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Farm income inequality and the role of caste: new evidence from India

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Abstract

The paper analyses the relationship between net farm income per unit of land cultivated and caste divisions in India using a micro unit recorded nationally representative household survey conducted in 2004-05. Findings suggest that the groups that are generally considered disadvantaged ("Scheduled Castes/Scheduled Tribes") have, after controlling for other factors, substantially lower farm returns compared to the advantaged ("Others") castes, whereas the "Other Backward Classes" occupy position in between. Decomposition of overall net farm income inequality using mean-log deviation indicates that the caste based inequality forms a substantial part of the overall net farm income inequality. Results call for policies for neutralizing the impact of caste on agricultural returns in addition to the general policy of land redistribution.

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1. Introduction

While examining economic inequality, researchers have invariably narrowed down to uneven distribution of land as one of the major determinants as far as disparity among rural households is concerned (Griffin 1976; Nadkarni 1980; Ghonemy 1990; Adams and He 1995; Besley and Burgess 1998). The same has been attributed as a reason in case of India also, where there is large disparity in land holdings across different social groups (Deshpande 2001; Thorat 2002; Gaiha *et al.*, 2007; Bakshi 2008). Disparity in agriculture income across different social groups is understandable if there is social disparity in land holdings, but do rural households belonging to different social groups and having similar land holdings (and similar farm practices) receive similar returns in terms of net farm income per unit of land cultivated? If not, then it can be one of the hidden reasons behind the prevailing social inequality in income in the rural areas.

In India, there is a large diversity in terms of caste which forms major axis of social stratification. The two groups that are lowest in the Indian social hierarchy are the Scheduled Castes (SC) and Scheduled Tribes (ST) followed by castes which are categorized in Other Backward Classes (OBC) and the most advantaged castes which are referred to as the Upper castes or General category (Others Category, OC) (Deshpande 2001; Desai and Kulkarni 2008). The Hindu stratification system is so deep rooted in Indian society that, though India has been predominantly a Hindu nation, with a substantial degree of religious diversity, a significant percentage of Muslims, Christians, Sikhs etc. also identify and associate themselves with caste groups defined by Hindu traditions (Desai and Kulkarni 2008).

There is enough evidence to believe that the returns to farm cultivation may be lower for households belonging to SC/ST than those belonging to OBC, whose returns in turn may be lower than households belonging to OC. The belief comes from the fact that the lower castes have suffered severe exclusion from social activities and public resources, like water wells, public grounds etc. (Beteille 1969; Mendelsohn and Vicziany 1998; Bayly 1999; Shah *et al.*, 2006). Social exclusion is common in both villages and cities and also translates into active discrimination in access to different governmental and non-governmental services (Banerjee and Knight 1985; Bhattacharjee 1985;; Krishnan 1993; Banerjee and Bucci 1994; Lakshmanasamy and Madheswaran 1995; Deshpande 2000; Thorat 2002; Borooah 2005; Kijima 2006; Gaiha *et al.* 2007; Thorat and Attewal 2007; Gang *et al.* 2008). There is also evidence of substantial caste based disparity in consumption, income, ownership of assets, education, occupation, and other development indices (Deshpande 2001; Borooah 2005; Hasan and Mehta 2006; Mohanty 2006; Mehrotra 2006; Sundaram 2006; Bakshi 2008; Desai and Kulkarni 2008).

Though, the disparity in farm income and land ownership across different castes is a concern in itself and must be dealt with policy interventions, a more fundamental issue which has remained neglected both in qualitative and quantitative work is the question about farm returns. Do farmers belonging to different caste categories receive similar returns in terms of net farm income per acre of land cultivated? This question is difficult to answer, precisely because it is almost impossible to find a study which has examined (at the national level) the idea of differential returns to farm cultivation based on caste categories. This study, therefore explores just one basic question, if factors like farm size and farming practices are controlled, do rural households belonging to SC/ST categories receive net farm income (per acre of land cultivated)

comparable to that of households belonging to OBC and OC categories and do households belonging to OBC category receive net farm income (per acre of land cultivated) comparable to that of households belonging to OC category? If not, what is the share of caste based inequality in the overall inequality in net farm income per unit of land cultivated in rural India?

This paper indeed finds systematic caste based difference in net farm income per acre of land cultivated among Indian (rural) households. The returns to farming are lowest for SC/ST households, followed by OBC households and highest for OC households. With these thoughts, the next section presents the analysis used in the paper and the main results which is followed by concluding remarks.

