Women's self-help groups, decision-making, and improved agricultural practices in India

K. Raghunathan;

International Food Policy Research Institute, Poverty, Health and Nutrition Division, India

Corresponding author email: k.raghunathan@cgiar.org

Abstract:

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 advice they provide is poor. We investigate whether another platform – that of women's self-help groups – could be an effective way of improving access to information, women's empowerment in agriculture, improved agricultural practices, and production diversity. We used cross-sectional data on close to 3000 women from 5 states in India, and employ nearest-neighbor matching models to match SHG and non-SHG women along a range of pre-determined 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. Other constraints like income and social norms could be limiting the translation of knowledge into practice. Since SHGs are uniquely placed to change even these constraints, it is important to identify and account for them when advocating the use of these groups in improving agriculture and livelihoods.

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Abstract

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1 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, such as India, but where agricultural productivity is low. Although agricultural extension has been emphasized in recent central government planning exercises in India, the coverage of agricultural extension workers and the relevance of advice provided is poor (Glendenning, Babu and Asenso-Okyere, 2010). In addition, these 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 (Agricultural Census 2010-11), but control only a small proportion of operational holdings. Women farmers, in particular, control fewer than 13% of total operational holdings.

Improving access to information may also help increase production diversity for subsistence farming households, who depend on own-production for food. A recent review of nutrition-sensitive agricultural programs (Ruel, Quisumbing and Balagamwala, 2017) finds that there is generally a positive association between crop production diversity and dietary diversity, but that the extent to which on-farm production diversity matters differs according to context and is more important in more physically isolated locations (Jones, Shrinivas and Bezner-Kerr, 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, Krishna and Qaim, 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 could help with improving market access as well.

Another opportunity to improve productivity, incomes, and well-being for smallholder households may lie in empowering women and increasing their decision-making roles in agriculture. In rural Nepal, (Malapit *et al.*, 2015) found both that production diversity is strongly positively associated with mothers' and children's dietary diversity, and that greater women's empowerment in agriculture mitigates the negative impacts of low production diversity on these outcomes. Using nationally representative data from Bangladesh, (Seymour, 2017) found that reduced gender disparities within households (measured in terms of the empowerment gap between spouses) are associated with higher levels of technical efficiency both on plots that women jointly manage with their spouses, as well as those that women do not actively manage. (Sraboni *et al.*, 2014), using the same dataset from Bangladesh, found increases in women's empowerment in agriculture to be positively associated with energy availability and dietary diversity at the household level.

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 & Pretty 1993; Conley & Udry

2001; Munshi 2004), 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. As of December 2014, India's National Rural Livelihoods Mission (NRLM) had mobilized 3.2 million rural households into SHGs, and aimed to mobilize 100-120 million by 2024-25. Under the guidance of NRLM and of other NGOs involved in the formation and strengthening of these groups, SHGs in Indiaare implementing interventions in agriculture and livelihoods.The effectiveness of the SHG platform in providing these services, empowering women in agricultural decision-making, and improving agricultural outcomes is yet to be established.

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 women's groups in improving access to 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 (Brody et al. 2015) 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 this key sector, globally as well as in India, this is an important area of study.

Using primary data from five states in northern India, we examine the effectiveness of SHG membership in strengthening women's roles in agriculture. We present a conceptual framework outlining the multiple 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, we provide quantitative measures of the effects of SHG membership 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. 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 SHG membership on some aspects of women's empowerment in agriculture, but find limited evidence of any impact of SHG membership 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

Tracing the links between reaching women through SHGs and agricultural outcomes begins with recognizing various pathways to impact. We describe a simple conceptual framework that considers livelihoods initiatives, savings and credit linkages and group formation and capacity building as independent but complementary inputs in improving women's role as farmers (Figure 1). This framework builds on the theory of change outlined in (Kumar, Scott,

et al., 2017), modified to focus on those pathways that are relevant to our agricultural outcomes of interest.

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. NRLM's nationwide program, the *Mahila Kisan Sashaktikaran Pariyojana* (MKSP), and SHGs supported by NGOs are also involved in community sessions where they plan for agricultural seasons, and provide access to input providers, government schemes and markets. Livelihoods interventions improve women's exposure to better agricultural practices and crop selection. This in turn leads to the adoption of these improved agricultural practices. The possible outputs of this pathway are improved crop varieties, an increase in yield or food production, and income from the sale of food or cash crops.

ii. *Income pathway*

The income pathway is the standard SHG pathway. In most programs, 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 could increase the number of loans taken and assets purchased, particularly for poor women who were not deemed creditworthy, which could increase household income and assets, and enable the household to smooth its consumption over time.

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

Finally, the women's empowerment pathway underlies and interacts with all other impact pathways. This pathway operates through building social capital, taking collective action,

and empowering women. We expect that empowering women will enable them to participate more actively in decision-making around agriculture; if both the woman and her household have sufficient time and access to resources, increased decision-making power could also increase the amount of land allocated to nutrient-rich and diverse crops.

The bundling of agriculture and livelihoods programs with the broader women's empowerment agenda may increase women's decision-making role in farming, and has implications for women's time use, intrahousehold resource allocation, women's health and household nutrition (Gillespie et al. 2012). SHGs could be effective platforms for multi-sectoral programs focused on reducing malnutrition by improving women's control over resources and decision-making and their knowledge of health and nutrition. Some of the programs that aim to reduce micronutrient malnutrition also specifically involve women in horticulture and home gardening. Although few such programs have been evaluated to date, preliminary evidence suggests that they are more effective in improving nutritional outcomes than microfinance groups (Kumar, Scott, *et al.*, 2017).

