WP-2019-042

Commercialization, Diversification and Structural Determinants of Farmers' Income in India

Varun Kumar Das and A. Ganesh-Kumar

Indira Gandhi Institute of Development Research, Mumbai
December 2019

Commercialization, Diversification and Structural Determinants of Farmers' Income in India

Varun Kumar Das and A. Ganesh-Kumar

Email(corresponding author): varun@igidr.ac.in

Abstract

This paper examines the effect commercialization (sale ratio, market transaction, co-operative sale), and diversification (crop, animal husbandry, and non-farm diversification) may have on farmers' income. In investigating so, this paper takes into account the structural factors which could also affect farmers' income. The results show that increasing diversification (crop and non-farm diversification), and increasing commercialization in terms of ratio of crop sold, number of transactions that farmers undertake in crop and animal husbandry markets, and selling of crops to mandis, co-operative and government agency, could improve farmers' income. These findings substantiates the policy suggestions made by Dalwai Committee Report 2018 with regard to commercialization and diversification as important policy instruments for raising of farmers' income.

Keywords: Commercialization, market transaction, diversification, farmers' income

JEL Code: L25, Q12, Q15, Q18

Commercialization, Diversification and Structural Determinants of Farmers' Income in India

Varun Kumar Das[1] *A. Ganesh-Kumar*[2]

Abstract

This paper examines the effect commercialization (sale ratio, market transaction, co-operative sale), and diversification (crop, animal husbandry, and non-farm diversification) may have on farmers' income. In investigating so, this paper takes into account the structural factors which could also affect farmers' income. The results show that increasing diversification (crop and non-farm diversification), and increasing commercialization in terms of ratio of crop sold, number of transactions that farmers undertake in crop and animal husbandry markets, and selling of crops to *mandis*, co-operative and government agency, could improve farmers' income. These findings substantiates the policy suggestions made by Dalwai Committee Report 2018 with regard to commercialization and diversification as important policy instruments for raising of farmers' income.

Keywords: Commercialization, market transaction, diversification, farmers' income

JEL classification: L25, Q12, Q15, Q18

[1] PhD student, Indira Gandhi Institute of Development Research, Mumbai. Email: varun@igidr.ac.in
[2] Professor, Indira Gandhi Institute of Development Research, Mumbai. Email: agk@igidr.ac.in

1 Introduction

"Doubling of Farmers' Income" by the year 2022 is a stated policy agenda of the Government of India, following the announcement by the Prime Minister of India on 28th February 2016. Shortly thereafter, on 13th April 2016, the Government of India set up an inter-ministerial "Committee on Doubling Farmers' Income", under the chairmanship of Mr. Ashok Dalwai in order to prepare a framework for formulating policies for doubling of farmers' income by 2022.

The announcement by the Prime Minister represents a major shift in agricultural policies in the country, away from farm output (tonnage) to farmers' livelihood / income. Since Independence in 1947, agricultural policies over the decades have largely been aimed at achieving food security, a historic necessity in an economy suffering chronic food-shortage. The Green Revolution and all its associated policies and instruments were focused on measures that would directly / indirectly help improve crop yield levels and hence output. By and large these output-focused policies have been successful and the country is today net-surplus in major staples. The sweeping change in policy focus following the Prime Minister's announcement in 2016 has, not surprisingly, attracted a lot of public debate and academic scrutiny. Opinions have been divided as to the feasibility of achieving this target within the specified time frame (Chandrasekhar and Mehrotra 2016; NAAS 2016; Chand 2017; Birthal et al. 2017; Gulati and Saini 2016).

Chandrasekhar and Mehrotra (2016) observe that while farmers' income grew in all states during the last decade, it doubled only in the state of Odisha. Gulati and Saini (2016) point out that for farmers' income to double by 2022 agricultural GDP has to grow at a rate of 12% per annum, which has not happened historically. They also mention that this objective would require raising both agricultural productivity and rural non-farm employment. The study by NAAS (2016) delved into the potential and constraints to doubling farmers' income across diverse dimensions. It identifies inadequate public and private investments in the sector as a critical constraint to improving productive capacity in agriculture. Further it states that both input and output markets are subject to various institutional limitations resulting in asymmetries in market power wherein farmers are at a disadvantage vis-à-vis both input companies and output traders. Other important constraints include weak linkages in agricultural marketing chains between farmers and consumers and between farm and non-farm sectors including agro-processing sectors; difficulties in accessing frontier / proprietary technologies that could bridge the productivity gap; and low levels of farm mechanisation. Chand (2017), while acknowledging that achieving the target of doubling of farmers' income by 2022 will be a challenge, argues that a significant growth in the use of quality seeds, fertilizer, power supply, and expansion of irrigation network can help in this regard. Birthal et al. (2017) argue that policy of doubling of farmers' income should first of all identify low-income farmers, and try to reduce the pressure on land by reducing the excessive dependence on agriculture as a source of employment. They suggest land size as a possible criterion for identifying low income farmers and expansion of rural non-farm sector as a means to reduce the pressure on land.

Amidst this debate, the Committee on Doubling Farmers' Income submitted its report in 14 volumes to the Government in September 2018[3] (henceforth, the Dalwai Committee Report or DCR-2018). The Report presents a comprehensive assessment of various issues that impinge upon farmers' income directly / indirectly. These include farm level issues pertaining to soil health, seed quality, irrigation and water management, use of fertilizer and organic manure, pest and weed management, farm mechanization and farm labour productivity, post-harvest management and storage, risks arising from climate change and extreme events, marketing and commercialization issues, supply chain and agro-processing, agricultural research and extension, investments in agriculture specific and general infrastructure, agricultural credit and insurance, and so on.

Many of the recommendations of DCR-2018 pertain to factors that are clearly beyond farmers' control and are structural in nature. From among the several recommendations of DCR-2018, two in particular stand out as they essentially relate to the degree of structural transformation within agriculture. First is the emphasis on commercialization of agriculture for higher returns. The Report notes that market linked farming and market expansion would help in raising farmers' income. Second is the stress on diversification, both on- and off-farm, as a strategy for enhancing farmers' income. The Report notes that diversification towards high value products, such as horticulture and livestock, has tremendous potential for accelerating income growth for farmers, helps in value addition, adaptability to changing market trends, provides linkages for food processing, and food supply chain and marketing. The Report also stresses that due attention should be given to employment opportunities near-farm and in non-farm economic activities for farmers for raising their income.

Here one must note that while the focus of the DCR-2018 and the above mentioned studies is on farmers' income, much of their analysis and recommendations are largely in the domain of agriculture covering crops and animal husbandry even as they recognize the importance of non-farm activities as a source of employment and income for farming households. More critically, the recommendations of DCR-2018 (and various other studies mentioned above), while eminently sensible, are nevertheless not backed by adequate analysis that establish which among the various factors matter for farmers' income and how? Indeed, the literature on the determinants of farmers' income is itself very sparse. The few existing studies have examined the relationship between farmers' income with select factors. For instance, Birthal et al. (2015) find that crop diversification has a major role in alleviating rural poverty. Kishore et al. (2016), mention that diversification into dairying has become an important activity for small holder farmers in India.

In this study, we address the question "how do commercialization, diversification and various other beyond-the-farm structural factors stressed in DCR-2018 affect farmers' income?" Here, we build upon our earlier analysis wherein we had explored the role of farm size and diversification in influencing farmers' income (Das and Ganesh-Kumar, 2018). In that study, we had argued that analytically a distinction has to be made between "farm income" and "farmer's income". Farm income refers essentially to the returns to farming earned by a farmer household, through the implicit wages that they receive by working on their farm and any surplus that they receive by selling their farm produce after paying out for purchased inputs including hired labour and farm machine rentals. Such farm income can arise from crop cultivation and/or animal husbandry operations.

[3] http://agricoop.nic.in/doubling-farmers, last accessed on July 26, 2019

Farmer's income, however, is a larger concept that would include "non-farm income" (wages and salaries from non-farm sectors, and/or non-farm entrepreneurial income) and "transfer payments" received by the farmer household (such as pension, remittances). In order to assess the livelihood situation of farmers and the policy options to double farmers' income, one needs to understand the determinants of farmers' income as opposed to farm income.

Against this background, using data from the 70th Round National Sample Survey Office (NSSO), Situation Assessment Survey (SAS) for the agricultural year 2012-13, and combining it with information on several structural variables drawn from Census and other data sources, we examine the effect of commercialization, and diversification (crops, animal husbandry, and non-farm) on farmers' income *per capita*. We estimate linear regression models separately for the two seasons – Visit 1 and Visit 2. In doing so, we control for the structural features of the economy at the village, district and state levels.

The rest of this paper is structured as follows: Section 2 describes the data used in the study their sources and provides some summary statistics on the various variables of interest in this analysis. Section 3 discusses the empirical model specification and the estimation strategy. Section 4 reports the estimation results. Section 5 concludes the paper.

2 Data: Source, measurement and summary

As mentioned above, the primary data used in this study is the data on agricultural households from the 70th round National Sample Survey Office (NSS), Situation Assessment Survey (SAS) for the agricultural year July 2012 to June 2013[4]. The NSS 70th Round defines an "agricultural household" as one (i) receiving value of produce equal to or greater than ₹3000/- from agricultural activities (cultivation of crops, animal husbandry, poultry, fishing, etc.) during the last 365 days, and (ii) with at least one member of the household self-employed in agriculture either in principal status or in subsidiary status. The survey is canvassed in two visits. Visit 1 is canvassed for *kharif* season from July–December 2012, while Visit 2 is canvassed for the *rabi* season January–June 2013. It surveyed 34,907 agricultural households in both the two visits for the period July 2012 to June 2013. NSS provides information on various farm and household level characteristics.

The NSS data provides information on the farm and household characteristics of the households. It does not report any information on structural features of the village or district or district where the agricultural household resides. Indeed, it does not report the identity of the villages from where the sample has been drawn. However, it reports the identity of the district and state where the household resides. Hence, to bring in information on the structural characteristics of the place where the farm household resides, we combine the NSS data with district and state-level information from Census 2011 and other statistical sources (discussed later in this section). Since most of the structural variables considered here at the district-level, our analysis is limited to only those districts for which full set of information is available for all the structural variables. Hence, for

[4] Though a similar survey was conducted in its 59th round NSS survey (2002-2003), a change in the definition of agricultural household renders the 59th and 70th round incomparable. See Chapter 5, Instruction Manual, 70th round NSSO (2014).

this reason our study considers only 28,917 farm households, covering 20 major states for which data on structural variables are available. This covers around 85 per cent of the districts in India.