2. Analysis and Results

The study is confined to rural parts of India. The data has been taken from Indian Human Development Survey (IHDS), conducted by National Council of Applied Economic Research, New Delhi, India in collaboration with the University of Maryland, in 2004-05. The survey is a micro unit recorded, nationally representative survey based on a stratified, multistage sampling procedure. The survey was spread over all the states and union territories of India except Andaman & Nicobar Islands and Lakshadweep and covers 26,734 households (143,374 individuals) and 14,820 households (72,380 individuals) in rural and urban areas respectively. Along with background characteristics like (caste, religion etc.) the survey also reports the actual earnings for households and individuals from different sources. The survey contains detailed information on land holdings (such as, total land owned, own land cultivated, land rented out, land rented in etc.), income from different farm (income from crops cultivated) and other activities (including livestock, equipments rented out etc.) and expenditure incurred on farm and livestock (including expenses on hired labors, seeds, fertilizers and manures, pesticides and herbicides, irrigation, hiring of equipments, livestock etc.) for every rural household covered in the survey. This information is very important for the analysis presented in the present paper as it enables us to estimate net farm income per acre of land cultivated for every rural household.[1]

The analysis is based on net annual farm income per acre of land cultivated which has been obtained for each of the households by deducting the costs of inputs from the gross income.[2] It includes only the net income from the land cultivated (own land as well as land rented in) and doesn't include any income or expenditure from livestock, equipments rent out or land rent out. The net farm income per acre of land cultivated is nothing but the returns to farm cultivation. Since the study is based on the net annual farm income per acre of land cultivated, it excluded from the analysis, the rural households who didn't cultivate any land in the past year. Among the households who cultivated some land, there was an extremely small number who had zero or negative net farm income. Since, zero or negative farm incomes cannot be used for inequality decomposition using mean-log deviation (the choice of mean-log deviation as a measure for carrying out inequality decomposition has been explained subsequently) they were removed from the analysis. As there is evidence of productivity (and therefore farm income)

[1] The land holdings are reported by households in local units. But the survey provides conversion factors for converting the local units into acres which have been used to convert the land holdings into acres.
[2] The net income doesn't include any taxes. In India, agriculture income is exempted from income tax as per the income tax act.

being affected by farm size/ land holdings (Mazumdar 1963; Rao 1963; Sen 1964; Mazumdar 1965; Rao 1966; Bhagwati and Chakravarty 1969; Saini 1969; Banerjee 1999; Ghatak and Roy 2007), the households were divided into four categories based on total land cultivated.[3] The distribution has been made so as to have a finer control for the effect of land holdings on net farm income as well as to have similar proportion of households in each category.

Since, farm practices and awareness of farmers can also affect productivity (and therefore income), control for these factors have been introduced using the highest educational attainment of an adult in the household (which is taken as a proxy for farm practices and general awareness in the household about farming). It therefore results in each of the categories based on total land cultivated being further subdivided into four more categories. The aforesaid division of the households results into a total of sixteen categories which are referred to as cohorts (totally sixteen cohorts) in this study. The details of these cohorts have been provided in Table 1.

Table 1 Distribution of rural households into cohorts based on size of land cultivated and highest educational attainment of an adult in the household, India (IHDS, 2004-05)

Cohorts	Land Cultivated by household (acres)	Highest Educational Attainment in the household (years of schooling)
1	Greater than 1 but less than or equal to 2	0
2	Greater than 1 but less than or equal to 2	Greater than 0 but less than or equal to 5
3	Greater than 1 but less than or equal to 2	Greater than 5 but less than or equal to 10
4	Greater than 1 but less than or equal to 2	Greater than 10
5	Greater than 2 but less than or equal to 3	0
6	Greater than 2 but less than or equal to 3	Greater than 0 but less than or equal to 5
7	Greater than 2 but less than or equal to 3	Greater than 5 but less than or equal to 10
8	Greater than 2 but less than or equal to 3	Greater than 10
9	Greater than 3 but less than or equal to 5	0
10	Greater than 3 but less than or equal to 5	Greater than 0 but less than or equal to 5
11	Greater than 3 but less than or equal to 5	Greater than 5 but less than or equal to 10
12	Greater than 3 but less than or equal to 5	Greater than 10
13	Greater than 5	0
14	Greater than 5	Greater than 0 but less than or equal to 5
15	Greater than 5	Greater than 5 but less than or equal to 10
16	Greater than 5	Greater than 10

Analysis has been carried out separately for each of the above mentioned sixteen cohorts. In each of the cohort, the households are further divided into three groups (SC/ST, OBC and OC) based on the caste of household head. The net farm income per acre of land cultivated of these groups (each group contains the net farm income of households with same caste category) are then compared with one another. Since all the households in any particular group belong to the