Our paper focuses on two out of three pathways of impact: the agriculture pathway and the cross-cutting pathway of women's empowerment. Within agriculture, we look at the receipt of information on agricultural practices, the use of improved methods of cultivation, production diversity, and market orientation. Within the women's empowerment pathway, we examine women's decision-making in a range of agriculture-related activities, as well as the overall score in the five domains of empowerment, and the gender parity score, where available. We do not investigate the income pathway because we do not have detailed data on access to credit, loan-taking behaviour, or expenditure on agriculture-related inputs, so our measures of outcomes along this pathway would be crude.

3 Context and data

3.1 Context

In India, under the NRLM, state and local governments have partnered with NGOs to introduce livelihoods programs in sustainable agriculture, livestock rearing and fisheries through SHGs. These programs include agricultural extension to provide information on crops, improved practices and government subsidy schemes for inputs, access to crop loans, and increased market linkages. Groups are encouraged to pool inputs and outputs to achieve economies of scale, and may function as registered farmer producer organizations that contract with buyers and sellers.

The MKSP provides directed extension efforts, production subsidy programs for various food and cash crops, and subsidised drudgery-reducing technology to women. The extension efforts are primarily targeted at SHGs and involve group learning sessions, field demonstrations, and exposure visits conducted by Community Resource Persons. Jointly-cultivated horticulture and community kitchen gardens are also promoted. NGOs work either as implementation partners of the MKSP or independently through dedicated staff to further strengthen extension efforts targeted to women and to raise awareness about the need for women to play an equal role in productive decisions. Women are provided contextualized messages on intercropping, soil and water conservation, sustainable agriculture and livestock rearing, which can have positive externalities for the local farming community.

3.2 Data

We use data from a four-year evaluation of an SHG program being implemented by PRADAN, one of the largest NGOs in India. PRADAN has been working both independently

of as well as alongside NRLM since the 1980s to promote and strengthen SHGs and provide them with information on improved seeds, farming practices, crop diversification and animal husbandry. PRADAN's traditional agriculture and livelihoods programming 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. In addition, PRADAN emphasizes women's empowerment in their group meetings, encouraging discussions on gender equality, providing a platform for women to share their personal experiences with discrimination, and initiating social and political action wherever appropriate.

PRADAN recently partnered with the Public Health Resource Network (PHRN) to introduce a health and nutrition focused participatory behaviour change communication (BCC) component to their existing livelihoods programs. We use cross-sectional data from the 2015 baseline round of a four-year impact evaluation of this nutrition intensification effort to test for an association between SHG membership and 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 sample districts (n=8), two blocks with PRADAN presence were purposively selected, one receiving the standard PRADAN livelihoods interventions and the other receiving livelihoods interventions plus the nutrition-intensive component. An additional control block was identified based on its similarity to the intervention blocks along five demographic, standard of living, and agricultural dimensions. From each of the two PRADAN blocks, five villages were randomly selected from the complete list of villages where PRADAN was operational. From the control block seven villages were selected from the full list. Finally, 20 ever-married women between the age of 15 and 49 were randomly

selected from each village. The achieved sample size was 2744 women from 136 villages in 24 blocks across 8 districts.

In the two intervention blocks within each district, SHGs are formed and strengthened by PRADAN. In the control blocks within each district, SHGs may be promoted by government workers or other NGOs, and may be registered under the NRLM. The exact operational details differ across states and across districts within states. We assume that all these SHGs receive standard NRLM inputs such as capacity building and monitoring, as well as the livelihoods inputs under MKSP. About 38 percent of our sample belonged to an SHG at baseline.

The baseline 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 the following five domains of empowerment: (1) decisions about 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. 2 013 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). The comparison of the empowerment scores of a man and woman within the same household is used to compute a measure of equality between genders, the Gender Parity Index (GPI). The final WEAI score for the sample is a weighted combination of the scores on the 5DE and the GPI.

In this paper, we use the individual level 5DE scores for the respondent women, and the household-level measures of the GPI, 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 GPI. In the Appendix, we compare households where the WEAI was administered to both man and woman to those where only the woman responded.

4 Empirical Strategy[1]

This paper aims to examine the effect of SHG membership 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. Table 1 shows that women who are SHG members are, on average, older and more likely to have been married longer compared to those who are not members; they are also more likely to come from wealthier households. As a result, the average difference in an outcome of interest between women who are SHG members and those who are not – called the difference in unconditional means in the evaluation literature – is a biased estimate of impact that also reflects systematic differences between SHG members and non-members.

To eliminate the factors that bias our comparisons, we must construct a comparison group from among non-members that were similar to SHG members before the SHGs were introduced. The preferred approach to constructing such a comparison group is to randomly provide access to the program among similarly eligible individuals. However, because the

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

introduction of such SHGs was not randomly assigned across villages in our sample, this method was not feasible. The absence of "hard" targeting criteria (such as a means test, as used in (Pitt, Khandker and Cartwright, 2006) precluded the use of Regression Discontinuity Design and, after exploring instrumental variables approaches, 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 *et al.*, 2004; Abadie and Imbens, 2006)[2].