Farmers' income: Assessing farmers' income requires information on income from both on-farm and non-farm activities. But, there is no direct source of data on farmers' income in India. However, the 70th round NSS SAS provides data on returns from sale of crops and animal husbandry products. It also provides expenditure incurred on crop cultivation and rearing of animal husbandry. Thus, this allows estimating the aggregate net farm income (sales revenue less paid out cost) component of the household. The NSS data also provides information on wage earnings of household members by engaging in non-farm activities and net-receipt from engaging in non-farm businesses / entrepreneurship. This gives the non-farm income component of the household. Together with farm income, this gives the total farmers' income of the household[5]. Table 1 reports the income estimates for the two visits. The average crop incomes are ₹25085.59 and ₹ 4665.03 in Visit 1 and Visit 2, respectively, with average annual income at ₹9750.62. Average animal husbandry income is ₹6610.02 in Visit 1 and ₹2283.52 in Visit 2. The average annual animal husbandry income is around ₹8893.53. The average non-farm income in Visit 1 and Visit 2 are ₹17656.61 and ₹20617.37, respectively. Average annual non-farm income is ₹38273.98. The average total income from all sources are ₹49352.23, ₹37565.92 and ₹86918.14, in Visit 1, Visit 2 and annually, respectively.

Table 1: Income estimates (₹)

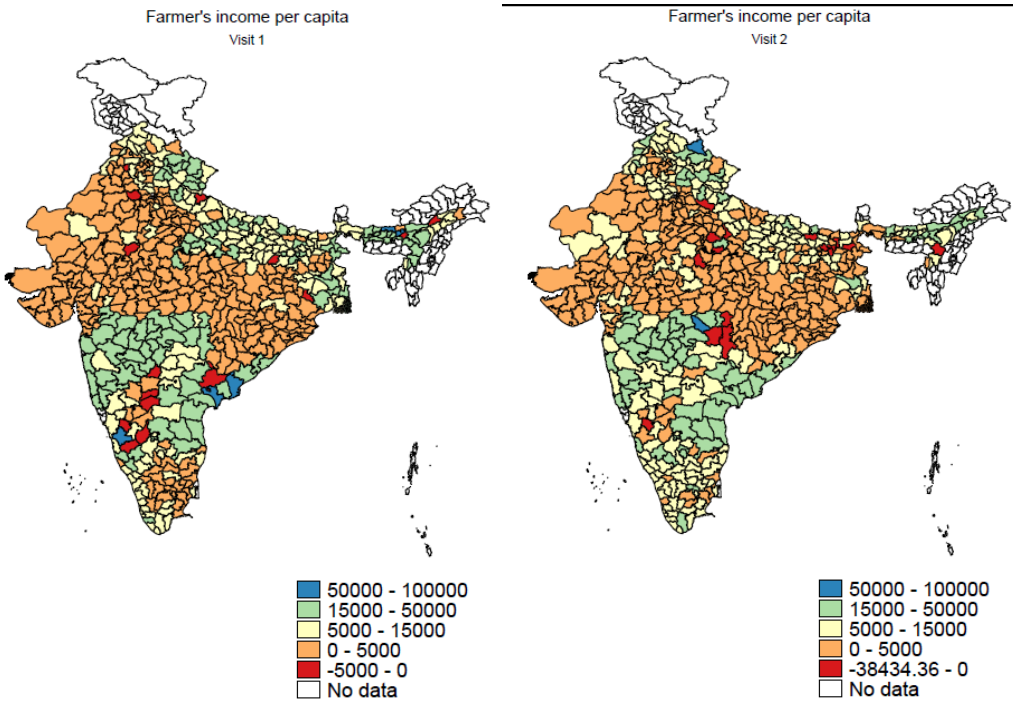
	Farm income			Non-farm income	Total income
	Crop	Animal husbandry	Total		
			Visit 1		
Average	25085.59	6610.02	31695.62	17656.61	49352.23
Standard deviation	158319.2	54580.94	168075.9	53737.91	177174.6
Minimum	-1814755	-2396490	-2411530	-1459000	-2405530
Maximum	11089460	2834100	11089580	2250000	11089580
			Visit 2		
Average	14665.03	2283.52	16948.54	20617.37	37565.92
Standard deviation	97576.79	27434.82	101469.3	84613.18	130977
Minimum	-2447250	-87000	-2447250	-9600000	-9519460
Maximum	4145600	3025020	4145600	3040500	4187600
			Visit 1 + Visit 2		
Average	39750.62	8893.53	48644.16	38273.98	86918.14
Standard deviation	188300.2	61241.27	198890.8	101847.6	223954.4
Minimum	-2384700	-2394090	-2413730	-9582000	-9513550
Maximum	11122210	3030840	11122330	3130860	11129230

Source: Authors' calculation based on NSS data.

[5] This estimate of the total farmer's income is nevertheless an underestimate as it does not include transfer payments received by the household. The NSS SAS does not report on earnings from remittances, pensions, transfers, etc.

In this study, farm household's total income *per* capita is considered. On an average, during Visit 1 the mean total income *per capita* of a farm household is ₹11253.5 (Table 2). During Visit 2, the mean total income per capita is ₹8946.4. However, there is wide variation in farmer's income per capita over Visit and space. Figure 1 shows district averages of farmer's income for each Visit 1 and Visit 2. The figures show that most of the districts with low farmers' income are clustered in parts of Central and western India. Most of the districts with high farmer's income are in the states of Maharashtra and Andhra Pradesh. This shows that there is wide variation in farmer's income over time and space.

Figure 1: District average farmers' income per capita.



Source: Authors' calculation.

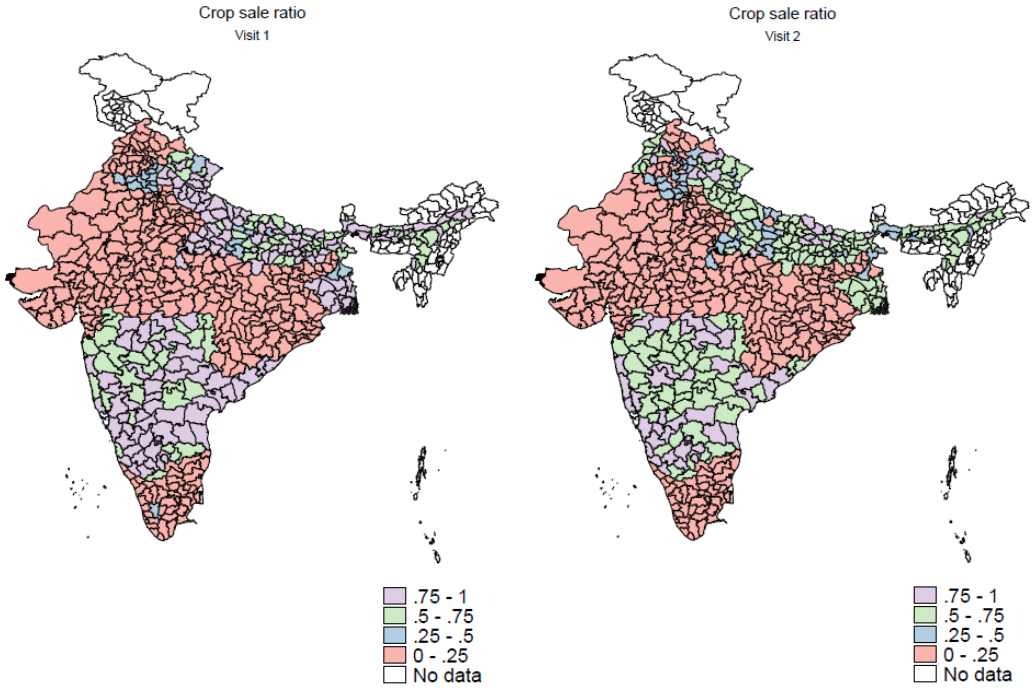
Commercialization: For each farm household, the NSS records (i) up to 5 different types of crops grown during each visit; and (ii) details of quantity and agency of sale of at most 4 types of crops. For each crop sold, NSS reports up to 3 major and 1 "other" sales transactions. With regard to agency of sale, NSS considers 6 different agencies, viz., local private, *mandis*, input dealers, cooperative / government agency, processors, and others. Using this information, we construct 3 measures of commercialization as follows: (a) ratio of number of crops sold to number of crops cultivated; (b) count of the number of sale transactions of crops and animal husbandry products carried out by the farm household; and (c) count of the number of crops and animal husbandry products sold at *mandis*, co-operative and government agencies (MCG). Table 2 reports the variable notations, their definitions and summary statistics of these three measures of commercialization and various other farm and household characteristics for the two visits.

It is seen that on an average, per household, ratio of crop sold to crop cultivated is 0.43 in Visit 1 and 0.36 in Visit 2. Total number of crop transactions is on an average 0.88 in Visit 1 and 0.77 in Visit 2. Around 0.67 average number of animal husbandry products were sold during Visit 1 and 0.63 were sold during Visit 2. Number of crops sold at *mandis*, co-operative and government agencies were on

an average 0.27 during Visit 1 and 0.23 during Visit 2. Similarly, number of animal husbandry produce sold at *mandis*, co-operative and government agencies were on an average 0.04 during Visit 1 and Visit 2.

