LAND, LIVELIHOODS AND TRIBAL DEVELOPMENT IN INDIA: AN ANALYSIS USING NSS UNIT LEVEL DATA

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Abstract: Tribal communities inhabited in different regions of India are not homogenous and neither is their level of development. Substantial gap exists among tribal communities and the other communities with respect to poverty, education, health, livelihood opportunities and assets, particularly in rural areas. The implementation of the New Economic Policy (1991) led to the total monetization of the rural economy and a corresponding increase in the overall price level of commodities. In such an economy, gains from both rural farm and non-farm activities require capital support. Their dependence on farm sector is high vis-à-vis non-farm sector, as the latter mostly provides less remunerative work to them. This paper attempts to identify the association between agricultural productivity and access to capital across two social groups: ST and the general population (non-ST) Households using NSS 77th Round Land and Livestock Holdings Unit-Level Data 2019. The present study also tries to show that the productivity of ST households is lower than that of non-ST households due to inadequate accessibility to capital resources.

Keywords: Tribal Development, Livelihood, Agricultural productivity, land holdings, Capital

Introduction

Access to resources is essential for the survival of tribal communities living in rural areas. Their dependence on the farm sector is high vis-à-vis the non-farm sector, as the latter mostly provides less remunerative work. Access and tenurial rights to resources not only have positive impacts on STs' socio-economic condition, but they also contribute to economic development in the long run (Deininger & Binswanger, 1999, p. 247; Bakshi, 2008, p. 2). According to Chambers and Conway (1992, 5), 'A livelihood comprises the capabilities, assets (including both material and social resources) and activities for a means of living'. It is defined as 'adequate stocks and flows of food and cash to meet basic needs'. The approach to livelihood generation must be sustainable and secured by assets such as land ownership, access to resources, income-generating work, and employment stability. A wider choice of livelihoods is possible only if individuals are well off, and this is enabled by economic growth. However,

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there is a need to improve human capabilities, equity and sustainability of development (Scoones, 2009, p. 175; Chambers & Conway, 1992, p. 5). Rawal & Karat (2014) found, in their study, that in 1987-88, across all categories, tribal households had the highest proportion of marginal land at 38 per cent. This remained the same during 2011-12, and the proportion of ST households that were landless accounted for 39 per cent. The proportion of landless among tribal households increased by 11 per cent from 1987-88 to 2011-12 (Rawal & Karat, 2014, p. 136). Not only was the STs' landholding small, but the land was also less fertile. Ricardo (2003) postulated that rent from less fertile land will be zero, or, in other words, the low productivity of such lands makes agricultural activities less rewarding (Roncaglia, 2003). Prajapati et al. (2014) used certain criteria such as seed selection, irrigation system, transportation facility for marketing of agricultural production, available modern machinery and implements, extent of use of chemical fertilisers, use of organic fertilisers etc. for agricultural modernisation to identify its impact on sustainable livelihoods among tribal and non-tribal farmers. The study revealed that agricultural modernisation through capital and technology infusion was advantageous for non-tribal households but not for tribal households. A possible reason is that non-tribal communities are more integrated into the market economy and have stronger market linkages. The study even concluded that non-tribal farmers have adapted to the changing policy and environment of the rural economy, but such changes were found to be very slow among tribals (Prajapati et al., p. 138-142).

Literature Review

The Bhuria Committee Report (2004) on 'Scheduled Areas and Scheduled Tribes Commission' described that tribal economy as based on water, forest and land, and they derive their livelihood from hunting, food gathering and practicing shifting or *Jhum* cultivation. The tribal economy is different from the economic activities practiced by the other communities. However, a transition has taken place in the tribal economy and their livelihood (GoI, 2004).

The policy of *integration* was first put forward by our first former Prime Minister, Shri Pandit Jawaharlal Nehru. He considered both the merits and demerits of policies of isolation and assimilation and came to adopt a policy that would integrate ST with the mainstream population without undermining their way of life. Here, he did not mean to transform ST into the mainstream population but to let these disadvantaged people grow in their own way of life, along with receiving education, better health facilities and other amenities of life. In this policy. An important remark he made was to take special measures to protect tribal lands, which form the basis of their socio-economic well-being (Elwin, 1957, pp. 1-13).

According to the *Human Development Report* (2016), the level of development achieved by different social groups differs,

and there are well-identified marginal groups within society who continue to suffer due to these disadvantages. Indigenous people are one among them. They lack access to livelihoods, healthcare, and productive assets, and they fall behind in many other development parameters (UNDP, 2016, p. 56-64).

Bhuria Commission Report (2004) revealed that STs in India make up the bottom-most layer of the Indian society. On the economic front, they lack irrigation facilities for agricultural activities, horticulture, and animal husbandry. On the social front, they have poor levels of health, education, access to safe drinking water, and shelter (GoI, 2004, p. 3-4).

The Lokur Commission Report (1965) asserted that the slow progress of such STs could be attributed to their relatively small population and constant movement, which prevented them from benefiting from development schemes designed for STs and SCs (GoI, 1965, p. 16).

Action Taken Memorandum on 2nd Report of National Commission of ST 2006-07, presented in Lok Sabha and Rajya Sabha in the year 2013, revealed that many States' poor performance in eradicating ST problems and issues arising. In Bihar, the Particularly Vulnerable Tribal Groups (PVTGs) like Birjias, Asurs, Sawars and Birhors lack access to safe drinking water in their residential areas and at primary health centres as well. In Tamil Nadu, Kattunayakans PVTGs face difficulty obtaining a community certificate, which deprives them of developmental facilities. There are other PVTGs in forest and hilly areas in India who are unable to avail of consumer items under PDS and other government-initiated benefits due to their location. An alternative way is required to support their livelihood. In States of Andhra Pradesh, Madhya Pradesh, Orissa and Karnataka, illiteracy problem among female STs and tribal students' dropout has to be addresed. Tribal children in many villages of Andhra Pradesh suffer from malnutrition. In Chhattisgarh, awareness programme relating modern health care system among tribal communities are needed (MoTA, 2013, p. 14-43).

