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Abstract

This paper investigates the relationship between returns to cultivation per hectare and size-class of land cultivated in India, using unit level data from the 59th round National Sample Survey, 2003. The analysis is done separately for 'kharif' and 'rabi' - for total value of cultivation from all crops at the all India level. The empirical evidence rejects the null hypothesis of no relationship and points to the existence of an inverse association. We argue that the efficiency of the small-holders has to be taken with a pinch of salt because their low absolute returns brings into focus the question of their livelihood sustainability which is further aggravated on account of higher unit costs. Being the first exercise in a series of proposed explorations into disaggregated analyses across states, and for specific crops, it opens up the classic debate on farm size and productivity in the 21st century.

Keywords:

agrarian crisis, agriculture, efficiency, livelihood sustainability, NSS, productivity, size-class.

JEL Code:

O13, Q12

Acknowledgements:

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Abstract

This paper investigates the relationship between returns to cultivation per hectare and size-class of land cultivated in India, using unit level data from the 59th round National Sample Survey, 2003. The analysis is done separately for 'kharif' and 'rabi' − for total value of cultivation from all crops at the all India level. The empirical evidence rejects the null hypothesis of no relationship and points to the existence of an inverse association. We argue that the efficiency of the small-holders has to be taken with a pinch of salt because their low absolute returns brings into focus the question of their livelihood sustainability which is further aggravated on account of higher unit costs. Being the first exercise in a series of proposed explorations into disaggregated analyses across states, and for specific crops, it opens up the classic debate on farm size and productivity in the 21st century.

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1. Introduction

In recent years, Indian agriculture has been reeling under a crisis and one of the concomitant outcomes is poor returns to cultivation which has rendered farming as an unsustainable livelihood option – particularly for the marginal and small holders.[2] This also raises the long debated question of inverse relationship between size-class and productivity, that is, whether marginal and small farmers are relatively efficient vis-à-vis larger size-class farmers? The current paper explores this aspect of Indian agriculture using unit level data from the Situation Assessment Survey of Farmers, administered in the 59th round of the National Sample Survey (NSS).This survey was conducted during 2003 and collected information for the agricultural year 2002-03.This is the latest (and the largest) nationally representative dataset for analyzing the state of farming in India. By conducting the analysis at the unit level, to the best of our knowledge, we provide the first baseline for the 21st century. An attempt has been made to assesses the relationship between size-class and returns to cultivation; and in doing so, it expects to contribute and open-up the long drawn out, and till recently dormant (the latest work being Chand *et al.*2011), debate.

The paper is structured as follows. In section 2, the question of inverse relationship is contextualized by revisiting the debate and highlighting its relevance in light of the current crisis in Indian agriculture. The dataset and methodology are described in section 3, followed by a discussion of the main results in section 4, and section 5 gives concluding remarks.

2. Returns to Cultivation

2.1 The Classic Debate

Going back in time, the early findings based on data of the 1950s-1970s motivated numerous studies to determine if the productivity of small and large farms differs significantly, and in case it did, what could possibly explain these observations. The bone of contention in the intensive debates was the underlying hypothesis of existence of an inverse relationship between farm size and farm productivity in Indian agriculture which provoked a series of academic investigations into the hypothesized relationship.

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[2] The persistence of crisis in Indian agriculture has been elucidated in some of the recent works of Deshpande and Arora (2010); Mishra (2007, 2008); Reddy and Mishra (2009); and Mishra and Reddy (2011) among others.

The celebrated debate originated almost half a century back in the pages of the *Economic and Political Weekly* (EPW; *The Economic Weekly* then) after Amartya Sen's comment on the possibility of an inverse relationship between size-class and productivity, based on the evidence from the Farm Management Studies (FMS) of the 1950s (Sen 1962).[3] The contested hypothesis can be best expressed in the words of Saini (1979, p.153): "the inverse relationship between farm size and productivity is a confirmed phenomenon in Indian agriculture and its statistical validity is adequately established." On the contrary, critiques (e.g. Bardhan 1973) cautioned against the inverse relationship being a stylized fact for all of Indian agriculture. Given the insufficiency of evidence on the statistical validity of the purported inverse relationship and lack of convergence among the results of the numerous studies, the need for more rigorous analyses to arrive at a comprehensive view of the phenomenon was realized (e.g. Bhattacharya and Saini 1972; Chattopadhyay and Rudra 1978).

Interestingly, in spite of decades of fundamental inquiries into this important question, there is no consensus among researchers and policy makers, prompting us to consider this academic debate as a classic in the literature as it has been acutely debated over an extended period of time without any resolution. After a long hiatus, with the latest addition to the discourse by Chand *et al.* (2011), the debate has finally resurfaced as it brings out the relative productivity advantage of small-holders using published tables of the National Sample Survey (NSS). However, as a departure from Chand *et al.* (2011), our current analysis is based on unit level data from the NSS and attempts to reopen the cold case for further investigation in the 21st century by delving into theoretically motivated aspects of the issue. In the remainder of this section we present some perspectives at the core of the debate and review the myriad of explanations that have been propounded in defence of the opposing positions on the inverse relationship.

As a reminder of the intensely debated question, it should be borne in mind that, while many studies have supported the existence of an inverse relationship between size-class and

[3] The antecedents of this farm size-class and productivity are implicit (a) in the Chayanovian demographic differentiation where, under condition of abundant land, peasant households with smaller farm sizes are those with less number of workers but not necessarily those with a lower output per unit land (Chayanov, 1966/1925), and (b) in the writings of the father-son duo of James and John Stuart Mill among others who argued in favour of land revenue directly from the peasant (*ryot*, under the Ryotwari system) in 19th century India because of higher productivity by small holders when given some property rights on the land they cultivate (Bagchi 1987; 2003; Platteau 1983); Sivakumar (1980) also discusses the theoretical foundations for the efficiency of the peasantry.