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, the caste category she belongs to, and her household's age and gender composition. We also do not have much information on selection criteria of the SHGs that operate in these areas, although we know that SHGs

[2]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.

typically group women from similar socioeconomic backgrounds to empower them economically through savings and credit activities.

Appendix Table A.2 presents the probit model of the probability that the respondent woman belongs to a SHG, as a function of respondent woman characteristics, her status and time use, household characteristics, whether the household is in a PRADAN area, and state and district dummies. These results show that that woman's age, women's say in decision-making and ownership of assets, access to multiple sources of credit (other than through the SHG) and average wealth levels 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.

We use a comprehensive list of respondent woman, household, and village characteristics in our estimations. We control for 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, wealth, 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 control for geographic location using district dummy

variables. Thus, we are effectively matching SHG members with non-members within the same broad locality, an important consideration since our data spans several culturally, economically and geographically diverse states. The full list of covariates is provided in Table A.1.

In addition to presenting the matching estimates, we present the simple ordinary least squares estimates of the relation between SHG membership and the outcomes of interest, estimated as follows:

$$Y_{ivbds} = \alpha + \beta SHG_{ivbds} + \gamma X_{ivbds} + \delta Z_{vbds} + \phi_d + \epsilon_{ivbds},$$

Where the i, v, b, d and s subscripts refer to the individual, village, block, district and state, Y_{ivbds} are outcomes of interest, $SHG_{ivbds}$is a dummy variable indicating that the respondent woman belongs to an SHG, X_{ivbds} are individual covariates, Z_{vbds} are village level covariates, and ϕ_d are district fixed effects. ε_{ihds} is the individual-specific error term clustered at the block level.

5 Results

We first compare outcomes of interest of SHG women and non-SHG women in all study locations, including both NRLM SHGs and SHGs promoted by other organizations. We then compare SHG women to non-SHG women in PRADAN areas to measure the differential impact of PRADAN's intensive livelihoods programs and their strong focus on women's empowerment.

5.1 Descriptive statistics

Table 1 presents respondent woman, household and village characteristics for the whole sample as well as for PRADAN areas only, separately for SHG members and non-members.

On average, SHG women are 34 years old, 2 years older than non-SHG women. About a quarter of these women are housewives, with a slightly greater proportion of non-SHG women reporting this as their occupation. They work a little under 5 hours a day. Less than 20% of the SHG women have more than primary education. About 44 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.

Families have slightly less than 5 members on average, but the number of children under 5 is less than 1 per household on average. Households of SHG members own more than twice as much land as the non-SHG households, though the principal component analysis (PCA) of their asset ownership does not reveal any large differences. More than two-thirds 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.

Table 2 presents the means of the main agricultural outcomes of interest. Less than a third of households received information on any agricultural practices, with information on improved seeds, line plantation, and field crop selection being the most common. Fewer than 20% of the households used these practices. Households grow on average about two food crops a year, and about a third of the produce is grown for sale in the market. Fewer than 3% grew a cereal crop in the summer and a pulse in winter along with another rotation, only about 7% grew a cereal in both seasons along with another rotation.

Overall, decision making regarding agriculture seems to be higher among SHG women than non-SHG women (Table 3). About 30% of SHG women took decisions on cash crop farming,

while 97% reported that they provided some inputs into these decisions. Very few women reported taking decisions regarding inputs for agricultural production, the types of crops to grow, taking crops to the market, or inputs for livestock raising. However, about half the women in SHGs reported that they felt they could participate in the decision-making process. This was consistently higher among SHG women than non-SHG women.

5.2 Receipt of information

Table 4 presents OLS and NNM estimates of the impact of SHG membership on receipt of information on agricultural practices for the entire sample and for PRADAN areas only. 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.

In the pooled sample, NNM estimates suggest that SHG members were 5.2 percentage points more likely to have received information regarding line planting, 6.2 percentage points more likely to have received information on improved seeds, and 7.4 percentage points more likely to receive information on the system of rice intensification (SRI). These differences were statistically significant. Other forms of information were also positively associated with SHG membership (except in the case of livestock rearing), but the coefficients were not significant. The NNM and OLS estimates are similar in magnitude, direction, and significance.

Within PRADAN areas (Panel B), differences in the receipt of information between SHG members and non-members information are larger. SHG membership has a statistically significant positive effect on the probability of receiving information, with effect sizes ranging from 3.6 percentage points (for fishing) to 11.7 percentage points (for improved

seeds). These results suggest that, while all SHG members have greater access to agricultural extension and related information services, those in PRADAN areas receive more intensive information dissemination. The largest impacts are found for information regarding improved seeds, SRI and pest management.

5.3 Women's empowerment

Table 5 presents estimates of the impact of SHG membership on alternative measures of women's empowerment – the 5DE score, the gender gap in empowerment scores, the number of agricultural domains in which the individual feels that she can make a decision or has some input into decisions, and a measure of her autonomy in agricultural decision making.

In the pooled sample (Panel A of Table 5), the composite empowerment score, 5DE, does not show any statistically significant association with the SHG membership variable. However, being a member of an SHG has a negative effect on the gender gap in empowerment scores of about 0.033. Given a baseline gender gap of 0.15, this is a sizeable narrowing of the empowerment score gap between men and women. This estimate is available only for the 60% of households in which the male member was interviewed.

The effects of SHG membership are also heightened when we restrict the sample to PRADAN areas (Panel B). The gender gap declines by 0.039 on a baseline value of 0.16. In addition, SHG membership results in an 8 percent increase in the number of agricultural domains in which the individual has some input into decisions, based on a mean of 4.26 agricultural domains.