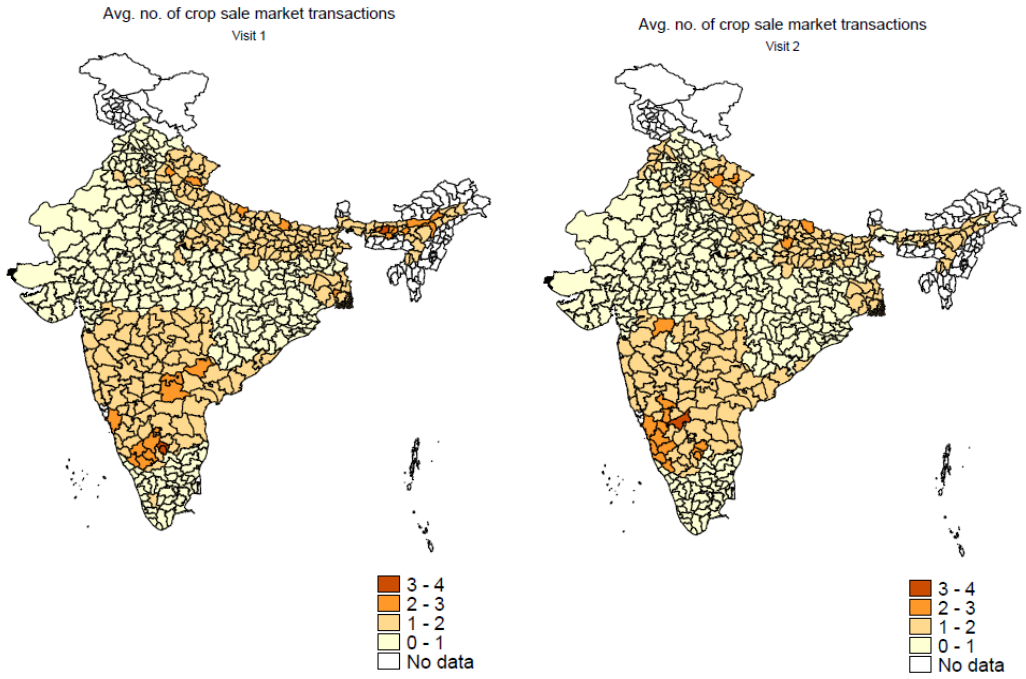
As with income, there is wide variation in different aspects of agricultural commercialization across regions and visits. Figure 2 shows variation in district average crop sale ratio across different districts in India over the two visits. High district average crop sale ratio is mostly concentrated to certain regions such as Maharashtra, Karnataka, Andhra Pradesh and Telangana. Similarly, district average numbers of crop and animal husbandry market transactions are mostly in these regions (Figure 3 and 4). There is hardly any variation in district average number of crops and animal husbandry products sold at *mandis*, co-operative and government agencies (Figure 5 and 6). All these figures present variation in district averages of commercialization. However, it is to be noted that there is still wide variation among households in commercialization within a village or a district.

Figure 2: District average crop sale ratio.



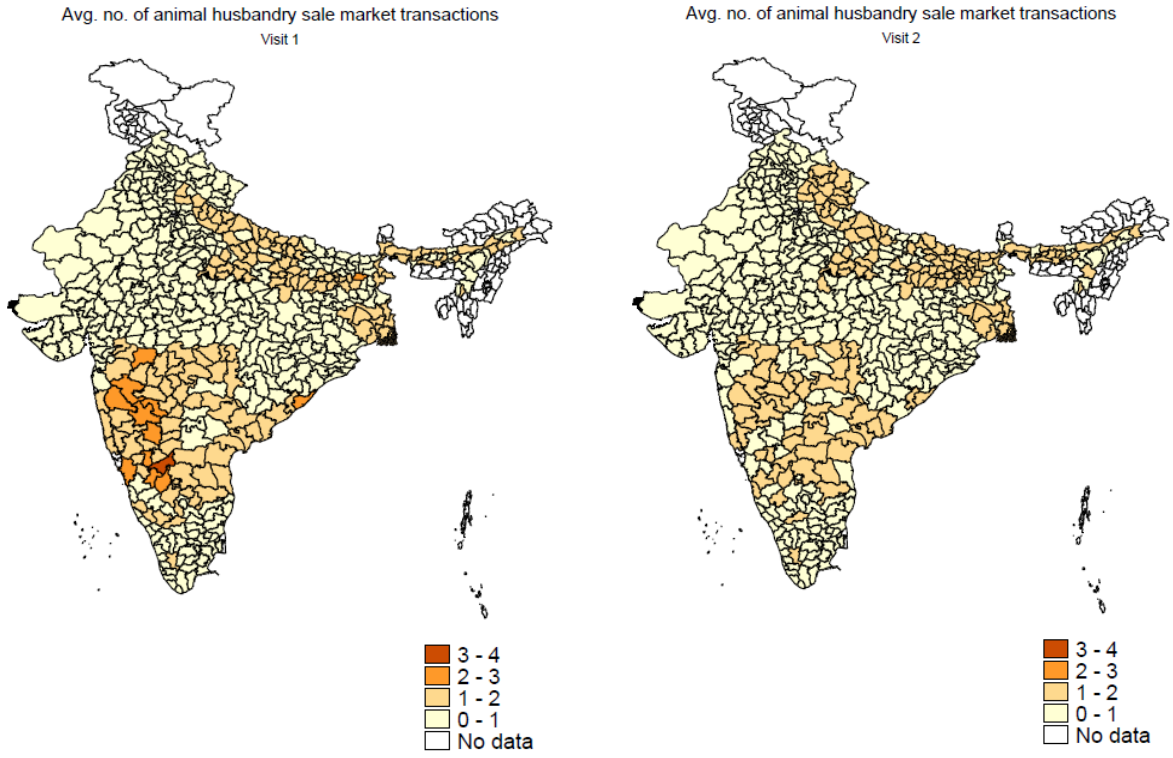
Source: Authors' calculation.

Figure 3: District average number of crop sale market transactions.



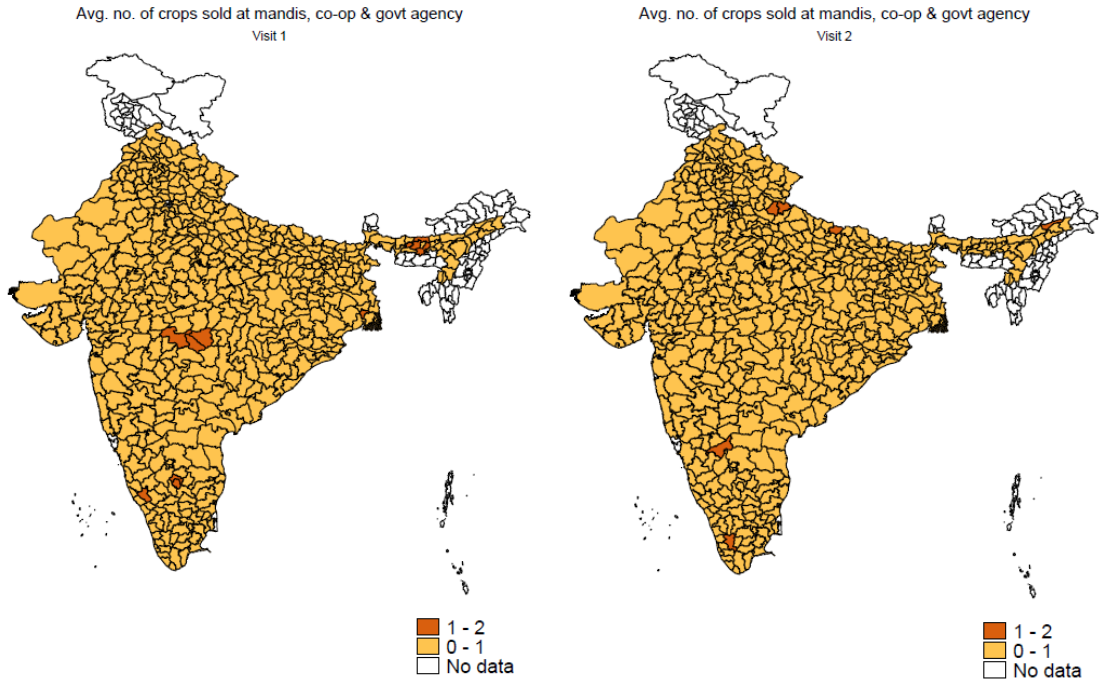
Source: Authors' calculation.

Figure 4: District average number of animal husbandry sale market transactions



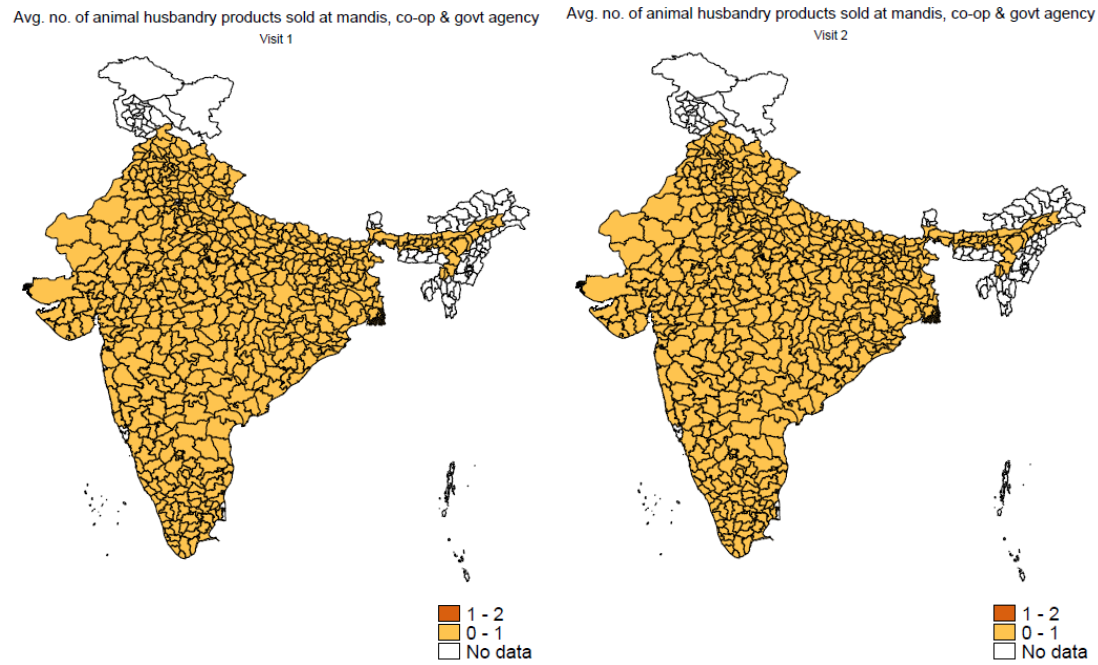
Source: Authors' calculation.

Figure 5: District average number of crop sold at mandis, co-operative and govt. agency.



Source: Authors' calculation.

Figure 6: District average number of animal husbandry products sold at mandis, co-operative and govt. agency.



Source: Authors' calculation.

