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Can group farms outperform individual family farms? Empirical insights from India

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ABSTRACT

Is there an alternative model to small family farming that could provide sustainable livelihoods to millions of resource-constrained and often non-viable smallholders in developing countries? Could group farming constitute such an alternative, wherein smallholders voluntarily pool land, labour and capital to create larger farms that they manage collectively? In South Asia, for instance, over 85% of farmers are small and increasingly female. Potentially, group farming could provide them economies of scale, a dependable labour force, more investible funds and skills, and greater bargaining power with governments and markets. But can this potential be realised in practice? In particular, can group farms economically outperform small family farms? A rare opportunity to test this is provided by two experiments begun in the 2000s in the Indian states of Kerala and Telangana. Constituted only of women, the groups lease in land to farm collectively, sharing labour, the cost of inputs, and the returns. But the states differ in several respects, including the technical support the groups receive, and their institutional base, composition, land access and cropping patterns. Based on the author's primary sample surveys in both states, this paper compares the productivity and profitability of group farms with that of small individual family farms in the same state. Kerala's groups perform strikingly better than the predominantly male-managed individual farms, both in their annual value of output per hectare and annual net returns per farm, while in Telangana group farms perform much worse than individual farms in annual output, but are equivalent in net returns. In both states, groups do much better in commercial crops than in traditional foodgrains, where the largely male-managed individual farms, owning good quality land and with longer farm management experience, have an advantage. The factors underlying the differential performances of Kerala and Telangana, and the lessons learnt for possible replication, are also discussed. Overall, the paper demonstrates that group farming *can* provide an effective alternative, subject to specified conditions and adaptation of the model to the local context.

1. Introduction

In the global concern with food security, poverty, and sustainable livelihoods, rather little attention has been paid to the institutional transformation of agriculture. The discussion has focused largely on the desirability or otherwise of two types of farm enterprises: small family farms, which constitute most farms globally,[1] and large-scale commercial farms. Some see smallholders as having substantial potential for providing food security and viable livelihoods (HLPE, 2013; Imai, Gaiha, & Garbero, 2014), while others favour large commercial farms on grounds of economic efficiency (Collier & Dercon, 2014). But neither institutional form adequately addresses the diverse problems encountered by most farmers today. On the one hand, small farmers, and especially the growing proportion of women farmers, face serious resource constraints and poverty in developing countries (Agarwal, 2014). On the other hand, by most assessments, at least in the near future, agricultural development remains the main option for reducing rural poverty and absorbing the vast body of existing and new entrants to the workforce, given limited prospects for this in the non-farm sectors of most developing countries (Imai et al., 2014, Hazell, Poulton, Wiggins, & Dorward, 2010), including India (Chand, Srivastava, & Singh, 2017; Himanshu et al., 2013; Lanjouw & Murgai, 2009). Large commercial farms appear unlikely to play this role (Mellor & Malik, 2017). The situation thus begs for alternative models of farming, involving smallholders.

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[1] This can be surmised from two types of assessments for the 2000s: first, out of an estimated 570 million farms globally, at least 500 (88%) are family farms (FAO, 2014; Graeub et al., 2016); second, 84% of all farms across 111 countries are under 2 hectares in size (FAO, 2014:12). Also farm size is declining in most countries (Lowder, Skoe, &, Raney, 2016).

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Could an alternative lie in group farming—wherein small farmers voluntarily pool their resources (land, labour, capital and skills) to create a larger enterprise (but without forfeiting rights in any owned land), and cultivate it jointly, sharing costs and benefits. Can group farming enhance small farmer productivity and profitability? This paper empirically examines this little researched question.

The idea of group farming, in itself, is not new, but over the decades it has taken different forms, arriving in what we may term 'waves'. Broadly periodised, the first wave was of socialist collectivisation. The second wave involved efforts to promote cooperative farming in the 1950s and '60s by newly independent postcolonial countries (as part of agrarian reform), and by some European countries, especially France (Agarwal & Dorin, 2017). The third wave emerged in the form of collectivities formed voluntarily after decollectivisation of agriculture in the 1990s, in many former socialist regimes. And the fourth wave is the current one in countries such as India. The first wave is best researched, each subsequent wave less and less so, while the fourth wave is virtually unexamined, especially in relation to the economic effects of group farming.

Conceptually, there are many reasons why we might expect resource pooling and joint cultivation to help small farmers enhance their productivity and get favourable returns: enlargement of farm size; economies of scale; saving on hired labour and access to a dependable labour force, especially in peak seasons; more funds for investing in machines and inputs; a larger pool of skills and knowledge; and greater bargaining power in input and output markets as well as with government agencies that provide technical information and training. These potential advantages could prove especially important for women farmers who face production constraints over and above those faced by small farmers in general (FAO, 2011; World Bank, 2009). In addition, there can be gender-specific benefits. For instance, cultivating in a group that is separate from the family would give women autonomy in making production decisions, control over output, and an independent identity as a farmer. All this is seldom possible within male-managed family farms where women's contributions are often rendered invisible. Also, women who want to farm but own little or no land (the typical situation) can improve their land access by being part of a group, since this would increase their financial resources as well as negotiating power in land lease markets. Most importantly, women in many cultures face social restrictions on their mobility and ability to interact freely in public institutions and markets. Groups are found to help overcome such restrictions (Agarwal, 2010a). These extended advantages could prove especially important for agricultural development, given a growing feminisation of agriculture (Agarwal, 2014).

At the same time, any type of group functioning can be subject to collective action challenges, such as free riding. Although most collective action theory focuses on common pool resources (Olson, 1965, Ostrom, 1990, Verughese & Ostrom, 2001), issues such as group size and homogeneity, and the risk of free riding raised by that theory, remain relevant, even when focusing on private property resources. Indeed we might expect them to matter even more, given the density, complexity, and daily nature of interaction required in group farming. Can these challenges be overcome?[2]

A rare opportunity to empirically assess the performance of group farms is provided by initiatives taken in two states of India in the early 2000s, one in Telangana (earlier part of undivided Andhra Pradesh), the other in Kerala. In both cases, the groups are constituted only of women. They lease in land owned by group members and/or non-group landlords, which they cultivate jointly, sharing input costs, labour and returns. The two initiatives differ, however, in the origin of the groups, their size and social composition, the state support they receive, the institutional structure within which they operate, and the freedom they enjoy in deciding what to grow. These and other differences can affect productivity. The two examples thus give us an opportunity not only to compare the performance of individual and group farms in each state, but also to assess the conditions under which collective farming, especially by women, is more likely to be successful, economically.

In specific terms, the paper addresses three interrelated questions. First, how do the groups perform relative to small family farms in the same regions, in terms of (a) productivity, and (b) profitability? Second, are there notable differences in this regard between Telangana and Kerala? If so, to what may we attribute these differences? Third, what lessons might these programmes hold for their potential replication in other regions of India, and more generally in South Asia and developing countries elsewhere?

None of these questions have been addressed before. To answer them, I conducted primary surveys in both states. Existing studies which have examined the impact of group farming on farm productivity have focused predominantly on former socialist regimes, usually comparing production under various types of collectivised/cooperatized farms with farm enterprises that emerged in the post-reform period, or after decollectivisation. Given this specificity, their experience is at best indicative; it cannot provide substantive lessons on the potential outcomes of group farming in today's developing countries. This paper seeks to do so.

The paper is divided into 5 sections. Section 2, which follows, outlines the existing literature on group farming and productivity, and provides a background to the Telangana and Kerala initiatives. Section 3, describes the data and the broad characteristics of the farms. Section 4 outlines the model and hypotheses, and Section 5 presents the results. The concluding Section 6 reflects on the broader lessons we can draw from this analysis.

2. Existing studies and Indian initiatives

2.1. Existing studies

Studies which seek to assess the impact of group farming on farm productivity can be divided into two broad sets, both linked to former socialist countries. One set of studies, mostly undertaken in the 1980s and early 1990s, compare farm productivity under smallholder agriculture with various types of large, state-promoted farm enterprises (state farms, producer associations, collectives, communes, as the case may be). These studies present assessments (typically based on production figures for regions, rather than at the farm level) for a diversity of countries—China, Vietnam, Nicaragua, Cuba, and Ethiopia—and give mixed results. Some observe lower outputs or yields under collective enterprises relative to individual farms;[3] others find higher outputs, or mixed outcomes.[4] Some authors, such as Deininger (1993), also argue on theoretical grounds, based on assumptions of neoclassical economic

[2] Cooperation around marketing is widespread, globally and historically, and well researched. But typically it does not involve joint production of the marketed item, and hence does not pose the same challenges, or hold the same potential benefits, as the 'fully integrated cooperation' required in group farming. See Agarwal (2010b) for elaboration.

[3] See, Nolan (1988) and Lin (1990) for China, and Beresford (1990) and Pingali and Xuan (1992) for Vietnam: in both countries output rose after decollectivisation. See Deininger (1993) for Nicaragua on large state farms; and Mengisteab (1990 cited in Deininger 1993) for Ethiopia in the 1970s.

[4] See, Ghai, Kay, and Peek (1988) for Cuba, where output was higher among small cooperative farms relative to large state farms; Kung and Putterman (1997) for China, who find productivity gains both during collectivisation and decollectivisation of agriculture; and Griffin and Hay (1985) who find mixed effects for specific crops when comparing peasant farms, producer cooperatives and state farms for Ethiopia.

theory (such as the difficulty of achieving pareto-optimality with group farms) that agricultural production cooperatives are unlikely to be more productive than individual farms. But these early studies relate to collectivities which typically had a large number of members, were formed under state pressure, required forfeiture of individual property rights, and were subjected to coercive extraction of surpluses by the state, although there were country-specific deviations on specific features (see Agarwal, 2010b, for details).