Ballabh & Batra (2015) in their study of Central India region found that considerable number of tribal populations across different states and regions are found to work in low paid works, practice agriculture on marginal land, works as agriculture labourers or work as unskilled workers in secondary and tertiary sectors and continue to remain in a constant state of poverty. The planned development could not bring about overall progress among ST. Their study found that ST communities have immense potential to learn and adopt new technologies and skills when supported by appropriate institutions. Tribal produce and handicraft products require investment in capacity development (Ballabh & Batra, 2015, p. 271-281).

Studies by Dang (1980) revealed that ST communities are far from innovation and modern technology either be it primary sector, or tertiary sector. Low

productivity and low levels of technology stands as barriers for development (Dang, 1980).

The post-liberalisation period in India has led to the displacement of the tribal population due to the construction of capital-intensive development projects like dams, coal and bauxite mining, etc., in land where tribal live since many centuries. Tribal families in the States of Andhra Pradesh, Orissa, Madhya Pradesh, Karnataka and Gujarat faced the worst impact. Such development projects may increase the States' profits, but they have deprived people in those regions, particularly tribals, of their lives, creating livelihood insecurity and marginalisation (Meher, 2010; Reddy and Kumar, 2010; Jaysawal, 2014).

Objectives of the Study

The following are the objectives of the study:

1. To examine the extent of inequality in resource ownership between STs and other communities

2. To examine the impact of economic development policies on tribal communities

3. To examine the extent of inequality in resource ownership between STs and other communities

Data and Methodology

Based on theoretical and empirical literature, a micro-econometric model has been developed to examine the objectives of the study. A binary logistic model was constructed to identify factors influencing the agricultural productivity of ST households. The study used unit-level data from the 77th round of NSS on Land & Livestock Holdings at the all-India level (2019) for 9780 ST households with agricultural landholdings and 11938 non-ST households with agricultural landholdings.

Distribution of Landholdings among Various Social Groups from the National Sample Survey (NSS) 70th round.

In this section, the study highlights the landholding status of different social groups from the NSS 70th round of survey on Land and Livestock holdings (2013). This is an All-India round conducted only in rural areas. The survey covered 4,529 villages and 35,604 households.

The survey report highlights that, among social groups, the proportion of landless households was highest among tribal households, at 9.41 per cent. Scheduled Tribes and Scheduled Castes households have the lowest proportion of large landholdings (0.03%) among social groups. Among all other social groups, OBC households and other households hold 0.23 per cent and 0.53 per cent of large landholdings, respectively. This is shown in Table 1. It is a matter of concern that the highest proportions of the population are marginalised, and the condition is worse for communities like the Scheduled Castes and the Scheduled Tribes. They are predominantly holders of marginal landholding. In terms of household classification, the percentage distribution of households engaged in self-employment in cultivation is highest among scheduled tribe households. The

proportion of households engaged in livestock farming self-employment is lower across all social groups (1.75%), with ST households the lowest. The survey found that, at the all-India level, across different categories of operational land holdings with at least one household member staying away from the village for employment, the highest proportion of households belongs to marginal landholders. The proportion of marginal landholders is highest in states like West Bengal, Tamil Nadu, Kerala, Jharkhand, Himachal Pradesh, and Jammu & Kashmir. Large landholdings are negligible for all states and also for the landless category. Only in the states of Karnataka, Madhya Pradesh, and Rajasthan have large operational landholdings been found at the all-India level (NSS, 2013, p. 15).

Agricultural Productivity of ST Households and Their Access to Capital

Lax & Krug (2013) advocated that access to five different livelihood capitals is important for a sustainable livelihood framework. These livelihood capitals are *financial* capital, *human* capital, *social* capital, *physical* capital and *natural* capital. Financial capital includes credit, savings, and remittances. Components of human capital are knowledge, skills, health and labour availability. Social capital refers to social organisations and ethnic networks. Physical capital includes household assets, agricultural implements and infrastructure. Natural capital includes land quality, soil fertility, water, forest, and grazing resources (Lax & Krug, 2013, p. 8). Carter & Wiebe (1990) asserted that access to capital is essential for land productivity in any agrarian economy. Their study found that productivity varies significantly with farm size, family labour participation on small farms, and how land is allocated to various activities (Carter & Wiebe, 1990, p. 1146-11). Urgessa's (2015) study revealed that agricultural productivity and non-farm income influence rural household income. Land-labour ratio, use of fertiliser, use of pesticides, manure, dependency ratio, and household size significantly influence agricultural land and labour productivity. The study found that the sex of the household head was mainly responsible for variation in rural household income (Urgessa, 2015, pp. 1-91). Awotide et. al. (2015) in their study showed that credit constraints have significant adverse effects on farm output, farm investment and farm profit (Awotide et. al., 2015). Seven & Tuman (2020) argued in their study that greater access to credit,

Table 1: Percentage Distribution of Households by Size Category of Landholdings for Each Household Social Group

Size of Land holdings	ST	SC	OBC	Others
landless	9.41	7.18	6.98	7.4
Marginal	68.83	85.7	75.25	70.22

