm activities has potential implications for their food security status as well (9, 25, 28). Non-farm income not only augments purchasing power, but also reduces the risk of intra-year food availability (25). 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 could potentially undermine 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 an empirical investigation into the relationship between household dietary diversity and non-farm income. We focus on India as the country of analysis where non-farm income

opportunities have been a major driver behind the process of structural transformation. At the same time, it is also undergoing a dietary transition. Households are spending a greater share of expenditure on non-traditional staples, leading to diversification of diets. Dietary diversity as a measure of
45 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 abil-
50 ity 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 the non-farm income and dietary diversity is theoretically ambiguous.

55 Pathways from agriculture to nutrition (36, 56, 27, 37), often tend overlook the importance of non-farm activities for nutrition, which is an issue of concern. 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 (29). In India, 88%
60 of the rural households which are primarily engaged in agriculture and allied activities, also undertake additional economic activity in the non-farm sector (17). 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
65 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 been an increasing feature of rural livelihoods in India, we also show that remittance income has an important role to play in improving food consumption.

70 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
75 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-
80 farm income growth and nutrition.

The scheme of the paper is as follows. In the following section, we provide a background to the present study. This is followed by a description of data and summary statistics in section 3. Empirical strategy employed in the paper and results are presented in section 4. The following section concludes the paper with a discussion.

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. (12) 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 faster than the overall agricultural output (32). This increase in rural non-farm output and employment opportunities have led to reduction in rural poverty and income inequality (31, 44, 43, 35, 52, 33, 5). Non-farm income sources are specifically crucial for small scale farmers in India. According to an estimate by (15), 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, high levels of malnutrition confounds researchers and policy makers alike. India now faces the challenge of "triple burden of malnutrition, where undernutrition co-exists with a rise in obesity and micro-nutrient deficiency (46). Calorie consumption in India on an average, however, has been declining, mainly on account of lower caloric requirements and better health and hygiene environment (21).

In terms of aggregate levels of food security, India is self-sufficient in food production. However, there are concerns about access to food at a household level given widespread disparity 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 rural population and 50% of the rural population to staple grains (rice and wheat) at highly subsidized prices. While ensuring enough food is essential for enhancing food access, improving household diet remains a bigger challenge for improving overall nutrition which is a multidimensional concept (54). While

NFSA takes take of one dimension of it, there is plenty of scope for a reconfiguration of food security policies in India (50).

Changes in dietary practices and rise in non-farm income have been a
125 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
130 increased. Similarly, over time, the 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.

135 The role of occupational structure for food security in rural India has been recently highlighted by (18). They find that agricultural workers in India are found to have worse food security indicators as compared to those households primarily engaged in cultivation. These findings underscore the challenges
140 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
145 link is the role of remittance income as a result of greater out-migration. Remittance based income has been an increasing feature of the Indian rural economy whose impact on diets and nutrition has not been studied well.

2.1. Link between Non-farm income and dietary diversity

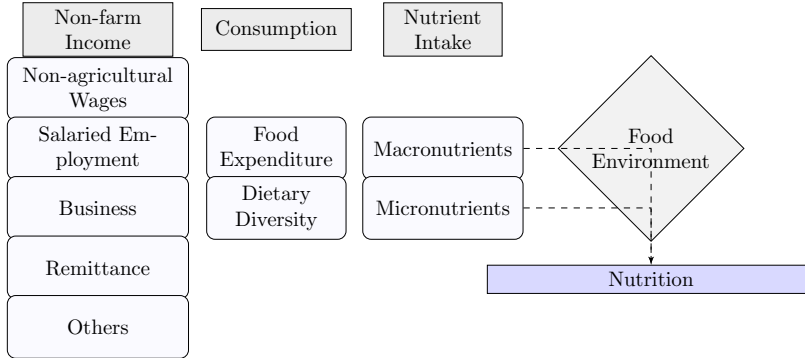
(25) argues that income diversification towards non-farm activities plays
150 a significant role in maintaining food security levels through smoothing food consumption over time. Results from other countries do suggest that non-farm income has significant implications for food security (49, 48, 7, 58, 59). The pathway from non-farm income could be multiple, but the empirical literature on the link between non-farm income and food security is nascent and
155 only speculates on the potential intermediate channels. Assuming farming as a household enterprise, increase in the non-farm income could enable greater investments in agriculture leading to higher income (19). Non-farm income could improve food security, even for the households who can't invest back in agriculture by smoothing their food consumption over time or ameliorates

the food shortage risks in the case of unexpected crop failures (57).

In figure 1, we provide a schematic representation of the pathway through which income from non-farm sources affect nutrition. The income pathways work directly from earning to expenditure on food and the diversity of diet, through the Sen’s “wage-labour entitlement” component of food security (55). 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 staple items like rice or wheat, is more likely to increase the consumption of calories. Household food consumption is an intermediate pathway to better nutrition. 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.

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



For the Indian case, (55) provide an overview of the role non-farm sector in improving food security in India. They argue that diversification into non-farm income activities and income earned from the same is enables food security in rural India 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 the rural transformation of Indian agriculture between 1960-2010, (12) hypothesise that rise in income from the non-farm sector would lead to reduction in hunger together with poverty in the rural areas. The role of occupational structure for food security in rural

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India has further been highlighted by (18). using nationally representative surveys, they show that the agricultural workers are found to have worse
190 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
195 non-farm diversification is rise in the share of remittance. (66) 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, (65) find that remittance play an instrumental
200 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
205 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(1, 6, 20, 38, 51, 61, 68). In an systematic review of 20 such studies (63) finds ample evidence of remittances on greater access to food, smoothing consumption expenditures over time and reduction in malnutrition, thereby reducing household vulnerability to food insecurity. However,
210 the authors call for further research for a greater empirical validity of this association.

3. Data and Summary statistics

We use longitudinal household information on ~25,000 rural households
215 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 (22, 23). This dataset contains a rich source of information on various socio-economic indicators
220 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 village level demographic characteristics as
225 our control variables. For our analysis, we also use additional datasets to

construct instrumental variables, which help us in establishing causal association. First, we use the 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
 230 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
 235 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, which also considers access, stability and quality of food, in addition to overall level of food production in the
 240 country, for improved nutritional outcomes. 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 (13).