Diversification: In the literature, diversification is typically measured using diversification indices such as the Simpsons index, Herfindhal index, etc. Such methods use output or land shares to compute diversification index. Using land shares one can measure the extent of "crop

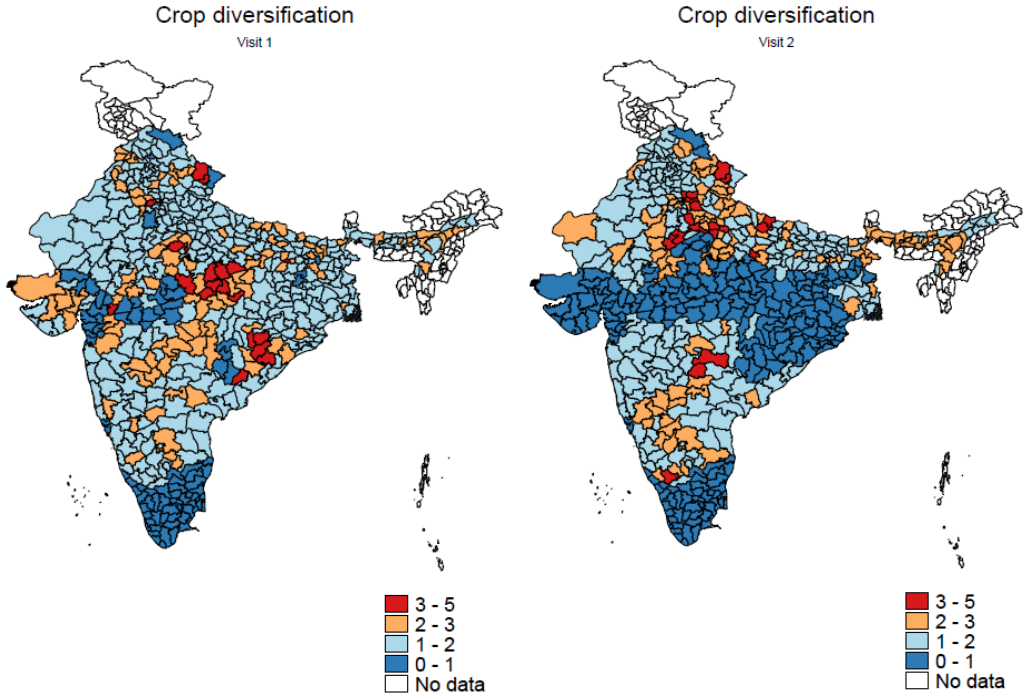
diversification" alone, but no the full extent of on-farm diversification, which involves animal husbandry as well. Using the value of output shares one can measure on-farm diversification through the Simpson / Herfindhal indices. However, value shares may not truly reflect the relative intensity of input or resource use. For instance, the labour use shares of various crops and animal husbandry activities are known to be quite different from their value of output shares. Therefore, in this study diversification, diversification is measured using the count method. Count method brings out the competitive claims on labour time as a resource, regardless of scale of operation.[6] Accordingly, we use three count measures of diversification in this study, viz., crop count, animal husbandry count, and non-farm count.

From Table 2 it is seen that approximately, households grew around 2 crops in Visit 1 and 1 crop in Visit 2. They were engaged on an average in 1 animal husbandry activity during both Visit 1 and Visit 2. Households were engaged on an average in 1 non-farm activity in Visit 1 and Visit 2. On an average, the total land of a farm household is reported to be around 1.58 hectare. Around 44% of farm household's land is under irrigation. On an average, around 50% of households report to have outstanding formal credit. About 68% of households employ hired farm labor in Visit 1, and this falls to 53% during Visit 2. 73% and 54% of farm households use fertilizers in Visit 1 and Visit 2, respectively

There is variation in climatic and geographic conditions across districts in India. Depending on the availability of rainfall, irrigation, agro-climatic conditions, and other resources, diversification pattern changes across districts and over the two seasons. Figure 7 shows the variation in district average crop diversification across districts in the two visits. Though there is some degree of high crop diversification in Visit 1, it significantly falls during the Visit 2. However, for animal husbandry diversification there is not much of a change in pattern across districts or visits (Figure 8). Similarly, district average non-farm diversification levels are also low, and there is hardly any variation across the two visits (Figure 9). These figures present a district average pattern of diversification (crop, animal husbandry and non-farm). But, there is still variation in household level diversification pattern within a village or within a district.

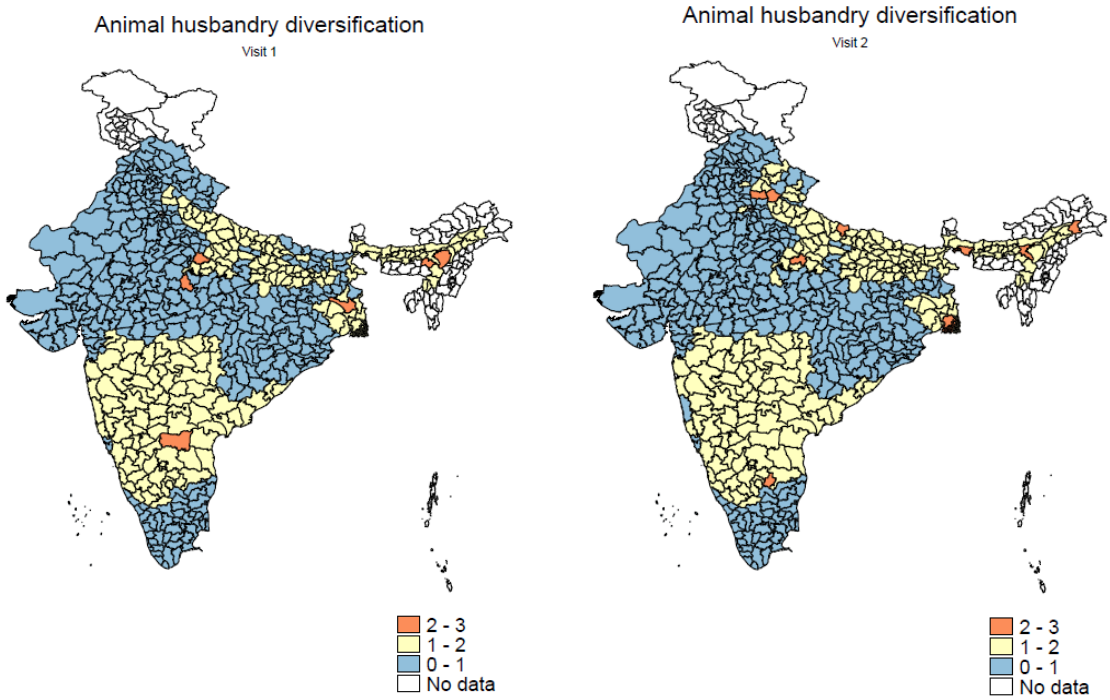
[6] A generic criticism of the count method is that it gives uniform weight to all items. One possible way to get around this limitation is to adopt a weighted-count measure. However, it is not evident what the weights should be. Using value of output of individual items or land shares as weights may not appropriate for reasons explained in the main text. Hence, we continue to use the simple (un-weighted) count as the measure of diversification. Even while we recognize its limitation, we believe that in the context of our study focusing on the determinants of farmers' income this may not be a major problem. Note that the farm and the non-farm components of income as measured here are really net-returns (net of paid out costs for purchased inputs) to those activities respectively. However, these estimates of net-returns do not account for farmers' time as a resource. We believe that the opportunity cost of time as a resource spent on a particular activity (regardless of the scale of its operation) can affect the managerial effectiveness of the farmer in other activities, and hence the productivity levels and net-returns of various items. Our central argument in favour of the (un-weighted) count method is precisely that it captures this opportunity cost of time as a resource regardless of the scale of operation of individual items.

Figure 7: District average crop diversification.



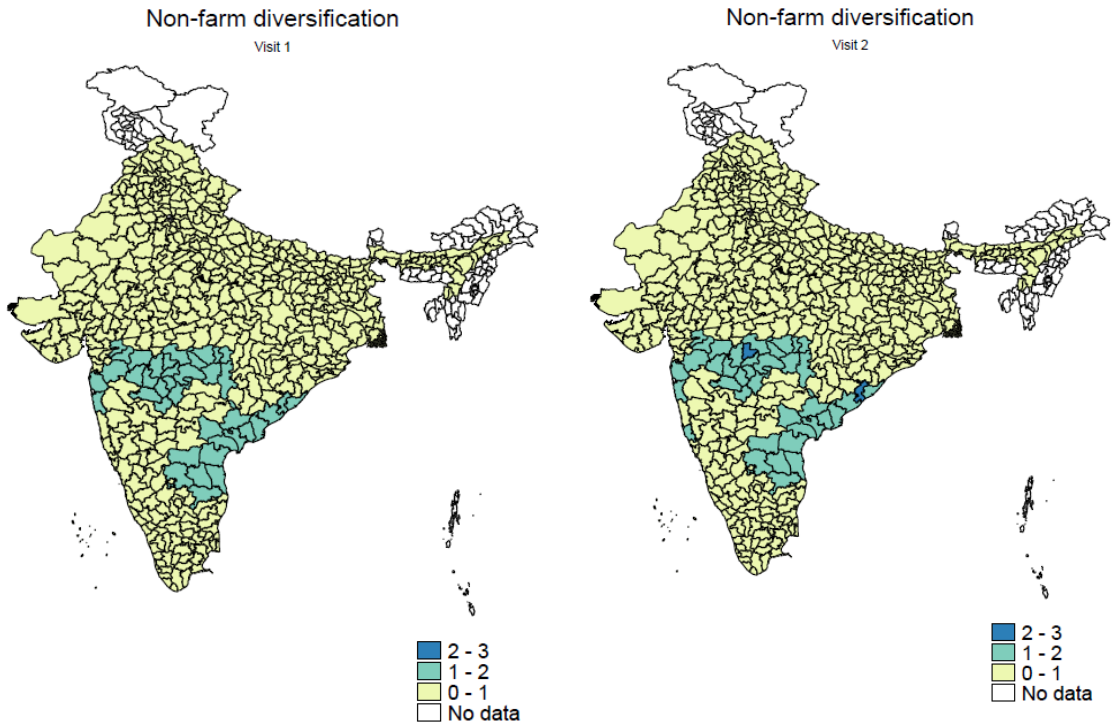
Source: Authors' calculation.

Figure 8: District average animal husbandry diversification



Source: Authors' calculation.

Figure 9: District average non-farm diversification



Source: Authors' calculation.