productivity (Mazumdar 1965; Rao 1966, 2005; Khusro 1968, 1973; Saini 1969; Bardhan 1973; Sen 1964a, 1964b 1975; Berry and Cline 1979; Sen 1981; Carter 1984; Rosenzweig and Binswanger 1993; Krishna 1995; Chattopadhyay and Sengupta 1997; and Dyer 1998 among others), the literature on scepticism toward the inverse relationship is equally impressive (e.g. Rao 1967; Rudra 1968a, 1968b, 1973; Barbier 1981; Chattopadhyay and Rudra 1976 to cite a few); also see Mahesh (2000) which has an excellent review of the literature. Reconciling the two opposing positions, Rudra and Sen (1980), provide an excellent review of the analytical and empirical foundations of the debate and argued against drawing generalizations.[4] There have also been mixed-results which add analytical layers to the interesting questions. For instance, Bharadwaj (1974) found inverses relationship in majority of her sample, but the estimates lacked statistical significance. Deolalikar (1984) could not reject the hypothesis of inverse relationship at low levels of agricultural technology, but could reject it at higher levels using district level data for India. However, Chattopadhyay and Sengupta (1998) reported a strong inverse relationship in agriculturally developed parts of West Bengal. Chadha (1978) showed interesting variations across different samples and time periods for Punjab. Rao (1975) provided evidence on the positive relationship between size-class and productivity, arguing that the higher returns of the larger size-classes are on account of higher application of cash-intensive inputs prescribed by the 'green revolution'. These contradictory findings indicate a lack of convergence in the vast literature, on whether the inverse relationship is likely to disappear with technological progress and adoption of modern agricultural practices.[5] In light of the discussion so far, an obvious question that can be raised is: what could explain such divergent results?

According to the critics of the purported inverse relationship, the major drawbacks of earlier investigations emerge from their being prone to serious statistical biases and misplaced emphasis on the theoretical arguments. There have been serious concerns about the possibility of a spurious statistical relationship arising out of problem in aggregation of village level data (Rudra 1967, 1968); reliance on micro-data collected predominantly by the Farm Management Studies in the pre 'green revolution' period; arbitrary nature of class

[4] Interestingly, Rudra and Sen (1980) saw a change in Sen's position on the inverse relationship since his 1975 work. However, as rightly identified by Chattopadhyay and Sengupta (1998), Rudra and Sen's (1980) reference to Chattopadhyay and Rudra (1976) was confusing as they used only aggregated data.

[5] From a non-Indian perspective, in the context of rural Egypt, Dyer (1991) concludes that the process of technological advance has rendered the breakdown of the inverse relationship; Cornia (1985) has interesting cross-country comparisons.

limits (Barbier 1981); and lack of standardization of land units (Deolalikar 1984). It is well established that differences in level of aggregation of data and aspects of land have contributed to the heterogeneity in the results. Sen (1975) argues that the inverse relationship based on size-class average data is more pronounced in disaggregated inter-farm data from different villages (pooled data) than from observations within the village.[6] Barbier (1981) questions the validity of the pooling procedure and proposes dismissal of the evidence on the inverse relationship on the basis of equal sized farm groups to handle aggregation bias. He failed to find a well behaved inverse and monotonous relationship as found in other studies using the same dataset; and points out that the differences between quality of land arising from differences in rainfall, irrigation, and soil moisture among others and that between villages would be eliminated if one analysed data for each village separately.

From a careful review of the literature, it is obvious that, at the heart of the discord among past empirical studies is the lack of clarity on conceptual foundations and an apprehension of their being misleading in nature − on the grounds that they were oversimplified. Most criticisms targeted the benchmark regressions without adequate controls and low explanatory power of the models which ignored the agrarian relations associated with real production.[7] The fierceness of the staunch criticisms of the incumbent analytical methods can be best captured in this comment by a critic: "One is thus left with the impression that a number of authors feel somewhat embarrassed about the restrictive framework of analysis which they used: to compensate for this weakness and to avoid being accused of any kind of 'Ricardian Vice', they show much more flexibility when they venture into formulating some policy conclusions then when they set up their framework of analysis. Yet it is not very scientific since the policy qualifications do not really follow from the analysis proper but seem to 'fall from the sky' at the last moment." (Barbier 1984, p.A189).

[6] Bhattacharya and Saini (1972) stands out as they used disaggregated data (separate village wise) and found evidence in one pool (Muzzafarnagar) while not in Ferozepur. They also comment on the Green Revolution changes.

[7] In our opinion, low explanatory power (R squared values) is not a real problem since cross sectional studies generally have such low R squared and we can add other controls later as Bhalla (1979, 1988). Moreover R squared is relevant as long as the linear models are appropriate specifications of the true relationship, which unfortunately, is not the case in agricultural production functions and we have to settle with restrictive assumptions on the average functional relationship.

Having discussed the wide range of contradictory results emerging from the review of the relevant literature and divided consent on the theme, we believe it is worthwhile to understand the theoretical underpinnings of the empirical discrepancies. This is taken up next.

2.2 Theoretical Foundations of Empirical Dissonance

After initiating the debate, Sen (1964) subsequently gave three alternative lines of explanation for the inverse size-class-productivity phenomenon, namely, (i) technique based, (ii) labour cost based, and (iii) fertility based.[8] The well-known inverse relationship between crop yields per unit area cultivated and size of holdings is usually explained in terms of more intensive labour use on smaller farms (Berry and Cline 1979; Ahmed 1981; Cornia 1985), in alignment with the labour market dualism argument.[9] Peasant households are believed to be applying their own labour to homestead cultivated to the point where the value product of own (family) labour is less than prevailing wages in the market (Chayanov 1966/1935; Sen 1966, 1975; Lipton 1969); Platteau 1983; Ellis 1993; and Bliss and Stern 1982) have an in depth discussion on the classical explanations for the existence of an inverse relationship by arguing on the efficiency of the peasant household in comparison to the wage-hiring, larger farm household.

Diminishing returns or increasing marginal costs of some input (mostly labour) with respect to land and other inputs, coupled with various types of market imperfections is also a popular explanation (e.g. Bharadwaj 1974). Binswanger and Rosenzweig (1986) discuss how informational imperfections in labour search cause misallocation of labour in underdeveloped economies. Similarly, Platteau (1992) collates the tension between explanations for the phenomenon from a labour market imperfections and transactions cost perspective.