However, another set of studies undertaken in the 2000s, namely a decade or so after post-socialist decollectivisation, and based on careful statistical analysis of farm-level primary or secondary data, demonstrate the opposite. They show that group farms of small to medium size, constituted voluntarily by smallholders to overcome resource constraints, had higher returns than individual family farms. These studies relate to post-socialist countries as diverse as Kyrgyzstan, East Germany, Nicaragua and Romania.[5] The small or medium size of these group farms, their voluntary nature, participative decision-making, and equitable sharing of work, costs, and profits, were all features that distinguished them from the socialist collectives. At their height in the late 1990s, such post-socialist group farms accounted for a fairly large percentage of farms and area in these countries. In Kyrgyzstan, for instance, they accounted for 64% of all farms, and in Romania they covered 43% of farm area (Sabates-Wheeler & Childress, 2004; Sabates-Wheeler, 2002).

Although these group farms emerged in special circumstances, namely post-socialism, in many respects their conditions were similar to those of small farmers in developing countries today, namely scarcity of land, labour, capital, or machinery. They sought to overcome these scarcities by working cooperatively.

2.2. The Indian initiatives: Background

The two Indian examples, like the post-socialist group farms, pool land, labour and inputs, but they are distinct in other ways. To begin with, they are constituted only of women (who are members in their individual capacity) rather than of families. They trace their origins not to socialist ideology but to a range of more recent ideas and practices, seeking to find solutions to farmers' production constraints on the one hand, and empowering women economically on the other. Some of these ideas came from practitioners, especially those who had formed women's groups initially for other purposes, or who saw enormous potential in adapting the self-help group (SHG) model, which originated to promote savings-and-credit (Tankha, 2002) but has diversified since (NCAER, 2008), and is widespread in India today. Other ideas stemmed from academics who emphasised the need for resource pooling and cooperation among women, including by leasing in land, since they typically lack adequate access to land or other resources on an individual basis (e.g. Agarwal, 1994, 2003). Added to this has been the success of group approaches in managing common pool resources (Agarwal, 2010a; Ostrom, 1990).

Also, unlike in post-socialist countries, group farming in India did not emerge spontaneously but through external interventions. The Telangana group farms resulted from a project launched by the United Nations Development Programme (UNDP) in India, in collaboration with the Government of India (GoI). The project supported 500 such farms—termed Samatha Dharani Groups (SDGs)—for five years, 2001–2005. It was implemented in the field through a local quasi-NGO—the Andhra Pradesh Mahila Samatha Society, (APMSS)—which had already formed women's groups (sanghas) several years earlier for the GoI's Mahila Samatha (education for women's equality) programme.[6] The Mahila Samatha sanghas took up group farming as an experiment in economic empowerment, and typically all or most sangha members in a village (each village had one sangha) joined the group farm. Hence there was little self-selection by individual women.[7]

Under the project, UNDP-GoI provided the women a seed grant of Rs. 35,000 as a start-up revolving fund, agricultural implements, training in specialised agricultural practices, and financial literacy. The support lasted five years, but a large proportion of SDGs continued after the project ended, overseen by APMSS and the federations of sanghas it had constituted. At the time of my survey, about half the groups were still active.

Kerala's group farming project also began in the 2000s, but was carefully crafted by senior officials of the State Planning Board, Kerala's Ministry of Rural Development, and the National Bank for Agriculture and Rural Development (NABARD). The SHG model was modified to constitute village-level neighbourhood groups (NHGs) as savings-cum-credit groups, located within a multi-level structure of governance with three pillars. The first pillar is the State Poverty Eradication Mission of the Government of Kerala (the Kudumbashree Mission or K. Mission). The second pillar is the Kudumbashree community network (or K. Network), established as an autonomous registered body whose office bearers are elected, consisting of Community Development Societies (CDSs) at the gram panchayat (village council) level, Area Development Societies (ADSs) at the ward level,[8] and neighbourhood groups at the village level. In turn, the K. Network mediates with the third pillar—the gram panchayat—as the base unit of local government.

Group farms or Joint Liability Groups (JLGs), as they are termed, are constituted by women who are all prior members of pre-existing NHGs or belong to families of NHG members.[9] There is a fair degree of uniformity in the characteristics of NHG members, since Kudumbashree's NHG programme promotes savings-cum-credit groups among economically less privileged women; there is near-universal female literacy in Kerala; and a 2015–16 sample study of 350 NHGs across Kerala found that 95% of members had a bank account in their own name, and 95% came from households owning very small plots (homestead or farm land) (Kannan & Raveendran, 2017). Thus while not all NHG members take up group farming (hence there is a degree of self-selection here), on important variables such as primary schooling, overall economic status, and access to credit there is little systematic difference between NHG members who constitute group farms and those who don't.[10]

Although the concept of a JLG was initiated by NABARD to provide institutional credit to small farmers,[11] Kudumbashree adopted

[5] See, Sabates-Wheeler and Childress (2004) for Kyrgyzstan; Sabates-Wheeler (2002) for Romania; Mathijs and Swinnen (2001) for East Germany; Ruben and Lerman (2005) for Nicaragua; and the discussion on these and other examples in Agarwal (2010b).

[6] In terms of nomenclature, the all-India programme was called Mahila Samakya, but at the state level, in Andhra Pradesh, it was registered as Mahila Samatha.

[7] Notably, even at the earlier stage when Mahila Samatha groups were constituted, almost all scheduled caste and marginal household women in the village joined (APMSS 2004, and author's discussions with former APMSS functionaries). Hence, here too, there was rather little self-selection among those who fulfilled the criteria of socio-economic status.

[8] A ward is a sub-unit of the gram panchayat, which in Kerala is typically very large, serving populations of 30,000–35,000 on average. Some gram panchayats have as few as 13 wards, others as many as 23.

[9] One adult woman per household can join an NHG, but all women of the member households can attend NHG meetings and training programmes.

[10] Moreover, Kannan and Raveendran (2017) found that only 18% of NHG members were ≥60 years of age, which is very close to the 17.4% figure for group farm members in my sample. (See also endnote 16 on unobservables).

[11] Under this scheme, groups constituted of 4–10 persons of similar socio-economic backgrounds and from the same locality can get a bank loan without collateral, but bear joint responsibility for repayment.

the term to denote women's group farms when they registered with the CDS, and bank linkage only became mandatory in 2015 (K. Mission, 2015). This three pillar institutional structure is a key feature in the programme, enabling it to sustain and expand despite political shifts in state governance. In 2016, there were over 60,000 JLGs spread across all 14 of Kerala's districts (Kudumbashree website).

The K. Mission and CDS are supposed to provide JLGs with a range of support, including extension services; training in agricultural practices (preparing organic inputs, growing specialised fruits and vegetables, etc.) and the use of farm machinery;[12] and crop-specific area incentives (based on area under the specified crop) and production incentives (based on crop yields of JLGs relative to state averages). In practice, there have been gaps in implementation, especially in the delivery of incentives.

3. Data and farm characteristics

3.1. Data

My primary survey covered three districts of Telangana (Medak, Mahbubnagar, and Karimnagar) and two districts of Kerala (Alappuzha and Thrissur) for the crop year 2012–13, with additional gap-filling undertaken during 2013–14.

The Telangana group farms—SDGs—were formed (as noted) under the jurisdiction of APMSS which was active in the region when the study began. Three districts were selected out of the original five picked for the UNDP-GoI project, since they had the largest proportion of group farms still active after the project ended. Seventy SDGs (each village had only one) were selected randomly from the universe in each district, the numbers being proportionate to their incidence in that district vis-à-vis the total for all three districts. The sample came to 27, 21 and 22 SDGs for Medak, Mahbubnagar, and Karimnagar respectively. These SDGs had cultivated in 2011–12 and were planning to continue cultivating in 2012–13 (the survey year).

Small farmers from the same villages as the SDGs constituted the control sample. Two types of individual farms were identified: (i) those cultivated by non-group farmers (NGFs) independent of the SDG members, and (ii) those cultivated by the families of SDG women (SWIFs). For selecting NGFs, a census of farmers by farm size was conducted in each sample village. Seven farmers were then randomly selected per village from amongst those who in 2011–12 had cultivated 5 acres or less.[13] For selecting SWIFs, in each sampled SDG three group members were randomly selected from among those whose families were doing individual farming on 5 acres or less. In each selected village, therefore, the sample was constituted of one SDG, seven NGFs and three SWIFs. A few farmers who later reported no output due to crop failure, or had incomplete or unreliable data, were dropped from the analysis. The final sample analysed consists of 70 SDGs, 485 NGFs and 208 SWIFs, that is 763 farm enterprises in 70 villages.

For Kerala, out of its 14 districts, two were selected for the survey: Alappuzha to represent a region dominated by the main subsistence crop, paddy, and Thrissur to represent a district dominated by the commercial cultivation of banana. In both districts vegetable farming was also important. Using the Kudumbashree data base (which lists each JLG by location and main crops), wards were identified within each district which had at least some group farms growing mainly paddy and some growing mainly vegetables in Alappuzha. From each such ward, two group farms (one growing mainly paddy, another growing mainly vegetables) were selected through random sampling. In Thrissur, similarly, the wards identified were those which had some groups growing mainly banana or mainly vegetables, and from each ward two groups were randomly sampled (one growing mainly banana and one mainly vegetables).

In all, 69 JLGs (33 in Alappuzha and 36 in Thrissur)[14] were studied, which had been functioning for at least 2–3 years prior to the survey. In addition, for each sampled JLG, three group members whose families were also cultivating their own plots were selected randomly. Where only one or two JLG members were doing individual farming, all were selected. The final sample consists of 250 farm enterprises (69 group farms and 181 individual farms). In Kerala, separate non-group farms were not sampled, since JLGs were receiving local government support and it would have proved difficult to separate the effect of that support from the effect of being in a group.