Like any other welfare indicator, these indices though theoretically elegant, have their own disadvantages in capturing food security (64). Here, we focus on the food expenditure patterns and dietary diversity as the measure of food security. Food expenditure shares and dietary diversity indicators are crucial intermediate outcomes in the pathway from agriculture to improved
 250 nutritional intake in India (36). Share of food expenditure to total expenditure is expected to decline with income as per the Engels law, which says that with improvement in economic status of the household, the proportionate share of spending on food declines. However, we still observe a positive relationship between food share and expenditure for rural India since access
 255 to food for a large section of the population continues to remain a concern. Over time, there has been a decline in the food share Engel curve, though with greater share of food expenditure being spent on other more nutritious food items such as the animal based protein items. To capture this effect, we further disaggregate total food expenditure by spending on cereals and
 260 animal products to explore how income from non-farm sources abet or aid this transition from cereals to non-cereals.

To investigate the impact of non-farm income on diets, we focus on dietary diversity which is a key component of any health diet. Dietary diversity
 265 at the household level is defined in relation to energy availability as well as

the diet quality. It is widely recognized as a key component of healthy diet. From the perspective of developing countries, dietary diversity is essential to understand many facets of malnutrition such as child growth, malnutrition and nutritional adequacy (60). The two most commonly used dietary
 270 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:

$$\begin{aligned} \text{Simpson Index} &= 1 - \sum_i w_i^2 \\ \text{Shannon Index} &= - \sum_i w_i \log(w_i) \end{aligned}$$

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
 280 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
 285 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

One of the conceptual issue in this literature is the measurement of non-farm income. According to standard definitions, non-farm sector comprises
 290 of all economic activities which take place in rural areas with the exception of agriculture, livestock, fishing and hunting(42). 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
 295 MNCs to part-time self-employment in household based industries or petty trading activities, which may or may not be skill-based (29).

Non-agricultural incomes in the rural areas has been synonymously used with terms like “off-farm”, “non-agricultural”, or “non-traditional” sources
 300 of income (9). Based upon the existing literature (9, 55, 14), 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
 305 “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.

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

| Income Source | 2004-05 | 2011-12 |
|----------------------|----------------|----------------|
| <i>Farm</i> | 29% | 25% |
| <i>Agri-Wage</i> | 13% | 11% |
| <i>Animal</i> | 7% | 4% |
| <i>Agri-Property</i> | 1% | 2% |
| <i>NREGS</i> | 0% | 2% |
| <i>Salary</i> | 18% | 16% |
| <i>Non-ag Wage</i> | 13% | 16% |
| <i>Business</i> | 12% | 11% |
| <i>Govt. Benefit</i> | 1% | 2% |
| <i>Remittance</i> | 3% | 8% |
| <i>Other</i> | 4% | 4% |

¹NREGS 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.

Figure 2: Kernel density estimates for food expenditure

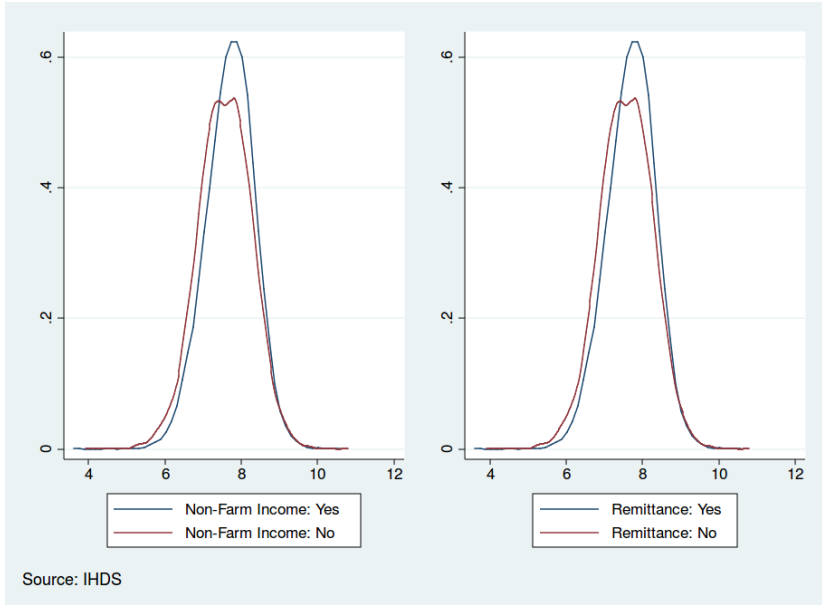
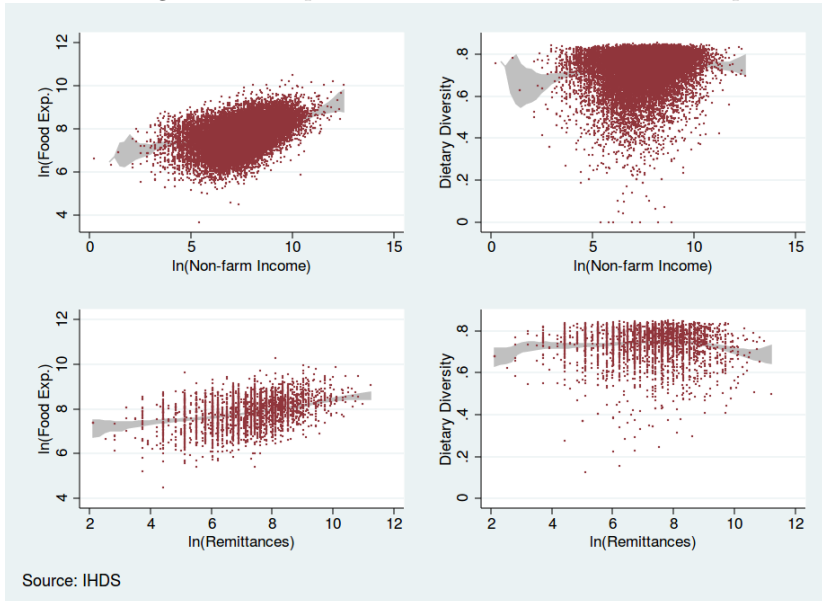


Figure 3: Non-parametric associations with consumption indicators



4. Empirical Strategy and Results

We estimate a panel regression model, where logarithm of non-farm income is our outcome of interest. We are using a panel data because of two reasons (8). 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 dietary-pattern of a household. The panel regression model is of the following form:

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

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, primary income source, ration card type, access to household amenities (toilet, water, electricity), and land owned in our regression. 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. Using a panel data regression model, does not entirely take care of the simultaneity between non-farm income and food security. 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 approach to circumvent this problem.