[3] Note that households with less than one acre of cultivated land have not been included in the analysis. This is because there can be large fluctuations in income from unknown reasons, as well as general problem of error in reporting income for very small farmers. However, this will not affect the analysis or results in any ways because the analysis has been done separately for each category and the results on disparity are independent for each individual category. If the category of households with less than one acre of cultivated land would have been included in the analysis, results for one more category had been added to the results but the addition (or omission) doesn't affect results for other categories.

same caste category, whereas the household belonging to different groups are from different caste categories the difference in net farm income per acre of land cultivated between the three groups can be safely attributed to caste based inequality (as each group in any cohort have similar land holding and similar awareness about farm practices).

It can be observed from Table 2 that in every cohort the net annual farm income per acre of land cultivated for OC households is systematically higher than OBC households and that of OBC households is systematically higher than SC/ST households.

Table 2 Descriptive Statistics: Mean household net farm income (annual in Indian Rupees) per acre of land cultivated, India (IHDS, 2004-05)

Cohorts	Households belonging to Others (OC)	Households belonging to OBC	Households belonging to SC/ST	Total
1st (1<L≤2 & E=0)	12927.70	8075..47	5549.71	8014.74
	172	292	350	814
2nd (1<L≤2 & 0<E ≤5)	11308.25	7686.00	6804.07	8304.63
	149	265	189	603
3rd (1<L≤2 & 5<E ≤10)	20892.25	11343.68	8639.92	13884.44
	405	504	297	1206
4th (1<L≤2 & E>10)	20720.28	13797.67	14327.52	16947.50
	257	213	114	584
5th (2<L≤3 & E=0)	10169.14	7028.86	4843.66	6587.30
	80	204	216	500
6th (2<L≤3 & 0<E ≤5)	11843.6	6616.40	4792.65	7147.11
	73	158	110	341
7th (2<L≤3 & 5<E ≤10)	12550.68	8752.20	6614.54	9501.61
	296	403	208	907
8th (2<L≤3 & E>10)	13977.72	13501.04	6645.30	12532.95
	192	200	80	472
9th (3<L≤5 & E=0)	10664.23	6468.39	3658.42	5923.01
	57	173	161	391
10th (3<L≤5 & 0<E ≤5)	10621.55	5375.49	5124.64	6621.30
	84	164	88	336
11th(3<L≤5 & 5<E ≤10)	11735.37	8290.25	6163.38	9017.58
	266	370	159	795
12th (3<L≤5 & E>10)	16659.00	8482.89	5744.98	11148.20
	201	223	95	519
13th (L>5 & E=0)	6213.27	5208.50	3686.30	4843.12
	83	151	146	380
14th (L>5 & 0<E ≤5)	6806.13	5971.63	3422.83	5572.30
	90	179	85	354
15th (L>5 & 5<E ≤10)	9955.72	7106.30	6066.59	8037.14
	416	542	149	1107
16th (L>5 & E>10	12042.47	8937.13	5734.40	9984.39
	419	408	109	936
Total	13598.07	8557.12	6168.65	9555.43
	3240	4449	2556	10245

Notes: 1. First row: mean; second row: no. of observations (number of households).
2. L: total land cultivated by the household; E: highest educational attainment in the household.

For example, for the first cohort, the mean net annual farm income per acre of land cultivated per household is Rs 12927.70 for OC, Rs 8075.47 for OBC and Rs 5549.71 for SC/ST households, respectively. For this cohort, the mean net annual farm income per acre of land cultivated per household for OC households is 60% more than that of OBC households and 133% more than that of SC/ST households. This transitivity in returns to farm cultivation across the three caste groups is true for every cohort.

The statistics add to and are in line with the existing literature on differential returns to endowments/characteristics of the households/individuals belonging to different caste categories with the returns lowest for the households/individuals belonging to SC/ST category (Borooah 2005; Kijima 2006; Gang et al. 2007; Gaiha et al. 2007). For example, Borooah (2005) found that "at least one-third of the average income differences between SC/ST households and Others households was due to the 'unequal treatment' of SC/ST attributes". Similarly, Gang et al. (2007) found that 37.5% of the difference in poverty incidence between SC and non-SC/ST households is due to differences in returns to assets (or endowments). Though, there have been studies which have documented differential returns, but the documentation is mostly related to education or occupation. A literature search on the issue, however, doesn't result in any study which has methodically estimated the differential nature of farm returns for households belonging to different caste groups in India.