For 763 farm enterprises in Telangana and 250 in Kerala, weekly data were collected in 2012–13 for every output and input (including labour) for each crop season, for 12 months, or until the last crop was harvested.[15] Additionally, supplementary quantitative and qualitative information on a range of aspects was also collected through in-depth focus group discussions, one with members of each group farm and another separately with the sampled individual farmers of each village.

3.2. Farm characteristics

Before examining productivity and net returns, consider some broad characteristics of the sampled farms.

3.2.1. Demographic characteristics

When we compare group farms in the two states, we find that apart from the noted differences in their origins and extent of state support, SDGs and JLGs also differ in other important respects, which could impinge on their economic returns. To begin with, since SDGs were constituted of pre-existing sanghas which were formed for women's social empowerment, many of the groups are large (ranging between 10 and 54 members, with an average of 22) and fairly homogenous (93% are Hindus, 85% of whom are Scheduled Caste (SC): see Table 1). Also, 38% of the women are still illiterate, despite the Mahila Samatha education programme. But the majority (86%) come from landowning households, although owning small plots. Kerala's JLGs, by contrast were established for women's economic empowerment. The groups are small in size (3–12 women with an average of 6) and socially heterogeneous in terms of religion (20% are Christians or Muslims) and caste (most Hindu members are not scheduled caste—76% are from other backward castes and 15% are upper-caste). The members are educated (99% are literate), and all come from landowning households, although owning very small plots. In Telangana, constituting homogenous SDGs from the lowest castes appears logical for social empowerment, but it can prove disadvantageous for farming, since it narrows the base of social capital for accessing land and inputs. And a large group size reduces per capita benefits and ease of coordination, although it also lowers expenditure on hired labour.

[12] Each CDS received Rs. 50,000 for setting up farmer facilitation centres, containing equipment such as sprayers, weed cutters, wheel barrows, etc. which JLGs can borrow.

[13] Five acres (about 2 ha) was used as the cut-off, since most farms globally fall under five acres and small farmers are also the ones most likely to gain from pooling resources.

[14] From an initial sample of 70, one JLG which had ceased to be a group farm was dropped.

[15] For example, for banana, data collection continued until the last harvest in September 2013.

Table 1
Telangana and Kerala: Demographic characteristics of adult members.

Characteristics	Telangana			Kerala	
	Individual farms[a]		Group farms	Individual farms[a]	Group farms
	NGF (N = 1811)	SWIF (N = 843)	SDG (N = 1549)	JWIF (N = 571)	JLG (N = 369)
	Religion				
% Hindus	98.8	99.8	93.1	74.3	80.5
% Muslims	1.0	0.2	0.1	2.3	1.4
% Christians	0.2		6.8	23.5	18.2
	Caste (of Hindus)				
% SCs or ST	34.4	80.6	85.3	5.9	8.8
% Backward castes	59.8	17.7	12.5	76.4	76.4
% Other castes	5.8	1.7	2.2	17.7	14.8
	Age				
Mean age of adult members	37.4	37.1	47.2	43.2	45.1
% adult members ≥60 years old	11.6	10.9	17.4	13.7	9.2
	Education[b]				
% Illiterate/dropout	61.9	60.9	37.7	1.3	0.5
% Reading & writing or signing own name	4.0	2.3	30.8		
% Schooling <class 5	0.7	1.1	12.7	4.4	8.2
% Schooling ≥class 5	33.4	35.7	18.9	94.4	91.3

Source: Author's survey. Calculated from focus group discussion data and baseline data.
Note: Figures in brackets give the number of observations.
[a] Calculations are based on all adult members of the household.
[b] This information was missing in some cases, ranging from 0.3% to 3.3% of members across the two states. The calculations are based only on cases with information.

When we compare group and individual farms within each state, we find no striking differences in Kerala but three notable differences in Telangana: one, only a third of the non-group farmers are scheduled caste/tribe relative to over 80% of SDGs and SWIFs; two, a greater percentage of group farms have members over 60 years of age; and three, illiteracy is higher among individual farmers, although they also have a higher percentages of adults with schooling above class 5. In other words, group farmers are disadvantaged in terms of their caste and age composition, but somewhat better-off in terms of literacy. In addition, group farms are disadvantaged in terms of land access, as discussed below.[16]

3.2.2. Land characteristics

In both states, group farms are dependent entirely on leased-in land and are larger in size than individual farms (Table 2). In Telangana, 71% of the SDGs lease land solely from group members (at lower than market rates) and the rest wholly or partly from non-group landlords, while individual farmers mostly cultivate their own land. The average farm sizes are 1.14, 0.92 and 2.06 ha respectively for NGFs, SWIFs and SDGs in terms of net sown area. Half the NGFs are irrigated, relative to 40% of SWIFs and 44% of the group farms.

In Kerala, the pattern is similar in some respects, but different in others. Here also, on average, JLGs cultivate more land than individual farmers (0.96 relative to 0.35 ha of NSA and 1.22 relative 0.48 ha of GCA) and the latter own all or most of the land they farm. However, the leasing arrangements differ from those of Telangana. JLGs lease land solely or mostly from non-group landlords, and only 13% lease solely from group members. The majority of farms (group or individual) are irrigated, but individual farms have some advantage over group farms.

In both states, 95% of the individual sample farms are male-managed,[17] and they seldom complain about land access since they own cultivable land, while women's groups complain constantly about the difficulty of leasing in good quality land in a single plot. These problems are rampant in Telangana, where the group farms, constituted predominantly of scheduled castes, have limited access to the land of the well-endowed upper castes. The citation below is illustrative:

> We face a problem in getting land on lease. The landlords in the village think that since all our members belong to the SC community, if they lease to us we will get the patta [land title] in the sangha's name. So none are prepared to lease land to our SDG. (SDG, Rollapad village, Medak district, Telangana).

Much of the collective action literature emphasises that social homogeneity is conducive to cooperation, but homogeneity can also limit social capital, as we see in Telangana. Moreover, although the law permits land leasing in the state, landlords fear losing their land with formal leases, in case the tenant establishes occupancy rights from long use.

In Kerala, land leasing is banned, hence all leases are oral, but many landlords allow the JLGs (like the SDGs) to pay part of the rent after harvest. The caste heterogeneity of JLGs is advantageous for tapping a wider social circle for leasing land, without limiting cooperation,[18] although JLGs do report difficulties in getting consolidated plots.

[16] It could of course be argued that unobservables may still exist, in that some of the women joining group farms could have more 'ability'. But this is unlikely to be systematic. Also this is likely to be negated by the known legacy of disadvantage faced by women farmers in general (who seldom own land or have prior experience of independent farm management), relative to the legacy of advantage that the predominantly male individual farmers have in land ownership and farm management experience. This is common to both states. In my sample, only 19% of SDG women and 39% of JLG women themselves owned any land, although the households of most SDG women and all JLG women owned some.

[17] Female-headed farms were not specifically sampled because (a) we wish to compare group farms and individual farms, rather than group farms and *women's* individual farms; and (b) for most women in the group farms, the default option is not female-headed farming but family farming.

[18] Literature from other contexts also indicates that group homogeneity is not always a necessary condition for successful cooperation, and there are contexts in which heterogeneity can help (see discussion in Baland & Platteau, 1996).

Table 2
Telangana and Kerala: Farm size, land source, and inputs used.

Land and inputs used	Telangana			Kerala	
	Individual farms		Group farms	Individual farms	Group farms
	NGF	SWIF	SDG	JWIF	JLG
	Farm size				
Net sown area (ha)	1.14	0.92	2.06	0.35	0.96
Gross cropped area (ha)	1.35	1.08	2.49	0.48	1.22
	Source of land cultivated (% farms)				
Using owned land only	90.7	90.4		71.3	
Using owned + leased land	9.1	7.7		28.7	
Using leased land only	0.2	1.9	100.0		100.0
	Source of land leased by SDGs (% farms)				
From group members			71.4		13.0
From non-group landlords			25.7		56.5
From both			2.9		30.4
	Seasonal use of land (% farms)[a]				
Cultivating in both seasons	34.2	29.8	42.9	74.0	76.8
	Farms using specified inputs (% farms)				
Fertilisers	98.8	97.6	97.1	62.4	84.1
Manure	24.3	25.0	17.1	90.1	89.9
Fertilisers and/or manure	98.8	98.1	97.1	100.0	100.0
Pesticides	86.6	76.9	65.7	52.5	71.0
Farms with irrigation	50.1	40.4	44.3	96.1	88.4
Total No. of observations	485	208	70	181	69

Source: Author's survey. Calculated from weekly data and focus group discussion data.
[a] Perennial crops such as banana have been counted as occupying land for both seasons.

In both states therefore, access to good quality consolidated land is difficult to obtain on lease, especially for paddy cultivation. Also, given the rarity of written leases (which can prove that the applicant is a cultivator) and land tax certificates (which only owners have) it is difficult for most group farms to access the government's input subsidies. Notably though, a larger proportion of both SDGs and JLGs, relative to individual farmers in each state, uses the land in both seasons. In Telangana, 43% of SDGs relative to 34% of NGFs cultivate in both seasons; and in Kerala 77% of JLGs and 74% of JWIFs do so.

On other inputs, although about the same proportions of SDGs and individual farms use fertilisers, manure and pesticides, SDGs persistently mention difficulties in accessing good quality seeds, fertilisers, or tractors in time. The following experience is typical:

> Yes we have a problem in getting good quality seeds. To some extent, the whole village faces this problem, but women face it more. Moreover, for getting one bag of fertiliser we have to queue in long lines for an entire day, and that is very difficult for women. Also in the peak season, getting a tractor is not easy. We are charged high rates—Rs. 1200 per hour or more—and these [male] tractor owners keep changing the price according to demand and season. We are also made to wait 2–3 days. We don't get timely compensation for crop loss either, so we are sometimes unable to pay the full lease amount. (SDG members, Kondapur village, Karimnagar district).