4.1. Choice of Instrumental Variable

The Instrumental variable (IV) approach is useful when in the case of potential endogeneity of non-farm income. Here, food security outcomes and income from non-farm sources could be influenced by other household characteristics which is not captured in the survey data (40). Unobserved heterogeneity could therefore lead to measurement errors and bias our estimated coefficients on β_1 . 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 affects Y_{it} directly, but through its effect on NFI_{it} . Here, we

365 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 instru-
 ments for non-farm income.

370 Our choice of IVs are informed by the existing literature which has estab-
 lished that improved road-access in villages are considered to be important
 pathways to escape poverty (39). This is based upon the premise that in-
 creased market access and reduced transport costs reduce barriers to engage
 in non-farm activities (11, 26). In particular, (34) show that reduction in
 375 transport costs is associated with rising household welfare mainly through
 positive non-farm income shock. More specifically, for the Indian case, (4)
 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, (45) have also show that access to roads positively influence
 380 participation in non-agricultural work in the villages. (3) shows that villages
 that received paved road access under the *Pradhan Mantri Gram Sadak Yo-
 jana* (PMGSY) saw an observable shift in occupation pattern. Most notably,
 women in the age-group 14-20 shifted to occupations like animal rearing,
 tailoring and textile manufacturing.

385 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 out-
 comes including food security. For instance, (53, 41) employ the *municipio*
 390 (district) level share of non-agri employment as an instrument for off-farm in-
 come. 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 ex-
 cellent proxy of economic activity, even at the local level at which economic
 395 output figures are hardly available (30, 24, 47). 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

400 4.2.1. Association between different Non-farm income sources on dietary di- versity

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 measures. In order to do so, we estimate panel regression coefficients for each of the outcome variables on all the non-farm income sources. We find that income from regular employment and entrepreneurship has greater impact on dietary diversity, expenditure on non-cereal food, expenditure on egg-fish-meat, etc. This is consistent with the findings by (33) that the reduction in economic vulnerability from non-farm income is much higher for more comparatively skilled employment. These results are also in line with the existing evidence from other countries. (7) find that greater non-farm income in Nigeria lead to greater calorie intake and better diet quality. (67) 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 regression². 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 greater education level spend lesser on 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.

²*lnfoodexp*: Log food expenditure, *foodexpShr*: Share of food expenditure in total monthly per-capita expenditure (MPCE), *lnrclexp*: 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.

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
440 chosen instruments validate the OLS results. Table 4 shows the results of the 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
445 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 also find that non-farm income is also negatively
450 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 the household 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
455 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
460 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.
465 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 (62) indicating that the chosen instruments are relevant and explain the variation in non-farm income.

470 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 for panel regressions. We find that remittance income, controlling for household

475 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, the relationship is not causal. There is endogeneity issue that renders our panel estimates biased.

480 We identify the relationship by using an instrument for remittances. We use the status of outmigrants in the survey villages as an instrument.³ We argue that out-migration from the village would affect remittance income while 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.

485

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 non-cereal food items relative to cereals, and on egg, fish, and meat. However, we

490 also 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

495 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.

³In the village characteristics, the survey collects information whether the village has an inflow or outflow of workers.

