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Women's self-help groups, decision-making, and improved agricultural practices in India: From extension to practice

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ABSTRACT

This research was undertaken as part of the Women Improving Nutrition through Group-based Strategies (WINGS) study, and was aimed at understanding ways to improve agricultural practices among women farmers in India. Effective agricultural extension is key to improving productivity, increasing farmers' access to information, and promoting more diverse sets of crops and improved methods of cultivation. In India, however, the coverage of agricultural extension workers and the relevance of extension advice is poor. We investigate whether a women's self-help group platform could be an effective way of improving access to information, women's empowerment in agriculture, agricultural practices, and production diversity. We use cross-sectional data on close to 1000 women from 5 states in India, and employ nearest-neighbor matching models to match self-help group (SHG) and non-SHG women along a range of observed characteristics. We find that participation in an SHG increases women's access to information and their participation in some agricultural decisions, but has limited impact on agricultural practices or outcomes, possibly due to financial constraints, social norms, and women's domestic responsibilities. SHGs need to go beyond provision of information to changing the dynamics around women's participation in agriculture to effectively translate knowledge into practice.

Keywords: agriculture, India, self-help groups, information, empowerment

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ACRONYMS

5DE	Five domains of empowerment score
BCC	Behavior change communication
INR	Indian rupee
NGO	Non-governmental organizations
NNM	Nearest neighbor matching
NRLM	National Rural Livelihoods Mission
OLS	Ordinary Least Squares
PRADAN	Professional Assistance for Development Action
SC	Scheduled Caste
SHG	Self-help groups
SRI	System of rice intensification
ST	Scheduled Tribe
WEAI	Women's Empowerment in Agriculture Index

Introduction

Agricultural extension systems aim to improve productivity and raise incomes by increasing farmers' access to information about agricultural practices, prices and markets, along with the promotion of more diverse sets of crops and improved methods of cultivation. Effective agricultural extension is particularly important in countries where the agricultural sector accounts for the bulk of the country's employment, but where agricultural productivity is low, such as India (Gillespie et al. 2012, Planning Commission 2007, Census of India 2011). Although recent central government planning exercises in India have emphasized agricultural extension, the coverage of agricultural extension workers and the relevance of advice provided is poor (Glendenning et al. 2010). Moreover, extension workers typically work with large farmers, who are predominantly male, thereby potentially excluding small, marginal and women farmers, who comprise a considerable proportion of the farming community but control only a small proportion of operational holdings. Women farmers, in particular, control fewer than 13% of total operational holdings (Agricultural Census 2010-11).

Extension directed at women has the potential to increase technical efficiency, improve adoption of technologies that have disproportionate benefits for women, and increase production diversity. Interventions that aim to provide women with information may achieve these impacts through empowering women and increasing their decision-making roles in agriculture. Providing women with a greater role in decision-making can reduce the wage gap (Hertz et al. 2008) and increase the adoption of labor saving or drudgery reducing technology (Khan et al. 2016). Using nationally representative data from Bangladesh, Seymour (2017) found that a smaller empowerment gap between spouses is associated with higher levels of technical efficiency both on plots that women jointly manage with their spouses, and as those that women do not actively manage. Sraboni et al. (2014), using the same dataset, found increases in women's empowerment in agriculture to be positively associated with energy availability and dietary diversity at the household level. Finally, in rural Nepal, Malapit et al. (2015) found that greater

women's empowerment in agriculture mitigates the negative impacts of low production diversity on mothers' and children's dietary diversity.

Extension messages encouraging production diversity may also have important nutritional implications for those households who depend on own-production for food. A recent review of nutrition-sensitive agricultural programs generally finds a positive association between crop production diversity and dietary diversity (Ruel et al. 2017); however, on-farm production diversity is more important in physically isolated locations (Jones et al. 2014) or those with imperfect market infrastructure (Zambia in Kumar et al. 2015; and Nepal in Shively & Sununtnasuk 2015), compared with those located closer to well-functioning markets. Sibhatu et al. (2015) have argued that if production diversity is important for dietary diversity mostly among households that have limited access to markets, recommendations to diversify production everywhere may be misguided; supporting commercialization of smallholder farms may be a more effective strategy to improve nutrition. Effective extension services and collective marketing could help with improving market access as well.

Given the limited reach of government extension services in India as well as the potential gains from empowering women in agriculture, could another information delivery platform—women's self-help groups (SHGs)—be effective in providing agricultural information to women farmers, increasing adoption of improved agricultural practices, and increasing production diversity and market orientation? Local knowledge, social networks, and participatory training (neglected in traditional extension) are increasingly being recognized as important determinants of technology adoption (Chambers and Pretty 1993; Foster and Rosenzweig 1995; Munshi 2004; Magnan et al. 2015; Maertens 2017; Bandiera and Rasul 2018), and women's groups may be a promising platform to effect change on these fronts. Globally, women's groups have emerged as an important platform for promoting the economic, political and social empowerment of poor women, and in India, SHGs have become a central component of many rural development interventions. Under the guidance of the National Rural Livelihoods Mission (NRLM)

and other NGOs involved in the formation and strengthening of these groups, SHGs in India are implementing interventions in agriculture and livelihoods. Professional Assistance for Development Action (PRADAN), one of India's largest NGOs, has worked with women farmers over the last thirty years both alongside and independent of the government's NRLM, and has pioneered efforts in providing agriculture extension for and through women's SHGs in rural India.

In this paper, we evaluate the impact of membership in a PRADAN SHG on a range of agricultural outcomes. We first describe the pathways through which SHGs can affect agricultural practices, recognizing that women's empowerment affects all these pathways. Using cross-sectional household survey data from a quasi-experimental impact evaluation of a multi-sectoral SHG-based program being implemented by PRADAN, we provide quantitative measures of the effects of the program on women's access to information on agricultural practices, women's role in agricultural decision-making, the use of better agricultural practices, production diversification, and market orientation.

Our paper contributes to several strands of the literature on SHGs and development outcomes. First, we provide some of the first quantitative evidence on the effectiveness of a women's group-based program in improving access to agriculture-related information in India. Providing agricultural extension through groups presents an opportunity to overcome the inefficiency of the public extension system, but this modality needs to be tested. Second, we contribute to the growing body of evidence on the impact of these groups on women's empowerment (Karlan et al. 2017; also see Brody et al. 2015 for a comprehensive review) by focusing on empowerment in agriculture, measured using the Women's Empowerment in Agriculture Index (WEAI), a recently available standardized measure of empowerment. Given the frequent exclusion of women from decision-making in agriculture, globally as well as in India, this is an important area of study.