In Kerala, by contrast, a higher proportion of JLGs than individual farmers use both fertilisers and pesticides.

Most importantly, individual and group farms differ in their dependence on hired labour. This dependence is much greater in individual farms, since their family labour is insufficient for peak operations such as weeding, harvesting, and (for paddy) transplanting. Group farms are able to save on hired labour substantially in Telangana, given the large size of SDGs. This is less the case in Kerala where especially the smaller groups have to hire a fair amount of additional labour for peak operations. Also, in both states, since SDGs and JLGs are all-women's groups, they have to pay charges for the male drivers who come with their machines for land preparation, sowing, spraying, and so on.

Table 3 gives the average annual expenditure on purchased inputs by individual and group farms. In both states, a striking 37–40% of the total expenditure of individual farms is on hired labour, which is their single most important paid out cost. Telangana's group farms spend rather little on hired labour, given their large group size; rent constitutes their biggest expense (since they lease all their land), and their total expenditure on purchased inputs is lower than that of individual farmers. For Kerala's group farms, however, the fertiliser and manure costs match labour hiring expenses (given their smaller group size compared to Telangana). They also spend a good deal on 'materials' (such as frames for vegetable vines). Moreover, the overall cost on purchased inputs per hectare is much higher on average among Kerala's JLGs than its individual farms. These differences will play out, as we will see, in net returns.

Finally, it needs mention that both SDGs and JLGs deal with the main collective action issue—absenteeism—in similar ways. Everyone is expected to contribute labour equally, whatever their other obligations (including to their family farms). Although none of the groups keep attendance records, they have clear rules for absence. An absentee must send a replacement (a family member or hired labourer), or contribute extra time later, or pay a fine equal to the daily wage. Leniency is exercised only for brief absences due to illness. These rules *are* implemented, since the groups give examples (Agarwal, 2017): for instance, replacement by family members constituted 57% of the 121 cases of absenteeism reported in the survey year in Telangana, and 41% out of 49 cases reported in Kerala (where some absentee members were even made to forfeit their output shares). In both states, about a third of the members have at least one relative in the group, which adds to intra-group trust and cohesion,

Table 3
Telangana and Kerala: Average annual expenditure on purchased inputs per unit of gross cropped area (Rs/ha).

Inputs used	Telangana			Kerala	
	Individual farms		Group farms	Individual farms	Group farms
	NGF	SWIF	SDG	JWIF	JLG
Rent-Lease	645.0	939.7	8916.2	3083.1	8899.8
	(1.8)	(2.6)	(34.2)	(8.9)	(14.2)
Labour	14402.8	13648.1	1643.5	13923.4	16902.9
	(39.7)	(37.2)	(6.3)	(40.3)	(26.9)
Seed	3315.8	3702.7	2357.4	2579.2	4237.7
	(9.1)	(10.1)	(9.0)	(7.5)	(6.8)
Fertilisers + manure	6855.3	6955.5	4687.0	10782.0	17059.4
	(18.9)	(18.9)	(18.0)	(31.2)	(27.2)
Pesticide	2680.1	2549.7	1362.4	1052.4	1020.5
	(7.4)	(6.9)	(5.2)	(3.0)	(1.6)
Animal time	2277.7	2431.9	1932.0		
	(6.3)	(6.6)	(7.4)		
Machine time	5058.7	5598.5	4626.6	1838.3	1753.3
	(14.0)	(15.3)	(17.7)	(5.3)	(2.8)
Transport	1036.6	897.0	578.0	598.3	1412.3
	(2.9)	(2.4)	(2.2)	(1.7)	(2.2)
Materials				720.6	11500.2
				(2.1)	(18.3)
Total Input Cost	36272.0	36723.0	26103.1	34577.3	62786.1
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
No. of observations	485	208	70	181	69

Source: Author's survey. Calculated from weekly data.
Note: Own inputs and own labour (that is not-purchased inputs) are not included. Figures in brackets give percentage of total expenditure on given inputs.

as does living in the same neighbourhood. This also means that they know each others' capabilities.

Let us now consider the relative productivity and profitability of group and individual farms, for each state.

4. Model and hypotheses

4.1. Model

To measure productivity differences between group and individual farms, the basic model used is as below:

$$\text{Telangana}: log(Y) = \beta_0 + \beta_1 d_{farm1} + \beta_2 d_{farm2} + \sum_j \alpha_j log(W_j) + \beta_3 d_{irri} + \beta_4 X_{cp} + \sum_k \gamma_k Z_k + \beta_5 d_{dist1} + \beta_6 d_{dist2} + \varepsilon$$

$$\text{Kerala}: log(Y) = \beta_0 + \beta_1 d_{farm} + \sum_j \alpha_j log(W_j) + \beta_3 d_{irri} + \beta_4 d_{cp} + \sum_k \gamma_k Z_k + \beta_5 d_{dist} + \varepsilon$$

where Y = value of output
d_{farm}, d_{farm1}, d_{farm2} = farm type dummies
W_j = inputs: area under the crop(s), fertilisers + manure/ha, pesticides/ha, labour/ha
d_{irri} = irrigation dummy
X_{cp} = cropping pattern: percentage gross cropped area under foodgrains
d_{cp} = cropping pattern dummy
Z_k = demographic variables: % adults who have schooling ≥class 5; % adults ≥60 yrs
d_{dist}, d_{dist1}, d_{dist2} = district dummies

Output has been measured as follows. For Telangana, where two seasons can be clearly demarcated, there are two measures for annual output: value of output per unit of gross cropped area (GCA) and value of output per unit of net sown area (NSA). (NSA x cropping intensity = GCA). In addition, separate regressions were run for foodgrains and cotton. The crop-specific analysis is based on a limited sample, since most farmers grow several crops per season, and inputs used cannot be separated by crop. The crop-specific regressions are thus restricted to farmers who grow only foodgrains or only cotton in kharif (the main crop season), so that inputs purchased in that season can be attributed to those crops. This reduces the sample size, but the results are still indicative.

For Kerala, many farmers, especially in Thrissur district, grow perennial crops, mainly banana, but sometimes also coconut and rubber. Here crop seasons cannot be separated on many farms. Also, there are almost no solely banana growers in Alappuza and few purely paddy farmers in Thrissur. The measures used here for productivity are therefore the value of output per GCA (not per NSA) for both districts; value of bananas per unit of banana area (for Thrissur), and value of paddy output per unit of paddy area (for Alappuzha). I use a dummy for cropping pattern differences, since several farms have mixed cropping on a single plot, and the area under each crop cannot be separated. Our aim is to assess if the type of farm enterprise—group or individual—makes a significant difference to aggregate annual output and individual crop yields, after controlling for the mentioned variables.

In addition, to compare the relative profitability of group and individual farms, annual net returns realised per farm are assessed by deducting annual costs of purchased inputs from the annual value of output. These net returns (taken as profits) already capture the effect of inputs used. However, regression analysis was undertaken to assess if the returns differed significantly by farm type, over and above district-wise differences.

4.2. Hypotheses

If the advantages of group farming listed in Section 1 are realised in practice, we can expect group farms to perform better than individual farms in terms of both productivity and profitability.

Overall, we would expect a positive relationship between crop output and inputs such as irrigation, fertiliser, manure, pesticides and labour. Land is more complex. A number of studies argue that the negative relationship observed between farm size and productivity in the 1960s and 1970s persists, although weakened (see e.g. Gaurav & Mishra, 2015, and references therein). However, these studies include both large and small farms, while the current study focuses only on smallholders. Here we would expect a positive effect of land size on productivity, due to the scale benefits of moving up from very small plots.

The cropping pattern variable, which seeks to capture the effect of crop choices on farm performance, is also complex. SDGs in Telangana were strongly encouraged by APMSS to grow foodgrains (cereals and pulses), on the argument that this will enhance family food security. But since this region is semi-arid, with low and uncertain rainfall and limited irrigation, growing foodgrains, especially paddy, increases the risk of crop failure. The emphasis on foodgrains can thus negatively affect SDG performance relative to individual farmers, many of whom choose to grow cotton for which there are good local markets. In Kerala, JLGs, like individual farms, are free to choose the crops they grow.

On the demographic variables, we expect farms with a higher proportion of educated adults to have a positive effect on productivity and those with a higher proportion of elderly members to have a negative effect. The exceptions could be family farms where older women may look after their grandchildren, releasing their daughters-in-law for farming. Finally, location-wise, some districts are likely to perform better than others. Especially in Telangana, Karimnagar farmers may do better because it has higher rainfall, less poverty, and better infrastructure than the other two districts, but there may be crop-specific differences.

The above hypotheses are, however, subject to a caveat. Two types of disadvantages could play out for the group farms. One would be gender-specific, since the group farms are managed by women-only while the individual farms, as noted, are almost all male-managed;[19] here the difficulties women face in accessing agricultural inputs and services may only partly be overcome by being in a group. The second potential disadvantage relates to a mix of gender and general factors, arising from the high dependence of groups on land leased from non-group landlords: as noted, 26% of groups in Telangana and 56% in Kerala lease land wholly from landlords. For a start, this dependence is higher for women than men, since rather few women tend to own land. In addition, in general, landowners who have invested in their land over the years usually self-cultivate their best quality land, especially paddy plots, so groups can end up with poorer quality land, even fallow land. In addition, since most of the groups are tenants with oral leases, they tend not to have the required papers for accessing government subsidies that are given to proven cultivators.