Size of Land holdings	ST	SC	OBC	Others
Small	14.64	4.77	10.43	11.31
Semi-medium	5.74	1.84	5.12	7.18
Medium	1.36	0.48	1.99	3.34
Large	0.03	0.03	0.23	0.55

Source: NSS Report on 70th Round Land & Livestock Holdings, MoSPI, GoI

Table 2: Percentage Distribution of Households by Size Category of Landholdings for Each Household Social Group

States	Marginal	Small	Semi-medium	Medium
Andhra Pradesh	61.5	28.9	9	0.7
Assam	79.3	14.2	6	0.4
Bihar	74.9	21.4	3.5	0.1
Chhattisgarh	53.9	37.1	7.7	1.2
Gujarat	83.1	14.3	1.9	0.9
Haryana	79.3	7.9	12.8	0
Himachal Pradesh	94.7	4.4	0.9	0
J & K	97	1.9	1	0
Jharkhand	93.8	4.2	2	0
Karnataka	51.4	20.3	4.1	19.8
Kerala	97.5	1.3	1.2	0
Madhya Pradesh	75.3	16.1	6.9	1.4
Maharashtra	49.2	34.5	12.8	3.5
Odisha	89.9	8.8	1.1	0.3
Punjab	66.4	23.2	5.8	4.6
Rajasthan	62.6	19.6	13.3	4.1
Tamil Nadu	93.9	3.7	1.6	0.8
Telangana	48.8	16.7	30.8	3.6
Uttar Pradesh	77.1	20.5	1.8	0.7
West Bengal	97.6	1	1.3	0.1
North East States	51.9	30.9	14	3.3
Group of Union Territories	90.6	9.4	0	0

Source: NSS Report on 70th Round Land & Livestock Holdings, MoSPI, GoI

for example, access to agricultural banking services, increases productivity. However, in developing countries, this increase in productivity would be through its impact on agricultural production, rather than on agricultural labour productivity (Seven & Tuman, 2020, p. 4). Poonia (2015) viewed that households owning small and marginal land ensure lower productivity and contribute less to agriculture (Poonia, 2015, p. 5). It can be seen that access to capital forms the base of determining agricultural productivity. To understand how access to capital influences productivity, the present study uses the 77th Round NSS unit-level data from the Land and Livestock Holdings Survey.

Econometric Modelling on Agricultural Productivity & Access to Capital

Following Greene (2018), the study constructs the binary logistic regression model. This model considers the hypothesis that access to capital influences agricultural productivity among ST and non-ST communities in rural India. To examine it, the study uses micro-level data from the 77th round of Land & Livestock Holdings (2019) by the MoSPI, Government of India.

The National Statistical Office in rural India conducts the Land and Livestock Holdings of Households (L&LS) survey. The NSS 77th round, Land & Livestock Holdings, was conducted from January 2019 to December 2019. The information was collected during two visits to the same set of sample households (Visit 1: July-Dec 2018; Visit 2: Jan-Jun 2019). Excluding the villages of the Andaman & Nicobar Islands due to their inaccessibility, the survey covered the whole of rural India. The first visit covered 58035 households, and the second visit covered 56894 households. Using unit-level data from Visit-1, this section aims to identify the factors (accessibility to capital) associated with household productivity (value of agricultural productivity) using independent variables identified from the NSS 77th round L&LS survey data. This analysis was made for two groups: ST households and non-ST households (i.e., 'Others' among all social groups). Out of the total households covered in All-India Survey data, Scheduled Tribes (ST) = 9780 with agricultural land and non-Scheduled Tribes (non-ST)= 11938 with agricultural land were considered to examine how their agricultural productivity is influenced by their accessibility to capital.

The study used agricultural production as a proxy for productivity, as NSS data provide information in categorical terms. This is the outcome or dependent variable that takes two possible values (0, 1). For households with low productivity (i.e., agricultural productivity is either less than or equal to Rs. 4000), the assigned value is 0. For households with high productivity (i.e., agricultural productivity exceeding Rs. 4000), the value assigned is 1. Independent variables that influence the outcome variable are gender, education, irrigation facilities, agricultural training, age, household size, and household land holding. Hence, five independent variables are considered.

The binary logistic model considered for

the study is of the form:

$$\text{Logit(P)}=\log\left(\frac{P}{1-P}\right)$$

$$= \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + u \quad \ldots (1)$$

(Hosmer & Lemeshow, 2000)

Taking exponential on both sides, we get

$$e^{\log\left(\frac{P}{1-P}\right)} = e^{\left(\beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5 \atop +\beta_6X_6+\beta_7X_7+\beta_8X_8+u\right)}$$

Therefore,

$$\left(\frac{P}{1-P}\right) = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + u \quad \ldots (2)$$

Where, P = the odds of the probability that rural ST Households productivity are low. This model will try to estimate the relationship between rural productivity (*binary dependent variable)* with four categorical and four continuous independent variables. Age in this model is a proxy for experience. We consider age and also age square because if we have a positive effect of age and a negative effect of age square it would imply that as people age then impact of age on the independent variable decreases. On the contrary, if age and age square are both have positive effect then it means the effect of age on the dependent variable gets stronger with ageing of the people.

X_1 = age of the household member between (15-64) years, age is taken as proxy of experience

X_2 = age square

X_3 = household size

X_4 = landholdings in acres

X_5 = sex

X_6 = education:

X_7 = whether any household members received agricultural training

X_8 = whether land irrigated or not

The codes of dependent and independent variables assigned are listed in Table 3.