We find that SHG women are more likely to have received information on a range of agricultural practices, but are not more likely to have put this information into practice. We do find a positive effect of the program on some aspects of women's empowerment in agriculture, but limited evidence of any impact of the program on production diversity and market orientation. Thus, while the initial pathways to impact are being activated as women start to play a more active role in household decision-making, barriers still exist to adopting improved agricultural practices and achieving desired outcomes.

The rest of the paper is organized as follows. Section 2 lays out the conceptual framework, and describes the hypothesized pathways to impact. Section 3 describes the context and data, and section 4 presents the empirical strategy. Section 5 discusses the results, and section 6 concludes.

2 Conceptual Framework

Women's group-based livelihoods programs may improve agricultural outcomes through multiple pathways (Kumar et al. 2017). Multi-sectoral interventions such as PRADAN's typically comprise group formation and capacity building, savings and credit linkages, and livelihoods initiatives as independent but complementary inputs in improving women's role as farmers. These inputs can affect agricultural outcomes by (i) improving access to inputs, markets and technical knowledge, or the *agriculture pathway*, (ii) increasing access to finance, or the *financial pathway* and (iii) improving women's role in decision-making on agriculture, or the *empowerment pathway* (Figure 1).

i. *Agriculture pathway*

Inputs provided by SHGs include dissemination of information on best practices through farmer field schools, demonstrations, promotional material, community trainers and exposure visits. SHGs supported by PRADAN are also involved in community sessions where they plan for agricultural seasons, and receive help in accessing input providers, government schemes, and markets. These livelihoods interventions increase women's exposure to better agricultural practices and crop selection, which in turn

leads to the adoption of improved agricultural practices. Assuming that there are no other constraints (for example, resource or access constraints) to the adoption of these practices, the possible outputs of this pathway are improved crop varieties, and an increase in yield or food production, market access and income from the sale of food or cash crops.

ii. *Financial pathway*

The financial pathway is the SHG savings and credit pathway. Typically, SHGs promoted by Government departments or NGOs are formally registered, conduct regular savings activities, open bank accounts, and access credit prior to undertaking income-generating activities. Participating in the SHG may increase members' ability to take loans, which is important for poor women who are not deemed creditworthy. Increased access to credit could increase household income and assets, and enable the household to smooth its consumption over time. Increased income could also relax budgetary constraints on the household's ability to adopt better agricultural practices, triggering the agricultural pathway.

iii. *Cross-cutting pathway: women's empowerment*

Finally, the women's empowerment pathway underlies and interacts with the other impact pathways. This pathway operates through building social capital, taking collective action, and empowering women. We expect that the bundling of agriculture and livelihoods programs with the broader women's empowerment agenda will increase women's decision-making role in farming, which may improve her bargaining power, potentially improving health and nutrition outcomes.

Our paper focuses on all three pathways to impact. We look at the receipt of information on agricultural practices, the use of improved methods of cultivation, production diversity, and market orientation (agriculture pathway). We study household loan taking behaviour, access to a bank account, and total household consumption expenditure (financial pathway). Finally, we examine women's decision-making

in a range of agriculture-related activities, as well as the overall empowerment score and the gender parity score, where available (women's empowerment pathway).

3 Context and data

3.1 Context

SHGs are local community groups comprised of 10-20 adult women who meet at regular intervals to deposit small amounts of money into a common pot from which members can take loans. Along with savings and subsidised credit, these groups receive training and inputs to pursue income-generating activities and are often recruited to help with public works or service delivery.

Since the 1980s, PRADAN has been working in five states (Odisha, Madhya Pradesh, Jharkhand, Chhatisgarh and West Bengal) to promote and strengthen SHGs through their agricultural programs. PRADAN has also partnered with state and local governments to manage livelihoods programs under the NRLM framework. As their core activity, PRADAN organizes women's groups, enabling women to acquire financial independence and agency, play a bigger decision-making role in their household, and empower other women in the community. Groups are initially encouraged to save and lend internally, taking on other tasks as they mature. PRADAN also works with women extensively to generate awareness on gender equality, providing a platform for women to share their personal experiences, and initiating social and political action wherever appropriate.

PRADAN's livelihoods interventions include the provision of information about improved agricultural practices, the demonstration of agricultural techniques, the organization of women farmers into producer groups, and the provision of support to negotiate better prices for their produce. Their extension program is delivered through group meetings and involves field demonstrations of best practices, exposure visits, collective planning for the upcoming agricultural season, entrepreneurial skill development and linkages to input suppliers and markets. SHG members are encouraged to invite their spouses to join the meetings

that plan for the upcoming agriculture season. In some places, PRADAN has supported women in forming farmer producer organizations that purchase inputs in bulk and make quality inputs available to members at fair prices. These organizations also facilitate aggregating produce to reduce transaction costs, and accessing larger markets. In other places, these services are being provided by agriculture entrepreneurs who are selected from communities and provide quality inputs, raise high quality vegetable seedlings, and provide mechanization and market aggregation support.

3.2 Data

We use cross-sectional data from 2015 to examine the impact of PRADAN's livelihood program on several intermediate and final outcomes along our theory of change. Our data is from eight districts across five states in India. In each of our eight sample districts, two blocks with PRADAN presence were purposively selected, one receiving the standard PRADAN livelihoods interventions and the other receiving livelihoods interventions plus a nutrition-intensive component. From each of the two PRADAN blocks, five villages were randomly selected from the complete list of villages where PRADAN was operational. Finally, 20 ever-married women between the age of 15 and 49 were randomly selected from each village. The achieved sample size was 1617 women. Since the focus of this paper is on agricultural practices, we further restricted our sample to only those households that either owned or cultivated land. This resulted in a loss of 640 observations, leaving us with a final analysis sample of 977 women from 80 villages in 16 blocks across 8 districts.

The data we use come from the baseline survey of a multi-year panel study (called Women Improving Nutrition through Group-based Strategies, or WINGS) evaluating the impact of adding nutrition behavior change communication (BCC) into PRADAN's standard SHG model. For the purposes of the larger study, we also collected data on women from a third arm with no PRADAN presence; this arm has been omitted from the analysis in this paper. The survey was conducted by Oxford Policy Management, and

female enumerators were trained on the context, material and interview methods for two weeks prior to data collection.