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

| | lnfoodexp | foodexpShr | lnrlexp | nccExp | lnfinexp | DD |
|------------------------------|----------------------|----------------------|----------------------|----------------------|---------------------|----------------------|
| lnincNonFarm | 0.047*** (0.004) | -0.002*** (0.001) | 0.029*** (0.001) | 0.004*** (0.001) | 0.059*** (0.006) | 0.003*** (0.000) |
| Caste | | | | | | |
| OBC | -0.006 (0.048) | 0.007 (0.012) | 0.016 (0.046) | -0.010 (0.012) | -0.299 (0.196) | -0.014* (0.006) |
| SC | -0.028 (0.051) | 0.012 (0.013) | 0.019 (0.051) | -0.018 (0.014) | -0.317 (0.189) | -0.014 (0.008) |
| ST | 0.009 (0.057) | 0.021 (0.014) | 0.055 (0.057) | -0.020 (0.014) | -0.106 (0.191) | -0.001 (0.011) |
| Others | -0.002 (0.047) | 0.011 (0.012) | 0.019 (0.045) | -0.010 (0.011) | -0.260 (0.202) | -0.012* (0.006) |
| Religion | | | | | | |
| Muslim | -0.015 (0.094) | -0.017 (0.020) | -0.170 (0.096) | 0.053 (0.028) | 0.084 (0.196) | 0.020 (0.011) |
| Sikh,etc. | -0.110 (0.078) | 0.005 (0.012) | -0.106*** (0.032) | 0.007 (0.047) | -0.208 (0.143) | 0.001 (0.014) |
| Highest edu | 0.028*** (0.001) | -0.002*** (0.000) | 0.017*** (0.001) | 0.002*** (0.000) | 0.037*** (0.004) | 0.001*** (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*** (0.003) | -0.001 (0.001) | 0.092*** (0.002) | -0.011*** (0.001) | 0.036*** (0.007) | -0.003*** (0.000) |
| PDS | 0.177*** (0.019) | -0.028*** (0.005) | -0.117*** (0.011) | 0.082*** (0.008) | 0.378*** (0.044) | 0.040*** (0.004) |
| Primary Income Source | | | | | | |
| Ag labour | -0.057** (0.022) | 0.009 (0.006) | 0.018 (0.015) | -0.021*** (0.006) | -0.088* (0.037) | -0.007 (0.004) |
| Non-ag labour | -0.019 (0.020) | -0.002 (0.005) | -0.007 (0.015) | -0.004 (0.006) | 0.007 (0.041) | 0.007* (0.003) |
| Salaried | -0.072*** (0.020) | -0.020*** (0.005) | -0.084*** (0.019) | 0.008 (0.006) | -0.104* (0.052) | 0.003 (0.004) |
| Other | -0.092*** (0.020) | -0.002 (0.005) | -0.104*** (0.016) | 0.007 (0.005) | -0.109* (0.045) | -0.001 (0.003) |
| Ration Card | | | | | | |
| BPL | -0.099*** (0.024) | 0.017** (0.006) | 0.096*** (0.018) | -0.053*** (0.007) | -0.174** (0.054) | -0.012** (0.004) |
| APL | -0.006 (0.025) | 0.022** (0.007) | 0.188*** (0.020) | -0.053*** (0.009) | -0.086 (0.063) | -0.003 (0.005) |
| Toilet Facility | | | | | | |
| Traditional | 0.192*** (0.030) | 0.008 (0.006) | 0.102*** (0.014) | 0.015 (0.010) | 0.068 (0.075) | 0.003 (0.003) |
| Flush | 0.222*** (0.024) | -0.003 (0.004) | 0.159*** (0.013) | 0.008 (0.005) | 0.261*** (0.050) | 0.011*** (0.003) |
| Electricity | 0.277*** (0.020) | -0.029*** (0.005) | 0.142*** (0.012) | 0.035*** (0.007) | 0.433*** (0.040) | 0.024*** (0.003) |
| Land Class | | | | | | |
| 0.01-0.4 | 0.092*** (0.023) | -0.015** (0.005) | 0.082*** (0.016) | -0.001 (0.006) | 0.041 (0.042) | -0.000 (0.003) |
| 0.4-1.0 | 0.072*** (0.021) | -0.011 (0.006) | 0.088*** (0.016) | -0.008 (0.005) | 0.051 (0.047) | -0.003 (0.003) |
| 1.0-2.0 | 0.024 (0.024) | -0.014* (0.006) | 0.038 (0.019) | -0.004 (0.007) | -0.031 (0.055) | -0.007 (0.004) |
| 2.0-4.0 | -0.036 (0.032) | -0.013 (0.007) | -0.059* (0.025) | 0.010 (0.007) | -0.065 (0.088) | -0.003 (0.004) |
| 4.0-10.0 | -0.009 (0.041) | -0.007 (0.009) | -0.042 (0.033) | 0.013 (0.012) | 0.125 (0.118) | 0.002 (0.007) |
| 10+ | -0.109 (0.089) | -0.050* (0.021) | -0.249*** (0.060) | 0.046** (0.018) | 0.287 (0.262) | 0.017 (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: *Caste*: Brahmins. *Religion*: Hindu. *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) lnfoodexp | (2) foodexpShr | (3) lnrlexp | (4) nccexp | (5) lnfeinexp | (6) DD |
|------------------------------|----------------------|--------------------|---------------------|----------------------|---------------------|---------------------|
| lnincNonFarm | 0.393*** (0.107) | -0.059 (0.035) | 0.024 (0.083) | 0.112* (0.050) | 0.397** (0.132) | 0.076* (0.037) |
| Caste | | | | | | |
| OBC | -0.013 (0.100) | 0.010 (0.017) | 0.025 (0.054) | -0.017 (0.030) | -0.324 (0.268) | -0.016 (0.018) |
| SC | -0.026 (0.108) | 0.016 (0.018) | 0.031 (0.056) | -0.023 (0.032) | -0.321 (0.270) | -0.016 (0.021) |
| ST | -0.013 (0.126) | 0.029 (0.021) | 0.050 (0.060) | -0.027 (0.036) | -0.179 (0.281) | -0.007 (0.024) |
| Others | 0.011 (0.092) | 0.013 (0.017) | 0.029 (0.050) | -0.011 (0.027) | -0.252 (0.268) | -0.011 (0.017) |
| Religion | | | | | | |
| Muslim | 0.018 (0.178) | -0.026 (0.030) | -0.181 (0.113) | 0.068 (0.048) | -0.021 (0.255) | 0.031 (0.035) |
| Sikh etc. | -0.148 (0.085) | 0.003 (0.016) | -0.132 (0.099) | 0.007 (0.048) | -0.354* (0.154) | -0.000 (0.018) |
| Highest edu | -0.015 (0.013) | 0.005 (0.004) | 0.017 (0.010) | -0.011 (0.006) | -0.009 (0.018) | -0.008 (0.004) |
| 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*** (0.007) | 0.000 (0.002) | 0.093*** (0.004) | -0.014*** (0.002) | 0.037*** (0.011) | -0.005** (0.002) |
| PDS | -0.051 (0.075) | 0.011 (0.023) | -0.112 (0.060) | 0.010 (0.034) | 0.133 (0.113) | -0.008 (0.024) |
| Primary Income Source | | | | | | |
| Ag-labour | 0.212* (0.088) | -0.035 (0.027) | 0.016 (0.067) | 0.063 (0.039) | 0.142 (0.108) | 0.049 (0.029) |
| Non-ag labour | -0.603*** (0.179) | 0.093 (0.058) | 0.002 (0.141) | -0.185* (0.084) | -0.548* (0.216) | -0.116 (0.062) |
| Salaried | -0.781*** (0.217) | 0.093 (0.070) | -0.082 (0.167) | -0.209* (0.101) | -0.789** (0.267) | -0.145 (0.075) |
| Other | -0.780*** (0.211) | 0.110 (0.069) | -0.095 (0.164) | -0.208* (0.099) | -0.776** (0.260) | -0.146* (0.074) |
| Ration Card | | | | | | |
| BPL | 0.096 (0.065) | -0.014 (0.020) | 0.096 (0.054) | 0.007 (0.029) | -0.063 (0.075) | 0.029 (0.021) |
| APL | 0.138* (0.056) | -0.002 (0.016) | 0.187*** (0.047) | -0.010 (0.024) | -0.017 (0.084) | 0.027 (0.018) |
| Toilet Facility | | | | | | |
| Traditional | 0.012 (0.075) | 0.038 (0.020) | 0.104* (0.050) | -0.041 (0.030) | -0.001 (0.104) | -0.034 (0.021) |
| Flush | 0.028 (0.069) | 0.029 (0.019) | 0.157** (0.049) | -0.051 (0.029) | 0.127 (0.078) | -0.028 (0.021) |
| Electricity | -0.046 (0.099) | 0.023 (0.032) | 0.142 (0.077) | -0.063 (0.045) | 0.113 (0.133) | -0.041 (0.034) |
| Land Class | | | | | | |
| 0.01-0.4 | 0.081* (0.036) | -0.014 (0.008) | 0.075*** (0.021) | -0.001 (0.012) | 0.029 (0.058) | -0.001 (0.008) |
| 0.4-1.0 | 0.175** (0.058) | -0.028* (0.014) | 0.080** (0.031) | 0.028 (0.022) | 0.104 (0.072) | 0.020 (0.015) |
| 1.0-2.0 | 0.214* (0.085) | -0.044* (0.022) | 0.038 (0.048) | 0.056 (0.034) | 0.004 (0.078) | 0.033 (0.024) |
| 2.0-4.0 | 0.196 (0.107) | -0.051 (0.026) | -0.068 (0.064) | 0.085* (0.042) | -0.089 (0.123) | 0.045 (0.031) |
| 4.0-10.0 | 0.318* (0.141) | -0.060 (0.037) | -0.047 (0.090) | 0.118* (0.058) | 0.268 (0.252) | 0.071 (0.043) |
| 10+ | 0.224 (0.217) | -0.104* (0.044) | -0.257* (0.124) | 0.154 (0.081) | 0.265 (0.502) | 0.087 (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: *Caste*: Brahmins. *Religion*: Hindu. *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