Some other interesting findings (though they are not the focus of this study) which can be observed from Table 2 are the effects of size of total land cultivated and the highest educational attainment in the household on net annual farm income per acre of land cultivated. It can be seen that for the same caste category and the same highest educational attainment in the household, the net annual farm income per acre of land cultivated decreases in general (with rare exceptions) with the increase in total land cultivated. This observation of a kind of inverse relationship between land size and productivity is considered like a "stylized fact" in Indian Agriculture (Mazumdar 1963; Rao 1963; Sen 1964; Mazumdar 1965; Rao 1966; Bhagwati and Chakravarty 1969; Saini 1969; Banerjee 1999; Ghatak and Roy 2007) and is not pondered upon here. Similarly, it can also be observed that for the same caste category and similar total land cultivated, the net annual farm income per acre of land cultivated increases in general (with rare exceptions) with the increase in highest educational attainment of an adult in the household. This is not hard to believe as general awareness in the households about better farm practices will improve with the increase in educational attainment in the household. As in the previous case, it is not the focus of this research and therefore is not further deliberated upon.

One may argue here that the reason for the difference in net farm income across different caste groups is due to the difference in fertility of land (and not caste effect) belonging to the different groups. This argument can be negated by considering the following: if there is no systematic difference in the fertility of land owned by the households belonging to different caste groups, then fertility of land cannot be the cause of the systematic difference in farming returns. If fertility of land is behind the systematic difference in returns, it can be possible only if there is a systematic difference in the fertility of land owned by households belonging to different caste groups with the fertility of land owned by OC households being systematically greater than those owned by OBC households and the fertility of land owned by OBC households being systematically greater than those owned by SC/ST households. This systematic difference in

fertility of land belonging to different caste groups can only result from a systematic division of land (based on fertility) among different caste groups, in which case caste can be taken as the primary cause and fertility of land as the channel through which caste affects the farm returns.

The argument that caste can be the primary cause and fertility of land as the channel through which caste affects farming returns can indeed be true if seen in the light of caste based social exclusion in India. The literature on social exclusion and caste based discrimination in India (details provided in the introduction section, for example, Beteille 1969; Mendelsohn and Vicziany 1998; Bayly 1999; Shah et al. 2006) clearly brings out the fact that in rural areas (at the village level), the households belonging to lower caste categories were restricted to small localities or confinements ("untouchable hamlets") at the border (or outskirts) of the villages, on lands which were seemingly not useful and prohibited for people from higher castes. The individuals from lower castes were barred from public lands, wells, ponds and other public resources. This condition existed at the village level in all the geographical regions of India. This village level phenomenon if aggregated for all the regions (or states of India) gives the all India picture.

The above discussion reveals that, in both the cases (no systematic difference in fertility of land and systematic difference in fertility of land), the fertility of land being the primary cause behind the difference in farm returns among households belonging to different caste categories can be reasonably ruled out (in the second case, it might be the channel through which caste affects returns).

Researchers can also argue that the difference in net farm income per acre of land cultivated across different caste categories is due to difference in nature of crops or other farm inputs like seeds, pesticides, fertilizers or even human capital (thus denying caste effect), that is, may be households belonging to OC category are cultivating high yielding varieties or cash crops or using more (or better) pesticides, fertilizers or human capital where as the households belonging to disadvantaged caste categories are cultivating low yielding varieties or traditional crops and lesser (or inferior) pesticides, fertilizers or human capital. My counter argument to this is as follows: since the analysis has been carried out separately for each cohort and households in each cohort have similar land holdings and highest educational attainment (and therefore similar awareness), why a household will cultivate low yielding or traditional crop (or lesser/inferior pesticides, fertilizers etc.) when there is information that another household (belonging to another caste but in the same village or adjacent village) with similar landholding is cultivating cash crop/ high yielding crop and earning more. And the argument that throughout rural India, households belonging to OC category systematically cultivate high yielding or cash crops or use better fertilizers (and pesticides etc.) where as their counterparts belonging to the disadvantaged castes, though, with similar land holding and awareness systematically cultivate low yielding or traditional crops or use lesser (inferior) fertilizers (and pesticides etc.) is impossible to accept.[4] Lastly, agricultural output is also affected by local endowments which can vary across groups to the extent supply of public infrastructure varies systematically with respect to caste composition of communities. If this is a reason, then it can also be safely attributed to caste effect.

[4] Our analysis and results should be seen in the light of the implicit assumption that there is no systematic difference in the farming practices of households belonging to different caste groups if these households have similar land holdings and educational attainments.