Table 3: Description of Variables of the Binary Logistic Model for Rural ST Households Productivity

Variable	Description	Codes/Values	Name
1	Value of Agricultural Production	0 = less than Rs.4000 1 = more than Rs.4000	PROD
2	Gender (Dummy)	0 = Male 1 = Female 2 = Transgender	GEN
3	Education (Dummy)	0 = Not literate to upper primary level 1 = Secondary to higher secondary level 2 = Graduation & above	EDU

Variable	Description	Codes/Values	Name
4	Agricultural training (Dummy)	0 = No 1 = Yes	TRAING
5	Irrigation used (Dummy)	0 = No 1 =Yes	IRRG
6	Age (Continuous interval)	Years	AGE
7	Age square (Continuous interval)	Years	AGESQ
8	Household size (Continuous interval)	Numbers	HHS
9	Landholdings (Continuous ratio)	In acres	LAND

Summary Statistics

The summary statistic provided in Table 4 shows that the average age of ST rural household is 40.7 with a S.D. of 13.17. The average household size is 5 with a S.D. of 2. Average landholdings were found to be 1.99 acres with S.D. 2.26.

Table 4: Summary Statistics of Key Variables on ST Rural Productivity used in Estimations

Variables	Code	Obs	Mean	Standard Deviation	Min	Max
Productivity of ST Rural Household (Dependent variable)	PROD_ST	9780			0	1
Gender of household head member (Binary)	GEN	9780			0	2
Education of household head member (Binary)	EDU	9780			0	2
Agricultural Training (Binary)	TRAING	9780			0	1
Irrigation used (Binary)	IRRG	9780			0	1
Age	AGE	9780	40.69847	13.17889	15	64
Age Square	AGESQ	9780	1830.031	1056.426	225	4096
Household Size	HHS	9780	5.344581	2.259763	1	23
Landholdings	LAND	9780	1.991766	2.264705	.01	61.8

Source: NSS survey data (2019) using STATA software version 17.

Results and Findings

The results of the logistic regression model used to analyse the relationship between ST agricultural productivity and access to capital. Results show that the gender of the head of household (GEN 2) is not statistically significant. The education level (IX-XII) (EDU 1) was not statistically significant, but the educational level of Graduation & above (GEN 2) was significant. Households that receive agricultural training are found to be insignificant. Households that used irrigation (IRRG 1) significantly influenced the ST agricultural productivity. Age in the working-age group (15-64), household size (HHS), and landholdings (LAND) were found to be statistically significant.

The Output obtained in Table 5 showed that for irrigation, for one unit increase in use of irrigation by ST households going from 0 to 1, the odds of high agricultural productivity versus the low agricultural productivity is 4.23 times greater. For age, the value of odds ratio is 0.91. This indicates that with increase in years of age, there will be 0.91 times decline in odds of high agricultural productivity. The possible reasons for such relationship can be that the efficiency of persons increases 5 to 10 per cent every 10 years of age to the age of interval of 35 to 44 years and then decreases at the same rate (Tauer, 1995, p. 63-69). For household size, with the increase in number of household member in the family, the odds of agricultural productivity increase 1.16 times. Again, in case of landholdings, with one unit increase in size of landholdings, the odds of high agricultural productivity compared to low agricultural productivity is 2.02 times greater.

Table 5: Estimated Odd Ratios for Binary Logistic Regression Model of Rural ST Household Agricultural Productivity

Logistic regression					Number of obs = 9,789	
					LR chi2(5) = 647.34	
Log Likelihood = –2389.487					Prob > chi2 = 0.0000	
					Pseudo R2 = 0.1193	
PROD_ST	Odds ratio	Std. err.	z	P > |z|	[95% conf. interval]	
IRRG						
Yes	4.228759	.5882226	10.37	0.000	3.219663	5.554124
AGE	.954682	.016957	–4.77	0.000	.8828292	.9493138
AGESQ	1.00098	.0002307	4.25	0.000	1.000528	1.001433
HHS	1.168501	.0233631	7.79	0.000	1.123595	1.2152
LAND	2.025335	.0885864	16.14	0.000	1.858943	2.206621
_cons	10.11973	3.797269	6.17	0.000	4.850308	21.11392

Note: ***_cons*** estimates baseline odds.

Source: NSS Survey micro-level data

Figure 1: Probability cut off, Sensitivity & Specificity (ST)

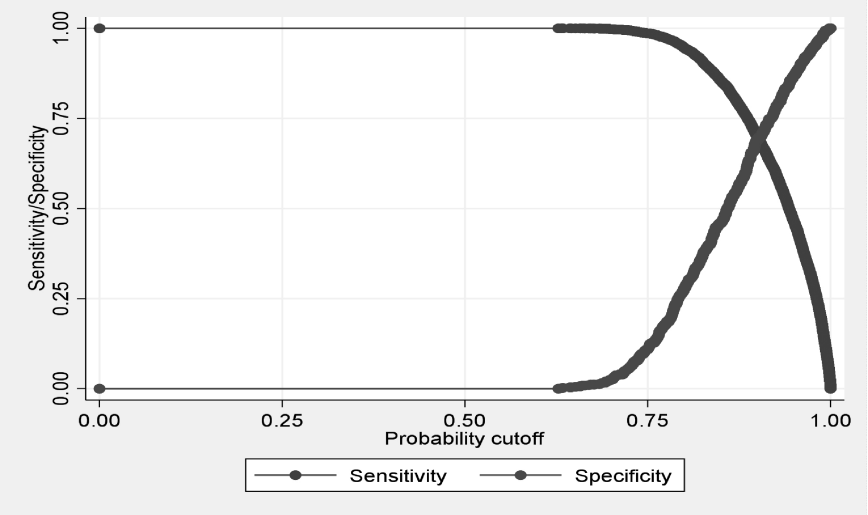


Figure 2: ROC Analysis (ST)