As another line of explanation, lower informational asymmetries and lower supervision costs within a principal-agent framework have been argued to ensure the incentive compatibility for small-holders to more effectively cultivate their farm lands vis-a-vis larger size-class farmers (Carter and Kalfayan 1989). Arguing from a similar perspective, Feder (1985) and Eswaran and Kotwal (1986) show that because of increasing marginal cost of supervision, the land to labour ratio is higher for richer (large size-class) farmers, which

[8] These arguments have been refuted by further studies (e.g. Chattopadhyay and Sengupta 1997). Sen's fertility based and labour cost based arguments (Sen, 1975) make it more likely for 'between village' data to show inverse relationship vis-à-vis 'within village' data.

[9] This implies that the small-holders facing a lower opportunity cost of labour than the larger farm households.

leads to decreasing output per hectare with respect to farm size as the smaller farmers have a lower land to labour ratio indicative of their higher labour intensity in the production process. Moreover, such theoretical arguments that labour market failures and lower supervision costs made the peasant households more productive, found influence in policy circles as they suggested that any type of land reform that reduces the inequality of landholdings will have a positive effect on productivity According to Barbier (1984) and Dyer (1991), the economic rationale for redistributive land reform found support in the empirical evidence on inverse relation between farm size and farm productivity. They raised concerns that this frequently suggested statistical property would induce a small farm bias in agricultural development strategy. However, Ghose (1979) argued that the inverse relationship does not reflect a superiority of peasant production over wage-labour-based production as is often supposed. According to him it exists independently of production relations and thus reflects only a 'static superiority' of small-scale over large-scale production - an essential precondition for this superiority, being the technological backwardness.

Moreover, as a departure from conventional wisdom, Assuncao and Ghatak (2003) showed that even in the absence of diminishing returns one can provide an alternative explanation for this phenomenon using endogenous occupational choice and heterogeneity with respect to farming skills. [10] Other explanations also abound. Carter (1984) used a pooled farm level dataset to distinguish between alternative explanations of the inverse farm-size productivity relationship in India. His analysis supported the 'mode of production' explanation for the inverse relationship and argued that the relationship did not reflect a bias resulting from sample selection based on farmer literacy, nor was it a misidentification of village effects.

Furthermore, risk in agriculture has also been propounded as an explanatory factor. While Bardhan (1973) attributed the inverse relationship to production uncertainty and Srinivasan (1973) to yield risk, Barrett (2006) explained it using price uncertainty. The latter stands out in the sense that it is able to show that a non-degenerate land distribution and price risk can together produce an inverse relationship, even in the absence of more common explanations. Using advances in the analysis of the effects on price risk on producer

[10] Heltberg (1998) attributed it to inequalities and diversities in market participation of different groups of peasantry, albeit, in the Pakistani context.

behaviour, and a simple two-period model of an agricultural household that both produces and consumes under price uncertainty at the time labour allocation decisions are made.[11]

Other explanations also exist. Differences in quality of land (Bhalla 1979; Bhalla 1988; Bhalla and Roy 1988; Benjamin 1992) and differences in cropping patterns (Bharadwaj 1974; Fafchamps 1982) have been argued to explain the productivity differentials between small-holders and large size farms. Verma and Bromley (1987) attribute differences in farm organization, tenancy relations, and differential access to lands of differing quality as consequential for observed productivity differences. Another substantive argument that has been extended to support violation of the inverse farm size-productivity hypothesis is the popular wisdom that having alternative (non-farm) income source gives the larger farm size groups a higher farm expenditure possibility than those cultivators who have limited or no income diversification opportunities. Association between agrarian class structure (Roemer 1982) and returns to cultivation has also been attempted at.[12]

In our opinion, for the theoretical arguments to be corroborated or refuted by the empirical evidence we need to solve the problem of identification of the causal factors and the causal channel through which farm size influences farm productivity. We revisit the questions using unit level data from a nationally representative sample and provide the first evidence on differentials across the Indian states and union territories. We take net returns for the first time to encompass production conditions in one go in a drought year 2002-03. Associations with cropping pattern and expenditure patterns across size-class are also explored. We discuss the results in light of the agrarian crisis in section 2.3. Our dataset, described in section 3, overcomes the identification problem associated with technological change, as in the year 2002-03, it has been more than four decades since the 'green revolution' and the time lag is long enough for agricultural transformations to have set in substantially. This ensures that the ambiguity around technological change can be safely assumed away. Almost half-a-century has passed since the debate was initiated and more than a decade since any major contributions came in. In light of the current crisis in Indian agriculture, as elaborated below, it is pertinent to revisit this.

[11] Barrett (2006) is in the non-Indian context as he uses Madagascar data. His analytical framework remains to be replicated or extended in the Indian context, and promises to be an interesting problem for future research.
[12] Factors like caste have also been related to productivity differentials in Indian agriculture (Desai *et al.*2010; Singh 2010).

2.3 The Persistence of Crisis

There has been an unprecedented crisis and a cumulative decay in Indian agriculture for nearly two decades (Reddy and Mishra 2009; also see its review in Gaurav 2009). Despite public policy interventions in recent years, the crisis persists and manifests itself in twin dimensions, agrarian and agricultural (Mishra and Reddy 2011), which is also akin to displacing people and ideology (Bhaduri 2008). This disconcerting trend is alarming since agriculture continues to employ nearly three-fifths of the workforce, yet its share in national income is around one-fifths. So what caused this crisis?

Patnaik (2008) argues that this ‘arrested development’ can be attributed to a combination of a deflationary fiscal policy that stymied growth of public investment in agriculture on one hand, and a trade liberalization policy that is insensitive to the structural decline in primary product prices, on the other. From the crisis literature it is evident that this worrisome transformation is the result of a multiplicity of factors like increasing marginalization; decreasing returns to farming; and a systemic withdrawal of the state in agricultural investments, research and extension and credit that has resulted in agrarian ‘dystopia’ (Harriss-White 2008). The agrarian crisis is symptomatic of the larger malaise ailing Indian agriculture. There have been a spate of farmers’ suicides (Mishra 2006a; 2006b; 2007) and the economic viability of farming as a profession has been put under the scanner. At this juncture, a fundamental perspective that is relevant from the academic and policy discussions is a deeper understanding of the returns to cultivation. This is investigated using the Situation Assessment Survey of Farmers from NSS, as described below.