Table 2: Definitions and summary statistics on farm and household characteristics used in the analysis

Variable	Description	Mean	Std. Dev.
FARM, HOUSEHOLD & VILLAGE (Visit 1) – Source: NSS 70th round			
(i) Commercialization			
Ratio crop sale	Ratio of no. of crops sold to no. of crops cultivated	0.43	0.45
No. of crop transactions	Total no. of crop sale market transactions	0.88	1.08
No. of animal husbandry transactions	Total no. of animal husbandry sale market transactions	0.67	1.02
No. of crops MCG transactions	No. of crops sold at mandis, co-op & govt agency	0.27	0.63
No. of animal husbandry MCG transactions	No. of animal husbandry sold at mandis, co-op & govt agency	0.04	0.20
(ii) Diversification			
Crop count	Total no. of crop types cultivated	1.63	1.26
Animal husbandry count	Total no. of animal husbandry activities	0.79	0.91
Non-farm count	Total no. of non-farm activities	0.51	0.61
(iii) Other farm controls			
Total land	Total land possessed (in hectares)	1.58	1.97
Proportion of land under irrigation	Share of irrigated land	0.44	0.49
Dummy insurance	Dummy=1 if any crop insured	0.05	0.22
Dummy human labour	Dummy variable=1 if human labour used	0.68	0.47
Dummy fertilizer	Dummy variable=1 if fertiliser used	0.73	0.44
Dummy electricity	Dummy variable=1 if electricity used	0.11	0.32
Dummy veterinary	Dummy variable=1 if expenditure on veterinary	0.15	0.36
Dummy outstanding credit	Dummy=1 if any outstanding institutional credit	0.50	0.50
(iv) Household			
Farmers' income	Total farm and non-farm income *per capita*	11253.5	48023.74
Dummy head male	Dummy=1 if head is male, 0 otherwise	0.93	0.25
Dummy head illiterate	Dummy=1 if head is illiterate, 0 otherwise	0.36	0.48
Household size	Household size	5.41	2.77
Dummy SC/ST household	Dummy=1 if household ST/SC	0.28	0.45
Proportion of dependents	Proportion of dependents in the household	0.47	0.25
Male female ratio	Ratio of male to female members in the household	0.52	0.16
Avg household age	Average age of the household members	31.76	11.89
Avg age of members in agri	Average age of the household members engaged in agriculture	40.95	12.39
Graduates	Proportion of household members graduate & above	0.05	0.15
Proportion of MGNREGA workers	Proportion of household members engaged in MGNREGA	0.04	0.20
(v) Village			
Village proportion of non-farm workers	Proportion of households engaged in non-farm activities in the village (except itself)	0.46	0.34

Variable	Description	Mean	Std. Dev.
FARM, HOUSEHOLD & VILLAGE (Visit 2) – Source: NSS 70th round			
(i)Commercialization			
Ratio crop sale	Ratio of no. of crops sold to no. of crops cultivated	0.36	0.43
No. of crop transactions	Total no. of crop sale market transactions	0.77	1.05
No. of animal husbandry transactions	Total no. of animal husbandry sale market transactions	0.63	0.82
No. of crops MCG transactions	No. of crops sold at mandis, co-op & govt agency	0.23	0.60
No. of animal husbandry MCG transactions	No. of animal husbandry sold at mandis, co-op & govt agency	0.04	0.21
(ii) Diversification			
Crop count	Total no. of crop types cultivated	1.40	1.40
Animal husbandry count	Total no. of animal husbandry activities	0.89	0.95
Non-farm count	Total no. of non-farm activities	0.58	0.63
(iii) Other farm controls			
Total land	Total land possessed (in hectares)	1.58	1.97
Proportion of land under irrigation	Share of irrigated land	0.44	0.49
Dummy insurance	Dummy=1 if any crop insured	0.03	0.16
Dummy human labour	Dummy variable=1 if human labour used	0.53	0.50
Dummy fertilizer	Dummy variable=1 if fertiliser used	0.54	0.50
Dummy electricity	Dummy variable=1 if electricity used	0.13	0.34
Dummy veterinary	Dummy variable=1 if expenditure on veterinary	0.13	0.34
Dummy outstanding credit	Dummy=1 if any outstanding institutional credit	0.50	0.50
(iv) Household			
Farmers' income	Total farm and non-farm income per capita	8946.41	38151.47
Dummy head male	Dummy=1 if head is male, 0 otherwise	0.92	0.27
Dummy head illiterate	Dummy=1 if head is illiterate, 0 otherwise	0.36	0.48
Household size	Household size	5.41	2.77
Dummy SC/ST household	Dummy=1 if household ST/SC	0.28	0.45
Proportion of dependents	Proportion of dependents in the household	0.47	0.25
Male female ratio	Ratio of male to female members in the household	0.52	0.16
Avg household age	Average age of the household members	31.76	11.89
Avg age of members in agri	Average age of the household members engaged in agriculture	40.95	12.39
Graduates	Proportion of household members graduate & above	0.06	0.16
Proportion of MGNREGA workers	Proportion of household members engaged in MGNREGA	0.02	0.10
(v) Village			
Village proportion of non-farm workers	Proportion of households engaged in non-farm activities in the village (except itself)	0.50	0.34

Variable	Description	Mean	Std. Dev.
DISTRICT – Source: Census 2011, RBI (2012, 2013), GoI (2011, 2013, 2017)			
(i) Social composition, infrastructure, agro-climate			
Proportion of SC	Proportion of SC population in the district	0.19	0.09
Proportion of ST	Proportion of ST population in the district	0.12	0.18
Proportion with towns within 5kms	Proportion of villages in the district with town < 5 kms	0.25	0.28
Proportion of agri credit to total credit	Proportion of agricultural credit to total credit	0.38	0.19
Proportion of finservices	Proportion of villages with access to financial services	0.32	0.27
Proportion with agricultural markets	Proportion of villages with agricultural markets	0.44	0.32
Avg village manf items	Avg no. of manufacture & handicrafts produced	0.2	0.32
Total power availability (hrs/day)	Total power available for agri, commercial & domestic use (Summer)	27.89	16.37
Total power availability (hrs/day)	Total power available for agri, commercial & domestic use (Winter)	29.13	16.56
(ii) Agro-climatic			
District rainfall deviation	Rainfall deviation from normal (Visit 1)	-19.4	43.9
District rainfall deviation	Rainfall deviation from normal (Visit 2)	89.7	565.2
Moisture availability index	Moisture available in the soil type of the district	0.7	0.4
Share of groundwater recharge	Replenishable share of groundwater recharge (Summer)	0.8	0.2
Share of groundwater recharge	Replenishable share of groundwater recharge (Winter)	0.4	0.3
(iii) Urban agglomeration			
Class 1 cities	Number of urban centers with population 100000 or above	1.1	1
Class 2 cities	Number of urban centers with population 50000-99999	1	1.2
Class 3, 4, 5, 6 cities	Number of urban centers with population 20000-49999, 10000-19999, 5000-9999, below 500	11.3	13.1
Ratio of class 1 and 2 cities to total cities	Ratio of class 1 & 2 urban centers	0.2	0.2
STATE – Source: RBI (2013, 2015)			
Total agri expenditure (₹ million/ha)	Total capital and revenue expenditure in agriculture	3503.5	2192.9
Per capita state GDP	Per capita State GDP	87092.4	42089

Source: Authors' calculation based on sources as stated in the table.

Other farm, household and village characteristics: About 93% of households are headed by males. About 36% of household heads are illiterate. SC/ST households comprise of 28% of households. Average age of households is around 32 years, with an average standard deviation among household members of 12 years. Average age of household members engaged in agricultural work is around 40 years. On an average, household male to female ratio is around 52%.

As mentioned earlier, NSS does not report any information on the village-level characteristics from where the sample is drawn. However, NSS assigns a village code for every household, which allows identifying all the households in a particular village. This allows the construction of some village level characteristics. Using NSS data, for each household, the proportion of rest of the households (excluding the household concerned) in that village engaged in any form of non-farm activity is calculated. This proportion measures the extent to which diversification into non-farm activity is prevalent in the vilage as a whole. On an average 46% of households in a village have non-farm workers in Visit 1, and 50% during Visit 2 (Table 2).

District & State characteristics: While NSS assigns a village code for every household, the village itself cannot be identified. However, NSS reports the identity of the district and state where the household resides. This allows us to bring into our analysis information on district and state characteristics from other data sources. We use the district level data on social composition, infrastructure, and urban centers from Census 2011 (GoI 2011). District level variables are measured in terms of proportion / average. The social composition of the district is given by proportion of SC and ST households in a district. On an average 19% of district's population are SC, and 12% are ST population. On an average, 25% of villages in a district have towns within 5 kms. District agricultural credit information has been taken from RBI (2012). The average agricultural to total credit was around 38%. On an average, 32% of villages in a district had access to any kind of financial services. Around 44% of villages in a district had access to agricultural markets within the village. The average total rural power available in a district (agricultural, commercial, and domestic) was 27 hours/day during summer, which rose to 29 hours/day during winter.

Data on agro-climatic condition and soil characteristics is derived from different sources. Agricultural season wise district rainfall deviation is taken from GoI (2013). Further, district agro-climatic and soil conditions such as soil moisture availability index and soil type is compiled using ICRISAT. Moisture availability and soil types reflect the district's natural suitability for diversification. Due to lack of irrigation facility, many farmers in India depend upon ground water for irrigation. And, ground water depletion or changes during agricultural seasons could significantly affect household farming activities. Hence, it is important to take into account season wise ground water availability while modeling farm diversification decision. In this regard, data on district wise ground water availability is collected from GoI (2017) for both *kharif* and *rabi* seasons separately.

Information on urbanization is collected from Census (GoI 2011). Class 1 and 2 cities are large urban centers with a population between 1,00,000 and above, and 50,000 to 99,999, respectively. Class 3, 4, 5, and 6 are relatively smaller urban centers. On an average, each district has one Class 1 and / or Class 2 cities, and 11 Class 3, 4, 5 and 6 cities combined.

At the state level we collate data on state expenditure on agriculture and gross state domestic product from RBI (2013, 2015). Using the data on expenditure, we measure state agricultural policy by per hectare agricultural capital and revenue expenditure. The general economic condition of the state is represented by per capita state gross domestic product. On an average a state spent ₹3503.5/- million per hectare on agriculture in 2012-2013 (Table 2), and the average per capita state GDP is around ₹87092/- in that year.