Given the focus of SHGs on empowering women to take action and make decisions, particularly in the realm of agriculture, the lack of association between SHG membership and the 5DE may seem surprising. However, because 5DE is an aggregative index, the process of aggregation could be masking possible 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. In the pooled sample (Panel A of Tables 6), we see evidence of an increase in sole or joint decision-making on adoption of seeds, application of fertilizer and use of plant protection measures, with effect sizes ranging from 4.9 to 5.9 percentage points. We do not see any changes in decision-making on types of crops to grow, taking crops to the market, or on inputs for agricultural production. Surprisingly, we see a decline in input into decisions on poultry raising, an activity usually managed by women.

Again, effects are larger in magnitude when we restrict our analysis to PRADAN areas, which is expected given its strong focus on women's empowerment. Being a member of a PRADAN SHG has a positive and significant impact on sole or joint decision making in adoption of seeds, fertilizer, plant protection measures, and, interestingly, also in decisions around crop rotation. These effect sizes range from 6.7 to 7.7 percentage points (Panel B of Table 6). We also note that the increase in the receipt of information regarding pest management seen in the last section is backed by an improvement in the woman's ability to take decisions on plant protection.

6.4 Improved agricultural practices

Do increased access to information and increases in women's decision-making power in some agricultural domains translate into improved agricultural practices? Table 7 presents

impact estimates of SHG membership on the use of improved seeds, treatment of seeds before planting, the use of a method other than broadcasting, hoeing of the field, and the use of irrigation for wheat, paddy and maize for all study areas combined. Because only those respondents who reported growing these crops responded to the questions, our sample size was drastically reduced, so we could not conduct this analysis for PRADAN areas separately. Disappointingly, there was no impact of SHG membership on any of these improved practices, except in the practice of broadcasting seeds (columns 7 and 9) and indeed the association is negative for several of the outcomes presented here.[3]

Why might this be the case? There are multiple constraints to the adoption of new technologies or methods of production. First, income constraints may be binding: if improved seeds are more expensive, women farmers may not be able to purchase them even if they have information on the benefits of their use Second, social norms and traditions around cultivation practices are hard to shift. Several studies show that farmers often learn from progressive farmers and consider the experiences of neighbours when adopting a new crop or technology (Bandiera & Rasul 2004, Beaman et al. 2015; Maertens & Barrett 2012). This process takes time, even if there are accompanying improvements in information and in the woman's ability to translate that information into decisions.

6.5 Agricultural outcomes

Finally, we turn to measures of production diversity and market orientation (Table 8). Unsurprisingly, given our earlier findings of no change in agricultural practices, we do not

[3]The last row of the table presents the minimum detectable difference (MDD) assuming we have the full sample of 1726 matched women, and assuming equal division of these women into the 24 clusters. We see that in all but 3 outcomes the MDD is larger than the effect size observed, suggesting that we are under-powered to detect differences at these levels.

find any evidence of a positive impact of SHG membership on the number of crops grown, on crop rotation practices, the number of food crops grown, or share of crops marketed. Although agroecological factors largely determine the feasibility of crop diversification, we have controlled for these by matching within the same district and controlling for irrigation source and still do not find any impact of SHG membership.

7 Conclusion

This paper asked whether SHGs could be an effective platform for providing agricultural information to women farmers, increasing adoption of improved agricultural practices, and increasing production diversity and market orientation. We investigated the pathways to impact from membership in SHGs to improved agricultural outcomes, operating through access to information as well as through women's empowerment in agriculture. We found evidence along the agricultural pathway that women's groups improved access to information, but very limited evidence that SHG membership increased the use of improved agricultural practices or diversification. On the cross-cutting women's empowerment pathway, women improved their decision-making power around agriculture to some extent, and the gender gap in empowerment within the household decreased. However, despite the activation of some of the initial pathways to impact, SHG membership had no impact on production diversity or market orientation. This suggests that the answer to our question is a partial "yes": the effect of SHG membership along various impacts pathways is incomplete, possibly because of barriers along the pathways to impact. If SHGs are to be an effective extension service delivery platform, we need to understand both 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. We have found that SHG participation increases women's political participation, expands and strengthens their social

networks, and increases awareness and utilization of public entitlement schemes (Kumar, Raghunathan, *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 impede the adoption of improved practices and more diverse cropping patterns. SHGs, especially PRADAN SHGs, have the potential to change the dynamics around agricultural decision-making and control of resources within the household. While evidence on direct income effects of SHG membership is limited, there is evidence that these groups improve women's economic empowerment (Brody *et al.*, 2017). SHG membership may also change social norms and traditions, particularly those around women's participation in agriculture.

Finally, estimating the impact of agricultural extension is challenging in general due to the difficulty of measuring exact extension input, the timeline for impacts and the complexity of socio-economic, infrastructural and psychological drivers of crop choice (Birkhaeuser, Evenson and Feder, 1991).