In our sampled blocks, we assume that all SHGs receive the standard PRADAN inputs such as capacity building and monitoring, as well as the livelihoods inputs and focus on improving women's empowerment. About 39 percent of our sample belonged to an SHG at baseline.

Our survey collected data on demographic and socioeconomic characteristics, participation in women's collectives, receipt of agricultural information, cropping practices in the two seasons prior to the survey, and women's empowerment in agriculture, as measured by the WEAI. The WEAI identifies five domains of empowerment: (1) decision-making power around agricultural production, (2) access to and decision-making power about productive resources, (3) control of use of income, (4) leadership in the community, and (5) time allocation (see Alkire et al. 2013 for details). These domains consist of one to three sub-indicators. A simple nested weighting structure with equal weights for each domain is used to aggregate scores on these five domains into a sub-index called the five domains of empowerment score (5DE).

In this paper, we use the individual level 5DE scores for the respondent women, the difference between men's and women's 5DE scores, as well as several of the component questions around women's participation in agricultural decision-making within the household. While data on the WEAI is available for all respondent women, male household members were interviewed in only slightly more than 60% of the sample, resulting in a smaller sample for the calculation of the gender gap in empowerment scores. In the Appendix, we compare households where the WEAI was administered to both man and woman to those where only the woman responded (Table A.3).

4 Empirical Strategy[1]

This paper aims to examine the effect of PRADAN SHG membership[2] on the outcomes of interest. Although one could compare mean outcomes for SHG members and non-members, this approach does not recognize that women who are SHG members are likely to be systematically different from non-members. As a result, the average difference in an outcome of interest between SHG members and non-members, or the difference in unconditional means, is a biased estimate of impact that also reflects systematic differences between these two groups.

To make unbiased comparisons, we must construct a comparison group from among non-members that were similar to SHG members before the SHGs were introduced. Although the preferred approach to constructing the counterfactual is to randomly provide access to the program among similarly eligible individuals, this method was not feasible because SHGs were not randomly introduced across our sample. The absence of "hard" targeting criteria (such as a means test, see Pitt, Khandker, and Cartwright (2006)) precluded the use of Regression Discontinuity Design and, after exploring several instruments that proved to be weak, we decided to use matching methods. We constructed a comparison group by matching SHG members to non-members based on observable respondent, household, and community characteristics. We estimate impacts of SHG membership using nearest neighbor matching (NNM) - a form of covariate matching in which the comparison group sample of non-members is selected based on similarity to the SHG member sample in observable characteristics (Abadie and Imbens 2006; Abadie et al. 2004)[3].

[1]This section draws from related work on SHGs and other development outcomes (Kumar et al. 2017).

[2] Since PRADAN does not typically work with either NRLM or another NGO to form groups, women living in PRADAN areas will belong to PRADAN SHGs. For brevity and ease of exposition we will use the term 'PRADAN SHGs' to mean all SHGs in PRADAN areas.

[3]These approaches rely on two assumptions about the data and the model. The first is that, after controlling for all pre-program observable respondent, household, and community characteristics that are correlated with program participation and the outcome variable, non-beneficiaries have the same average outcome as beneficiaries would have had if they did not receive the program. The second assumption is that for each beneficiary household and for all observable characteristics, a comparison group of non-beneficiaries with similar observable variables exists.

Some details and limitations of the matching procedures used deserve attention. It is important to choose variables that are associated both with the probability of being an SHG member and with the outcome of interest (Heckman and Navarro-Lozano 2004). However, these variables should be determined before the SHGs were established to ensure that they were not affected by the SHG membership itself. Since our data comes from a single cross-section, we do not have data on these observables before the women became members. Therefore, we use variables that are either exogenous or predetermined such as age, education and marital status of the respondent women, her caste category, and her household's age and gender composition. We also do not have much information on selection criteria of the SHGs, although SHGs typically group women from similar socioeconomic backgrounds.

Appendix Table A.2 presents the probit model of the probability that the respondent woman belongs to a PRADAN SHG, as a function of a comprehensive list of respondent woman, household, and village characteristics. These include respondent woman characteristics (age, education, marital status, occupation), indicators of her status and time use (has own disposable income, regularly communicates with own family, fetches water from a distant source, number of hours of work per day), household characteristics (presence of mother-in-law and husband, household size, number of children, caste, size of land owned, whether irrigation is rainfed, and access to credit from non-SHG sources), and village level characteristics (population, averages of women's education, size of land owned, wealth, presence of a government primary school, electricity, distance to bank, distance to nearest agricultural wholesale market and shocks). We also include state and district dummies. These results show that that woman's age, women's education, financial independence (as captured by having money of her own), and average land ownership in the village are important correlates of SHG membership. This model is used to compute the propensity score for the matching exercises, to check that the balancing property across the SHG members and non-members is satisfied, to ensure common support of the propensity score between the two groups (Figure 2) and to obtain a trimmed sample which excludes observations with extremely

high and low propensity scores. The nearest neighbor matching model is estimated on this trimmed sample.

The same list of covariates is then used to match SHG-members and non-members. Since we use state and district dummies in our matching models as well, we are matching SHG members with non-members within the same broad locality. The full list of covariates is provided in Table A.1. The main limitation of the matching exercise is that it cannot correct for unobservable characteristics that affect both the decision to join an SHG as well as the outcomes of interest.

We also present the simple ordinary least squares estimates of the relation between SHG membership and the outcomes of interest:

$$Y_{ivbds} = \alpha + \beta SHG_{ivbds} + \gamma X_{ivbds} + \delta Z_{vbds} + \mu_s + \phi_d + \epsilon_{ivbds}, \quad (1)$$

where the i, v, b, d and s subscripts refer to the individual, village, block, district and state respectively, Y_{ivbds} are outcomes of interest, SHG_{ivbds} is a dummy variable for the respondent woman's belonging to an SHG, X_{ivbds} are individual covariates, Z_{vbds} are village level covariates, and μ_s and ϕ_d are state and district fixed effects. ε_{ihds} is the individual-specific error term clustered at the block level. The list of covariates is identical to those in the matching models.