These disadvantages of land leasing are different from those emphasised in a sizable economics literature on sharecropping contracts, which has argued that tenant farmers will have less incentive to apply inputs and labour intensively on sharecropped land (Jacoby & Mansuri, 2006; Shaban, 1987). In my sample, 99.8% of lessees in Telangana and 91% in Kerala pay a fixed cash rent. And the women working in groups are strongly motivated, since they control decisions and returns, while on family farms they are typically subordinate to male heads of farms. Hence the problem here is not one of tenants having low incentives, but of proving their credentials as farmers in the absence of written leases, and the difficulty of getting good quality land in the first place.

In Telangana, we could also expect differences between the two categories of individual farms—NGFs and SWIFs: although both have the advantage of owning their farms, SWIFs like SDGs can face caste-related disadvantages in input access.

On profitability, similarly, we expect group farms to perform better than individual farms if the advantages of being in a group are realised. But again, as with productivity, there can be mediating factors arising from gender bias in access to land, and markets for inputs and outputs, not all of which may be overcome by farming in groups.

5. Results

5.1. Productivity

5.1.1. Cross tabulations

Telangana and Kerala perform very differently on productivity. As seen from Table 4, in Telangana, group farms perform worse than individual farms especially in terms of the annual value of output per hectare (of GCA and NSA) for all crops, and for kharif foodgrains alone.[20] The slightly higher cropping intensity of SDG farms is not enough to bridge the gap with individual farmers on annual output per hectare of NSA. In Kerala, we observe the opposite: group farms perform significantly better than individual farms in per hectare annual value of output as well as banana yields, although not in paddy yields. How do these play out in the regressions, when we control for inputs, cropping patterns, demographic variables, and location?

5.1.2. Regression results

In all the equations, robust standard errors, clustered for the primary survey unit, are reported. None of the equations show multicollinearity among the explanatory variables when tested using the Variance Inflation Factor (VIF).[21]

5.1.3. Telangana

Table 5 and Appendix Table A1 give the regression results and descriptive statistics for productivity in Telangana. We find that SDGs perform less well than both types of individual farms—NGFs and SWIFs—in output per hectare of gross cropped area (Eq. 1). They also perform less well than NGFs in output per unit of net sown area (Eq.2), while the differences between NGFs and SWIFs are not significant in either equation. This holds after controlling for all inputs, the cropping pattern, education level, the proportion of elderly women among the SDGs/farmer families, and location by district. Assessing from the farm type coefficients, NGFs, relative to group farms, are found to have 23% higher output per hectare of GCA.[22]

The coefficients of land, fertlisers + manure, pesticides and labour use are all positive and significant, as hypothesized. The most important input driving output is labour use, with a 1% increase in labour time/ha leading to a 0.45% increase of output per ha of GCA and a 0.61% increase per ha of NSA. Area cultivated

[19] Several studies (mostly for Africa) that measure differences in productivity between male and female-managed farms give diverse results, but none have examined the effect of farms managed by women's *groups* (Agarwal, 2014).

[20] In both states, the prices used for calculating the value of output (including fruits and vegetables) are the actual sale prices reported by the farmers for given varieties of the produce.

[21] The maximum VIF value was 2.8, much below 10 which is deemed econometrically problematic (Wooldridge, 2009).

[22] This figure is arrived at as follows: $(e^b - 1) * 100$, where b is the coefficient of the dummy variable.

Table 4
Telangana and Kerala: Average value of output per hectare, all crops and crop-specific (Rs/ha).

	Telangana			Kerala	
	NGF	SWIF	SDG	JWIF	JLG
	Annual value of output/GCA			*Annual value of output/GCA*	
Mean	53572.97	49478.03	36544.37	101156.20	179183.70
	(485)	(208)	(70)	(181)	(69)
Min.	1412.03	2790.84	4767.07	741.32	2119.66
Max.	228572.30	261289.00	115707.00	775078.00	1053274.00
	Annual value of output/NSA				
Mean	63618.86	59049.22	46402.94		
	(485)	(208)	(70)		
	All foodgrains (kharif) (Rs/ha)			*Paddy, Alappuzha (Rs/ha)*	
Mean	36167.90	28956.70	25079.35	80741.02	69548.15
	(286)	(117)	(52)	(23)	(7)
	Cotton (kharif) (Rs/ha)			*Banana, Thrissur (Rs/ha)*	
Mean	83765.00	79169.10	71821.00	258064.10	413734.20
	(259)	(116)	(16)	(17)	(14)

Source: Author's survey. Calculated from weekly data.
Notes: Figures in brackets give the number of observations

comes next, with a 1% increase in GCA leading to a 0.18% increase in output/GCA (and similarly for output/NSA), giving a positive farm size–productivity relationship. Irrigation too has a positive impact, but it is not statistically significant, probably because the dummy variable does not adequately capture reliability (e.g. some complain of not having power, even when they have an irrigation facility). The two demographic variables are insignificant except in Eq. (3) (discussed further below), where the presence of older women is negatively significant.[23] The negative sign of the cropping pattern variable is especially notable, although the coefficient is small. The greater the area under foodgrains as versus other crops, the less the value of output per ha of GCA and NSA.[24] This confirms the earlier observation that in a semi-arid zone with limited irrigation, the strong emphasis APMSS placed on SDGs growing foodgrains and eschewing commercial crops like cotton, left the groups vulnerable to low yields and crop losses.

This point is further strengthened in the crop-specific regressions for kharif foodgrains and cotton (the principal non-food crop grown during kharif by individual farmers). For foodgrains, NGFs have significantly higher yields than group farms (Eq. 3), but there is no notable difference between farm types in cotton yields (Eq. 4). This suggests that women's groups could have performed better and made up for some of the productivity gap with individual farms, if they had been able to choose a commercial crop like cotton, rather than grow only foodgrains.[25] Where some SDGs did grow cotton in kharif, they performed better and had no difficulty in finding remunerative markets for the crop.

Apart from the enforced cropping pattern, other constraints faced by the group farms which are important, but difficult to capture empirically, include difficulty in procuring fertilisers and tractors in time (described earlier) and getting good quality land, as explained lucidly by SDG members in Chinnadarpalli village, Mahbubnagar, Telangana:

> There is a difference in group cultivation and individual cultivation. We need to compare the kind of land that the group is leasing with the land that individual farmers have. The SDG is leasing wasteland, fallow land, and land at a distance from their habitation. We have to put in a lot of energy and money in order to get good output, but we are not able to achieve this from fallow and wastelands. We are not reaping the profit that individual farms are getting mainly due to the low quality of land we get on lease. Another problem is that SDGs don't have the option of growing commercial crops. We have to obey the norms of cultivation proposed by APMSS of growing only foodcrops.

5.1.4. Kerala

Kerala's performance is in marked contrast to Telangana's (see Table 6 for the regressions and Appendix Table A2 for descriptive statistics). Here the group farms, relative to individual farms, are found to have 30% higher annual output per gross cropped hectare. Also farmers with larger gross cropped area, and higher per hectare use of fertiliser, manure, pesticide and labour, have significantly higher yields. Labour use and cropping patterns make a particular difference. A 1% increase in labour time per ha increases output/GCA by 0.57%. And those who grow paddy or banana, wholly or partly, perform better than those focusing only on tubers and vegetables or other mixed crops. In Kerala, as noted, there is no pressure on the groups to grow any specific crop, and in fact JLGs are encouraged to experiment with new crops. At the same time, the type of land they can lease can restrict choices, especially for paddy cultivation.

The effect of farm type on the yields of the main crops—banana in Thrissur and paddy in Alappuza—has been assessed separately. The regressions (Eqs. 2 and 3) show that JLG performance is strikingly better than that of individual farmers for banana, but not for paddy. Among banana growers, group farms are found to have 348% higher yields (in Rs/ha) than individual farms. The banana story is important. Although all farmers try and take advantage of high banana prices in the festival season (August–September) by coordinating their harvest and sales accordingly, the women's groups are able to work the market especially well. In some regions, they are also able to get contracts with niche markets, including temples requiring special banana varieties, such as Kaddali. Groups probably have an advantage here over individuals in being able to provide an assured delivery of the product in needed quantities.

In paddy, JLGs perform less well than individual farmers and the labour use variable is also unexpectedly negative. Probing the reasons for these results is revealing. On paddy yields, I found that

[23] In addition, I tested for the effect of caste differences in Telangana, using percentage members who are scheduled caste as an explanatory variable, but the coefficient was consistently insignificant.
[24] In addition, to see if crop diversification makes a difference, I tested a dummy variable with monoculture = 1 and >1 crop = 0, but it was consistently insignificant in both states.
[25] Some link farmer suicides in Telangana to cotton cultivation, but the empirical evidence on this is disputed (see e.g. Ravi, 2015).

Table 5
Telangana: Productivity by farm type, regression results.