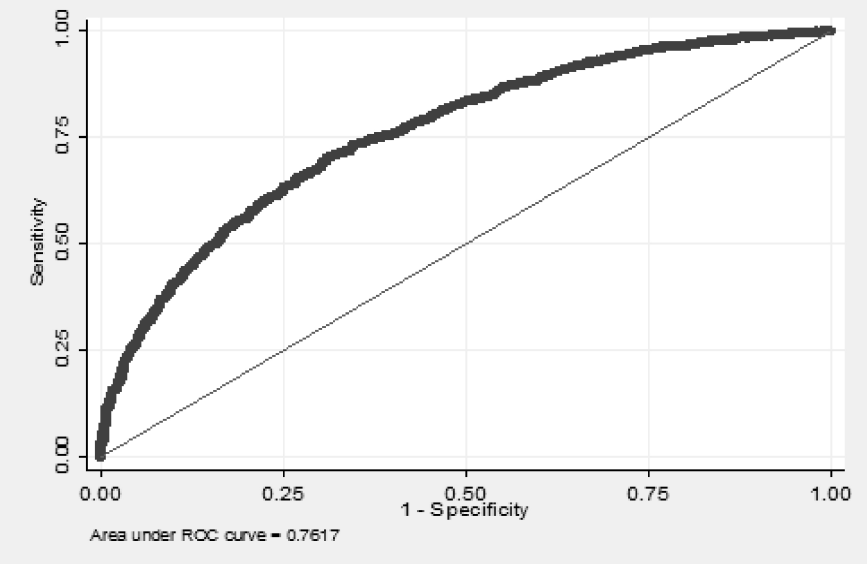


Figure 3 (a): Standard Residual

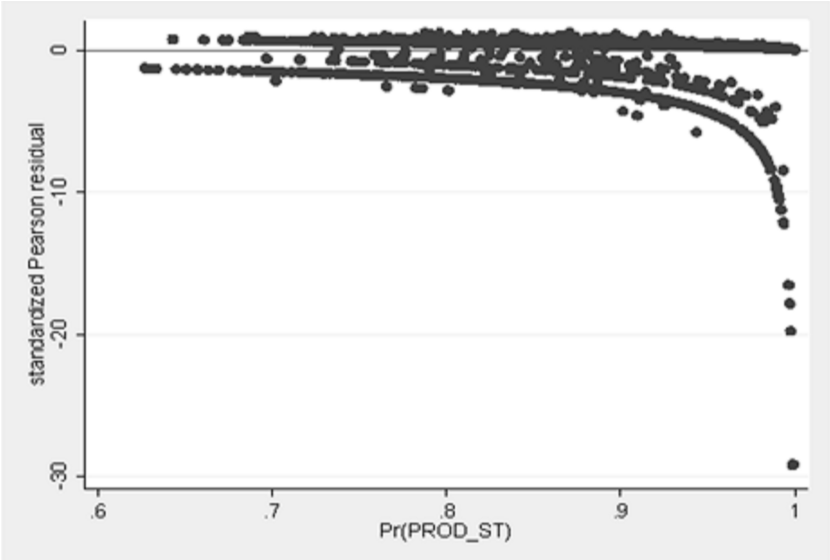


Figure 3(b): Deviance Residuals

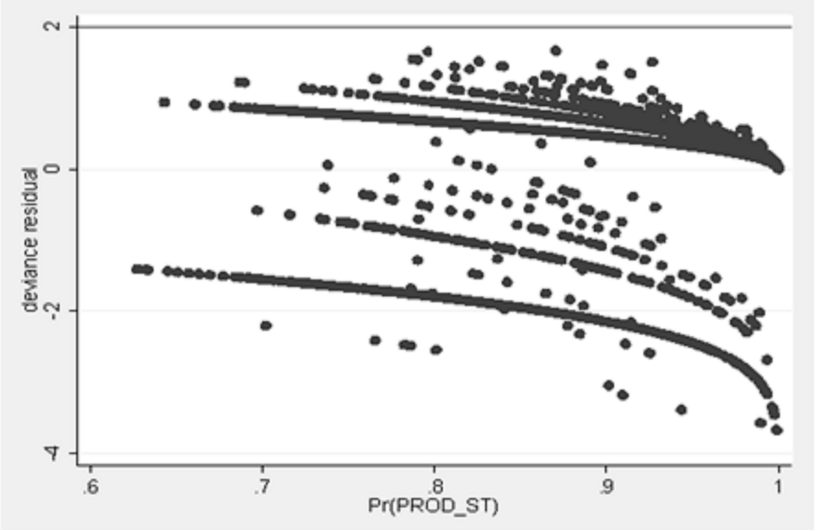


Figure 3 (c): DeltaX Residuals

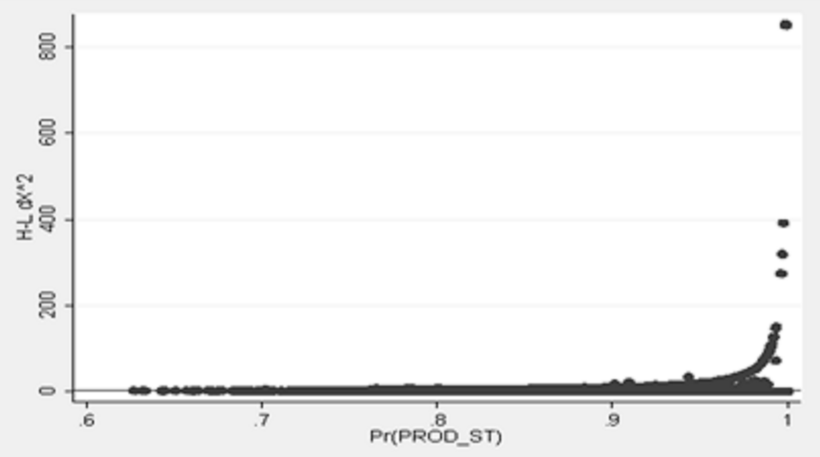
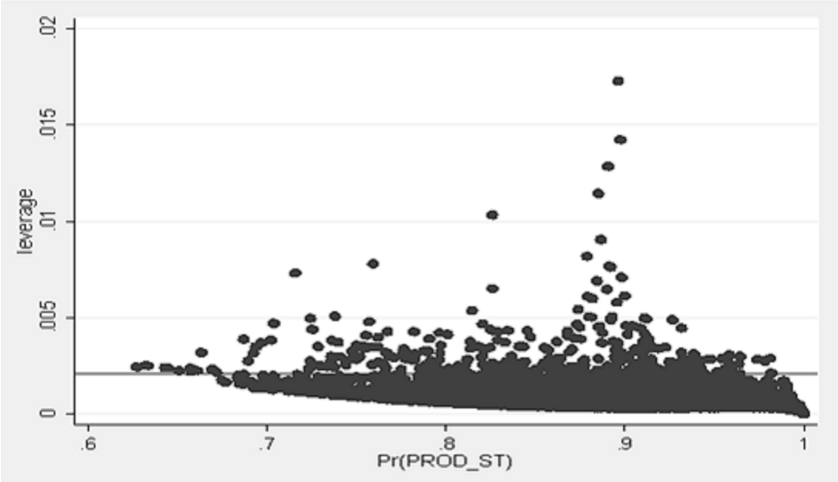


Figure 4: Influential Observations



Model Fit

Hosmer & Lemeshow (2002) suggested some measures for assessing the fitness of the logistic regression model. These includes Pearson Chi-square statistic and deviance, Hosmer-Lemeshow test, Classification tables and area under the ROC curve (Hosmer & Lemeshow, 2002, p.143). In line with this, the study used *likelihood test* to check the model fit. The probability value found to be less than 0.05. It indicates that model is significant. Using classification tables, the study identifies how many times the prediction was correct. A cut – off value of 0.5 is used. The best cut-off is where sensitivity equals specificity. From the classification table, the study found that the model

correctly classified around 69.42 per cent of observations. From *ROC Analysis*, study conclude that the area under ROC curve is 0.7617 that implies good discrimination. This model is doing acceptable work relative to data.

Results of Binary Logistic Regression model on Rural non-ST Household Agricultural Productivity

In the previous section, the study identified the factors that influences ST agricultural productivity. In this section, using the same microeconometric model given in equation (1) and equation (2), similar problem will be examined for the non-ST agricultural household. All the variables considered in case of ST households, will be considered for non-ST households to see variation. The summary statistic provided in Table 6 for non-ST households shows that the average age of non-ST rural household is 42.7 with S.D. 13.7. Average household size is 5 and S.D is 2. Average landholdings were found to be 2.49 acres with S.D. 3.69.

Table 6: Summary Statistics of Key Variables of Non-ST Rural Household Agricultural Productivity used in Estimations

Variables	Code	Obs	Mean	Standard Deviation	Min	Max
Productivity of non-ST Rural Household (Dependent variable)	PROD_nonST	11938			0	1