Our findings contribute to an unexplored area of research on gender dynamics in agricultural decision-making and technology adoption in South Asia. Because it is often assumed that most farming in Asia is done jointly, even if there are homestead plots or livestock that are women's exclusive responsibility (Peterman, Behrman and Quisumbing, 2014), there is relatively little evidence on men's and women's separate technology adoption decisions and the factors driving those decisions. In Maharashtra, (Khan, Kishore and Joshi, 2016) find that women tend to prefer labor-saving technology while men prefer technology that increases

profits, a result driven by the fact that 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 larger 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. 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

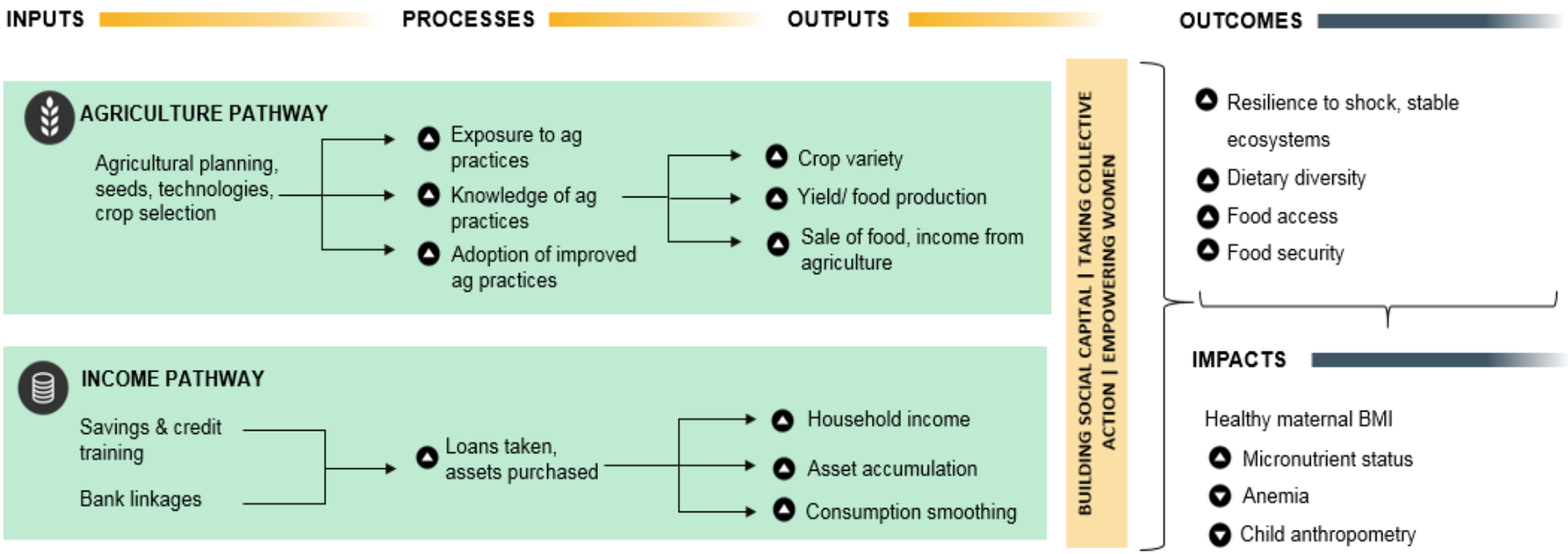

Figure 1: Theory of change – impact of SHG membership on agricultural outcomes and via these, on health and nutrition indicators

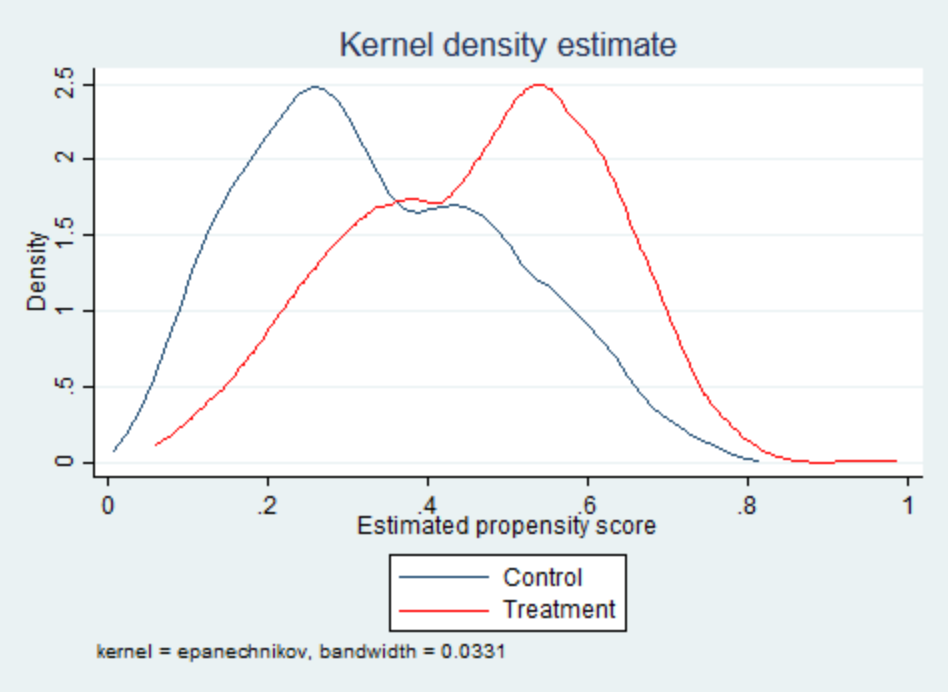

Figure 2: Kernel density of probability of SHG membership (control= non SHG, treatment = SHG)