Our outcomes of interest were chosen to correspond to the various steps along the agriculture, financial and women's empowerment pathways:

Agriculture pathway:

1. Receipt of information on field crop selection or rotation, use of improved seeds, line plantation, system of rice intensification (SRI), pest management, soil improvement, irrigation, poultry rearing, livestock rearing and fishing,
2. Agricultural outcomes: number of crops grown in the summer and winter seasons, the number of food crops, dummies for production diversity, and the share of marketed crops. Production

diversity is measured using two dummy variables. The first takes a value of 1 if the household planted a cereal crop in summer, a cereal crop in winter, plus one other non-cereal non-pulse crop during the year (this last rotation could be nuts, fruits or vegetables etc.), and 0 otherwise. The second dummy takes a value of 1 if or if the household planted a cereal in the summer, a pulse in the winter, plus one other non-cereal non-pulse crop during the year, and 0 otherwise. Since the standard agricultural practice in India is to grow a cereal in summer and a pulse or cereal in winter, these production diversity variables capture diversification into other types of crops, as well as multi-season cropping.

Financial pathway:

1. Whether the respondent woman has a bank account,
2. Whether anyone in the household took a loan in the 12 months preceding the survey,
3. Total household expenditure on food in the last week (in INR).
4. Total household expenditure on durables in the last year (in INR).

Women's empowerment pathway:

1. Composite measures of empowerment – the women's 5DE score and the gender gap in empowerment scores,
2. The number of agricultural domains (out of 10) where the individual has some input in decisions or feels they can make a decision,
3. The sum of the relative autonomy indicators across the three sub-areas (ranges from minus 27 to 27),
4. Whether the woman has input into agricultural decisions (food and cash crop farming, livestock and poultry raising),

5. Whether she feels she can participate to a medium or high degree in decisions on inputs for agricultural production, types of crops to grow, taking crops to the market and inputs on livestock raising,
6. Whether she takes the decision alone or jointly on adoption of seeds, fertilizer, plant protection measures and the changing of crops.

The large number of outcome variables makes a p-value correction for multiple hypothesis testing across each set of outcomes appropriate. Each table contains both the standard p-value and the corrected p-values that account for the false detection rate. These corrections are based on the suggestions of Benjamini and Hochberg (1995) and Benjamini, Krieger, and Yekutieli (2006), abbreviated as BH1995 and BKY2006 respectively.

5 Results

5.1 Descriptive statistics

Table 1 presents respondent woman, household and village characteristics for PRADAN SHG members and non-members. On average, SHG women are 34 years old, 2 years older than non-SHG women. They work a little under 5 hours a day. Fewer than 20% of the SHG women have more than primary education, slightly higher than the proportion among non-SHG women. About 48 percent of SHG women have access to money of their own, and more than half have contact with family members other than those living in their household. Those women who are part of an SHG have, on average, been members for slightly over 4 years (not shown in table).

On average, households have slightly fewer than 5 members and less than 1 child under the age of five. Households of SHG members own the same amount of land as the non-SHG households, about 2.6 acres. More than 60 percent of the sample is Scheduled Tribe (ST). Almost all villages have at least one

government primary school, and are about 21 kilometres from the nearest town, and about 3.2 kilometres from a bank.

5.2 Agricultural pathway

Table 2 presents OLS and NNM estimates of the impact of SHG membership on receipt of information on agricultural practices for PRADAN areas. Because OLS estimates do not account for the endogeneity of SHG membership, we focus on the NNM estimates; all effect sizes described in the text refer to the NNM estimates, unless specifically mentioned.

The differences in the receipt of information between PRADAN SHG members and non-members are large. SHG membership has a statistically significant positive effect on the probability of receiving 8 out of 10 types of information, with effect sizes ranging from 3.8 percentage points (for fishing) to 11.9 percentage points (for SRI). These results suggest that SHG members receive more intensive information dissemination than non-SHG members, with the largest impacts found on SRI, improved seeds, and crop selection or rotation. Increases in information receipt are sizeable relative to the control group mean values presented in the last row of the table. In almost all regressions the OLS estimates are very similar to the NNM estimates. Correcting the p-values for multiple hypothesis testing does not significantly alter statistical inference.

Without any measures of knowledge of the agricultural practices, exposure to information on these practices is our closest proxy for actual changes in beneficiary knowledge. Although we collected information on agricultural practices for major crops, because only a small fraction of the sample reported growing those crops, further restriction to PRADAN areas left too small a sample size for the matching algorithm. Instead we investigate outcomes further along the agricultural pathway using measures of production diversity and market orientation (Table 3). We do not find any evidence of a positive impact of SHG membership on the number of crops grown, the number of food crops grown, crop rotation

practices, or share of crops marketed. Even after accounting for agroecological factors by matching within the same district and controlling for irrigation source, we do not find any impact of SHG membership.

5.3 Women's empowerment pathway

Table 4 presents estimates of the impact of SHG membership on alternative measures of women's empowerment. We do not find any significant impact of SHG membership on the women's 5DE score. However, SHG membership results in a large and significant 22 percent fall in the gender gap in empowerment (column 2) and a 9 percent increase in the number of agricultural domains in which the woman has some input into decisions, based on the control means.

Given the focus of PRADAN SHGs on empowering women to make decisions, particularly in agriculture, the lack of association between SHG membership and the 5DE may seem surprising. However, because the 5DE is an index, the process of aggregation could mask offsetting effects of SHG membership on the WEAI's component indicators. To investigate this further, we examined women's participation in decision-making around agriculture-related actions (Table 5).

Being a member of a PRADAN SHG has a positive and significant impact on joint decision making in adoption of seeds, fertilizer, plant protection measures, and decisions around crop rotation (columns 9-12). These effect sizes range from 5.9 to 6.7 percentage points. Interestingly, the increase in the receipt of information regarding pest management seen in the last section is consistent with an improvement in the woman's ability to take decisions on plant protection. Counter-intuitively, we see a statistically significant decline in women's input into decision making around poultry raising. Again, the OLS and NNM results are very similar. In this case, however, correcting the p-values for the false detection rate does change the statistical significance of the OLS estimates substantially, rendering insignificant the association between SHG membership and decision-making around adoption of seeds and fertilizer use (columns 9-10).

The control group means show that the extent to which women participate in decisions varies depending on the type of decision considered. Women's participation in decisions around food and cash crop farming, livestock raising and poultry raising is almost universal, perhaps because these broad decisions are closely linked to household livelihoods. In contrast, women's participation in specific decisions, like what inputs to use for agricultural production, what types of crops to grow, whether to take crops to the market and so on is almost non-existent, accounting for less than 10 percent in all cases. It is interesting that the positive results on women's decision-making do not occur at either extreme, but on those decisions where about half the women are already participating. This suggests that while the SHGs are increasing women's decision-making in some areas, they have not yet affected those areas that may be perceived as being 'traditionally' the men's purview.