An additional issue which can be raised about the pan-India nature of study itself is whether the study can be conducted for the whole India or not. The common argument against the pan-India nature is that one acre of dry land is different from one acre of wet land (or one acre of land in the northern region is different from one acre of land in the southern region) which is indeed true. But the argument in favor of the study is that one acre of dry land for an SC/ST household in a region shouldn't be different from one acre of dry land for an OC household in the same region. Same should be the case with wet lands. Similar argument holds for the comparison of land across the different geographical regions. Therefore, aggregation at all India level is not likely to affect the nature of analysis.

Since, in every cohort the inequality between the different caste groups can now be safely attributed to caste based inequality, it is important to discuss the inequality decomposition exercise carried out in this paper. For every cohort, the decomposition of net farm income per acre of land cultivated, into within-group and between-group (the groups based on caste categories) has been carried out separately using mean-log deviation. The exact decomposition procedure is as follows:

Let the index (mean log deviation) be represented by *M*, and suppose that the set of households (in any cohort), *N*, is partitioned into m proper subgroups N_k ($k = 1,2, \ldots,m$), with respective income vectors y^k, mean incomes μ_k, population (households) sizes n_k, and population (households) shares $v_k = \frac{n_k}{n}$. Also, let $\bar{y}^k$ denote the distribution obtained by replacing each income in the vector y^k with the subgroup mean, μ_k. Then,

$$M(y) = M(y^1, y^2, \ldots, y^m) = \frac{1}{n}\sum_{k=1}^{m}\sum_{i\in N_k} \ln\frac{\mu}{y_i}$$

$$= \sum_{k=1}^{m}\frac{n_k}{n}\frac{1}{n_k}\sum_{i\in N_k} \ln\frac{\mu_k}{y_i} + \frac{1}{n}\sum_{k=1}^{m}\sum_{i\in N_k} \ln\frac{\mu}{\mu_k}$$

$$= \sum_{k=1}^{m} v_k M(y^k) + \sum_{k=1}^{m} v_k \ln\frac{\mu}{\mu_k}$$

$$= W + B \qquad (1)$$

where W is the within group inequality and B represents the between group component.

For example, if first cohort is considered (households with a total cultivated land of more than one acre but less than or equal to two acres and highest educational attainment of an adult in the household being zero years), the three subgroups in this cohort (as in other cohorts also) are the households belonging to SC/ST, OBC and OC categories respectively. If the inequality in net annual farm income per acre cultivation (per household) is now decomposed using mean-log deviation, it will yield two components; the first component will be the weighted average of within-group inequality values (commonly referred as within-group component, *W*). The second component is the between-group component, representing the level of inequality obtained by replacing the net farm income per acre of land cultivated of each household with the mean net farm income per acre of land cultivated of their respective subgroup. The second component is nothing but the between-caste component or the caste based inequality, *B*. Thus, for the mean-

log deviation, the overall level of inequality for each cohort can be expressed in an intuitively appealing fashion as an exact sum of the average inequality within the caste groups and the inequality due purely to differences in the average net farm income per acre of land cultivated between the caste groups. The ratio of between-group component to the overall inequality will give the caste based inequality as a proportion of the overall inequality. This process has been repeated for all the sixteen cohorts to obtain the share of caste in the overall inequality in per acre net annual farm income in each cohort.

The choice of mean-log deviation as the inequality measure for decomposing overall inequality in net farm income per acre of land cultivated into within-group inequality and between-group inequality was rather limited. The limitation comes from the properties which need to be satisfied in order to carry out the required decomposition. The inequality measures commonly used by authors in empirical work include the following: (a) the relative mean deviation; (b) the variance; (c) the coefficient of variation; (d) the Gini coefficient and (e) Generalized single parameter class of entropy measures, commonly known as GE measures which include the mean log deviation or GE(0), the Theils's index or GE(1) and the half coefficient of variation squared or GE(2) (Singh 2010). Mean log deviation (MLD) was chosen because it is the only measure which satisfies the following six axioms or properties. [5] The six axioms or properties comprise of the four standard axioms of (i) anonymity or symmetry; (ii) population replication or replication invariance; (iii) mean independence or scale invariance; (iv) Pigou-Dalton principle of transfers and the additional axioms of (v) additive subgroup decomposability and (vi) path independence.[6] The additional properties of additive subgroup decomposability and path independence are particularly important for the present study. The additive subgroup decomposability is important because the study primarily decomposes the overall net farm income per acre inequality into within-group and between-group components. Since the interest is in between-group component, the property of path independence is also required in the sense that the decomposition must yield the same result or the decomposition is invariant to whether the within group inequality is eliminated first and the between group component computed second, or vice versa (Ferreira and Gignoux 2008; Barros et al. 2009). The use of MLD in the present study is in line with earlier studies (Ferreira and Gignoux 2008; Barros et al. 2009; Checchi and Peragine 2010; Singh 2010) which have used similar decompositions in different contexts.