3. Data and Methodology

From a careful review of the much-debated literature it is clear that data and methodological limitations have prohibited drawing generalizations about the observed relationship (both sign and significance) between yield (productivity) and farm size beyond the samples being studied. Building upon the suggestion by Bhattacharya and Saini (1972) and Dyer (1991) we attempt to investigate the relationship between size-class and productivity beyond the usual small sampled datasets. This study utilizes the hitherto largest nationally representative sample to conduct the analysis. In 2003, under the 59th round of NSS, a Situation Assessment Survey of Farmers was conducted using schedule 33 that was canvassed to farmer households in rural India. This was a year-long survey divided into two visits. The first visit was during January-August that covered 51,770 and asked some generic questions as also details regarding the *kharif* crop of 200203. The second visit conduct during September-December 2003 did away with the generic part and asked details regarding the *rabi* crop of 2002-03 to 51,105 households.

Both the visits had questions on expenses and gross returns to cultivation. Gross returns comprise of the value of output and value of by-products aggregated across all crops. Expenses (which are paid out) comprise of seeds, pesticides, fertilizers/manure, irrigation, minor repair and maintenance of machinery and equipment, interest paid, lease rent for land, labour expenses (regular and casual), and other expenses. The total value of gross returns less the total expenses is considered as net returns. This is used as a measure of productivity, as it is not possible to capture yield or output when aggregated across all crops.

The advantage of the dataset is that it is a rich and representative cross-sectional unit level data on Indian farmers and to the best of our knowledge this is the first nationally representative survey on farm households. Moreover, the muti-stage stratified sample-design is such that it can give reasonable state level estimates and in some cases one can compute estimates for other sub-groups within the state. This requires the use of appropriate weights to represent the multipliers as per the sample design, which has been incorporated in our calculations. For the current exercise, net returns across subgroups of size-class of farmers for all India are estimated.

The specific questionnaire on returns and expenses has information on land cultivated as well. This information for *kharif* has been used to construct the following size-class sub-groups with exclusive class intervals, which in some sense indicate size of operational holding. The same classification has also been used for *rabi* because an independent and separate classification would not be an appropriate representation. The size-classes are near landless: up to 0.1 hectare (ha), marginal: 0.1-1 ha, small: 1-2 ha, medium: 2-4 ha, semi-medium: 4-10 ha, and large: 10 ha or more. Based on this, our effective sample size is 42356 for *kharif* and 31145 for *rabi*. For sub-group consistency, all weighted averages are based on this sample size.

Besides cross tabulations of net returns across size-class, the analysis looks into shares of by-products and expenditure (cost of production) in total gross returns; the share of different crop groups in net returns; and the production input wise composition of expenditure across size-class. To add to the robustness of the cross-sectional tabulations and statistical validation of the observed associations between size-class and productivity, the relationship between net returns per hectare (NR) and land size in hectare (L) is analyzed without the use of weights, through Ordinary Least Squares (OLS) estimation using a linear and a double log specification, as follows:

$$NR_i = \alpha_1 + \beta_1 . L_i + \varepsilon_{1i} \text{ (linear model)} \quad (1)$$

$$Ln(NR_i) = \alpha_2 + \beta_2 . Ln(L_i) + \varepsilon_{2i} \text{ (double log model)} \quad (2)$$

where, i = 1,..., 42356 for *kharif; i* = 1,..., 31145 for *rabi.*

In (1) and (2), Ln denotes natural logarithm. α's denote the constant of regression and β's represent the slope coefficients. A statistically significant result rejects the null hypothesis of the absence of any relationship and a value of β greater (or less) than zero indicates a positive (or negative) relationship. The double log model coefficients have more relevant marginal effects interpretation (percentage change in productivity associated with a percentage change in land), but there is loss of information as non-positive values (zero and negative values) are dropped (about 15 per cent of the sample in *kharif* and 9 per cent of the sample in *rabi*). This is a matter of concern because the year under study, 2002-03, was a drought year and double log model might not be the best option. It may also be noted that alternative functional forms like transcendental logarithm (translog) has been employed in the literature (Rao and Chotigeat 1981), but the use of the simpler versions in this paper is motivated by a preference for parsimony as this is a baseline investigation.

4. Results and Discussions

4.1 Livelihood Sustainability versus Efficiency

The relationship between net returns and size-class for *kharif* and *rabi* during the agricultural year of 2002-03 are indicated in Table 1. In both the seasons, the net returns per average land cultivated increases with landholding, while the mean net returns per hectare of land registers a secular decline; but for the anomaly in *rabi* that small size-class farmers have little lower net returns per hectare than that of semi-medium farmers. Interestingly, in *kharif*, the net returns per hectare for the large size-class farmers is one-sixth of the marginal farmers, while in *rabi* this gap is around two-fifths. This vindicates our expectation of substantial productivity differential among the size-classes. However, in the context of the crisis in Indian agriculture, it is pertinent to understand not only the relative productivity (efficiency) of the small-holders, but also the absolute levels of returns to cultivation. Interestingly, this would enable a separability of 'livelihood sustainability' and efficiency.

An analysis for farmer households across size-class points out that income falls short of the expenditure for even the semi-medium class (National Sample Survey Organisation 2005, Government of India 2007) and per capita per day returns to farm households from cultivation, farm animals and non-farm business was less than a meagre Rs.8 in 2002-03 (Mishra 2007). This substantiates our finding on the secular increase in net returns per average land cultivated across size-class of farmer households, which can often be misrepresented as a sign of inefficiency of the small and marginal farm households, but actually what it represents is, the difficulty in their 'livelihood sustainability'. However, the secular decline of net returns per hectare, which is an appropriate indicator for efficiency, turns the story on its head and calls for further investigation.