Tables

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

	All areas			PRADAN areas		
	SHG women (N=712)	non-SHG women (N=1014)	p-Values for tests of difference	SHG women (N=414)	non-SHG women (N=563)	p-Values for tests of difference
	Mean (SD) or Proportion	Mean (SD) or Proportion		Mean (SD) or Proportion	Mean (SD) or Proportion	
Respondent woman characteristics						
Age	34.6 (7.9)	32.2 (8.5)	0.000	34.8 (7.8)	32.1 (8.7)	0.001
Age-squared	1262.3 (551.9)	1110.8 (571.8)	0.000	1271.5 (544.8)	1107.1 (580.9)	0.002
Has some or all primary education	16	14.5	0.370	17.4	14.7	0.294
Has more than primary education	19	20.3	0.572	18.8	19.5	0.849
Married	94.4	93.6	0.642	95.2	93.6	0.323
Ag or non-ag day laborer	33.3	30.9	0.329	30.7	27	0.372
Housewife	23.5	28.8	0.006	25.8	30.7	0.016
Women's status and time use						
Has money of her own	44.4	42.9	0.598	48.6	43	0.131
Talks to own family other than household	53.5	51.8	0.578	55.8	53.3	0.553
Fetches water from distant source, summer/winter	39.6	31	0.033	41.3	35	0.234
Number of work hours per day	4.7 (3.2)	4.4 (3.2)	0.025	4.6 (3.2)	4.3 (3.3)	0.172
Household characteristics						
Mother-in-law is present	20.4	26.7	0.001	20.3	29.1	0.001
Husband lives in HH	90.2	89.4	0.667	91.5	89.7	0.335
Household size	4.8 (1.8)	4.8 (1.8)	0.870	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)	0.106	0.5 (0.8)	0.6 (0.8)	0.098
Household head is SC	11.4	9.8	0.302	10.9	11.4	0.767

Household head is ST	66.7	73.5	0.096	64	73.2	0.131
Household head is OBC	16.9	13.3	0.190	18.6	11.2	0.059
Amount of farmland owned (in acres)	5.4 (75)	2.6 (2.9)	0.312	2.6 (4.4)	2.7 (3)	0.689
PCA of asset ownership	0.6 (1.4)	0.6 (1.3)	0.390	0.6 (1.4)	0.5 (1.4)	0.242
Household belongs to poorest wealth quintile	7.9	6.5	0.233	8.5	7.3	0.474
Rain is the main source of irrigation for crops	88.6	83.8	0.080	89.9	82.4	0.086
Ability to borrow from multiple sources	19.7	20	0.767	20.5	19.7	0.816
Village characteristics						
Population of the village	858.5 (855.5)	905.4 (925.1)	0.506	834.8 (862.6)	964.9 (1009.2)	0.183
Average education of women in the village	2.3 (1.2)	2.2 (1.3)	0.451	2.3 (1.1)	2.3 (1.2)	0.661
Average land owned by a household in the village	2.1 (1.2)	2 (1.1)	0.632	2.1 (1.2)	2 (1.1)	0.862
Average wealth index of village	0.6 (0.8)	0.6 (0.9)	0.664	0.6 (0.9)	0.5 (0.9)	0.599
Village has at least one government primary school	90.4	85.7	0.043	88.6	88.8	0.928
Village has electricity in all areas	79.9	76.3	0.169	75.4	70.3	0.150
Distance from the bank (in kilometres)	3.2 (1.2)	3.1 (1.2)	0.116	3.3 (1.2)	3.2 (1.3)	0.222
Distance from village to nearest town	21.3 (18.9)	23.4 (19.2)	0.295	21.8 (19.4)	23.2 (18.1)	0.513
Livestock loss due to an unexpected event was experienced in village in the last year	77.7	79.9	0.402	80	84.2	0.310
Crop loss due to an unexpected event was experienced in village in the last year	91.6	92.4	0.754	93	90.4	0.462

Table 2: Agricultural outcome variable characteristics

	SHG women		non-SHG women		p-Values for tests of difference	SHG women in PRADAN areas		non-SHG women in PRADAN areas		p-Values for tests of difference
	Mean (S.D) or Proportion	N	Mean (S.D) or Proportion	N		Mean (S.D) or Proportion	N	Mean (S.D) or Proportion	N	
HH received information on:										
Field crop selection or rotation	28.2	685	21.8	963	0.023	33.2	401	23.1	533	0.007
Improved seeds	29.3	679	19.5	947	0.005	36.1	396	20.5	522	0.000
Line plantation	29.8	682	22.1	959	0.004	32.1	399	24.3	536	0.023
SRI	18.0	654	9.7	917	0.002	21.9	383	10.7	506	0.004
Pest management	26.6	674	20.3	952	0.041	33.0	394	21.1	530	0.007
Soil improvement	20.2	673	15.3	943	0.098	26.0	392	16.4	526	0.018
Irrigation	15.8	672	12.2	942	0.054	20.4	393	14.3	526	0.023
Poultry rearing	10.4	680	8.4	954	0.149	11.8	398	9.4	530	0.251
Livestock rearing	14.8	675	13.0	951	0.420	17.7	396	13.1	528	0.081
Fishing	5.8	678	4.1	957	0.250	7.6	397	4.5	532	0.092
Used improved seed for										
Wheat	24.7	73	28.6	70	0.519	22.9	35	27.3	44	0.616
Paddy	29.1	684	27.7	962	0.665	32.2	391	27.6	525	0.337
Maize	9.8	266	12.6	318	0.442	12.9	147	13.8	189	0.878
Finger millet	8.7	23	7.0	86	0.722	7.1	14	10.0	40	0.025
Treated seeds before planting for:										
Wheat	17.3	75	25.4	71	0.224	25.0	36	27.3	44	0.857
Paddy	18.1	685	15.7	966	0.872	19.6	392	17.2	529	0.419
Maize	12.0	266	10.6	322	0.045	12.2	147	10.4	192	0.169
Finger millet	8.7	23	11.6	86	0.150	14.3	14	17.5	40	0.141
Did not broadcast seed for:										
Wheat	40.0	75	31.0	71	0.410	33.3	36	31.8	44	0.824
Paddy	44.8	685	41.5	966	0.349	45.4	392	36.5	529	0.633
Maize	17.7	266	19.9	322	0.338	16.3	147	21.4	192	0.124
Finger millet	8.7	23	9.3	86	0.632	14.3	14	17.5	40	0.141
Practiced hoeing in the field:										