5.4 Financial pathway

Being a member of a PRADAN SHG increases the likelihood of the woman having a bank account by 15 percentage points, or almost 32 percent (Table 6). It also increases the likelihood that someone in the household took a loan in the 12 months preceding the survey by 16 percent, which is a substantial 70 percent increase over the baseline mean. We do not, however, see any impact on total household expenditure on food in the week preceding the survey. Finally, while the coefficient on expenditure on consumer durables in the year preceding the survey is positive (column 4), it is not significant. Similar to the previous two pathways, the OLS and NNM estimates are very close. Correcting the p-values does not alter the statistical significance of the OLS estimates.

6 Conclusion

Can SHGs be an effective platform for providing agricultural information to women farmers, improving production diversity and increasing market orientation? We investigated the pathways to impact from membership in SHGs to improved agricultural outcomes, operating through access to information and finance, and through women's empowerment in agriculture. Along the agricultural pathway, we found

that women's groups improved access to information, but did not significantly increase the use of improved agricultural practices, number of crops grown, or diversification in cultivation. On the cross-cutting women's empowerment pathway, women improved their decision-making power around agriculture, and the gender gap in empowerment within the household decreased. On the financial pathway, SHG membership had large impacts on access to bank accounts and on loan taking behaviour, though not on food-related or consumer durable expenditure.

Some of this lack of impact on production diversity or market orientation could simply be due to imperfect measures. Without plot-level cropping information, we only have crude measures such as the number of crops grown in each season or the share of crops marketed. These fail to capture changes on the intensive margin, for example, adjustments in the area allocated to each crop, substitution of high-risk high-yield varieties for low-risk low-yield ones, or shifts to crops of greater market value. With this caveat in mind, our results suggest that the effect of SHG membership on desired agricultural outcomes is limited, possibly because of barriers along the pathways to impact.

To make SHGs an effective extension service delivery platform, we need to understand the factors that promote the transmission of information and women's empowerment, as well as those that hinder the translation of knowledge of agricultural practices to actual practice. SHG participation increases women's political participation, expands and strengthens their social networks, and increases awareness and utilization of public entitlement schemes (Kumar et al. 2017), among others, but awareness is not enough. Better general knowledge and increased participation may not result in improved agricultural practices because SHG membership does not improve women's decision-making related to the *specific* agricultural outcomes of taking crops to the market and decisions around what crops to grow.

Income constraints, limited market access, social norms and traditions, and women's domestic responsibilities may also impede the adoption of improved practices and more diverse cropping patterns.

Despite the limited evidence on direct income effects of SHG membership, there is evidence that SHGs empower women economically (Brody et al. 2017) and may potentially change the dynamics around agricultural decision-making and control of resources within the household. Group membership may also change social norms and traditions, particularly those around women's participation in agriculture.

Our findings contribute to an unexplored area of research on gender dynamics in agricultural decision-making and technology adoption in South Asia. There is relatively little evidence on men's and women's separate technology adoption decisions and the factors driving those decisions. In Maharashtra, Khan et al (2016) find that women tend to prefer labor-saving technology while men prefer technology that increases profits, possibly because women contribute a large share of unpaid labor in transplanting rice, while the men have greater control over how the money is spent. In Uttar Pradesh, Magnan et al. (2015) find that while women do participate in agricultural decision-making and have large social networks, their connections are more likely to be with poorer households that are less likely to adopt the new technology, who may not be useful sources of information about agricultural innovations. In Mali, Beaman and Dillon (2017) show that the flow of agricultural information through influential nodes can exclude women if they do not have adequate social links. NGOs working with SHGs may break the knowledge barrier by providing agriculture extension directly to poor women, and improve women's control over household income, but the other barriers that hinder adoption, which may be deeply rooted in social and cultural norms, remain to be addressed. By identifying the gap between knowledge and practice along the SHG impact pathways, our work suggests new areas for future SHG programming and policy research.

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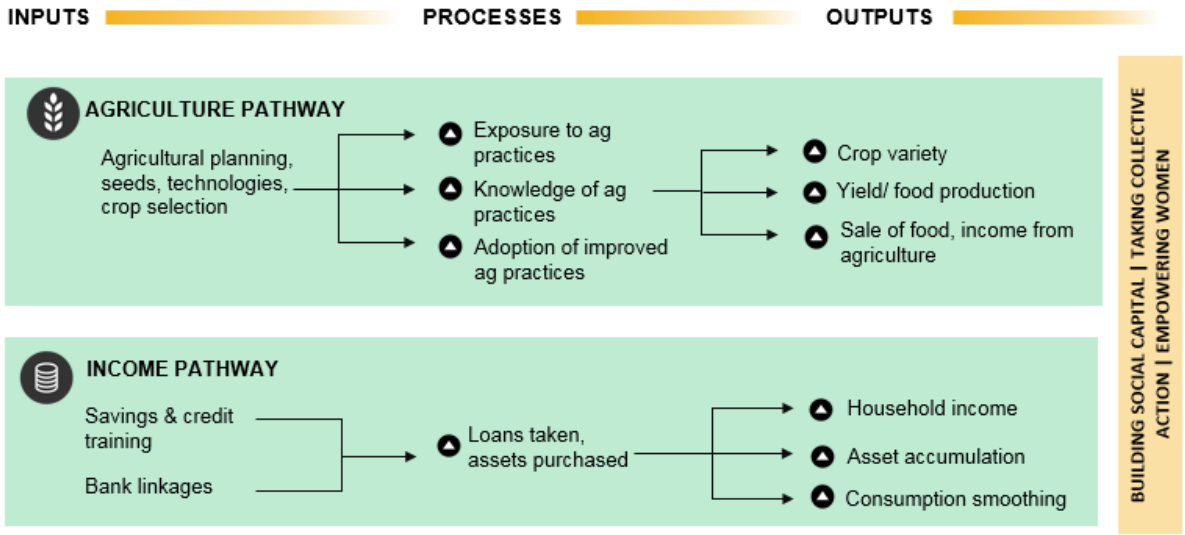
Figures



Source: Adapted from Kumar et al. (2017)