Table 1: Size-class wise Land Cultivated, Net Returns per Average Land Cultivated and Net Returns per Hectare, *kharif* and *rabi*, 2002-03

Size Class	*Kharif*					*Rabi*				
	N	Land Culti-vated (Ha)	Net Returns per Avg Land Cultiva-ted (₹)	Net Returns per Ha (₹)	Avg FamilySize	*N*	Land Culti-vated (Ha)	Net Returns per Avg Land Cultiva-ted (₹)	Net Returns per Ha (₹)	Avg FamilySize
Near Landless	*3010*	0.06	765	12215	4.8	*2568*	0.10	1093	11309	5.0
Marginal	*23925*	0.45	2849	6289	5.2	*17508*	0.46	3247	7097	5.5
Small	*7997*	1.20	6465	5386	5.8	*6036*	1.00	6419	6446	6.0
Semi Medium	*4572*	2.20	10746	4891	6.2	*3381*	1.67	11104	6664	6.5
Medium	*2494*	4.36	16467	3775	6.9	*1838*	3.22	19827	6153	7.2
Large	*358*	10.28	21396	2081	7.8	*264*	7.50	31354	4183	8.3
All	42356	1.07	5195	6205	5.5	31145	0.89	5754	7191	5.8

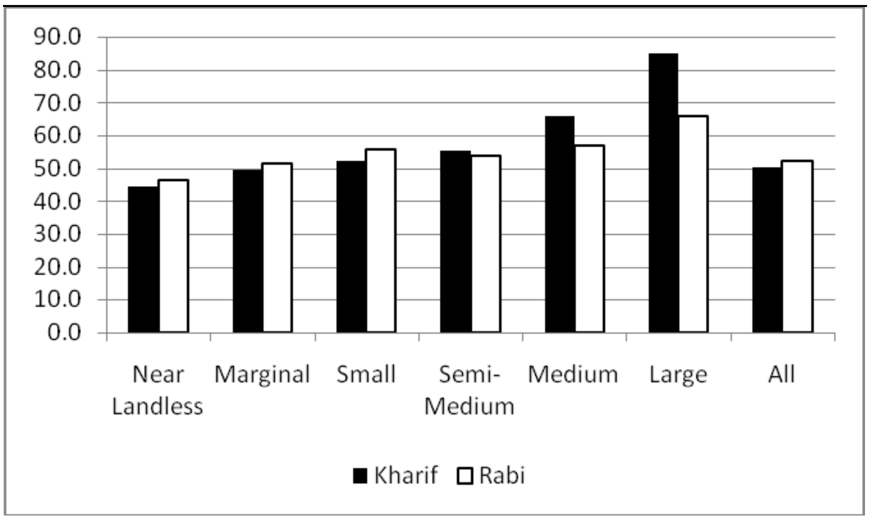
Source: Author's calculation based on unit level data from 33rd schedule of NSS 59th round.
Note: Near Landless (up to 0.1 ha); Marginal (0.1-1 ha); Small (1-2 ha); Semi Medium (2-4 ha); Medium (4-10 ha); Large (> 10 ha of land). Avg indicates average, N indicates number of observations; ₹ indicates Indian Rupee and Ha. indicates hectares.

As shown in Table 1, the average family size increases by size-class, both for *kharif* and *rabi*. This implies that the households with less land have a lower family size, a result concomitant with land partition across generations, and raises doubt on the thinking that the poor have a larger family size. Even if one controls for family size, per capita earnings from cultivation are higher for higher size-classes. But, it still leaves the question of efficiency open.[13] This, on the one hand, opens up the old debate on size-class and returns to cultivation and, on the other hand, contextualizes the question of livelihood sustainability versus efficiency. Next, the analysis on production processes of different size-classes is by focusing on input costs.

4.2 Input Costs: Risk or Burden?

The total input costs (taken as a sum of all independent input items of expenditure) as a proportion of gross returns by size-class, is given in Figure 1. It indicates an increasing trend for both *kharif* and *rabi*, except for a dip in semi-medium for *rabi*. This is indicative of an increase in risk for higher size-class in the sense that the costlier the production process, the riskier it is, for given level of output.[14] If we consider per hectare costs, then for each and every input, one observes a declining trend with an increase in size-class, that is, higher costs for lower size-classes (Table 2). The item wise distribution of input-cost share shows that for both *kharif* and *rabi* the share of input costs increases with size-class for seeds, pesticides, repair & maintenance, interest payments and regular labour; and as a corollary it decreases for irrigation, casual labour and other expenses.

Figure 1: Expenditure share (%) by size-class for *kharif* and *rabi*, 2002-03



[13] Another intriguing observation is that from the households that cultivated, the average family size for *rabi* is greater than that of *kharif* for each and every size-class, but an exploration of this is beyond the domain of the current exercise.
[14] This is so because the farmer stands to bear higher financial losses in the eventuality of bad yield and price outcomes. This brings out the need for appropriate insurance mechanisms and alternative livelihood strategies for the vulnerable farmers given the affordability constraints imposed by stochastic farm returns and the uncertainties involved in dynamic production systems involving high production costs (sunk costs).

The increasing share of expenditure as a proportion of gross returns is indicative of a greater dependence on the market leading to paid out cost by the higher size classes. At the same time, a decreasing per hectare costs indicates a greater burden by smaller size-classes. Despite this, per hectare returns are higher for smaller size-classes. Some possible reasons for this greater cost burden of the lower size-class could be economies of scale; lack of appropriate technology, and cropping pattern. A detailed analysis of the former two are beyond the scope of the current exercise, but we now take up a brief analysis of the latter by

Table 2: Item wise costs per hectare (and their distribution, %) by size-class, *kharif* and *rabi*, 2002-03