Gender of household head member (Binary)	GEN	11938			0	2
Education of household head member (Binary)	EDU	11938			0	2
Agricultural Training (Binary)	TRAING	11938			0	1
Irrigation used (Binary)	IRRG	11938			0	1
Age	AGE	11938	42.75909	13.66499	15	64
Age Square	AGESQ	11938	2015.056	1115.091	225	4096
Household Size	HHS	11938	5.36321	2.59892	1	23
Landholdings	LAND	11938	2.487054	3.696282	.01	90

Source: NSS survey micro-level data (2019) using STATA software version 17.

Using the logistic regression model, the results in Table 7 provide estimates for 11936 non-ST households. Among the independent variables considered in Table 6, education and the gender of the household were statistically insignificant. Age of the household head, household size, landholdings, access to irrigation and agricultural training were statistically significant and positively associated with high agricultural productivity of non-ST households, with age as an exception. The results show that age, which was considered a proxy for years of experience, was found to be negatively associated with agricultural productivity. Omitting the insignificant independent binary variables from the model, the study provides results using significant variables in odds ratio as shown in Table 8.

Table 7: Estimated Coefficients for Binary Logistic Regression Model of non-ST Productivity

Logistic regression					Number of obs = 11,936	
					LR chi2(9) = 857.76	
Log Likelihood = –1881.9464					Prob > chi2 = 0.0000	
					Pseudo R2 = 0.1856	
PROD_nonST	Coefficient	Std. err.	z	P > |z|	[95% conf. interval]	
GEN						
female	–.001479	.1058801	–0.01	0.989	–.2090001	–.2060422
transgender	0	(empty)				
EDU						
secondary to higher sec...	.00895	.1023359	0.09	0.930	–.1916247	.2095248
graduation & above	.2165747	.1635594	1.32	0.185	–.1039958	.5371453
TRAING						
Yes	2.563346	1.008527	2.54	0.011	.5866707	4.540022
IRRG						
Yes	1.937829	.1315527	14.73	0.000	1.67999	2.195668
AGE	–.0690624	.0208418	–3.31	0.001	–.1099116	–.0282131
AGESQ	.0008415	.0002578	3.26	0.001	.0003361	.0013468
HHS	.2269043	.0234661	9.67	0.000	.1809115	.2728971
LAND	.7055158	.0551499	12.79	0.000	.597424	.8136076
_cons	1.626124	.1382217	3.71	0.000	.767225	2.485022

Source: NSS Survey micro-level data.