All the other members (including the Theil's index) of the generalized entropy class satisfy the first five of the above axioms but fail to satisfy the path independence property therefore making them less desirable for the present study. The Gini index which is one of the most commonly used inequality measure also satisfies the first four axioms but is not additively decomposable in the same way as the mean log deviation (Bourguignon 1979; Shorrocks 1980; Shorrocks and Wan 2005; Ferreira and Gignoux 2008). Some authors have attempted to decompose the Gini index in specific contexts (Lambert and Aronson 1993). The closest decomposition (of the Gini index) similar to the additive subgroup decomposability property of the generalized entropy class measures yields three components, within-group component,

[5] See Bourguignon (1979), Shorrocks (1980), Foster and Shneyerov (1999, 2000), Shorrocks and Wan (2005), Ferreira and Gignoux (2008) and Checchi and Peragine (2010) for a detailed discussion on the inequality measures and the six axioms.
[6] These properties have been described in Appendix I.

between-group component and a residual or interaction effect. The residual effect vanishes only when the range of the incomes of the subgroups do not overlap (which is clearly not the case in this study) and is otherwise strictly positive (Shorrocks and Wan 2005). When the residual term (or the interaction term) is not zero then the between-group effect cannot be obtained clearly from the decomposition.

The results of the decomposition exercise are presented in Table 3. Since, the inequality decomposition has been carried out separately for each of the sixteen cohorts the results should be interpreted separately for each cohort.

Table 3 Inequality decomposition (within-group and between-group, group defined by caste) for each cohort – Mean Log Deviation, India (IHDS, 2004-05)

Cohorts	Within-group inequality (W)	Between-group inequality or Caste based Inequality (B)	Overall Inequality in net farm income (per acre of land cultivated) (O)	Caste share (%)
1st (1<L≤2 & E=0)	0.54	0.05	0.59	8
2nd (1<L≤2 & 0<E ≤5)	0.51	0.03	0.54	6
3rd (1<L≤2 & 5<E ≤10)	0.64	0.06	0.7	9
4th (1<L≤2 & E>10)	0.69	0.04	0.73	5
5th (2<L≤3 & E=0)	0.61	0.04	0.65	6
6th (2<L≤3 & 0<E ≤5)	0.49	0.06	0.55	11
7th (2<L≤3 & 5<E ≤10)	0.47	0.03	0.5	6
8th (2<L≤3 & E>10)	0.59	0.03	0.62	5
9th (3<L≤5 & E=0)	0.57	0.07	0.64	11
10th (3<L≤5 & 0<E ≤5)	0.58	0.05	0.63	8
11th (3<L≤5 & 5<E ≤10)	0.54	0.03	0.57	5
12th (3<L≤5 & E>10)	0.53	0.08	0.61	13
13th (L>5 & E=0)	0.66	0.02	0.68	3
14th (L>5 & 0<E ≤5)	0.83	0.03	0.86	3
15th (L>5 & 5<E ≤10)	0.57	0.02	0.59	3
16th (L>5 & E>10	0.56	0.03	0.59	5

Notes: 1. Between-group inequality is nothing but the caste based inequality
2. Caste share (%) = B/O *100
3. L: total land cultivated by the household; E: highest educational attainment in the household

The share of caste based inequality (between-group component) as a proportion of overall net farm income (per acre of land cultivated) inequality varies from 3% (for the cohorts 13th, 14th and 15th) to 13% (for the 12th Cohort) with a simple average of 7% across different cohorts. It must be noted here that all the cohorts (13th, 14th and 15th) for which the caste based inequality is lowest (3%), have households with the largest land holdings (each household has more than five acres of cultivated land). If the cohorts with the largest land holding (greater than three acres) are not considered, then the simple average of caste based inequality across remaining cohorts comes out to be 8% with the range from 5% to 13% across cohorts. How significant are these estimates in terms of their size (whether they are large enough to be considered or not) is debatable and this study's objective is not to join that debate. The sole objective of the present study is to demonstrate the existence and to measure the extent of caste based inequality in returns to

farming and it is left to the readers to decide upon the significance of the extent. However, it must be mentioned here that the estimates are conservative and there is possibility that the share of between-group (caste based) inequality might increase if a more elaborate caste system (e.g. five instead of three) is used.[7] But a finer division of sample into more groups leads to the general problem of data insufficiency in studies using nonparametric approach as the present one. Further, the approach shouldn't be questioned on this account as it is able to analyze and answer the questions raised in the paper in a meaningful manner while keeping the analysis simple and general for a wider readership. Also, the justification of dividing the households into three caste groups has already been explained and dividing them into even finer categories doesn't add any new insight. Some additional remarks about the results have been provided in the following section which concludes the study.