Dependent variable Explanatory variables	Log annual GCA output (Rs/ha GCA) Eq. (1)	Log annual NSA output (Rs/ha NSA) Eq. (2)	Log kharif foodgrain output (Rs/ha foodgrain area) Eq. (3)	Log kharif cotton (Rs/ha cotton area) Eq. (4)
Farm type 1 dummy (NGF = 1)	0.21**	0.19**	0.29**	−0.10
	(0.024)	(0.043)	(0.039)	(0.519)
Farm type 2 dummy (SWIF = 1)	0.18*	0.18	0.15	−0.16
	(0.088)	(0.117)	(0.316)	(0.356)
Log GCA (ha)	0.18***			
	(0.005)			
Log NSA (ha)		0.21***		
		(0.003)		
Log Area under kharif foodgrains (ha)			0.16	
			(0.155)	
Log Area under kharif cotton (ha)				−0.03
				(0.735)
Log, fertiliser + manure (Rs/ha GCA)	0.04***			
	(0.000)			
Log, fertiliser + manure (Rs/ha NSA)		0.04***		
		(0.002)		
Log, fertiliser + manure (Rs/ha kharif foodgrains)			0.04***	
			(0.001)	
Log, fertiliser + manure (Rs/ha kharif cotton)				0.13***
				(0.010)
Log, pesticide (Rs/ha GCA)	0.01**			
	(0.033)			
Log, pesticide (Rs/ha NSA)		0.01**		
		(0.035)		
Log, pesticide (Rs/ha kharif foodgrains)			0.01	
			(0.110)	
Log, pesticide (Rs/ha kharif cotton)				0.01
				(0.151)
Log Labour (hrs/ha GCA)	0.45***			
	(0.000)			
Log Labour (hrs/ha NSA)		0.61***		
		(0.000)		
Log Labour (hrs/ha kharif foodgrains)			0.47***	
			(0.007)	
Log Labour (hrs/ha kharif cotton)				0.48***
				(0.000)
Irrigation dummy (irrigated = 1)	0.08	0.13	0.16	−0.03
	(0.317)	(0.144)	(0.271)	(0.832)
% GCA area under foodgrains	−0.005***	−0.004***		
	(0.000)	(0.000)		
% adults with ≥ class 5 education	−0.00	−0.00	−0.00	0.00
	(0.346)	(0.500)	(0.128)	(0.889)
% adults ≥60 years of age	−0.00	−0.00	−0.00*	−0.00
	(0.550)	(0.797)	(0.054)	(0.958)
District 1 dummy (Medak = 1)	−0.08	−0.13	−0.85***	0.22*
	(0.375)	(0.198)	(0.000)	(0.068)
District 2 dummy (Mahbubnagar = 1)	−0.75***	−0.78***	−1.17***	−0.41**
	(0.000)	(0.000)	(0.000)	(0.025)
Constant	7.23	6.23	7.03	8.79
No. of observations	763	763	286	205
Adjusted R^2	0.46	0.48	0.34	0.25

Notes: Robust standard errors, clustered for the primary survey unit, are reported in all equations.
Figures in brackets are *p* values. Significance: *** at 1%, ** at 5%, * at 10%.
Zeros are given a value of 0.0001 for log conversion.
In all 4 equations: differences in the coefficients of farm types 1 and 2 are not statistically significant, but district 1 does significantly better than district 2 at 1% in Eqs. (1), (2) & (4), and at 5% in Eq. (3).

a much larger proportion of the individual farms than JLGs in the regression are located in Cheruthana and Nedumudy CDS, where many have soils especially suited for paddy and get notably high yields. Here JLGs find it difficult to obtain land on lease, as also indicated by their responses below:

> It is easy to get land for vegetable cultivation in this area, but difficult to get paddy fields. Here only a few landlords have paddy fields, and those that do are self-cultivating and do not want to lease their land to us. (Thejus JLG, Cheruthana CDS).

> In this area most people depend on paddy farming and there is competition between the farmers for getting land on lease. Depending on demand, the lease rate also increases. (Samagra JLG, Nedumudy CDS).

What the regression results for farm type are thus capturing is the advantage that individual male farmers have, both in owning high quality paddy land and long experience in paddy cultivation. The negative labour input effect is due to the very high amounts of weeding labour used by some farmers (individuals and JLGs) to

Table 6
Kerala: Productivity by farm type, regression results.

Dependent variable	Log annual output GCA (Rs/ha GCA)	Log banana output, Thrissur (Rs/ha banana area)	Log paddy output, Alappuzha (Rs/ha paddy area)
Explanatory variables	Eq. (1)	Eq. (2)	Eq. (3)
Farm type dummy (JWIF = 1)	−0.26*	−1.50***	0.33*
	(0.072)	(0.006)	(0.056)
Log Gross cropped area (ha)	0.15		
	(0.109)†		
Log Area under banana Thrissur (ha)		0.41*	
		(0.091)	
Log Area under paddy Alappuza (ha)			−0.00
			(0.973)
Log, fertiliser + manure (Rs/ha GCA)	0.21***		
	(0.007)		
Log, fertiliser + manure (Rs/ha Banana)		−0.64	
		(0.131)	
Log, fertiliser + manure (Rs/ha Paddy)			−0.24
			(0.167)
Log, pesticide (Rs/ha GCA)	0.03**		
	(0.026)		
Log, pesticide (Rs/ha Banana)		−0.00	
		(0.745)	
Log, pesticide (Rs/ha Paddy)			0.23
			(0.112)
Log Labour (hrs/ha GCA)	0.57***		
	(0.001)		
Log Labour (hrs/ha Banana)		1.26***	
		(0.004)	
Log Labour (hrs/ha Paddy)			−0.72***
			(0.002)
Irrigation dummy (If irrigated = 1)	0.33		
	(0.241)		
Cropping pattern dummy (if no paddy or banana = 1)	−0.62***		
	(0.001)		
% adults with ≥class 5 education	−0.00	0.00	0.00
	(0.860)	(0.981)	(0.207)
% adults ≥60 years of age	0.00	0.01	0.01
	(0.155)	(0.453)	(0.332)
District dummy (Alappuza = 1)	−1.09***		
	(0.000)		
Constant	6.02	11.10	15.53
No. of observations	250	30	30
Adjusted R^2	0.51	0.42	0.34

Notes: Robust standard errors, clustered for the primary survey unit, are reported in all equations.
Figures in brackets are *p* values. Significance levels: *** at 1%, ** at 5%, * at 10%, † close to 10%.
Zeros were given a value of 0.0001 for log conversions.

Table 7
Telangana: Average annual net returns per farm.[1]

Indicator	Telangana			Kerala	
	Individual farms		Group farms	Individual farms	Group farms
	NGF	SWIF	SDG	JWIF	JLG
Mean	26814.8	17355.7	28956.6	23578.3	121048.5
Min	−60908.0	−42140.0	−28116.7	−223663.0	−127885.0
Max	286514.0	357872.3	210471.1	1027825.0	1691857.0
% farms with positive net returns	69.5	62.5	71.4	82.3	84.1
No. of observations	485	208	70	181	69

Source: Author's survey. Calculated from weekly data.
Note: [1]Net returns = value of total output minus value of all purchased inputs.

deal with the weed infested land they cultivate—in other words they are compensating for poorer land quality. Several JLGs and some individuals in Alappuzha reported this, including Thanima JLG in Kandaloor CDS:

> When we took the land it was uncultivated and of poor quality with a lot of weeds, so we had to hire more labour for removing the weeds. The labour wage is also high. We have to pay Rs. 200 per woman per day.

Hence, basically, two points stand out in the productivity results. First, overall, Kerala's group farms do substantially better than its individual farms, while Telangana's groups do much worse than its individual farms. Second, and notably, in both Kerala and

Telangana women's groups do much better when growing commercial crops (banana in Kerala, cotton in Telangana) than traditional foodgrains such as paddy, where high quality land and long experience matter more.

5.2. Profitability

How do group and individual farms perform in terms of profits and losses? Net returns have been calculated by subtracting all paid out costs from the total annual value of output, namely, by deducting the expenditure on land leases, hired labour, hired tractors and bullocks, and purchased fertilisers, manure, pesticides and seeds. No values were imputed for, say, owned land, family labour, or home produced inputs. Apart from the difficulty of assessing the opportunity cost of family labour time, imputing market values for owned land would have led to a substantial overestimation of the costs for individual farmers who own almost all the land they cultivate.[26] Notably too, in Telangana, although women do undertake wage labour, their time on SDG farms does not entail much opportunity cost in terms of bypassed options, since they are able to adjust work days among themselves by rotating tasks, leaving them time for wage work, if they wish (see also Agarwal, 2017). In Kerala's JLGs, again, women typically report that they were seldom hiring out their labour before constituting a JLG, and were mainly doing domestic work and helping on the family farm.[27] But here too task rotation among members releases their labour for other work.

5.2.1. Telangana

It is striking that although Telangana's SDGs perform systematically poorly in comparison with individual farms (NGFs and SWIFs) in overall productivity, except cotton yields, they *make up the difference* in terms of net returns, since they spend less on purchased inputs and hired labour. Table 7 shows that 71% of SDGs compared to 69% of NGFs and 62% of SWIFs report positive annual net returns, with SDGs and NGFs coming close to one another and both doing better than SWIFs. These observations hold when we control for districts in the regression in Table 8: group farms do as well as NGFs and both do significantly better than SWIFs.

However, neither individual nor group farms in Telangana do particularly well in comparison with state averages. SDGs and NGFs respectively (taking rounded figures) get around Rs. 29,000 and Rs. 27,000 annual net returns per farm, while the state average in the survey year was Rs. 50,800 (GoI, 2015). Yet specific farms do very well—the maximum returns reported are around Rs. 210,000 by an SDG and close to Rs. 358,000 by an SWIF, both from Medak district where, compared to other districts, cotton is an important crop, and even some SDGs grow it. In general, profit-making farms are found to have a much lower percentage of area under foodgrains than loss-making farms.

5.2.2. Kerala

In Kerala, a large percentage (82–84 percent) of both group and individual farms get positive net returns, but as with productivity JLGs outperform individual farms in profitability as well.

The difference between mean net returns of group and individual farms is strikingly large: JLGs get five times higher net returns per farm than JWIFs (Table 7) and these differences are statistically significant after controlling for district-level effects in the regressions (Table 9). Moreover, JWIFs get much lower average returns from farming than the state average of Rs. 42,500 per farm (GoI, 2015) while JLGs get substantially higher average returns. Equally striking is the maximum net return of close to Rs. 1692,000 achieved by one five-member group farm in Thrissur. This gave each group member an annual return of about Rs. 338,000. In contrast, the maximum achieved by an individual farm (also from Thrissur) is around Rs. 1028,000, which gives a per capita return of around Rs. 205,600 in a five member family.