Table 8: Estimated Coefficients for Binary Logistic Regression Model of non-ST Household Agricultural Productivity

Logistic regression					Number of obs = 11,938	
					LR chi2(6) = 855.94	
Log Likelihood = –1882.9591					Prob > chi2 = 0.0000	
					Pseudo R2 = 0.1852	
PROD_nonST	Odds ratio	Std. err.	z	P > |z|	[95% conf. interval]	
TRAING						
Yes	13.24615	13.35556	2.56	0.010	1.835935	95.57003
IRRG						
Yes	6.958173	.9141591	14.77	0.000	5.378548	9.001718
AGE	.9351921	.0188474	–3.32	0.001	.898972	.9728716
AGESQ	1.00081	.000251	3.23	0.001	1.000318	1.001302
HHS	1.259144	.0293896	9.87	0.000	1.202839	1.318084
LAND	2.026323	.111097	12.88	0.000	1.819868	2.256199
_cons	4.982851	2.046579	3.91	0.000	2.227761	11.14518

Note: ***_cons*** estimates baseline odds.

Source: NSS Survey micro-level data

Interpretation of Odds Ratio

The results in Table 8 showed that with one unit increase in agricultural training moving from 0 to 1, the odds of high agricultural productivity of non-ST households increases with 13.25 times the low agricultural productivity. For irrigation, one unit increase in access to irrigation facilities will result in 6.96 times increase in odd of high agricultural productivity. Age coefficient was found negative. Hence, increase in age factor causes 0.94 times decrease in odd of high agricultural productivity compared to low agricultural productivity. In case of HHS, increase in one member can cause odds of agricultural productivity to increase by 1.26 times. Likewise, increase in one unit of landholdings among non-ST households will lead to increase odd of high agricultural productivity by 2.03 times the low agricultural productivity.

Model Fit

Following Hosmer & Lemeshow (2002), the study assesses the fitness of the logistic regression model (Hosmer & Lemeshow, 2002, p.143). From *likelihood ratio test*, the probability value found to be less than 0.05. It indicates that model is significant. From the classification table, the study found that the model correctly classified

around 74.44 per cent of observations. From *ROC Analysis*, the study concludes that the area under ROC curve is 0.8328 that implies excellent discrimination. This model is doing acceptable work relative to data.

Figure 5: Probability cut off, Sensitivity & Specificity (non-ST)