3. Concluding Remarks

According to the egalitarian conception of a society, the outcomes should purely depend on efforts and choices exercised and not on characteristics like caste or religion which are exogenous to individuals and are decided at birth. The independence from social characteristics of outcomes like educational attainment or income has always been questioned in India. The present study has tried to explore one aspect of this question and has explored the returns to farm cultivation of households belonging to different caste groups. In this sense, it provides some new insights as it has decomposed overall net farm income (per acre of land cultivated) inequality into two components, the components being inequalities due to caste and inequalities due to factors other than caste. The decomposition analysis shows that inequality attributable to caste accounts for as much as 3% to 13% (across the different cohorts) of overall net farm income (per acre cultivation) inequality.

The average SC/ST and OBC household (and therefore individual) in India had lower farm returns compared to households from OC category in 2004-05. Between the SC/ST and OBC households (individuals) it is the SC/ST households (individuals) which were more disadvantaged. Considered in the light of the findings from earlier studies which reported extensive shortfalls of the average SC/ST household (or individual) in consumption, education, and other development indices, the scenario that emerges is one of persistent disadvantage for the lower caste groups in modern India.

The disadvantage in returns to farming suffered by the lower caste groups might be the result of social exclusion in access to public goods and various markets (Shah et al. 2006; Banerjee and Somanathan 2007; Anderson 2011). Anderson (2011) which is based on 120 villages drawn randomly from two (Uttar Pradesh and Bihar) of the poorest states of India specifically documents that the households belonging to lower castes had better access to irrigation only in villages dominated (ownership of majority land) by non-OC (OBC to be

[7] Please refer to Shorrocks and Wan (2005) for examining the effect of number of groups on between-group inequality.

specific).[8] It also suggests that households belonging to OC category do not like to or easily share or trade resources (water) with lower caste (SC/ST and OBC) households.

An all India study by Action Aid, conducted in the year 2000 and based on an intensive survey of 555 villages in eleven states across India, found direct discriminatory treatment of SCST persons in access to irrigation water, public and private services in more than one-thirds of the total villages (Shah et al., 2006). The study also relates the low productivity (and therefore low income) for the lower caste households to the discrimination in access to factor input market which results in higher prices for the factor inputs (compared to market prices) for the households belonging to the lower caste categories. It also reported about restrictions on selling of produce which results in lower selling prices (than market prices) and in turn to loss of income.

When there is heterogeneity along caste lines in access to basic public goods and difference in returns to farming based on caste, the policy of land redistribution to achieve greater social equality in rural areas may fail to attain the desired result. Since independence, the Central and State governments have focused on land reforms for reducing social disparity but have failed to accomplish their objectives partly because they fell short of addressing the important issue of differential farm returns based on caste. Focused policies which acknowledge the phenomenon of disparity in returns to farming across different caste groups are needed. They may be supplemented with policies which can neutralize the caste based differentials in returns to farming.

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[8] The villages were of two types; one type with one of the caste from OBC caste group owning majority of land and the other type with a caste from Others caste category group owning majority of land. There was no village which had majority of land owned by a caste from SC/ST category.

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Appendix I Details of the properties satisfied by mean log deviation as listed in section 2 (Analysis and Results).

The description of the properties has been provided in a generalized form in the context of individual income for which mean log deviation (MLD) and other common inequality measures are generally used. The same properties can be thought of in the context of farm income of households by replacing individual incomes with farm income of households. Since these are standard properties which have been fairly developed and described in the literature related to inequality measures, only an intuitive description has been provided here. For greater details see Bourguignon (1979), Shorrocks (1980), Foster and Shneyerov (1999, 2000), Shorrocks and Wan (2005), and Ferreira and Gignoux (2008).[9]

Consider a population of individuals represented by $N = (1, 2, \ldots, n)$, with $y = (y_1, \ldots, y_n)$ as the income vector. The mean income is denoted by μ. Inequality in income distribution is captured by an index, $I(y)$.