| | lnfoodexp | foodexpShr | lnrlexp | nccExp | lnefmexp | DD |
|------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| lnincRemittance | 0.025*** (0.003) | -0.002* (0.001) | 0.009** (0.003) | 0.004*** (0.001) | 0.028*** (0.005) | 0.002*** (0.000) |
| Caste | | | | | | |
| OBC | -0.008 (0.048) | 0.007 (0.012) | 0.016 (0.055) | -0.011 (0.011) | -0.311 (0.188) | -0.014* (0.006) |
| SC | -0.035 (0.052) | 0.012 (0.013) | 0.017 (0.056) | -0.019 (0.014) | -0.339 (0.183) | -0.014 (0.008) |
| ST | 0.010 (0.057) | 0.021 (0.015) | 0.057 (0.059) | -0.020 (0.014) | -0.106 (0.184) | -0.002 (0.011) |
| Others | -0.006 (0.046) | 0.011 (0.012) | 0.018 (0.050) | -0.010 (0.011) | -0.280 (0.196) | -0.012* (0.006) |
| Religion | | | | | | |
| Muslim | -0.012 (0.097) | -0.017 (0.020) | -0.170 (0.108) | 0.053 (0.029) | 0.112 (0.205) | 0.020 (0.012) |
| Sikh, etc. | -0.107 (0.079) | 0.005 (0.012) | -0.104 (0.100) | 0.007 (0.046) | -0.189 (0.145) | 0.002 (0.014) |
| Highest Edu | 0.035*** (0.002) | -0.002*** (0.000) | 0.021*** (0.002) | 0.003*** (0.000) | 0.046*** (0.004) | 0.002*** (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*** (0.003) | -0.001 (0.001) | 0.093*** (0.003) | -0.010*** (0.001) | 0.038*** (0.007) | -0.003*** (0.000) |
| PDS | 0.195*** (0.020) | -0.029*** (0.005) | -0.102*** (0.024) | 0.082*** (0.008) | 0.406*** (0.044) | 0.040*** (0.004) |
| Primary Income Source | | | | | | |
| Ag labour | -0.087*** (0.024) | 0.010 (0.006) | -0.001 (0.023) | -0.023*** (0.006) | -0.120** (0.039) | -0.008* (0.004) |
| Non-ag labour | 0.064** (0.022) | -0.006 (0.005) | 0.043 (0.023) | 0.003 (0.006) | 0.109* (0.042) | 0.012** (0.004) |
| Salaried | 0.019 (0.023) | -0.024*** (0.005) | -0.027 (0.023) | 0.015* (0.006) | 0.007 (0.052) | 0.008* (0.004) |
| Other | -0.011 (0.022) | -0.006 (0.005) | -0.050* (0.021) | 0.012* (0.005) | -0.004 (0.045) | 0.003 (0.003) |
| Ration Card | | | | | | |
| BPL | -0.120*** (0.025) | 0.017** (0.006) | 0.082** (0.031) | -0.054*** (0.007) | -0.191*** (0.056) | -0.013** (0.004) |
| APL | -0.026 (0.027) | 0.022*** (0.007) | 0.176*** (0.034) | -0.055*** (0.009) | -0.103 (0.065) | -0.004 (0.005) |
| Toilet Facility | | | | | | |
| Traditional | 0.206*** (0.030) | 0.008 (0.006) | 0.114*** (0.026) | 0.015 (0.010) | 0.074 (0.076) | 0.003 (0.003) |
| Flush | 0.242*** (0.025) | -0.004 (0.004) | 0.173*** (0.023) | 0.009 (0.005) | 0.275*** (0.052) | 0.012*** (0.003) |
| Electricity | 0.309*** (0.021) | -0.030*** (0.005) | 0.165*** (0.021) | 0.036*** (0.007) | 0.476*** (0.041) | 0.026*** (0.003) |
| Land Class | | | | | | |
| 0.04-0.1 | 0.092*** (0.024) | -0.015** (0.005) | 0.083*** (0.023) | -0.002 (0.006) | 0.042 (0.044) | -0.000 (0.003) |
| 0.1-0.4 | 0.060** (0.022) | -0.010 (0.006) | 0.080*** (0.020) | -0.009 (0.005) | 0.043 (0.049) | -0.004 (0.003) |
| 0.4-1.0 | 0.001 (0.026) | -0.013* (0.006) | 0.024 (0.025) | -0.005 (0.007) | -0.036 (0.060) | -0.008* (0.004) |
| 1.0-2.0 | -0.062 (0.033) | -0.012 (0.007) | -0.076* (0.031) | 0.008 (0.007) | -0.065 (0.091) | -0.005 (0.004) |
| 2.0-4.0 | -0.051 (0.044) | -0.005 (0.009) | -0.068 (0.047) | 0.010 (0.012) | 0.091 (0.113) | -0.000 (0.007) |
| 4.0-10.0 | -0.149 (0.092) | -0.049* (0.021) | -0.275** (0.100) | 0.044* (0.017) | 0.264 (0.246) | 0.015 (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: *Caste*: Brahmins. *Religion*: Hindu. *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)