Figure 1: Impact pathways from SHG membership to agricultural outcomes

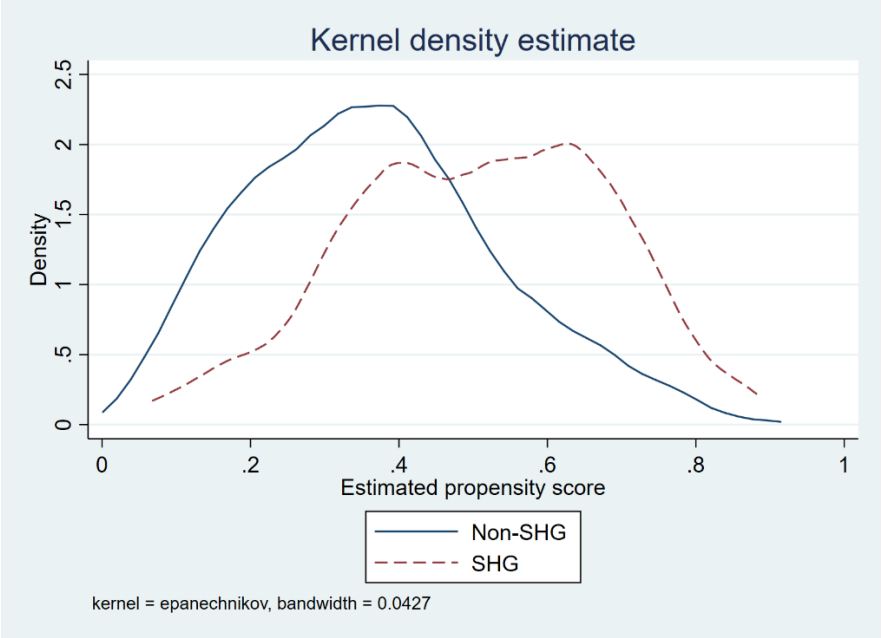


Figure 2: Kernel density of probability of SHG membership

Tables

Table 1: Respondent woman, household and village characteristics among farming households in PRADAN areas

	SHG women (N=414)	non-SHG women (N=563)	p-Values for tests of difference
	Mean (SD) or Proportion	Mean (SD) or Proportion	
Respondent woman characteristics			
Age	34.8 (7.8)	32.1 (8.7)	0.001
Age-squared	1271.5 (544.8)	1107.1 (580.9)	0.002
Has some or all primary education	17.4	14.7	0.294
Has more than primary education	18.8	19.5	0.849
Married	95.2	93.6	0.323
Agricultural or non-agricultural day laborer	30.7	27	0.372
Housewife	25.8	30.7	0.016
Women's status and time use			
Has money of her own	48.6	43	0.131
Talks to own family other than household	55.8	53.3	0.553
Fetches water from distant source, summer/winter	41.3	35	0.234
Number of work hours per day	4.6 (3.2)	4.3 (3.3)	0.172
Household characteristics			
Mother-in-law is present	20.3	29.1	0.001
Husband lives in HH	91.5	89.7	0.335
Household size	4.8 (1.9)	4.8 (1.8)	0.903
Number of children under 5 in household	0.5 (0.8)	0.6 (0.8)	0.098
Household head is SC	10.9	11.4	0.767
Household head is ST	64	73.2	0.131
Household head is OBC	18.6	11.2	0.059
Amount of farmland owned (in acres)	2.6 (4.4)	2.7 (3)	0.689
Household belongs to poorest wealth quintile	8.5	7.3	0.474
Rain is the main source of irrigation for crops	89.9	82.4	0.086
Ability to borrow from multiple sources	20.5	19.7	0.816
Village characteristics			
Population	834.8 (862.6)	964.9 (1009.2)	0.183
Average education of women	2.3 (1.1)	2.3 (1.2)	0.661
Average land owned by a household	2.1 (1.2)	2 (1.1)	0.862
Average wealth index	0.6 (0.9)	0.5 (0.9)	0.599
Village has at least one government primary school	88.6	88.8	0.928
Village has electricity in all areas	75.4	70.3	0.150
Distance from the bank (in kilometres)	3.3 (1.2)	3.2 (1.3)	0.222

Distance from village to nearest town	21.8 (19.4)	23.2 (18.1)	0.513
Livestock loss due to an unexpected event was experienced in the last year	80	84.2	0.310
Crop loss due to an unexpected event was experienced in the last year	93	90.4	0.462

Table 2: Effect of SHG membership on receipt of information: OLS and NNM estimates

	HH received information on:									
Dependent variable:	**Field crop selection or rotation**	**Improved seeds**	**Line plantation**	**SRI**	**Pest management**	**Soil improvement**	**Irrigation**	**Poultry rearing**	**Livestock rearing**	**Fishing**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
OLS										
Woman belongs to SHG	0.08**	0.13***	0.07**	0.11***	0.08**	0.06**	0.05*	0.02	0.03	0.02
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)
Standard p-value	*0.01*	*0.00*	*0.04*	*0.01*	*0.02*	*0.04*	*0.09*	*0.37*	*0.28*	*0.31*
BKY 2006 p-value$^{\alpha}$	*0.04*	*0.02*	*0.05*	*0.03*	*0.04*	*0.05*	*0.07*	*0.14*	*0.14*	*0.14*
BH 1995 p-value$^{\beta}$	*0.04*	*0.02*	*0.06*	*0.03*	*0.05*	*0.06*	*0.12*	*0.37*	*0.34*	*0.34*
N	919	901	918	872	906	900	900	909	905	910
R^2	0.151	0.151	0.127	0.144	0.197	0.187	0.113	0.109	0.106	0.085
NNM										
Woman belongs to SHG	0.08***	0.12***	0.07**	0.12***	0.08***	0.08***	0.06**	0.03	0.04	0.04**
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)	(0.02)
N	919	901	918	872	906	900	900	909	905	910
Mean	.230	.205	.242	.107	.211	.163	.143	.094	.131	.045

Notes:

*p<0.1, ** p<0.05, *p<0.01

α: Adjusted p-values calculated based on Benjamini, Krieger, and Yekutieli (2006)
β: Adjusted p-values calculated based on Benjamini and Hochberg (1995)

Table 3: Effect of SHG membership on agricultural outcomes: OLS and NNM estimates