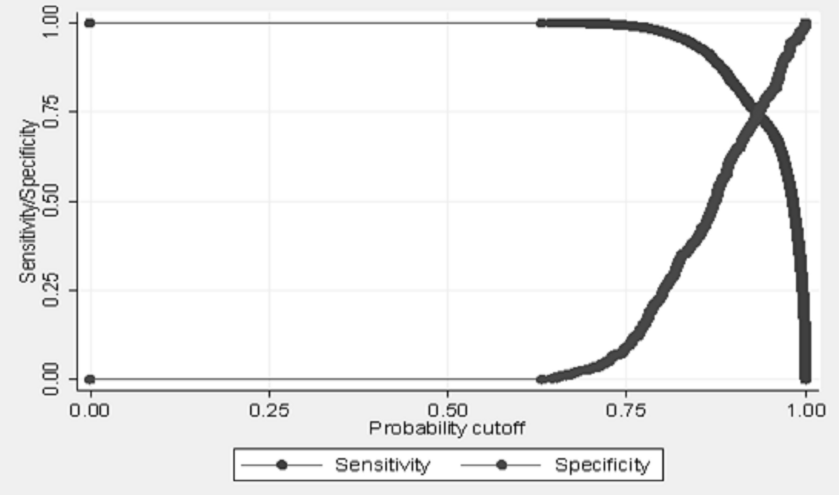


Figure 6: ROC Analysis

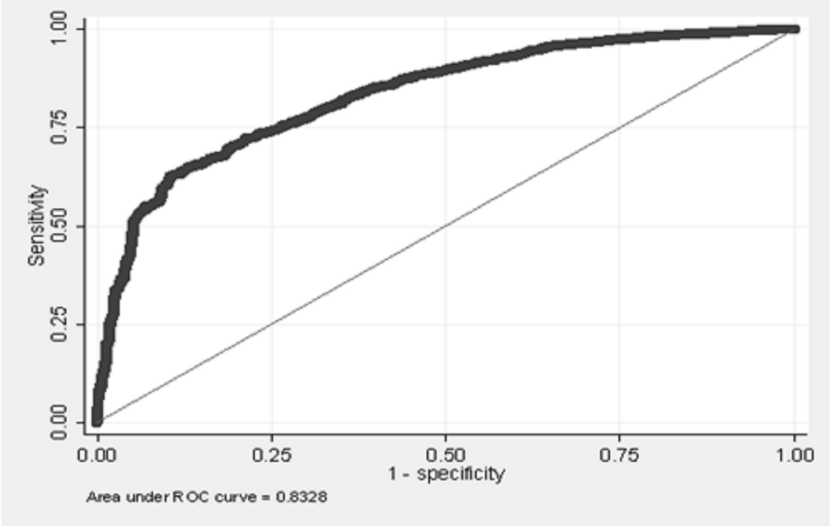


Figure 7 (a): Standard Residual

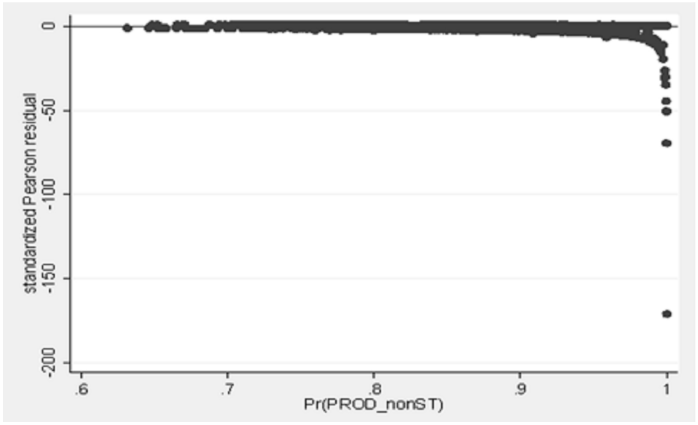


Figure 7 (b): Deviance Residuals

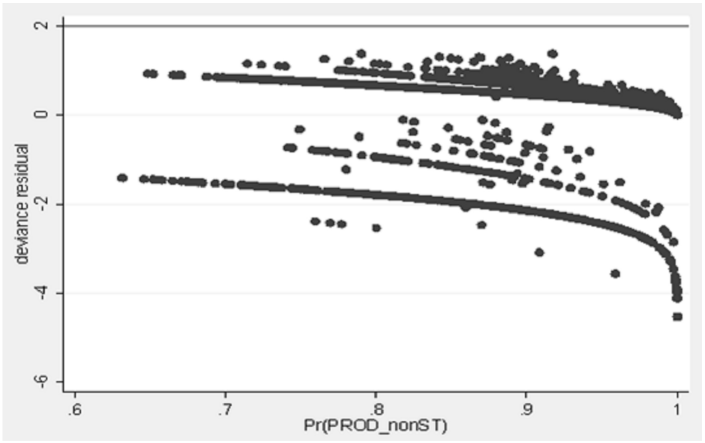


Figure 7 (c): DeltaX Residuals

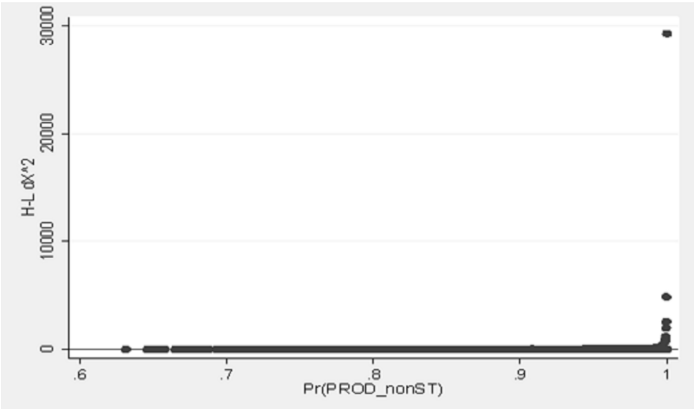
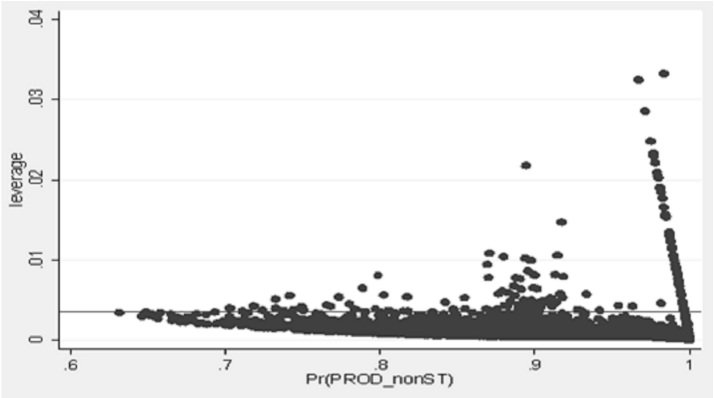


Figure 8: Influential Observations



Conclusion

Based on the results from binary logistic regression model, the study conclude that the null hypothesis proposed in the study is that there is a significant relationship between ST agricultural productivity and access to capital. The alternative hypothesis is that there is no significant relationship between ST agricultural productivity and access to capital. With total number of observations ST households = 9780, the Chi-Squared (5) = 647.34 (with p-value=0.000), shows that model is fit. The Psuedo R-Squared= 0.1193. Since the capital such as landholdings, households' size, age of household head and use of irrigation were found statistically significant to influence agricultural productivity of ST households, therefore, we fail to reject the null hypothesis. In case of 11938 non-ST households, the study fails to reject the null hypothesis because access to capital is significantly associated with agricultural productivity of non-ST households as well. Unlike ST households, agricultural training was also found significant along with irrigation, household size, landholdings and age. In comparing the effects of independent variables in case of both ST and non-ST agricultural households, the present study observed that agricultural training has no impacts on ST agricultural productivity but found significant in case of non-ST households. Hence, access to irrigation and household size has greater impact on non-ST household agricultural productivity compared to ST household. Landholdings have same impacts on both social groups. From the study it was found that age as a factor in agriculture is related to physical strength, therefore, after attaining certain age, increase in age may reduce ability to work and account for decrease in agricultural productivity in case of both ST and non-ST households.

Conflict of Interests

The author declares that there is no conflict of interests that are directly or indirectly related to this research work.

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