| | (1) lnfoodexp | (2) foodexpShr | (3) lnrlexp | (4) nccexp | (5) lnfemexp | (6) DD |
|------------------------------|---------------------|----------------------|---------------------|----------------------|---------------------|---------------------|
| lnincRemittance | 0.534** (0.169) | -0.009 (0.023) | 0.227+ (0.125) | 0.059* (0.027) | 0.500+ (0.290) | -0.001 (0.017) |
| Caste | | | | | | |
| OBC | -0.102 (0.111) | 0.009 (0.014) | -0.030 (0.070) | -0.023 (0.017) | -0.522* (0.257) | -0.014* (0.007) |
| SC | -0.168 (0.131) | 0.014 (0.015) | -0.044 (0.084) | -0.034+ (0.019) | -0.615* (0.307) | -0.014 (0.009) |
| ST | -0.105 (0.143) | 0.023 (0.016) | 0.002 (0.087) | -0.034+ (0.020) | -0.334 (0.274) | -0.001 (0.012) |
| Others | -0.092 (0.102) | 0.012 (0.013) | -0.025 (0.065) | -0.021 (0.016) | -0.536* (0.267) | -0.011+ (0.006) |
| Religion | | | | | | |
| Muslim | 0.099 (0.196) | -0.019 (0.020) | -0.122 (0.137) | 0.066* (0.033) | 0.227 (0.317) | 0.020 (0.013) |
| Sikh,etc | -0.108 (0.096) | 0.005 (0.012) | -0.104 (0.130) | 0.007 (0.039) | -0.153 (0.137) | 0.002 (0.014) |
| Highest Edu | 0.052*** (0.007) | -0.002* (0.001) | 0.028*** (0.005) | 0.004*** (0.001) | 0.054*** (0.007) | 0.002* (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*** (0.013) | -0.002 (0.002) | 0.110*** (0.010) | -0.006** (0.002) | 0.077*** (0.025) | -0.003* (0.001) |
| PDS | -0.034 (0.086) | -0.026* (0.012) | -0.200** (0.066) | 0.057*** (0.015) | 0.201 (0.140) | 0.042*** (0.008) |
| Primary Income Source | | | | | | |
| Ag labour | 0.007 (0.049) | 0.009 (0.007) | 0.040 (0.034) | -0.013 (0.009) | -0.039 (0.077) | -0.009* (0.004) |
| Non-ag labour | 0.159** (0.050) | -0.007 (0.006) | 0.084* (0.035) | 0.014 (0.009) | 0.185* (0.081) | 0.011** (0.004) |
| Salary | -0.046 (0.062) | -0.023*** (0.007) | -0.054 (0.036) | 0.008 (0.009) | -0.096 (0.119) | 0.009+ (0.005) |
| Other | -0.259** (0.096) | -0.002 (0.012) | -0.155* (0.066) | -0.015 (0.014) | -0.225 (0.147) | 0.005 (0.009) |
| Ration Card | | | | | | |
| BPL | -0.034 (0.052) | 0.016* (0.007) | 0.119** (0.039) | -0.045*** (0.010) | -0.149* (0.075) | -0.013** (0.004) |
| APL | -0.018 (0.052) | 0.022*** (0.007) | 0.179*** (0.038) | -0.054*** (0.010) | -0.148 (0.097) | -0.004 (0.005) |
| Toilet Facility | | | | | | |
| Traditional | -0.010 (0.094) | 0.011 (0.010) | 0.022 (0.063) | -0.009 (0.016) | -0.056 (0.132) | 0.005 (0.008) |
| Flush | 0.084 (0.070) | -0.001 (0.007) | 0.106* (0.049) | -0.008 (0.010) | 0.089 (0.128) | 0.013* (0.006) |
| Electricity | 0.086 (0.082) | -0.027* (0.011) | 0.070 (0.061) | 0.012 (0.012) | 0.258+ (0.141) | 0.027*** (0.008) |
| Land Class | | | | | | |
| 0.01-0.4 | 0.052 (0.046) | -0.015** (0.006) | 0.067* (0.027) | -0.006 (0.008) | 0.045 (0.064) | 0.000 (0.004) |
| 0.4-1.0 | 0.072 (0.044) | -0.011+ (0.006) | 0.087** (0.028) | -0.007 (0.006) | 0.050 (0.076) | -0.004 (0.003) |
| 1.0-2.0 | 0.011 (0.049) | -0.013* (0.006) | 0.029 (0.031) | -0.004 (0.008) | -0.084 (0.085) | -0.008* (0.004) |
| 2.0-4.0 | -0.031 (0.072) | -0.012 (0.007) | -0.062 (0.044) | 0.012 (0.010) | -0.137 (0.130) | -0.005 (0.005) |
| 4.0-10.0 | -0.055 (0.095) | -0.005 (0.009) | -0.069 (0.064) | 0.010 (0.014) | -0.116 (0.203) | -0.000 (0.006) |
| 10.0+ | -0.094 (0.178) | -0.049** (0.019) | -0.250* (0.112) | 0.050+ (0.027) | -0.240 (0.679) | 0.014 (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: *Caste*: Brahmins. *Religion*: Hindu. *Primary Income Source*: Cultivator. *Ration Card Type*: AAY. *Toilet*: No Toilet.*Land Class*: 0-0.01 hectares.

MPCE refers to Monthly per capita expenditure.

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. Though diversification into non-farm employment avenues have always been an integral part of rural livelihood strategy, the extent of diversification increases as a country goes through economic transition and the share of agricultural output declines. Recent experience suggests that non-farm income is increasingly important to sustain Indian 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 (16). 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 profitability. 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".⁴ (17) have shown that income from cultivation alone will be inadequate for increasing farmer's income. Policy should aim at increasing income from other non-farm sources to ensure the financial viability of farm households.

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 does 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, our 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.

⁴See <http://indianexpress.com/article/india/india-news-india/farm-incomes-dreaming-to-double-2939405/>.

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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. (9) 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. (2) 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.