Finally, in Table 10 we see the spread of the net returns. Between 70–85% of all three types of farms in Telangana, and individual farms in Kerala, are clustered in the range –Rs. 25,000 and Rs. 50,000. By contrast, 38% of Kerala's JLGs earn more than Rs. 50,000 net returns. This again highlights the notable success of group farms in Kerala, and especially those in Thrissur.

Table 8
Telangana: annual net returns per farm: Regression results.

Explanatory variables	Coefficients
Farm type 1 dummy (NGF = 1)	−1932.37
	(0.775)
Farm type 2 dummy (SWIF = 1)	−11302.11*
	(0.084)
District 1 dummy (Medak = 1)	−3080.03
	(0.656)
District 2 dummy (Mahbubnagar = 1)	−25354.45***
	(0.001)
Constant	37750.90
No. of observations	763
Adjusted R^2	0.06

Notes: Robust standard errors, clustered for the primary survey unit, are reported. Figures in brackets are *p* values. Significance levels: *** at 1%, ** at 5%, * at 10% Differences in the coefficients of farm type dummies 1 and 2 are significant at 5%, and of district dummies 1 and 2 at 1%.

5.3. Other effects: capability enhancement

Apart from the measurable productivity and profitability effects of group farming, qualitative evidence from both Telangana and Kerala shows that group farming has enhanced women's farming capabilities, which are likely to bring long-term economic benefits for SDGs and JLGs, as well as to women's own family farms.

To begin with, the women are now familiar with a wide range of public institutions, and forming groups has also increased their bargaining power and access to government officials. JLG women outline these benefits lucidly:

Table 9
Kerala: Annual net return per farm: Regression results.

Explanatory variables	Coefficients
Farm type dummy (JWIF = 1)	−86951.86***
	(0.008)
District dummy (Alappuza = 1)	−97959.93***
	(0.000)
Constant	167898.90
No. of observations	250
Adjusted R^2	0.14

Notes: Robust standard errors, clustered for the primary survey unit, are reported
Figures in brackets are *p* values. Significance: *** at 1%.

[26] Calculating returns based only on paid out costs also makes for easier comparison with government estimates of net returns which are similarly computed.

[27] This is also supported by Kannan and Raveendran's (2017) findings in their study of NHGs: two-thirds of the NHG members reported doing mainly domestic work before joining Kudumbashree.

Table 10
Telangana and Kerala: Percentage farms with specified annual net return per farm (Rs).

Annual net return per farm (Rs)	Telangana			Kerala	
	Individual farms		Group farms	Individual farms	Group farms
	NGF (485)	SWIF (208)	SDG (70)	JWIF (181)	JLG (69)
	% farms			% farms	
>–50,000	0.41	0.0	0.0	2.2	2.9
>–25,000 to ≤–50,000	3.7	4.3	2.9	1.1	1.5
<0 to ≤–25,000	26.4	33.2	25.7	14.4	11.6
>0 to ≤25000	30.7	38.0	35.7	61.3	37.7
>25,000 to ≤50,000	17.5	13.5	11.4	9.4	8.7
>50,000 to ≤100,000	13.8	7.2	14.3	7.7	10.1
>100,000	7.4	3.8	10.0	3.9	27.5

Source: Author's survey. Calculated from weekly data.
Note: Figures in brackets give the No. of observations.

> Before joining the JLG . . . we had no contacts with bank officials, agricultural officers and government officials. After registering as a JLG, we could start a bank account, attend classes, and develop a good rapport with bank officers, ward members and Krishi Bhavan [agricultural department] officers. (Sreedurga JLG, Thrissur).
>
> Our access to Krishi Bhavan, panchayat and block officials increased after forming a JLG. They are providing us information without delay. We were not getting support from these organizations before joining the JLG. (Pournami JLG, Alappuzha).

Second, both SDGs and JLGs have gained from technical training in agricultural practices. In Telangana, SDGs received such support for 4–5 years in the project period, but in Kerala JLGs continue to benefit from such support. Some JLG women are trained as master farmers. Given that the Kerala women are almost all educated, they are also more likely than the Telangana women to gain from and retain the knowledge acquired during training, and be able to transfer it to their fellow farmers.

In any case, many women, from both states, report using the knowledge acquired for their individual farms as well. This is a positive spill-over effect.

> After joining the SDG, we have learnt many things about agriculture. Some of us are also using the knowledge we have gained for our own farms. As a result, our incomes have increased (Narva SDG, Mahbubnagar, Telangana).
>
> We came to know more about agriculture due to the training we were given. I now apply that knowledge to my own farm as well. (Athira JLG member, Thrissur, Kerala).
>
> I have attended training classes from Kudumbasree on organic farming, they teach us how to make and apply organic fertilisers and pesticides. I will pass on this information to my own JLG and other JLGs in my locality. (Aishwarya JLG member, Thrissur, Kerala).

Third, group members have learnt to negotiate in multiple markets such as for land, inputs and outputs. In Telangana, many have also successfully negotiated access to storage for their produce in market centres. As P. Prashanti (Director, APMSS, 2015) told me:

> Earlier women were never seen in the market yards. Now they are very visible, bringing their produce, negotiating with buyers, and, if necessary, negotiating for physical space in the market yard to keep their produce till they decide to sell it.

These qualitative gains throw additional light on why so many groups have sustained in both states, and for their particular success in Kerala. Women's high motivation is another important factor. Although difficult to quantify, it is well illustrated by APMSS's description of SDG women making some 2262 ha of fallow land cultivable, across the 500 project villages. They 'levelled the land, dug contour trenches, erected contour bunds, farm ponds, and waste weirs, created rock bunds, built gully controls, and repaired water resources to make the land usable' (APMSS, 2004–05 Annual Report: 73–74). In Kerala, similarly, JLGs made 1260 ha of the fallow land they leased cultivable.[28] In both states, the land so reclaimed would also count as an economic gain to the community.

6. Concluding reflections

We began by asking whether group farming could provide an alternative model of viable agriculture to resource constrained small family farms. In particular, would groups perform better than small individual farms in terms of productivity and profitability? Two examples of group farming were analysed to address these questions, one in Telangana, the other in Kerala. Both states catalysed women-only groups that depend on leased in land. In effective terms, therefore, we compared not only group farms with individual farms but also women-managed farms with largely male-managed farms, as well as tenant-cultivators with owner-cultivators. The results thus reflect the implications of group farming, but mediated by gender and land constraints.

Notwithstanding these constraints, JLGs in Kerala perform consistently and strikingly better than individual farms, in terms of both annual productivity and profitability. And they do especially well in a commercial crop such as banana, but display no particular advantage in the main foodcrop, paddy. The groups also far exceed state averages in net returns per farm. And although in terms of overall economic performance, the Thrissur JLGs that grow almost no paddy stand out as impressive success stories of group farming, even Alappuzha JLGs that grow paddy do as well as individual farms in annual net returns, and they could perform much better with access to good quality land.

Telangana's SDGs get mixed results, doing poorly in annual productivity and foodgrain yields, but matching individual farmers in the yield of the commercial crop, cotton, and in annual net returns

[28] Personal communication, Rahul Krishnan, Thematic Anchor for farm livelihoods, K. Mission, Thiruvananthapuram, May 2016.

per farm. On net returns they make up for their lower outputs by saving on purchased inputs, especially hired labour.

Notably, in both states, groups perform much better when not cultivating traditional foodgrains where individual farmers owing good quality land have an advantage. But across both states, the positive land-productivity and labour-productivity relationships in most equations underline the advantage groups enjoy over individual farms by pooling land and labour, which helps them increase farm size and overcome peak season labour shortages.

Underlying the divergent performances of Telangana's SDGs and Kerala's JLGs there appear to be several factors. In Kerala, technical training and support from the K. Mission and K. Network through the innovative three-pillar institutional structure; the social heterogeneity of the groups, which enlarges their social capital base; their subsidised credit linkages with banks; and their focus on commercial crops (especially in Thrissur), all enable JLGs to alleviate (if not entirely overcome) their land, input and technical constraints, creating for them a more gender-equal playing field and helping them get high returns. The contrasting performance of Telangana's SDGs needs to be judged against the considerable odds they face in input and land lease markets, the absence of state support after the UNDP-GoI project ended in 2005, the composition of the groups which is predominantly low caste, and their concentration on foodgrains, especially paddy, which is particularly sensitive to soil type and the availability of irrigation.

Differences between the states are also embedded in the conceptualisation of the initiatives. SDGs typically have a large proportion of scheduled caste members, many of them elderly and illiterate, while the Kerala JLGs are constituted of a small number of relatively younger women of mixed caste, well-educated, and with wider social networks. Importantly, in Telangana, group farming was added to a pre-existing programme whose primary focus was social empowerment and not livelihood generation, while the centre point of Kerala's group farming programme was livelihood enhancement and interlinked social empowerment.

Nevertheless, in both states, group farming, catalysed by external interventions, has provided women farmers an important alternative to being unpaid workers on family farms. Notably, both states are located in south India, where women are relatively less subject to the social norms which restrict women's mobility and social interaction in northwest India—a point of relevance in considering the model's replication not only elsewhere in India but also in other parts of South Asia, and in developing countries more generally.

It needs mention that in neither state are there notable examples of male-managed group farms, although I located a few in Alappuza district in Kerala. All of them are larger than women's JLGs and have 15–19 members. They too lease in much of the land they cultivate collectively, since few own enough land to create a viable farm by pooling that alone. They are, however, able to lease in land more easily than women's groups through their male networks, and also draw extensively on the Padasekara Samitis—farmers associations that rent machines to paddy farmers and help them in watershed management, procuring inputs, and marketing their output. Women constitute only a small proportion of the Samiti members, and are rarely part of the Samiti's executive committees, although as a JLG they have more bargaining power, and report being able to draw on the Samitis to greater extent. At present, there are, however, too few male-only group farms to judge their effectiveness vis-à-vis women's groups.