Season/ Size-class	Seed	Pest-icide	Ferti-lizer	Irrig-ation	Re-pair	Rent	Inte-rest	Reg-Lab	Cas Lab	Oth-ers	Total
Kharif											
Near -Landless	21499	9328	37877	19001	1830	12965	1132	1168	29508	19335	153643
	(14.0)	(6.1)	(24.7)	(12.4)	(1.2)	(8.4)	(0.7)	(0.8)	(19.2)	(12.6)	(100.0)
Marginal	1764	851	3099	1265	196	649	142	199	2698	1193	12056
	(14.6)	(7.1)	(25.7)	(10.5)	(1.6)	(5.4)	(1.2)	(1.6)	(22.4)	(9.9)	(100.0)
Small	675	347	1066	415	83	184	78	73	808	329	4058
	(16.6)	(8.5)	(26.3)	(10.2)	(2.0)	(4.5)	(1.9)	(1.8)	(19.9)	(8.1)	(100.0)
Semi-Medium	381	204	519	216	56	100	43	64	365	152	2099
	(18.2)	(9.7)	(24.7)	(10.3)	(2.7)	(4.7)	(2.0)	(3.1)	(17.4)	(7.3)	(100.0)
Medium	197	118	273	95	25	56	24	47	171	76	1083
	(18.2)	(10.9)	(25.2)	(8.7)	(2.3)	(5.2)	(2.2)	(4.4)	(15.8)	(7.0)	(100.0)
Large	68	41	83	28	10	27	8	30	44	22	362
	(18.9)	(11.3)	(23.1)	(7.8)	(2.8)	(7.4)	(2.2)	(8.3)	(12.1)	(6.1)	(100.0)
All	1012	502	1677	693	117	365	91	123	1361	625	6565
	(15.4)	(7.6)	(25.5)	(10.6)	(1.8)	(5.6)	(1.4)	(1.9)	(20.7)	(9.5)	(100.0)
Rabi											
Near -Landless	15665	4394	22534	17283	774	6522	264	657	12085	13727	93905
	(16.7)	(4.7)	(24.0)	(18.4)	(0.8)	(6.9)	(0.3)	(0.7)	(12.9)	(14.6)	(100.0)
Marginal	2629	698	3476	2530	172	741	66	143	2053	1730	14238
	(18.5)	(4.9)	(24.4)	(17.8)	(1.2)	(5.2)	(0.5)	(1.0)	(14.4)	(12.1)	(100.0)
Small	1229	356	1571	1160	127	297	40	88	883	719	6470
	(19.0)	(5.5)	(24.3)	(17.9)	(2.0)	(4.6)	(0.6)	(1.4)	(13.7)	(11.1)	(100.0)
Semi-Medium	694	214	861	632	86	239	25	71	472	392	3685
	(18.8)	(5.8)	(23.4)	(17.1)	(2.3)	(6.5)	(0.7)	(1.9)	(12.8)	(10.6)	(100.0)
Medium	331	145	432	290	51	132	15	65	241	172	1874
	(17.7)	(7.7)	(23.1)	(15.5)	(2.7)	(7.1)	(0.8)	(3.5)	(12.9)	(9.2)	(100.0)
Large	121	52	134	82	18	68	9	47	76	48	654
	(18.4)	(8.0)	(20.6)	(12.5)	(2.7)	(10.4)	(1.4)	(7.1)	(11.6)	(7.3)	(100.0)
All	1521	435	2000	1462	125	459	43	108	1146	985	8285
	(18.4)	(5.3)	(24.1)	(17.7)	(1.5)	(5.5)	(0.5)	(1.3)	(13.8)	(11.9)	(100.0)

Note: Figures in parenthesis indicate distribution (share) of input costs to total input costs. Reg lab and Cas lab denote Regular labour and Casual labour respectively.
Source: Author's calculation based on unit level data from 33rd schedule of NSS 59th round.

by looking at the differences in share of net returns by cropping pattern. This is followed by a detailed inquiry into the existence of a statistically significant relationship between our measures of productivity and size-class.

4.3 Cropping Pattern Variations in Share of Net Returns

The analysis of variations in share of net returns by cropping pattern is based on a lower number of observations because the farmer households that gave information on crop specific details are lower than those that gave information on expenditure and value of output at the aggregate level for all crops put together. Some of the observations are as follows.

Table 3: Cropping pattern wise share of net returns by size-class, *kharif* and *rabi*, 2002-03

Season/ Size-class	N	Cer-eals	Pulses	Sugar-cane	Fruits and Vege-tables	Other food	Oil-seeds	Fibres	Plant-ation	Other Non food	Total
Kharif											
Near landless	3767	55.9	0.9	2.4	14.8	3.8	11.2	1.8	4.6	4.5	100
Marginal	24076	65.1	2.2	8.0	9.1	2.6	5.3	3.0	2.1	2.7	100
Small	6929	56.6	3.6	13.8	5.5	2.7	7.7	5.8	1.5	2.9	100
Semi-Medium	3396	49.3	3.6	12.6	5.3	3.4	11.4	10.1	1.0	3.3	100
Medium	1410	41.6	4.2	16.1	2.2	2.5	18.3	10.0	1.1	4.0	100
Large	180	39.2	2.4	14.9	6.2	3.1	15.7	12.0	1.3	5.1	100
All	39758	54.4	3.1	12	6.2	2.8	9.9	6.8	1.5	3.2	100
Rabi											
Near landless	2519	56.0	3.7	0.9	16.9	2.5	9.2	1.2	5.4	7.1	100
Marginal	16595	63.5	6.1	4.0	9.6	2.6	7.8	0.3	3.3	4.2	100
Small	5878	61.0	7.3	5.3	8.8	2.9	7.3	0.9	2.4	3.8	100
Semi-Medium	3277	57.8	9.4	6.6	7.8	2.0	9.6	0.5	1.6	3.3	100
Medium	1799	52.1	12.8	7.1	5.6	2.4	14.5	0.9	0.8	2.1	100
Large	258	50.6	19.3	0.9	9.1	2.2	13.9	2.2	0.0	0.1	100
All	30326	58.3	9.4	5.3	8.2	2.5	10.0	0.7	2.0	3.2	100

Notes: Other food items comprise of spices and others, Other non food items comprise of drugs, fodder, flowers, medicinal plants, aromatic plants and others.
Source: Author's calculation based on unit level data from 33rd schedule of NSS 59th round.

The near landless, quite in expectation of peasants' optimizing behaviour given very small plots of land and greater reliance on own family labour; have a relatively lower share of net returns from cereals and relatively greater share from fruits and vegetables, other food, oilseeds, plantation and other non food crops in comparison with both marginal and small size-class. Broadly, if one excludes the near landless in some cases or the large size-class in some others, it is observed that with an increase in size-class, there is a decline in the share of net returns for cereals, fruits and vegetables and plantation in both *kharif* and *rabi;* and for other non food crops in *rabi* alone. Also, with increase in size-class, there is an associated increase in the share of returns for pulses, sugarcane and oilseeds in both *kharif* and *rabi* and for fibres in *kharif* alone. Excluding the near landless size-class, the trends in cropping pattern do not seem to justify the higher cost burden for lower size-class. The answers could lie in economies of scale or the technology not being suitable for them. But these adversities notwithstanding, they turn out to be efficient, as evident from the net returns per hectare (Table 1). To add to the robustness of this result we further investigate the inverse relationship.