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

| | (1) lnfoodexp | (2) foodexpShr | (3) lnclrlxp | (4) nccexp | (5) lnefmexp | (6) DD |
|------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| lnincNonFarm | 0.316*** (0.033) | -0.014* (0.006) | 0.188*** (0.028) | 0.029*** (0.008) | 0.456*** (0.072) | 0.015*** (0.003) |
| Caste | | | | | | |
| OBC | -0.018 (0.084) | 0.008 (0.012) | 0.007 (0.065) | -0.012 (0.014) | -0.299 (0.286) | -0.015* (0.006) |
| SC | -0.025 (0.091) | 0.011 (0.013) | 0.018 (0.071) | -0.018 (0.015) | -0.284 (0.288) | -0.014 (0.009) |
| ST | -0.029 (0.104) | 0.023 (0.014) | 0.030 (0.079) | -0.024 (0.016) | -0.199 (0.301) | -0.003 (0.011) |
| Others | -0.003 (0.077) | 0.011 (0.012) | 0.015 (0.060) | -0.010 (0.012) | -0.222 (0.283) | -0.012 (0.006) |
| Religion | | | | | | |
| Muslim | 0.001 (0.145) | -0.018 (0.020) | -0.161 (0.147) | 0.054* (0.027) | -0.061 (0.265) | 0.021 (0.013) |
| Sikh | -0.125 (0.078) | 0.005 (0.013) | -0.115 (0.106) | 0.005 (0.046) | -0.320* (0.153) | 0.001 (0.014) |
| Highest edu | -0.005 (0.005) | -0.000 (0.001) | -0.002 (0.004) | -0.001 (0.001) | -0.018 (0.011) | -0.000 (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*** (0.005) | -0.001 (0.001) | 0.088*** (0.004) | -0.011*** (0.001) | 0.039*** (0.012) | -0.003*** (0.000) |
| PDS | 0.004 (0.036) | -0.021** (0.006) | -0.220*** (0.031) | 0.065*** (0.010) | 0.102 (0.091) | 0.031*** (0.005) |
| Primary Income Source | | | | | | |
| Ag-labour | 0.141*** (0.042) | 0.000 (0.008) | 0.136*** (0.034) | -0.002 (0.009) | 0.162* (0.076) | 0.003 (0.005) |
| Non-ag labour | -0.472*** (0.063) | 0.019 (0.011) | -0.274*** (0.053) | -0.047*** (0.014) | -0.647*** (0.134) | -0.014* (0.007) |
| Salaried | -0.619*** (0.078) | 0.005 (0.013) | -0.406*** (0.065) | -0.044** (0.016) | -0.893*** (0.171) | -0.022** (0.008) |
| Other | -0.630*** (0.074) | 0.022 (0.012) | -0.422*** (0.062) | -0.045** (0.016) | -0.905*** (0.161) | -0.026*** (0.008) |
| Ration Card | | | | | | |
| BPL | 0.051 (0.033) | 0.010 (0.006) | 0.185*** (0.033) | -0.039*** (0.008) | -0.041 (0.074) | -0.005 (0.005) |
| APL | 0.108** (0.036) | 0.016* (0.007) | 0.254*** (0.036) | -0.043*** (0.009) | 0.007 (0.089) | 0.002 (0.006) |
| Toilet | | | | | | |
| Traditional | 0.049 (0.045) | 0.015* (0.006) | 0.018 (0.033) | 0.001 (0.011) | -0.021 (0.102) | -0.004 (0.004) |
| Flush | 0.067* (0.033) | 0.004 (0.005) | 0.066* (0.026) | -0.007 (0.007) | 0.098 (0.065) | 0.004 (0.004) |
| Electricity | 0.031 (0.042) | -0.018* (0.007) | -0.003 (0.034) | 0.011 (0.011) | 0.052 (0.095) | 0.013** (0.005) |
| Land Class | | | | | | |
| 0.01-0.4 | 0.080** (0.029) | -0.015** (0.006) | 0.076** (0.025) | -0.002 (0.006) | 0.036 (0.063) | -0.001 (0.004) |
| 0.4-1.0 | 0.147*** (0.035) | -0.014* (0.006) | 0.134*** (0.026) | -0.001 (0.006) | 0.111 (0.073) | 0.000 (0.003) |
| 1.0-2.0 | 0.155*** (0.044) | -0.020** (0.007) | 0.117** (0.036) | 0.009 (0.008) | -0.017 (0.083) | -0.001 (0.004) |
| 2.0-4.0 | 0.126* (0.059) | -0.020* (0.008) | 0.038 (0.044) | 0.026** (0.010) | -0.095 (0.134) | 0.004 (0.005) |
| 4.0-10.0 | 0.231** (0.078) | -0.018 (0.011) | 0.103 (0.063) | 0.037* (0.015) | 0.271 (0.264) | 0.013 (0.009) |
| 10+ | 0.134 (0.153) | -0.061** (0.020) | -0.102 (0.108) | 0.070** (0.024) | 0.237 (0.543) | 0.028 (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: *Caste*: Brahmins. *Religion*: Hindu. *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)