Property 1. Anonymity (Symmetry)

$I(y_1, y_2, \ldots, y_n)$ is invariant to permutations of $(y_1, y_2, \ldots, y_n)$. That is, $I(y) = I(x)$ whenever x is obtained from y by a permutation. In simple terms only the income distribution matters and not the individuals who are earning them.

Property 2. Population Replication (Replication Invariance)

$I(y_1, y_2, \ldots, y_n) = I(y_1, y_2, \ldots, y_n; y_1, y_2, \ldots, y_n)$ or in general $I(y) = I(x)$ whenever x is obtained from y by a replication, that is, incomes in x are simply the incomes in y repeated a finite number of times. Simply put, cloning the whole income distribution doesn't affect the inequality measure.

Property 3. Mean Independence (Scale Invariance)

$I(y_1, y_2, \ldots, y_n) = I(\delta y_1, \delta y_2, \ldots, \delta y_n) \ \forall \delta > 0$; that is $I(y) = I(x)$ whenever x is obtained from y by a scalar multiple. The inequality measure doesn't change if income of every individual in the population is scaled up or down by the same multiple.

Property 4. Pigou-Dalton Transfer Principle

$I(y_1, y_2, \ldots, y_i - \lambda, \ldots, y_j + \lambda, \ldots, y_n) > I(y_1, y_2, \ldots, y_i, \ldots, y_j, \ldots, y_n)$ if $\lambda > 0$ and $y_i < y_j$. In simple terms, if income is transferred from a poorer individual to a richer individual (regressive transfer), the inequality measure increases. Analogous definition can be mentioned for progressive transfers also, where the inequality measure should decrease, in case income is transferred from a richer individual to a poorer individual.

[9] The details presented in this appendix have been derived from the referred studies. Also, some standard notations are retained in order to maintain coherence.

Property 5. Additive Decomposability

Consider that the individuals, *N*, are partitioned into m proper subgroups N_k ($k = 1,2, \ldots,m$) based on some criteria, with respective income vectors y^k, mean incomes μ_k, population sizes n_k, and population shares $v_k = \frac{n_k}{n}$. Also, let $\bar{y}^k$ denote the distribution obtained by replacing each income in the vector y^k with the subgroup mean, μ_k. Then (following Shorrocks and Wan 2005), for MLD as the inequality index,

$$I(y) = I(y^1, y^2, \ldots, y^m) = \frac{1}{n}\sum_{k=1}^{m}\sum_{i\in N_k} \ln\frac{\mu}{y_i}$$

$$= \sum_{k=1}^{m}\frac{n_k}{n}\frac{1}{n_k}\sum_{i\in N_k} \ln\frac{\mu_k}{y_i} + \frac{1}{n}\sum_{k=1}^{m}\sum_{i\in N_k} \ln\frac{\mu}{\mu_k}$$

$$= \sum_{k=1}^{m} v_k I(y^k) + \sum_{k=1}^{m} v_k \ln\frac{\mu}{\mu_k}$$

$$= W + B$$

where *W* is the within-group inequality and *B* represents the between-group component. *W* is nothing but a weighted average of subgroup inequality values and *B* is the between-group contribution to inequality, representing the level of inequality obtained by replacing the income of each individual with the mean income of their respective subgroup.

Therefore for MLD, the overall level of inequality for the population can be expressed in an intuitively appealing manner as an exact sum of the average inequality within groups and the inequality due purely to differences in average incomes between groups (Shorrocks 1980; Shorrocks and Wan 2005). Any inequality measure is said to be additively decomposable when it can be decomposed in this way.

Property 6. Path Independence

Consider an inequality measure which satisfies the above decomposability property and that we are interested in obtaining *W,* which is the within-group component. It can be directly obtained as follows: replace the individual incomes, y_i^k, in every group with $y_i^k \frac{\mu}{\mu^k}$ (where μ is the overall mean for the population). This operation will suppress all between-group inequality, leaving only inequality within groups. If the considered inequality measure is now applied on this "standardized" distribution, it will give the within-group component directly.

Instead, if we replace the individual incomes, y_i^k, in every group with the group-specific mean (μ_k), then all the within-group inequality will be eliminated, and the resulting "smoothed" distribution will have only the between-group component. The within-group component *W* can now be obtained (indirectly) from subtracting the inequality (using the considered inequality measure) in above "smoothed" distribution from the overall inequality (using the same inequality measure) in the actual distribution. If the within-group component obtained from the two processes is same, then the inequality measure is considered to be path independent (Ferreira and Gignoux 2008, p.9).