On the latter, the experience of both states taken together does provide insights on replicability, which also have significance in light of the noted growing feminisation of agriculture in Asia. First, state support, both administrative and technical, as well as start-up capital, appears essential. Second, prior constitution of neighbourhood groups provides a strong foundation for cooperation around group farming. Third, having groups with a degree of social and economic heterogeneity and with educated members is advantageous. Fourth, group size matters. Very small groups of 3–4 members face high costs of hiring labour, and very large groups can encounter problems of coordination and low returns per capita. Although it is difficult to predict an ideal group size, one closer to the maximum of 10 suggested in NABARD's JLG guidelines could serve as a norm. Fifth, cropping patterns need to take account of the local potential for commercial farming, and not be subject to the presumption that household food security necessarily requires growing your own food. At present, groups do much better in non-foodgrain commercial farming. Improving their performance in foodgrain production would need, in particular, easing the land constraint.

The land question, however, is complex and challenging. A farming model dependent on land leasing without tenure security remains vulnerable to uncertainties in the lease market, and reduces access to high quality land. Here solutions would lie in tenancy reforms which allow groups to enter into formal long-term leases, as well as measures which help group members to buy land. In fact, helping women's groups to collectively purchase land for joint cultivation was attempted with some success in the late 1980s, in undivided Andhra Pradesh, where the government introduced a grant-cum-subsidized loan scheme to help scheduled caste women buy land in small groups (Agarwal, 2003). There is also anecdotal evidence from Kerala that some of Thrissur's JLGs made enough profit to purchase land jointly for group farming,[29] but systematic State support could enable more groups to do the same. Another challenge will be the re-creation of an administrative structure akin to Kudumbashree's three pillared one, which has provided a foundation for Kerala's group farming initiative, and is a key factor in its ability to sustain and expand the programme. Successful replication could well depend on whether other states in India, or other developing countries, can demonstrate similar State capacity and commitment.

Conflicts of interest

None.

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[29] Details of several such cases were recounted to me by JLG members, in an annual experience sharing meeting of JLGs that I attended in Thrissur in 2015.

Appendix A.

See Appendix Table A1 and A2

Table A1
Telangana: Descriptive statistics (non-log values).

Variable Name	N	Mean	CV	Min	Max
Dependant Variables					
Annual output all crops per ha GCA (Rs/ha GCA)	763	50894.40	0.72	1412.03	261289.00
Annual output all crops per ha NSA (Rs/ha NSA)	763	60793.69	0.73	1412.03	348385.30
Output kharif foodgrains (Rs/ha kharif foodgrains area)	286	29988.34	0.76	1346.72	166734.50
Output kharif cotton (Rs/ha kharif cotton area)	205	79037.14	0.51	12231.71	228572.30
Annual net returns per farm (Rs)	763	24432.66	1.89	−60908.00	357872.30
Explanatory Variables for annual output all crops					
Farm type 1 dummy (NGF = 1)	763	0.64	0.76	0	1
Farm type 2 dummy (SWIF = 1)	763	0.27	1.63	0	1
Farm type 3 dummy (SDG = 1)	763	0.09	3.15	0	1
GCA (ha)	763	1.38	0.75	0.10	9.71
NSA (ha)	763	1.16	0.72	0.10	8.09
Irrigation dummy (irrigated = 1)	763	0.52	0.95	0	1
Fertiliser + manure (Rs/ha GCA)	763	6979.46	0.71	0	38449.56
Fertiliser + manure (Rs/ha NSA)	763	8207.06	0.69	0	38449.56
Pesticide (Rs/ha GCA)	763	2523.09	1.23	0	37230.51
Pesticide (Rs/ha NSA)	763	2793.91	1.18	0	37230.51
Labour (hrs/ha GCA)	763	1437.58	0.54	213.65	6276.47
Labour (hrs/ha NSA)	763	1705.74	0.59	213.65	7512.00
% adults completed class 5 and above	763	30.38	0.97	0	100
% adults aged 60 years and above	763	11.36	1.50	0	100
% GCA area under foodgrains	763	48.99	0.84	0	100
District 1 dummy (Medak = 1)	763	0.38	1.28	0	1
District 2 dummy (Mahbubnagar = 1)	763	0.31	1.50	0	1
District 3 dummy (Karimnagar = 1)	763	0.31	1.49	0	1
Explanatory variables for kharif foodgrains					
Farm type 1 dummy (NGF = 1)	286	0.57	0.88	0	1
Farm type 2 dummy (SWIF = 1)	286	0.29	1.57	0	1
Farm type 3 dummy (SDG = 1)	286	0.14	2.45	0	1
Area under kharif foodgrains (ha)	286	0.94	0.57	0.10	4.05
Irrigation dummy (irrigated = 1)	286	0.67	0.70	0	1
Fertiliser + manure (Rs/ha kharif foodgrains area)	286	6895.50	0.85	0	38449.56
Pesticide (Rs/ha kharif foodgrains area)	286	1218.84	1.56	0	10563.75
Labour (hrs/ha kharif foodgrains area)	286	1318.19	0.61	213.65	6276.47
% adults completed class 5 and above	286	28.26	1.03	0	100
% adults aged 60 years and above	286	11.04	1.53	0	100
District 1 dummy (Medak = 1)	286	0.32	1.47	0	1
District 2 dummy (Mahbubnagar = 1)	286	0.48	1.04	0	1
District 3 dummy (Karimnagar = 1)	286	0.20	1.99	0	1
Explanatory variables for kharif cotton					
Farm type 1 dummy (NGF = 1)	205	0.63	0.76	0	1
Farm type 2 dummy (SWIF = 1)	205	0.34	1.41	0	1
Farm type 3 dummy (SDG = 1)	205	0.03	5.77	0	1
Area under kharif cotton (ha)	205	1.01	0.64	0.10	5.01
Irrigation dummy (irrigated = 1)	205	0.09	3.14	0	1
Fertiliser + manure (Rs/ha kharif cotton area)	205	8541.95	0.59	148.26	27511.04
Pesticide (Rs/ha kharif cotton area)	205	4630.40	0.92	0	36423.30
Labour (hrs/ha kharif cotton area)	205	1728.75	0.52	483.23	6029.37
% adults completed class 5 and above	205	33.28	0.92	0	100
% adults aged 60 years and above	205	12.31	1.45	0	100
District 1 dummy (Medak = 1)	205	0.50	1.00	0	1
District 2 dummy (Mahbubnagar = 1)	205	0.08	3.33	0	1
District 3 dummy (Karimnagar = 1)	205	0.41	1.19	0	1

N = number of cases. CV = coefficient of variation.

Table A2
Kerala: Descriptive Statistics (non-log values).

	N	Mean	CV	Min	Max
Dependant variables all					
Annual output all crops (Rs/ha GCA)	250	122691.80	1.44	741.32	1053274.00
Paddy output Alappuza (Rs/ha paddy area)	30	78129.35	0.34	19388.25	120982.70
Banana output Thrissur (Rs/ha banana area)	30	313476.40	0.80	53374.71	837256.60
Annual net returns per farm (Rs)	250	50480.07	3.35	−223663.00	1691857.00

(*continued on next page*)

Table A2 (*continued*)

	N	Mean	CV	Min	Max
Explanatory variables for annual output all crops					
Farm type 1 dummy (JWIF = 1)	250	0.72	0.62	0	1
Farm type 2 dummy (JLG = 1)	250	0.28	1.62	0	1
Irrigation dummy (irrigated = 1)	250	0.94	0.25	0	1
Gross cropped area (GCA) (ha)	250	0.68	1.33	0.01	4.05
Fertiliser + manure (Rs/ha GCA)	250	17637.84	1.28	197.68	206007.60
Pesticide (Rs/ha GCA)	250	1421.55	2.12	0	27107.44
Labour (hrs/ha GCA)	250	1274.21	0.87	81.54	7480.55
% adults completed class 5 and above	250	90.62	0.18	0	100
% adults aged 60 years or above	250	12.18	1.64	0	100
Cropping pattern dummy (if no paddy or banana = 1)	250	0.35	1.37	0	1
District 1 dummy (Alappuza = 1)	250	0.56	0.90	0	1
District 2 dummy (Thrissur = 1)	250	0.44	1.12	0	1
Explanatory variables for paddy output Alappuza					
Farm type 1 dummy (JWIF = 1) (paddy)	30	0.77	0.56	0	1
Farm type 2 dummy (JLG = 1) (paddy)	30	0.23	1.84	0	1
Area under paddy (ha)	30	1.70	0.91	0.20	4.05
Fertiliser + manure (Rs/ha paddy area)	30	8229.55	0.59	3314.50	27558.40
Pesticide (Rs/ha paddy area)	30	4412.80	0.52	302.70	9004.76
Labour (hrs/ha paddy area)	30	743.63	0.39	106.69	1508.29
% adults completed class 5 and above (paddy)	30	85.17	0.23	50.00	100.00
% adults aged 60 years or above (paddy)	30	7.53	2.03	0	50
Explanatory variables for banana output Thrissur					
Farm type 1 dummy (JWIF = 1) (banana)	30	0.53	0.95	0	1
Farm type 2 dummy (JLG = 1) (banana)	30	0.47	1.09	0	1
Area under banana (ha)	30	0.65	0.97	0.09	2.47
Fertiliser + manure (Rs/ha banana)	30	37175.20	0.42	3265.32	67616.96
Pesticide (Rs/ha banana)	30	674.99	1.72	0.00	5677.67
Labour (hrs/ha banana)	30	1607.36	0.85	346.22	7480.55
% adults completed class 5 and above (banana)	30	90.44	0.15	60	100
% adults aged 60 years or above (banana)	30	8.72	1.51	0	40

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