3 Empirical model and estimation strategy

The effect of commercialization and diversification by farm households is estimated by the following linear equation specified separately for the two visits, t = 1, 2:

$$IPC_{ivdst} = \alpha_t + \beta_t COMM_{ivdst} + \gamma_t CRC_{ivdst} + \delta_t AHC_{ivdst} + \theta_t NFC_{ivdst} + \lambda_t FARM_{ivdst} + \eta_t HHLD_{ivdst} + \mu_t VILL_{vdst} + \pi_t DIST_{ds} + \rho_t STATE_s + \epsilon_{ivdst}$$

In the above set of equations, the dependent variable IPC_{ivdst} is the i^{th} farm household's total income (from both farm and non-farm sources) *per capita* in village *v*, state *s*, and visit *t*. $COMM_{ivdst}$, represent vector of market commercialization indicators for the i^{th} household. CRC_{ivdst}, represents number of crops cultivated (crop count). AHC_{ivdst}, is the number of animal husbandry activities (animal husbandry count). NFC_{ivdst}, represents number of non-farm activities (non-farm count) in season. $FARM_{ivdst}$, represents individual farm specific characteristics like farm size, access to irrigation, fertilizer use, etc. $HHLD_{ivdst}$, are the household socio-economic and demographic characteristics like household size, average age, education, etc. $VILL_{vdst}$ and $DIST_{ds}$, are the village and district characteristics, respectively. $STATE_s$, are the state policy variables. And, ϵ_{ivdst} is a random error term, and $\epsilon_{ivdst} \sim N(0, \sigma^2)$. As discussed earlier, data on the structural external variables are available only on an annual basis, and they are used as regressors in the equations for both seasons. This may lead the error terms over the two seasons to be correlated ($CoV(\epsilon_{ivds1}, , \epsilon_{ivds2}) \neq 0$). Hence, the above equations for the two visits are estimated under a seemingly unrelated regression (SUR) system framework.

As mentioned earlier, the explanatory variable on commercialization ($COMM_{ivdst}$) may represent various facets of marketing practices adopted by the farm household. It could represent ratio of crop sale (number of crops sold to the number of crops cultivated), number of market transactions (both for crops and animal husbandry), and could also indicate sale of produce to *mandis*, co-operative / government agency. These indicators are hypothesized to have a positive impact on farmers' income. On the other hand, there could be an optimal level of diversification that maximizes farmers' income *per capita*.

Diversification as measured by: CRC_{ivdst}, AHC_{ivdst} and NFC_{ivdst}, are hypothesized to have a positive impact on farmers' income. But, excessive diversification could affect the amount of quality time spent on each activity, which could ultimately affect the efficiency levels and hence income arising from each activity (Das and Ganesh-Kumar, 2018). To capture this aspect, quadratic terms for CRC_{ivdst}, AHC_{ivdst} and NFC_{ivdst} are introduced in the estimated model.

The, $VILL_{vdst}$, $DIST_{ds}$ and $STATE_s$ in the model include several variables discussed in the previous section. As mentioned earlier, they capture the structural features of the place of residence of the farm households at the village, district and state levels, that are beyond the farmers' control but which are expected to play a significant role in influencing their income levels. Many of these structural factors could affect income either individually or in combination with one another. To allow for the latter possibilities, we also include several interaction effects between various structural factors such as between proportion of agricultural credit to total credit in a district and proportion of villages in a district with access to financial services, proportion of villages with towns within 5kms and proportion of districts with agricultural markets, proportion of agricultural credit to total credit in a district and proportion of districts with agricultural markets.

4 Results and discussion

We estimate the above model in a hierarchical fashion beginning with farm and household level explanatory variables, then adding to it the village, district and state level variables. We designate these variants as Models A, B, C, and D as mentioned in Table 3. This allows us to carry out a series of model specification tests to see if the village, district and state level variables play a role in determining income per capita of farmers.

Table 3: Hierarchical model specification

Model A		**Model B = Model A + Village level variables**	**Model C = Model B + District level variables**	**Model D = Model C + State level variables**
Farm level	**Household level**			
Commercialization	Social group	Non-farm activity	Social composition	Agri. Exp.
Diversification	Age		Infrastructure	PC GSDP
Farm size	Education		Urbanization	
Farm inputs	Gender		Agro-climatic conditions	
Data source: NSS	Data source: NSS	Data source: NSS	Data source: NSS + Census+ other sources	Data source: NSS + Census+ other sources

Source: Authors

All these 4 variants are estimated first using the SUR framework. However, the Breusch-Pagan test for significance of the cross-equation correlation of the error terms in the equations for the two seasons turned out insignificant. Consequently, we re-estimated the two equations as separate equations using ordinary least squares (OLS). Since our estimation makes use of cross-section data, we allow for heteroskedasticity of a general form, and accordingly, Huber/White/sandwich robust standard errors estimators are used here. Based on these estimates, we carry out a series of likelihood ratio (LR) tests of the four variants Model A through Model D for the two visits separately, which are reported in Table 4. Comparing Model B over Model A, we find that Model B is not a better fit than Model A for both visits. However, comparing Models C and B, we find that Model C is a better specification than Model B for both visits. Finally, we find that Model D is a better specification over Model C for Visit 2. These test

results clearly show that external factors beyond the control of farm and household, affects farmers' income *per capita*. Hence, we present below the results for only Model D, which has all the relevant information on farm, household, village, district, and state level. We present the results for Model D for both visits, in order to allow us to compare the results across the two visits.

Table 4: Likelihood ratio tests for models

Models	Visit 1		Visit 2	
	LR-chi2	*p*-value	LR-chi2	*p*-value
Model A nested in Model B	0.89	0.347	0.56	0.455
Model B nested in Model C	137.52	0.000	108.75	0.000
Model C nested in Model D	4.32	0.365	10.660	0.031

Source: Authors' estimations.

4.1 Commercialization and diversification

The single equation OLS estimation results of Model D for the two visits are reported in Table 5. Commercialization measured as ratio of crop sale to crops cultivated leads to higher farmers' income per capita in both the two visits. This is obvious from the fact the more the farm household offers to sale in the market, more would be the returns than retaining it within the farm household. Similarly, higher the number of transactions of both crop and of animal husbandry products raises farmers' income. Also, sale of crops at *mandis*, co-operative and government agency also has a positive effect on farmers' income. This may be because selling produce to such agency may ensure that the farmer receives the prevailing market price. However, selling animal husbandry produce to *mandis*, co-operative and government agency does not have any impact on farmers' income.

Table 5: Estimation results

	Visit 1		Visit 2	
Farm and household levels				
(i) Commercialization				
Ratio crop sale	4342.2***	(2.69)	8907.0***	(7.79)
No. of crop transactions	2728.8***	(5.62)	1544.5***	(3.07)
No. of animal husbandry transactions	3343.6***	(5.92)	749.8*	(1.40)
No. of crops MCG transactions	5788.5***	(4.86)	3829.3***	(5.98)
No. of animal husbandry MCG transactions	2455.3	(1.40)	-1346.7	(-0.43)
(ii) Diversification				
Crop count	2551.6***	(3.37)	5121.4***	(6.47)
Square crop count	-441.6***	(-3.06)	-756.4***	(-5.47)
Animal husbandry count	2634.0	(0.82)	219.1	(0.12)

	Visit 1		Visit 2	
Square animal husbandry count	-460.7	(-0.58)	-7.656	(-0.02)
Non-farm count	6412.6***	(4.74)	7353.3***	(8.10)
Square non-farm count	1861.9*	(1.88)	1918.9***	(2.71)
(iii) Other farm controls				
Total land	-116.5	(-0.64)	-236.9**	(-2.06)
Square total land	0.800	(0.16)	4.591	(1.46)
Proportion of land under irrigation	-4035.7	(-1.20)	-2728.3	(-0.46)
Square proportion of land under irrigation	3939.9	(1.18)	591.7	(0.10)
Dummy insurance	-2728.9***	(-2.64)	-1189.0	(-0.82)
Dummy human labour	-982.4***	(-2.75)	-2512.7***	(-4.24)
Dummy fertilizer	-209.9	(-0.61)	-3693.3***	(-4.29)
Dummy electricity	-1731.2***	(-3.41)	-3187.3***	(-3.83)
Dummy veterinary	-987.5**	(-2.20)	311.6	(0.56)
Dummy outstanding credit	-7332.2**	(-2.13)	-4908.4***	(-3.59)
(iv) Household				
Dummy SC/ST household	-305.0	(-0.47)	397.0	(0.82)
Dummy head male	-1603.3	(-1.40)	-866.8	(-1.42)
Dummy head illiterate	-788.1	(-1.24)	-1559.6***	(-3.61)
Household size	-882.7***	(-10.35)	-774.5***	(-10.65)
Proportion of dependents	673.9	(0.40)	-946.3	(-1.26)
Male female ratio	-2266.4	(-0.96)	-3243.4*	(-1.67)
Avg. household age	269.6***	(3.89)	206.8***	(5.66)
SD household age	-264.2***	(-4.48)	-262.0***	(-5.76)
Avg. age of members in agri.	-56.64	(-1.31)	-50.13	(-1.47)
Graduates	11500.5***	(5.77)	13057.0***	(8.29)
Proportion of MGNREGA workers	-5187.5***	(-5.01)	-9484.1***	(-4.74)
Village level				
Village proportion of non-farm workers	-86.04	(-0.09)	1197.2**	(2.35)
District level				
(i) Social composition & infrastructure				
Proportion of SC	-3378.5	(-0.79)	1738.1	(0.58)
Proportion of ST	-1213.7	(-0.55)	-384.4	(-0.30)
Proportion with towns within 5kms	378.0	(0.31)	1187.9	(1.45)
Proportion of agri. credit to total credit	1239.6	(0.81)	1471.7	(1.24)
Proportion of fin. services	2549.8	(1.42)	-20.94	(-0.01)
Proportion with agricultural markets	1311.8	(0.96)	-921.0	(-0.45)
Avg village manf items	-486.2	(-0.58)	3540.0***	(4.13)
Total power availability	19.79	(0.62)	84.85***	(3.15)
(ii) Urban agglomeration				
Class 1 cities	48.96	(0.05)	2064.6***	(2.84)
Square of class 1 cities	7.201	(0.04)	-417.7***	(-3.34)
Class 2 cities	-281.9	(-0.51)	-877.5*	(-1.74)

	Visit 1		Visit 2	
Square of class 2 cities	176.3	(1.36)	139.5	(1.63)
Class 3, 4, 5, 6 cities	-67.80	(-0.83)	-15.21	(-0.21)
Square of class 3, 4, 5, 6 cities	-0.397	(-0.52)	-0.249	(-0.40)
Ratio of class 1 and 2 cities to total cities	-830.5	(-0.40)	1432.6	(0.59)
(iii) Agro-climatic conditions				
District rainfall deviation	4.046	(0.64)	-0.210	(-0.56)
District soil moisture availability index	2626.9**	(2.32)	-1624.8*	(-1.86)
Share of ground water recharge	-3667.2	(-1.16)	5107.2***	(4.99)
Proportion of land under each soil types	Yes		Yes	
State level				
Total agri expenditure (₹ million/hectare)	-1.720***	(-2.63)	-1.532***	(-3.00)
Square total agri expenditure	0.000155**	(2.19)	0.000135***	(2.72)
Per capita state GDP	-0.132	(-1.48)	-0.143***	(-3.25)
Square per capita state GDP	0.000000627	(1.61)	0.000000594***	(2.75)
Constant	14928.2**	(2.34)	10987.1***	(3.15)
R^2	0.0700		0.0830	
F-statistic (d-o-f)	31.15	(74, 28842)	30.91	(74, 28842)
Prob>F	0.000		0.000	
Root MSE	46372		36581	
N	28917		28917	

Source: Authors' calculation based on data as discussed.
Notes: (i) MCG refers to sale at *mandis*, co-operative and government agency.
(ii) 19 different soil types were considered in this study (as in ICRISAT data). The proportion of land area in each district for each of these 19 different soil types was calculated.
(iii) Z-statistics are reported in parenthesis. ***p < 0.001,**p<0.05,*p<0.1

Crop diversification during both Visit 1 (*kharif*) and Visit 2 (*rabi*) seasons have a positive impact on farmers' income *per capita*. However, the co-efficient of squared crop count is negative and significant, implying that crop diversification has an inverted U-shaped relationship with farmers' income *per capita*. This suggests that there could be an optimal number of crops during both visits which maximize farmers' income *per capita*. Animal husbandry diversification on the other hand, shows no such relationship with farmers' income.