| | (1) lnfoodexp | (2) foodexpShr | (3) lnrlexp | (4) nccexp | (5) lnfmxexp | (6) DD |
|------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| lnincNonFarm | 0.297*** (0.038) | -0.012 (0.007) | 0.202*** (0.028) | 0.018** (0.005) | 0.421*** (0.035) | 0.008*** (0.002) |
| Caste | | | | | | |
| OBC | -0.017 (0.080) | 0.008 (0.012) | 0.006 (0.067) | -0.011 (0.012) | -0.299 (0.275) | -0.014* (0.006) |
| SC | -0.025 (0.087) | 0.011 (0.013) | 0.018 (0.073) | -0.018 (0.014) | -0.287 (0.276) | -0.014 (0.008) |
| ST | -0.027 (0.099) | 0.023 (0.014) | 0.028 (0.081) | -0.022 (0.015) | -0.190 (0.289) | -0.002 (0.011) |
| Other | -0.003 (0.074) | 0.011 (0.012) | 0.015 (0.062) | -0.010 (0.011) | -0.226 (0.273) | -0.012* (0.006) |
| Religion | | | | | | |
| Muslim | -0.001 (0.139) | -0.018 (0.020) | -0.160 (0.152) | 0.054* (0.027) | -0.048 (0.254) | 0.020 (0.012) |
| Sikh, etc. | -0.124 (0.077) | 0.005 (0.013) | -0.116 (0.106) | 0.006 (0.046) | -0.310* (0.149) | 0.001 (0.014) |
| Highest edu | -0.003 (0.005) | -0.001 (0.001) | -0.004 (0.004) | 0.000 (0.001) | -0.013 (0.007) | 0.001 (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*** (0.005) | -0.001 (0.001) | 0.088*** (0.004) | -0.011*** (0.001) | 0.039*** (0.011) | -0.003*** (0.000) |
| PDS | 0.016 (0.038) | -0.022*** (0.006) | -0.229*** (0.033) | 0.072*** (0.009) | 0.126 (0.073) | 0.036*** (0.004) |
| Primary Income Source | | | | | | |
| Ag-labour | 0.127** (0.045) | 0.002 (0.007) | 0.146*** (0.035) | -0.011 (0.007) | 0.140* (0.062) | -0.002 (0.004) |
| Non-ag labour | -0.440*** (0.072) | 0.015 (0.012) | -0.298*** (0.054) | -0.028* (0.011) | -0.589*** (0.077) | -0.003 (0.005) |
| Salaried | -0.581*** (0.087) | -0.000 (0.015) | -0.434*** (0.064) | -0.021 (0.012) | -0.824*** (0.103) | -0.009 (0.006) |
| Other | -0.593*** (0.083) | 0.017 (0.013) | -0.451*** (0.061) | -0.022 (0.012) | -0.835*** (0.090) | -0.013* (0.005) |
| Ration Card | | | | | | |
| BPL | 0.041 (0.036) | 0.011 (0.007) | 0.193*** (0.035) | -0.045*** (0.008) | -0.053 (0.072) | -0.009* (0.004) |
| APL | 0.100** (0.038) | 0.017* (0.007) | 0.260*** (0.038) | -0.048*** (0.009) | -0.001 (0.087) | -0.001 (0.005) |
| Toilet Facility | | | | | | |
| Traditional | 0.059 (0.046) | 0.014* (0.007) | 0.010 (0.035) | 0.007 (0.010) | -0.013 (0.099) | -0.000 (0.004) |
| Flush | 0.078* (0.035) | 0.003 (0.005) | 0.058* (0.027) | -0.000 (0.006) | 0.112 (0.063) | 0.008** (0.003) |
| Electricity | 0.048 (0.044) | -0.020** (0.007) | -0.015 (0.037) | 0.022** (0.008) | 0.086 (0.067) | 0.019*** (0.004) |
| Land Class | | | | | | |
| 0.01-0.4 | 0.080** (0.028) | -0.015** (0.005) | 0.076** (0.026) | -0.002 (0.006) | 0.037 (0.060) | -0.000 (0.003) |
| 0.4-1.0 | 0.142*** (0.032) | -0.014* (0.006) | 0.138*** (0.027) | -0.004 (0.005) | 0.106 (0.068) | -0.001 (0.003) |
| 1.0-2.0 | 0.146*** (0.043) | -0.019** (0.007) | 0.124*** (0.037) | 0.003 (0.007) | -0.019 (0.078) | -0.004 (0.003) |
| 2.0-4.0 | 0.115* (0.057) | -0.019* (0.009) | 0.046 (0.048) | 0.019* (0.008) | -0.092 (0.126) | 0.000 (0.005) |
| 4.0-10.0 | 0.215** (0.075) | -0.016 (0.011) | 0.116 (0.066) | 0.026 (0.013) | 0.258 (0.250) | 0.007 (0.007) |
| 10+ | 0.118 (0.138) | -0.059** (0.020) | -0.089 (0.109) | 0.060** (0.020) | 0.241 (0.516) | 0.022 (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: *Caste*: Brahmins. *Religion*: Hindu. *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

| | (1) lnfoodexp | (2) foodexpShr | (3) lnrclexp | (4) nccExp | (5) lnefmexp | (6) dd |
|-----------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| lnincSalaryPrime | 0.114*** (0.010) | −0.008* (0.003) | 0.062*** (0.013) | 0.012** (0.004) | 0.177*** (0.022) | 0.009*** (0.002) |
| lnincBusinessPrime | 0.122*** (0.010) | −0.009** (0.003) | 0.071*** (0.010) | 0.011*** (0.003) | 0.173*** (0.019) | 0.012*** (0.002) |
| lnincNonAgWagePrime | 0.086*** (0.007) | 0.003 (0.002) | 0.054*** (0.008) | 0.006* (0.002) | 0.101*** (0.017) | 0.005*** (0.001) |
| lnincGovtBenefitPrime | 0.065*** (0.010) | −0.004* (0.002) | 0.037*** (0.011) | 0.007*** (0.002) | 0.140*** (0.016) | 0.004** (0.001) |
| lnincRemittancePrime | 0.053*** (0.010) | 0.001 (0.003) | 0.049*** (0.013) | −0.003 (0.004) | 0.077** (0.023) | 0.000 (0.002) |
| lnincOtherPrime | 0.055** (0.018) | 0.002 (0.003) | 0.048** (0.016) | 0.001 (0.003) | 0.052 (0.034) | 0.004* (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 caste, religion, highest education in the household, MPCPE, 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*** (-6.00) | -0.0486*** (-6.00) | -0.0481*** (-5.94) | -0.0435*** (-3.76) | -0.0481*** (-5.94) | -0.0486*** (-6.00) |
| F-statistics | 20.41 | 20.41 | 20.31 | 13.75 | 20.32 | 20.41 |
| Share non-agri | 15.37*** (24.11) | 15.37*** (24.11) | 15.32*** (23.96) | 15.40*** (16.45) | 15.31*** (23.95) | 15.37*** (24.11) |
| F-statistics | 581.2 | 581.2 | 574.3 | 270.7 | 573.5 | 581.2 |
| Nightlights | 40.71*** (24.39) | 40.71*** (24.39) | 40.62*** (24.31) | 93.00*** (24.46) | 40.61*** (24.31) | 40.71*** (24.39) |
| F-statistics | 594.7 | 594.7 | 591.2 | 598.2 | 590.7 | 594.7 |

Household-level controls include caste, religion, highest education 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*** (6.66) | 0.234*** (6.66) | 0.239*** (6.78) | 0.228*** (4.46) | 0.239*** (6.78) | 0.234*** (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 In-strumented | 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 (cor-related with remittances) parents of hh head or the spouse were migrants (cor-related 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 |

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