Wheat	48.0	75	70.4	71	0.118	50.0	36	68.2	44	0.306
Paddy	84.5	685	80.6	966	0.415	84.7	392	79.4	529	0.236
Maize	83.1	266	84.5	322	0.319	83.0	147	85.9	192	0.318
Finger millet	39.1	23	40.7	86	0.002	35.7	14	42.5	40	0.010
Used some method of irrigation for:										
Wheat	40.0	75	54.9	71	0.266	47.2	36	59.1	44	0.292
Paddy	11.0	685	13.9	966	0.156	9.4	392	13.8	529	0.266
Maize	7.5	266	9.3	322	0.266	8.8	147	13.0	192	0.242
Finger millet	26.1	23	22.1	86	0.652	28.6	14	35.0	40	0.412
Agricultural outcomes:										
No of crops grown in winter	0.5 (0.9)	712	0.4 (0.8)	1014	0.032	0.5 (0.9)	414	0.4 (0.8)	563	0.248
No of crops grown in summer	1.7 (0.9)	712	1.6 (0.9)	1014	0.329	1.7 (0.9)	414	1.6 (0.8)	563	0.394
No of food crops cultivated	2.1 (1.3)	712	2.0 (1.2)	1014	0.078	2.1 (1.3)	414	1.9 (1.1)	563	0.147
Share of crops grown for the market	0.3 (0.4)	712	0.3 (0.4)	1014	0.694	0.3 (0.4)	414	0.2 (0.4)	563	0.219
Cereal in summer, cereal in winter + one other crop	6.7	712	4.1	1014	0.100	6.3	414	3.9	563	0.257
Cereal in summer, pulse in winter + one other crop	2.1	712	0.8	1014	0.010	2.4	414	1.1	563	0.057

Table 3: Women's decision-making in agriculture

	SHG women		non-SHG women		p-Values for tests of difference	SHG women in PRADAN areas		non-SHG women in PRADAN areas		p-Values for tests of difference
	Mean (S.D) or Proportion	N	Mean (S.D) or Proportion	N		Mean (S.D) or Proportion	N	Mean (S.D) or Proportion	N	
No of agricultural domains where individual has some input in decision or feels can make decision	4.4 (2.2)	667	4.1 (2.2)	913	0.040	4.7 (2.2)	386	4.0 (2.1)	507	0.000
Sum of the relative autonomy indicators	0.6 (6.3)	712	0.4 (6.0)	1014	0.515	0.4 (5.8)	414	-0.1 (5.9)	563	0.290
Woman has input in decisions on:										
Food crop farming	94.1	460	93.9	607	0.870	95.8	264	95.4	329	0.808
Cash crop farming	97.1	206	94.9	275	0.086	96.3	135	96.0	151	0.795
Livestock Raising	97.2	355	95.5	465	0.172	97.5	197	96.0	247	0.375
Poultry raising	95.8	240	97.2	353	0.341	95.2	147	98.5	203	0.029
Woman feels she can participate to a medium/high degree in decisions of:										
Inputs for agricultural production	50.7	702	45.6	997	0.074	52.8	405	43.8	553	0.012
Types of crops to grow	48.7	700	44.3	994	0.094	49.0	406	42.9	552	0.077
Taking crops to the market	46.3	573	42.8	860	0.177	47.5	333	42.3	482	0.086
Inputs for livestock raising	55.2	623	48.8	881	0.023	55.3	362	47.6	494	0.033
Woman takes decisions (alone or jointly) regarding:										
Adoption of seeds	65.6	701	54.8	991	0.001	70.49	410	56.24	553	0.001
Fertilizer	63.9	698	52.0	988	0.001	69.7	406	53.37	549	0.001
Plant protection	63.5	619	51.3	897	0.000	68.33	360	52.88	503	0.001
Changing of crops	63.6	693	51.9	985	0.000	68.49	403	52.83	547	0.000

Table 4: OLS and NNM estimates of the association between SHG membership and receipt of information