Non-farm count during both the seasons shows a positive relationship with farmers' income. Further, the squared term of non-farm diversification also show a positive impact on farmers' income implying a monotonically increasing relationship with farmers' income. This may be because, compared to farm sector, the non-farm sector possibly provides a low risk and higher return environment.

As mentioned earlier, measuring diversification using the count method allows us to estimate the optimal number of activities. As results show that crop diversification (during both seasons) have an inverted U-shaped relationship with farmers' income per capita, there exists an optimal number of crops and number of animal husbandry activities which maximizes farmers' income. Based on the value and

signs of the coefficients of the linear and square terms, the estimate of the optimal number of crop cultivation is 3 types of crops during both *kharif* and *rabi* seasons. Engaging in less or more number of crops than 3 types of crops may not help in maximizing farmers' income levels. As can be seen in Appendix, on an average, farm households in India are engaged in less than the optimal number of crop cultivation in both the seasons (2 types of crops in Visit 1 and 1 type of crops in Visit 2). This gives further scope for improvement of farmers' income by cultivating more crops.

Thus, these results lend credence to the hypothesis that: (a) increasing on-farm diversification in the form of raising crop cultivation can help to improve farmers' income levels, but (b) excessive or less crop diversification could however, have an adverse effect on income levels via the opportunity cost of time spent on multiple crop types. (c) These results also show that non-farm diversification by farm households has a monotonically increasing relationship with farmers' income *per capita*.

4.2 Other farm and household characteristics

Farm size shows no significant association with farmers' income *per capita*. Even the squared term of farm size has no significant impact on farmers' income. This result is contrary to Gaurav and Mishra (2015, 2019), where they find an inverse relationship between farm size and net returns to cultivation. Farm size may have an impact on crop cultivation and hence crop income, which is not the focus of our study. However, if farmer's total income from all sources is considered, then the results show that farm size may not have any significant impact on farmers' income. A similar situation seems to be the case with irrigation proportion and its square, both of which do not have significant effect on farmers' income in both the visits. Again it is conceivable that irrigation proportion significantly raises crop income, which is out of scope of our study, but does not matter for total farmers' income.

Having crop insurance seems to have a negative impact on farmers' income only during Visit 1.[7] Hiring of labor has a negative impact on farmers' income during both the seasons. Expenditure on fertilizer has a negative impact on farmers' income only during Visit 2, whereas, electricity has a negative impact during both the visits. Spending on veterinary charges leads to a decline in farmers' income during Visit 1. Having any outstanding institutional credit (as a proxy for the interest burden) reduces farmers' income during both the seasons. All these items are expenditures and they reduce the net-returns to farming and hence total farmers' income per capita.

Turning to household characteristics, though SC / ST households are in general poorly endowed, our results show that the social category of the farm household does not matter for its income. Having an illiterate household head has a negative significant effect only during Visit 2, as does a high male to female ratio within the household. As household size increases, it significantly pulls down framer's income. However, neither the gender of the household head, nor proportion of dependents has any

[7] The cross section NSS data used here only records the premium paid on crop insurance. In the reporting period, at least, this is only an expenditure incurred by the farmers, and it does not allow us to capture the risk mitigating effects of crop insurance. For this, one needs panel data over several time periods that should include episodes of crop failures / insurance payouts.

impact on household income. While average age has a positive impact on farmers' income, however, the standard deviation of age of household members negatively affects farmers' income. This implies that higher the age differences within the household, greater will be the requirement of care givers within the house and hence less time available for productive activities. The relationship between average age of the household members engaged in agriculture and farmers' income is found to be negatively related. Greater the number of graduate members in the household, higher would be farmers' income. Higher the proportion of household members engaged in MGNREGA works, lower will be the farmers' income *per capita* during both the seasons. These results again suggest that the opportunity cost of time involved in MGNREGA works could be considerable. MGNREGA as a public works program could help raise rural employment, but may not necessarily be the optimal way of raising farmers' income.

4.3 Structural factors at the village, district and state-levels

The proportion of non-farm employment in the village does not impact farmers' income. Having a higher proportion of SC / ST households in the district does not affect farmers' income. Variables such as proportion of villages in the district with towns within 5 kms, proportion of agricultural credit to total credit, proportion of villages with access to financial services, and proportion of villages with agricultural markets, do not show any significant effect on farmers' income. Having higher number of village manufactured products helps in raising farmers' income only during Visit 2. Total power availability (total per day availability of power for agricultural, commercial and domestic use in rural areas) significantly affects farmers' income only during Visit 2. Similarly among the classes of urban centers, only class 1 size centers with a population of over a lakh, have a positive and inverted U-shaped relationship with farmers' income.

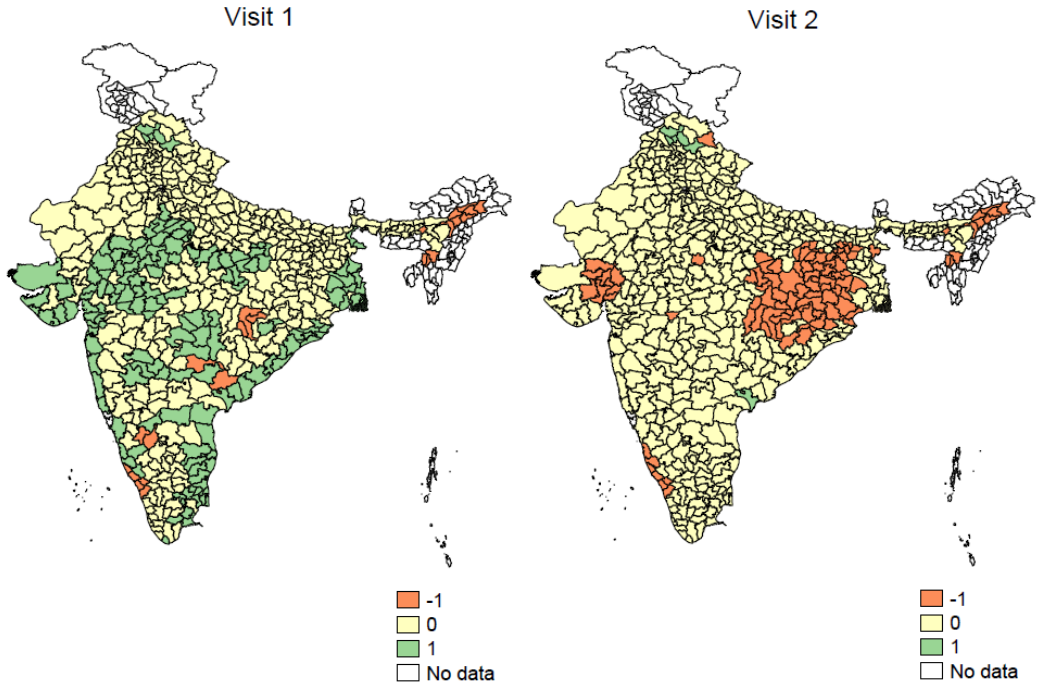
District soil moisture availability index show a positive effect on farmers' income during Visit 1, and share of ground water recharge has a positive effect only during Visit 2. Apart from controlling for moisture content of soil in the district, this study considers 19 different types of soil quality. However, data on soil types are available only at the district level. The proportion of area in each district, under each of these 19 different soil types is estimated. Based on results districts are categorized with soil types favorable or unfavorable for farmers' income per capita according to the following: Favorable for farmers' income *per capita* = 1; Not favorable for farmers' income *per capita* = -1; No effect on farmers' income *per capita* = 0.

The above district level soil type categorization is presented in maps in Figure 10. The soil types maps are presented separately for Visit 1 (*kharif*) and Visit 2 (*rabi*) periods. The green patches are those districts where the soil type favors in increasing farmers' income per capita, the orange patches are those districts where the soil type negatively affects farmers' income per capita, and the yellow patches are those districts where soil types have no impact on farmers' income per capita. During Visit 1, most of the coastal districts have soil type favorable for farmers' income. Even districts in Gujarat, many districts in central India, eastern Rajasthan, West Bengal have soil types which can positively influence farmers' income per capita. However, during Visit 2, the scene changes drastically. Almost all the coastal districts of India have soil types which have no impact on farmers' income. In fact, some of the districts in

Gujarat and eastern India have soil types which are detrimental towards farmers' income. Large portion of districts in the Chota Nagpur plateau region of Chhattisgarh, Jharkhand, Bihar, West Bengal, Orissa, have soil types which may not help in raising farmers' income. Therefore, it needs to be understood that soil types either provide a natural structural stimulus or barrier for increasing farmers' income per capita.

State expenditure in agriculture helps in raising farmers' income, but only at a higher level. That is to say, agriculture expenditure has a U-shaped relationship with farmers' income. Similarly, size of the state economy measured as state GDP *per capita* has a positive significant impact on farmers' income per capita only at a higher level.

Figure 10: Soil type and its impact on farmers' income



Source: Authors' calculation.