Dependent variable:	**No. of winter crops**	**No. of summer crops**	**No. of food crops**	**Cereal to cereal, plus rotation**	**Cereal to pulse, plus rotation**	**Share of marketed crops**
	(1)	(2)	(3)	(4)	(5)	(6)
OLS						
Woman belongs to SHG	0.05	0.08	0.12*	0.02	0.01	0.01
	(0.05)	(0.06)	(0.07)	(0.01)	(0.01)	(0.02)
Standard p-value	*0.33*	*0.22*	*0.10*	*0.12*	*0.35*	*0.64*
BKY 2006 p-value[α]	*0.56*	*0.56*	*0.56*	*0.56*	*0.56*	*0.71*
BH 1995 p-value[β]	*0.41*	*0.41*	*0.36*	*0.36*	*0.41*	*0.64*
N	950	950	950	950	950	950
R^2	0.251	0.274	0.333	0.213	0.050	0.167
NNM						
Woman belongs to SHG	0.06	0.05	0.11	0.02	0.01	0.01
	(0.05)	(0.06)	(0.08)	(0.01)	(0.01)	(0.03)
N	950	950	950	950	950	950
Mean	.400	1.611	1.941	.039	.011	.237

Notes:

*p<0.1, ** p<0.05, *p<0.01

α: Adjusted p-values calculated based on Benjamini, Krieger, and Yekutieli (2006)
β: Adjusted p-values calculated based on Benjamini and Hochberg (1995)

Table 4: Effect of SHG membership on women's empowerment measures: OLS and NNM estimates

Dependent variable:	**Women's 5DE score**	**Gender gap in empowerment scores**	**Number of agricultural domains individual has some input in decisions or feels can make a decision**	**Sum of the relative autonomy indicators in the three sub-areas**
	(1)	(2)	(3)	(4)
OLS				
Woman belongs to SHG	0.02	-0.03	0.38***	0.13
	(0.02)	(0.03)	(0.10)	(0.53)
Standard p-value	*0.24*	*0.27*	*0.00*	*0.81*
BKY 2006 p-value[α]	*0.37*	*0.37*	*0.01*	*0.56*
BH 1995 p-value[β]	*0.36*	*0.36*	*0.01*	*0.81*
N	574	342	872	950
R^2	0.159	0.213	0.177	0.133
NNM				
Woman belongs to SHG	0.03	-0.04**	0.36**	-0.07
	(0.02)	(0.02)	(0.16)	(0.40)
N	574	342	872	950
Mean	.453	.184	3.959	-.117

Notes:

*p<0.1, ** p<0.05, *p<0.01

α: Adjusted p-values calculated based on Benjamini, Krieger, and Yekutieli (2006)

β: Adjusted p-values calculated based on Benjamini and Hochberg (1995)

Table 5: Effect of SHG membership on women's decision-making measures: OLS and NNM estimates

	Woman has input into decisions on:				Feels she can participate to medium/high degree in decisions on:				Woman takes decision (alone or jointly) on:			
Dependent variable:	**Food crop farming**	**Cash crop farming**	**Livestock Raising**	**Poultry raising**	**Inputs for ag. prodn**	**Types of crops to grow**	**Taking crops to the market**	**Inputs for livestock raising**	**Adoption of seeds**	**Fertilizer**	**Plant protection**	**Changing of crops**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
OLS												
Woman belongs to SHG	-0.02	-0.00	-0.02	-0.06***	0.02	-0.02	-0.01	0.02	0.06*	0.06*	0.05	0.05
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.04)	(0.04)	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)
Standard p-value	*0.41*	*0.92*	*0.41*	*0.01*	*0.58*	*0.64*	*0.78*	*0.69*	*0.06*	*0.09*	*0.11*	*0.11*
BKY 2006 p-value[α]	*0.70*	*1.00*	*0.70*	*0.08*	*0.94*	*0.94*	*0.98*	*0.94*	*0.33*	*0.33*	*0.33*	*0.33*
BH 1995 p-value[β]	*0.70*	*0.92*	*0.70*	*0.08*	*0.83*	*0.83*	*0.85*	*0.83*	*0.27*	*0.27*	*0.27*	*0.27*
N	581	280	432	346	934	934	793	833	936	928	839	923
R^2	0.126	0.141	0.139	0.181	0.180	0.179	0.152	0.186	0.244	0.270	0.269	0.263
Woman belongs to SHG	-0.02	-0.02	-0.02	-0.07***	0.00	-0.04	-0.02	0.03	0.06*	0.07**	0.06*	0.07**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.04)	(0.04)	(0.03)	(0.03)	(0.04)	(0.03)
N	581	280	432	346	934	934	793	833	936	928	839	923
Mean	.954	.960	.960	.985	.080	.075	.053	.075	.562	.534	.529	.528

Notes:

*p<0.1, ** p<0.05, *p<0.01

α: Adjusted p-values calculated based on Benjamini, Krieger, and Yekutieli (2006)

β: Adjusted p-values calculated based on Benjamini and Hochberg (1995)

Table 6: Effect of SHG membership on outcomes along the financial pathway: OLS and NNM estimates

Dependent variable:	**Respondent woman has a bank account**	**HH took loan in last 12 months**	**Total household expenditure on food in last 7 days (INR)**	**Total household expenditure on durables in last one year (INR)**
	(1)	(2)	(3)	(4)
OLS				
Woman belongs to SHG	0.15***	0.14***	-8.81	2474.11
	(0.05)	(0.03)	(18.80)	(2100.90)
Standard p-value	*0.01*	*0.00*	*0.65*	*0.26*
BKY 2006 p-value[α]	*0.01*	*0.00*	*0.48*	*0.21*
BH 1995 p-value[β]	*0.02*	*0.00*	*0.65*	*0.34*
N	950	950	950	950
R^2	0.154	0.175	0.270	0.082
NNM				
Woman belongs to SHG	0.15***	0.16***	-8.75	5157.29
	(0.03)	(0.03)	(20.58)	(3583.52)
N	950	950	950	950
Mean	.45	.23	432.48	18049.26

Notes:
*p<0.1, ** p<0.05, *p<0.01
α: Adjusted p-values calculated based on Benjamini, Krieger, and Yekutieli (2006)
β: Adjusted p-values calculated based on Benjamini and Hochberg (1995)