4.4 The Inverse Relationship

In order to get a visual confirmation on the nature of the association between returns to cultivation and land cultivated. The scatter plots for *kharif* and *rabi* are given in natural logarithm scales for both variables in Figures 2 and 3 respectively. Logarithmic transformations take into account the large variations in values (scales) of net returns and land sizes; however, a limitation of this transformation is that there will be a loss of information as non positive values are dropped. As seen in the scatter plots, we can expect a negative relationship between the two variables of concern. The exactness of this expected association is further explored in the regression results at the aggregate level and also for each size-class for the seasons, *kharif* and *rabi*.

Table 4 reports results for the OLS model of net returns on land cultivated using double log and linear forms for the sample observations without using any weights. The findings at the aggregate level broadly corroborate the existence of an inverse relationship. The slope coefficients have a negative sign and are statistically significantly different from zero, thus rejecting the hypothesis of no relationship. Since the coefficients in the double-log model are elasticities of strictly positive returns with respect to land, they can be interpreted as a percentage change in net returns given a percentage change in land cultivated. both *rabi* and *kharif* for both the models. On excluding the near landless size-class the statistical significance of no relationship is still rejected in the truncated sample, but the coefficient values, as expected, fall.

Table 4: Size-class wise Coefficients for Double-log and Linear Models, *kharif* and *rabi*, 2002-03

Season / Size-class	Double log				Linear			
	Coefficient	Standard error	R-squared	N	Coefficient	Standard error	R-squared	N
Kharif								
Near Landless	-0.635 ***	0.021	0.26	2728	-106517.966 ***	39849.245	0.002	3010
Marginal	-0.304 ***	0.011	0.04	20396	-195.255	213.877	0.000	23925
Small	-0.407 ***	0.028	0.03	6821	-32294.871 ***	8962.614	0.002	7997
Semi Medium	-0.236 ***	0.038	0.01	3720	-747.768	621.125	0.000	4572
Medium	-0.378 ***	0.044	0.04	1944	-2435.872 **	1098.655	0.002	2494
Large	-0.338 ***	0.088	0.06	247	-38.802	29.251	0.005	358
All	-0.343 ***	0.006	0.12	35856	-1179.9 ***	406.986	0.000	42356
All_NL	-0.313 ***	0.007	0.07	33128	-674.271 *	8383.16	0.000	39346
Rabi								
Near Landless	-0.553 ***	0.020	0.24	2383	-125288 **	43165.871	0.003	2568
Marginal	-0.268 ***	0.009	0.05	15482	-92.777	73.192	0.000	17058
Small	-0.255 ***	0.016	0.04	5486	-828.49 ***	192.704	0.003	6036
Semi Medium	-0.174 ***	0.023	0.02	3015	-2327.998 ***	773.568	0.003	3381
Medium	-0.187 ***	0.030	0.02	1664	-624.245 ***	230.273	0.004	1838
Large	-0.344 ***	0.066	0.11	235	-3772.338	2993.476	0.006	264
All	-0.285 ***	0.006	0.11	28265	-619.917 ***	211.137	0.000	31145
All_NL	-0.243 ***	0.007	0.07	25882	-298.278 ***	81.900	0.000	28577

Notes: *** p < 0.01, ** p<0.05, * p<0.10; The coefficients are estimated without using weights. All_NL indicates All excluding near landless.

Figure 2: Scatter plot of land cultivated and net returns per hectare (natural log scales), *kharif*, 2002-03.

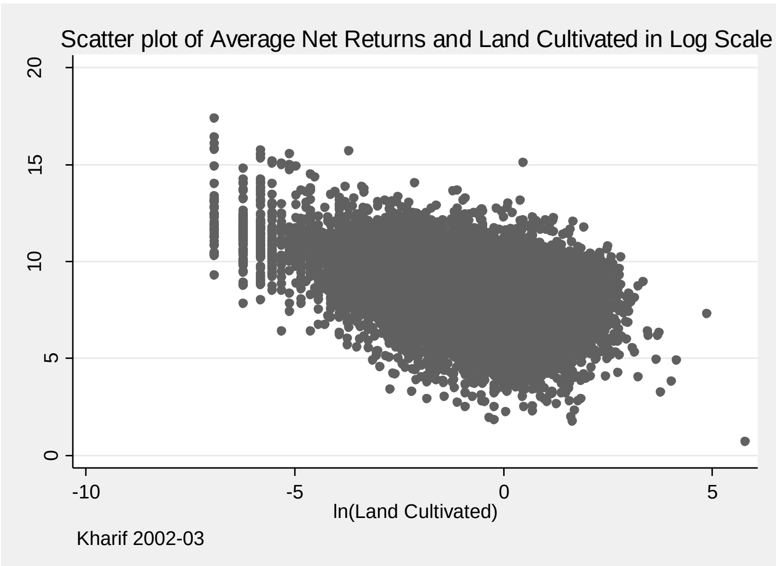
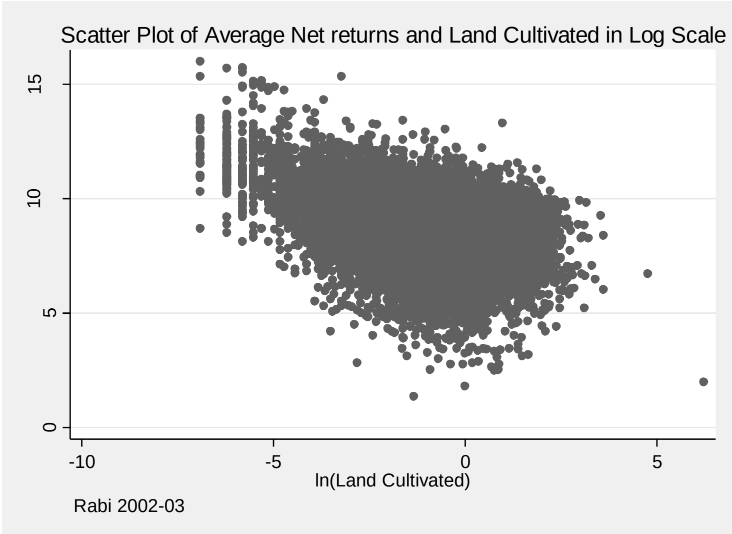


Figure 3: Scatter plot of land cultivated and net returns per hectare (natural log scales), *rabi*, 2002-03.