5 Conclusion

On account of the policy target of "Doubling of Farmers' income" by the year 2022, Dalwai committee (DCR 2018) was set up to suggest policy measures to achieve this target within the time frame. Two major policy advices of this report are increasing commercialization of farm produce and raising diversification. In the context of commercialization, the report mentions about various policy reforms required for raising farmers' participation in market transaction. This would enable farmers to receive better remunerative prices for their produce and hence help in enhancing farmers' income. On diversification side, the report mentions that raising both on-farm and non-farm diversification would

help not only in hedging of production and marketing risk associated with agriculture, but also raise their income by working in the non-farm sector. While these suggestions are eminently sensible they are not backed by empirical evidence.

Against this backdrop, this paper examines the nature of relationship between diversification (both on-farm and off-farm) and farmers' income. Using agricultural household level data from 70th round NSS Situation Assessment Survey for the year 2012-13, and combining it with information on structural factors drawn from Census 2011 and other statistical sources, this study examines the effect of commercialization, diversification (both on-farm and non-farm) and other structural factors on farmers' income *per capita*. Farmer's total income is the sum total of earnings from on-farm and non-farm sources. In this study, farm income is measured as the aggregate net farm income (sales revenue less paid out cost) from both crop and animal husbandry. Non-farm income includes net receipts from non-farm business, and wages and salaries that the members of the household receive by working in off-the-farm activities.

Linear regression models are specified to test the hypothesis separately for the two seasons, Visit 1 (*kharif*) and (*rabi*). Since the structural variables are available on an annual basis, the regressions for the two Visits were first estimated under a SUR set-up to allow for cross-equation correlation in the residuals. However, Breusch-Pagan test for significance of the cross-equation correlation of the error terms in the equations for the two seasons turned out insignificant. Hence, we estimated the two equations as separate equations using OLS, allowing for heteroskedasticity of a general form.

The results clearly show that commercialization by the farm household has a positive effect on farmers' income. Commercialization as measured by ratio of crop sale, market transactions, crop sale at *mandis*, co-operative and government agency lead to a higher farmers' income. Crop diversification has a positive relationship with farmers' income. With the squared term of number of crops showing to be negative and significant, there is also an inverted U-shaped relationship of crop count with farmers' income. This suggests that there may be an optimal number of crop cultivation which maximizes farmers' income. As per the regression results, this optimal number of crop cultivation is 3 during both the seasons. Comparing these estimates with the actual levels shows that, on an average, farmers in India are engaged in lesser number of crop cultivation. Thus, there is scope for income improvement with greater thrust on crop diversification.

The results also show that having higher number of graduate members in the household has a positive effect on farmers' income. This indicates that education helps in raising farmers' income. The proportion of household members engaged in MGNREGA works has a negative effect on farmers' income. This might be due to higher opportunity cost of time spent in such public works. The study also highlight the point that farm households always operate under the influence of a larger structural arrangement, which is beyond the control of the farm and the household. And, since farm household labour time is fixed, given its farm and household condition, these external features could affect farm household's total income. Thus, the policy implications stated in this chapter informs about the required policy measures for increasing diversification by farm households in India.

This study substantiates the policy suggestions made by the DCR (2018) regarding commercialization and diversification as policy instruments for raising farmers' income. The findings from this study show

that farmers' income could be raised by encouraging farm households to undertake crop diversification, and at the same time providing non-farm employment opportunities in rural areas. Provision of improved market facilities, and also bringing down market transaction costs so that farmers adopt more commercialization of their produce, will help in fetching better prices and hence improved income.

There are a few limitations in this study: first, different types of income sources have non-uniform reference periods in the NSS data. While income from crop cultivation and wages are surveyed with a reference period of 6 months, income from animal husbandry and non-farm enterprise are surveyed with a recall period of 30 days. These have been annualized for this study, which might entail some degree of under- or over- estimation of various income components, besides ignoring seasonality in them. Second, the NSS data does not report the amount of income from remittances and pensions due to which the non-farm income could be underestimated. Finally, while the study has used the data on expenditure on farm inputs as reported in the NSS, it must be pointed out that the NSS data itself could be an underestimate. This is because the NSS records only if there has been an 'out of pocket' expenditure on farm inputs, not if the farmer has used the input out of home stock, or borrowed, or obtained through government subsidy. Third, limitation in this study is that local village level labour market conditions are measured in an indirect manner. It would have been better if some direct measures were available. Since, such information is not available, the network effects different sectors might have on non-farm diversification decision cannot be estimated.

References

Acharya, S. S. (2004) Agricultural Marketing in India, *State of the Indian farmer: A millennium study*, New Delhi: Academic Foundation

Aggarwal, S. (2018). Do rural roads create pathways out of poverty? Evidence from India. *Journal of Development Economics*, Vol. 133

Asher, S. and Novosad, P. (2016). "Market access and structural transformation: Evidence from rural roads in India", Manuscript: Department of Economics, University of Oxford.

Banerji, A., and Meenakshi, J. V. (2004) Buyer Collusion and Efficiency of Government Intervention in Wheat Markets in Northern India: An Asymmetrical Structural Auction Analysis. *American Journal of Agricultural Economics*, Vol. 86

Birthal, P. S., Jha, A., Joshi, P., Singh, D., et al. (2006) Agricultural diversification in north eastern region of India: Implications for growth and equity. *Indian Journal of Agricultural Economics*, Vol. 61

Birthal, Pratap S., Negi, D. S. and Roy, D. (2017) Enhancing farmers' income: Who to target and how? Policy Paper No. 30, ICAR – National Institute of Agricultural Economics and Policy Research, New Delhi, April

Birthal, Pratap S., Roy, D. and Negi, D. S. (2015) Assessing the impact of crop diversification on farm poverty in India. *World Development*, Vol. 72

Chand, Ramesh (2017) Doubling farmers' income: Rationale, strategy, prospects and action plan. NITI Policy Paper No. 1/2017, March

Chandrasekhar, S. and Mehrotra, N. (2016) Doubling farmers' incomes by 2022: What would it take? *Economic and Political Weekly*, Vol. 18, April

Chhatre, A., Devalkar, S., and Seshadri, S. (2016) Crop diversification and risk management in Indian agriculture. *DECISION*, Vol. 43

Chatterjee, U., Murgai, R., and Rama, M. (2015) Employment outcomes along the rural-urban gradation. *Economic and Political Weekly*, Vol. 50

Das, V. K. and A. Ganesh-Kumar (2018), "Farm Size, Livelihood Diversification and Farmers' income in India". Decision. 45(2), pp. 185-201, DOI: 10.1007/s40622-018-0177-9.

DCR (2018) Report of the Committee on Doubling Farmers' Income. Vol. I to XIV, Committee on Doubling Farmers' Income, Ministry of Agriculture, Cooperation and Farmers Welfare, Government of India

Ellis, F. (2000) The determinants of rural livelihood diversification in developing countries. *Journal of Agricultural Economics*, Vol. 51

Fafchamps, M. and Hill, R. (2005) Selling at the farmgate or traveling to market, American *Journal of Agricultural Economics*, Vol. 87

Fafchamps, M., Hill, R., and Minten, B. (2006) The Marketing of Non-Staple Crops in India, Mimeo, World Bank, Washington, DC

Fafchamps, M., Hill, R., Minten, B. (2008) Quality control in non-staple food markets: Evidence from India", *Agricultural Economics*, Vol. 38

Fan, S., Hazell, P., and Thorat, S. (2000). Government spending, growth and poverty in rural India. *American Journal of Agricultural Economics*, Vol. 82

Gaurav, Sarthak and Mishra, S. (2015) Farm size and returns to cultivation in India: Revisiting an old debate. *Oxford Development Studies*, Vol. 43 (2)

Gaurav, S. and Mishra, S. (2019) Is small still beautiful? Revisiting the farm-size productivity debate. Working paper No. 74, Nabakrushna Choudhury Centre for Development Studies, Bhubaneswar

GoI (2011) Village Directory, Towns and Urban Agglomerations Classified by Population Size, Office of the Registrar General Census Commissioner, Ministry of Home Affairs, Government of India

GoI (2013) Rainfall Statistics in India, 2012-2013. India Meteorological Department, Ministry of Earth Sciences, Government of India

GoI (2017) Dynamic Ground Water Resources of India, As on 31st March 2013, Central Ground Water Board, Ministry of Water resources, River Development and Ganga Rejuvenation, Government of India

Gulati, Ashok and Shweta Saini (2016) From plate to plough: Raising farmers' income by 2022. *The Indian Express*, March 28

Lange, A., Piorr, A., Siebert, R., and Zasada, I. (2013). Spatial differentiation of farm diversification: How rural attractiveness and vicinity to cities determine farm household's response to the CAP. *Land Use Policy*, Vol. 31

Minten, B., Reardon, T., Singh, K.M. and Sutradhar, R. (2010) The benefit of cold storages: Evidence from Bihar, MPRA Paper No. 54345

NAAS (2016) Strategy for Transformation of Indian Agriculture for Doubling Farm Income and Improving Farmers Welfare, Strategy Paper No. 3, National Academy of Agricultural Sciences, New Delhi

Palmer-Jones, R. and Sen, K. (2003). What has luck got to do with it? A regional analysis of poverty and agricultural growth in rural India. *Journal of Development Studies*, Vol. 40

Rao, P. P., Birthal, P. S., Joshi, P., and Kar, D. (2007). Agricultural diversification towards High-Value Commodities and role of urbanisation in India. In Joshi, P. K., Gulati, A., and Cummings Jr., R., editors, Agricultural Diversification and Smallholders in South Asia. Academic Foundation

RBI (2012). District Banking Statistics for 2012-13, Reserve Bank of India

RBI (2013). Handbook of Statistics on Indian States for 2012-13, Technical report, Reserve Bank of India

RBI (2015). Study of state budgets for 2012-13, Reserve Bank of India

Shilpi, F. and Umali-Deininger, D. (2008) Market facilities and agricultural marketing: Evidence from Tamil Nadu, India, *Agricultural Economics*, Vol. 39

Singh, S. (2019) Re-organising Agricultural Markets for Doubling Farmer Incomes in India: Relevance, Mechanisms and Role of Policy, *Indian Journal of Agricultural Economics*, Vol. 74

Takeshima, H. and Nagarajan, L. (2012) Minor millets in Tamil Nadu, India: local market participation, on-farm diversity and farmer welfare, *Environment and Development Economics*, Vol. 17

Umali-Deininger, D. and Deininger, K. (2001) Towards greater food security for India's poor: Balancing government intervention and private competition, *Agricultural Economics*, Vol. 25

Vaidyanathan, A. (2010) Agricultural Growth in India: Role of Technology, Incentives and Institutions, New Delhi: Oxford University Press