Appendix

Table A.1: List of covariates

Covariates	Definition
Respondent woman	
Age	Age in years
Age-squared	Square of age in years
Has some or all primary education	Whether completed class 5/primary school
Has more than primary education	Whether completed a class or degree above class 5/primary school
Married	Whether married
Agricultural or non-agricultural day labourer	Whether respondent woman works as an agricultural or non-agricultural day laborer
Housewife	Whether respondent is a housewife/homemaker with no additional source of income
Woman's status and time use	
Has money of her own	Whether currently possesses or has access to disposable income over which she has full control
Talks to own family other than household	Whether communicates with her own family members more than once a month
Fetches water from distant source	Whether adult woman in household is responsible for fetching water and the water source is distant from the house.
Number of work hours per day	Total number of hours spent at work in a day
Household characteristics	
Mother-in-law is present[a]	Whether the mother-in-law of the married respondent woman currently resides in the same household
Husband lives in the household[a]	Whether the husband of the married respondent woman currently resides in the same household
Household size[a]	Number of persons currently residing in the household
Number of children under 5 in household[a]	Number of children less than 5 years currently residing in the same household
Household head is SC	Whether the household head belongs to a Scheduled Caste
Household head is ST	Whether the household head belongs to a Scheduled Tribe
Household head is OBC	Whether the household head belongs to Other Backward Caste
Amount of farmland owned	Total farmland owned in acres
Household belongs to poorest wealth quintile	Whether the household belongs to the poorest wealth quintile in the study sample
Rain is the main source of irrigation for crops	Whether the primary source of irrigation for crops cultivated by the household is rainwater
Ability to borrow from multiple sources	Whether the household can borrow in cash or kind from more than one source (among NGO, informal lender, formal lender, friends or relatives, group based microfinance or other women's groups) if required

Village characteristics[b]	
Population	Current population
Average education of women	Average of categorical indicator of education level attained by all surveyed women in the village
Average land owned by a household	Average land owned in acres by all HHs surveyed in the village
Average wealth index	Average of wealth PCA of all respondents in the village
Village has at least one government primary school	Whether village has at least one public school.
Village has electricity in all areas	Whether village has access to electricity in all areas
Distance from the bank	Distance from nearest public or private bank in kilometers
Distance to nearest town	Distance from village to nearest town in kilometers
Livestock loss due to an unexpected event was experienced in village in the last year	At least one household in the village experienced loss of livestock due to disease or injury etc
Crop loss due to an unexpected event was experienced in village in the last year	At least one household in the village experienced loss of crops due to flooding, drought, disease, animals, theft, etc.

[a]Reference period: the last 30 days

[b]Refers to village where respondent woman currently resides.

Table A.2: Probit model of propensity score estimation

Variables	Probability of being a PRADAN SHG member
Respondent woman's age	0.20***
	(0.05)
Respondent woman's age squared	-0.00***
	(0.00)
Has some or all primary education	0.24**
	(0.10)
Has more than primary education	0.29**
	(0.14)
Married	0.42
	(0.35)
Agricultural or non-agricultural day laborer	0.02
	(0.12)
Housewife	-0.05
	(0.09)
Has money of her own	0.22**
	(0.10)
Talks to own family other than household	0.08
	(0.06)
Fetches water from distant source	0.09
	(0.10)
Number of work hours per day	0.00
	(0.02)
Mother-in-law lives in household	-0.11
	(0.12)
Husband lives in the household	-0.04
	(0.26)
Household size	0.02
	(0.03)
Number of children under 5 in household	-0.00
	(0.09)
Household head is SC	-0.27
	(0.30)
Household head is ST	-0.36
	(0.25)
Household head is OBC	0.15
	(0.22)
Amount of farmland owned	-0.01
	(0.01)
Rain is the main source of irrigation for crops	0.38**
	(0.16)
Ability to borrow from multiple sources	-0.05
	(0.14)
Village population	-0.00**

	(0.00)
Average education of women	-0.05
	(0.06)
Average land owned by a household	0.13**
	(0.05)
Average wealth index in village	0.07
	(0.07)
Village has at least one government primary school	-0.03
	(0.11)
Village has electricity in all areas	0.36***
	(0.10)
Distance from the bank	0.14**
	(0.06)
Distance from village to nearest town	-0.01
	(0.00)
Livestock loss due to an unexpected event was experienced in village in the last year	-0.31**
	(0.14)
Crop loss due to an unexpected event was experienced in village in the last year	0.12
	(0.42)
Number of observations	950

Note: Also included are dummies for district. Standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1.

Table A.3: Comparison of households with and without male WEAI respondents

Household or respondent woman characteristic	Male respondent present (N=1675) Mean (SD)/%	No male respondent (N=1069) Mean (SD)/%	p-value for test of difference
Respondent woman characteristics			
Respondent woman's age, years	32.67 (8.43)	33.23 (8.21)	0.056
Number of years of education for women	2.37 (3.63)	2.18 (3.55)	0.296
Marital status of woman: married	98	84	0
Age at marriage	17.39 (3.06)	16.94 (3.04)	0.001
Age at first pregnancy	19.16 (3.11)	18.77 (2.98)	0.002
Currently member of an SHG	38	39	0.754
Household demographics			
Household size	4.81 (1.8)	4.41 (1.78)	0
No. male household members	2.39 (1.14)	2.05 (1.18)	0
No. female household members	2.42 (1.23)	2.36 (1.22)	0.209
Female to male ratio	1.25 (0.92)	1.31 (0.95)	0.175
Dependency ratio	83	98	0.001
Religion of household head, Hindu	86	87	0.638
Religion of household head, Muslim	0	0	0.295
Religion of household head, Christian	8	6	0.432
Caste of household head, SC	13	1	0.14
Caste of household head, ST	64	71	0.03
Caste of household head, OBC	17	15	0.294
Highest number of years of schooling in household	7.18 (3.68)	6.49 (3.87)	0.002
Highest number of years of schooling in household, male	6.33 (4)	5.76 (3.98)	0.02
Highest number of years of schooling in household, female	4.47 (4.04)	4.2 (4.05)	0.155
Household socio-economic characteristics			
Household owns home	97	96	0.015
Home has electricity	1.31 (0.46)	1.37 (0.48)	0.034
Type of cooking fuel:			
Electricity	0.24	0.47	0.274
LPG	2.93	3.37	0.615
Kerosene	0.18	0.19	0.953
Stone coal	0.78	2.81	0.109
Charcoal	27.1	16.65	0.07
Wood/straw/leaves	67.52	75.3	0.155
Animal dung	1.19	1.12	0.901
Use of improved materials for:			
Floor of house	0.19	0.15	0.255
Walls of house	0.25	0.24	0.49
Roof of house	0.62	0.65	0.515
Ownership of assets, land and animals:			
Assets (sum, out of 26)	5.39 (2.89)	4.71 (2.87)	0
Land (in acres)	2.04 (3.45)	1.74 (2.62)	0.024
Large livestock	2.13 (3.1)	1.73 (2.69)	0.007
Small livestock	1.46 (3.22)	1.01 (2.55)	0.001
Poultry	3.83 (8.19)	3.01 (11.04)	0.106

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