In general, the models do not give a good fit, but relatively speaking, the double log specification better explains the variations in net returns with associated variations in land size. The low fit of the models may be because of omission of important control variables like irrigation, quality of land or other important correlates of variation in net returns. The assumption of linearity may also be restricting the explanatory power of these parsimonious models. Moreover, the data pertains to a drought year, which also could have some implications. Some of these factors are being taken up in future exercises.

5. Conclusions

An analysis of size-class and returns to cultivation using nationally representative data from the Situation Assessment Survey of Farmers (SAS) of the 59th Round of the National Sample Survey, for the period 2002-03 opens up the classic debate on the efficiency of the small holder. Our empirical results, computed separately for *kharif* and *rabi*, at an aggregate all India level as also for each size-class reject the null of absence of any relationship between size-class and productivity and indicate the existence of an inverse relationship. While the small holder seems efficient the low absolute returns raises questions on livelihood sustainability. This is also important from the perspective of the risk bearing capacity of the small-holders given the fact of their per hectare costs being higher.

To the best of our knowledge, these are the first estimates for the 21st century and at the pan-Indian level; and could be used as a baseline for comparative analyses in the future. Our empirical evidence can be considered as an important contribution to the literature on size-class and productivity relationship. While opening up this cold case we are aware that one needs to go down to further details and control for other factors that may affect returns to cultivation. It would be equally important to analyse the variation across states, social groups as also the crop-specific patterns. We plan to do some of these in a series of future exercises.

In spite of the limitations of our study, it is a first attempt at a fundamental problem in Indian agricultural using a nationally representative sample. Given the relevance of our findings in corroborating the story of a crisis in Indian agriculture on one hand, and with the promise to reopen the classic debate on farm size and productivity on the other, we argue for the need for further inquiries, and if feasible, a future round of the SAS as it is almost a decade since the first (and only) survey.

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Erratum (27 January 2012)

This is the revised Table 2, which rectifies the absolute per hectare values, as the earlier values had divided land size twice. We are thankful to comments from participants in a seminar at Centre for Economic and Social Studies (CESS), Hyderabad on 28 December 2011.

Table 2: Item wise costs per hectare (and their distribution, %) by size-class, *kharif* and *rabi*, 2002-03

Season/ Size-class	Seed	Pest-icide	Ferti-lizer	Irrig-ation	Re-pair	Rent	Inte-rest	Reg-Lab	Cas Lab	Oth-ers	Total
Kharif											
Near -Landless	1346	584	2372	1190	115	812	71	73	1848	1211	9622
	(14.0)	(6.1)	(24.7)	(12.4)	(1.2)	(8.4)	(0.7)	(0.8)	(19.2)	(12.6)	(100.0)
Marginal	799	386	1404	573	89	294	64	90	1222	541	5462
	(14.6)	(7.1)	(25.7)	(10.5)	(1.6)	(5.4)	(1.2)	(1.6)	(22.4)	(9.9)	(100.0)
Small	811	416	1279	498	100	221	93	88	970	395	4870
	(16.6)	(8.5)	(26.3)	(10.2)	(2.0)	(4.5)	(1.9)	(1.8)	(19.9)	(8.1)	(100.0)
Semi-Medium	838	447	1140	474	122	219	94	141	802	335	4612
	(18.2)	(9.7)	(24.7)	(10.3)	(2.7)	(4.7)	(2.0)	(3.1)	(17.4)	(7.3)	(100.0)
Medium	861	515	1192	413	110	245	106	206	747	330	4724
	(18.2)	(10.9)	(25.2)	(8.7)	(2.3)	(5.2)	(2.2)	(4.4)	(15.8)	(7.0)	(100.0)
Large	703	421	858	289	105	276	81	310	449	227	3719
	(18.9)	(11.3)	(23.1)	(7.8)	(2.8)	(7.4)	(2.2)	(8.3)	(12.1)	(6.1)	(100.0)
All	847	420	1404	580	98	306	76	103	1139	523	5496
	(15.4)	(7.6)	(25.5)	(10.6)	(1.8)	(5.6)	(1.4)	(1.9)	(20.7)	(9.5)	(100.0)
Rabi											
Near -Landless	1514	425	2178	1670	75	630	26	63	1168	1327	9076
	(16.7)	(4.7)	(24.0)	(18.4)	(0.8)	(6.9)	(0.3)	(0.7)	(12.9)	(14.6)	(100.0)
Marginal	1203	319	1590	1158	79	339	30	65	939	791	6514
	(18.5)	(4.9)	(24.4)	(17.8)	(1.2)	(5.2)	(0.5)	(1.0)	(14.4)	(12.1)	(100.0)
Small	1224	355	1564	1155	126	296	40	88	880	716	6443
	(19.0)	(5.5)	(24.3)	(17.9)	(2.0)	(4.6)	(0.6)	(1.4)	(13.7)	(11.1)	(100.0)
Semi-Medium	1157	356	1434	1052	143	398	41	118	787	653	6140
	(18.8)	(5.8)	(23.4)	(17.1)	(2.3)	(6.5)	(0.7)	(1.9)	(12.8)	(10.6)	(100.0)
Medium	1068	466	1392	935	164	426	49	209	777	553	6040
	(17.7)	(7.7)	(23.1)	(15.5)	(2.7)	(7.1)	(0.8)	(3.5)	(12.9)	(9.2)	(100.0)
Large	903	390	1008	612	131	510	70	350	570	356	4901
	(18.4)	(8.0)	(20.6)	(12.5)	(2.7)	(10.4)	(1.4)	(7.1)	(11.6)	(7.3)	(100.0)
All	1217	348	1600	1170	100	368	34	86	917	788	6629
	(18.4)	(5.3)	(24.1)	(17.7)	(1.5)	(5.5)	(0.5)	(1.3)	(13.8)	(11.9)	(100.0)

Note: Figures in parenthesis indicate distribution (share) of input costs to total input costs. Reg lab and Cas lab denote Regular labour and Casual labour respectively.
Source: Author's calculation based on unit level data from 33rd schedule of NSS 59th round.