	HH received information on:									
Dependent variable:	**Field crop selection or rotation** (1)	**Improved seeds** (2)	**Line plantation** (3)	**SRI** (4)	**Pest management** (5)	**Soil improvement** (6)	**Irrigation** (7)	**Poultry rearing** (8)	**Livestock rearing** (9)	**Fishing** (10)
PANEL A: ALL STUDY AREAS										
OLS										
Woman belongs to SHG	0.05**	0.08***	0.07***	0.07***	0.03	0.02	0.02	0.01	0.00	0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.01)
N	1612	1588	1603	1533	1586	1576	1573	1593	1585	1594
R^2	0.112	0.127	0.132	0.138	0.179	0.165	0.091	0.109	0.111	0.076
NNM										
Woman belongs to SHG	0.037	0.062***	0.052**	0.074***	0.012	0.011	0.010	0.010	-0.006	0.018
	(0.026)	(0.024)	(0.024)	(0.018)	(0.027)	(0.020)	(0.019)	(0.016)	(0.020)	(0.012)
N	1612	1588	1603	1533	1586	1576	1573	1593	1585	1594
PANEL B: PRADAN AREAS ONLY										
OLS										
Woman belongs to SHG	0.083***	0.125***	0.068**	0.109***	0.072**	0.054**	0.047*	0.016	0.028	0.018
	(0.030)	(0.031)	(0.031)	(0.026)	(0.029)	(0.027)	(0.026)	(0.021)	(0.025)	(0.017)
N	919	901	918	872	906	900	900	909	905	910
R^2	0.159	0.162	0.150	0.147	0.200	0.192	0.115	0.127	0.115	0.089
NNM										
Woman belongs to SHG	0.081**	0.117***	0.062**	0.114***	0.088***	0.076***	0.051*	0.028	0.032	0.036**
	(0.032)	(0.032)	(0.031)	(0.026)	(0.032)	(0.028)	(0.027)	(0.021)	(0.026)	(0.016)
N	919	901	918	872	906	900	900	909	905	910

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

Table 5: OLS and NNM estimates of the association between SHG membership and women's empowerment measures

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)
PANEL A: ALL STUDY AREAS				
OLS				
Woman belongs to SHG	0.02	-0.04***	0.11	0.11
	(0.01)	(0.01)	(0.1)	(0.3)
N	1014	619	1537	1676
R^2	0.085	0.187	0.26	0.119
NNM				
Woman belongs to SHG	0.03	-0.033**	0.064	0.517
	(0.015)	(0.016)	(0.114)	(0.35)
N	1014	619	1537	1676
PANEL B: PRADAN AREAS				
OLS				
Woman belongs to SHG	0.024	-0.032*	0.310**	0.062
	(0.016)	(0.017)	(0.141)	(0.395)
N	574	342	872	950
R^2	0.166	0.214	0.264	0.137
NNM				
Woman belongs to SHG	0.025	-0.039**	0.347**	-0.283
	(0.016)	(0.019)	(0.153)	(0.397)
N	574	342	872	950

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

Table 6: OLS and NNM estimates of the association between SHG membership and women's decision-making measures

	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)
PANEL A: ALL STUDY AREAS												
OLS												
Woman belongs to SHG	-0.01	0.02	-0.00	-0.03**	0.00	-0.00	-0.02	0.02	0.05**	0.06**	0.06**	0.05**
	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.02)	(0.02)	(0.03)	(0.02)
N	1038	469	793	584	1652	1647	1390	1458	1642	1636	1472	1628
R^2	0.091	0.105	0.127	0.154	0.128	0.130	0.127	0.157	0.184	0.204	0.206	0.204
NNM												
Woman belongs to SHG	-0.008	0.006	0.003	-0.025**	-0.003	-0.001	0.007	0.026	0.052*	0.049*	0.059**	0.042
	(0.015)	(0.019)	(0.013)	(0.012)	(0.027)	(0.027)	(0.030)	(0.028)	(0.030)	(0.026)	(0.027)	(0.025)
N	1038	469	793	584	1652	1647	1390	1458	1642	1636	1472	1628
PANEL B: PRADAN AREAS												
OLS												
Woman belongs to SHG	-0.018	-0.003	-0.013	-0.056***	0.014	-0.020	-0.018	0.008	0.059*	0.067**	0.058*	0.055*
	(0.018)	(0.027)	(0.019)	(0.019)	(0.033)	(0.033)	(0.037)	(0.035)	(0.031)	(0.030)	(0.033)	(0.031)
N	581	280	432	346	934	934	793	833	936	928	839	923
R^2	0.126	0.152	0.141	0.195	0.184	0.182	0.162	0.197	0.245	0.275	0.271	0.265
NNM												
Woman belongs to SHG	-0.012	-0.019	-0.016	-0.053***	0.009	-0.023	-0.017	0.028	0.067**	0.077**	0.068*	0.074**
	(0.016)	(0.025)	(0.017)	(0.015)	(0.035)	(0.035)	(0.038)	(0.037)	(0.032)	(0.032)	(0.035)	(0.033)
N	581	280	432	346	934	934	793	833	936	928	839	923

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

Table7: OLS and NNM estimates of the association between SHG membership and use of improved agricultural practices, all study areas[1]

Dependent variable:	**Used improved seed for:**			**Treated seeds before planting:**			**Did not broadcast seed for:**			**Practiced hoeing in the field:**			**Used some method of irrigation:**		
	Wheat	**Paddy**	**Maize**	**Wheat**	**Paddy**	**Maize**	**Wheat**	**Paddy**	**Maize**	**Wheat**	**Paddy**	**Maize**	**Wheat**	**Paddy**	**Maize**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
OLS															
Woman belongs to SHG	-0.07	0.01	0.01	-0.16*	-0.05	-1.39	0.12	0.01	0.06*	-0.25	0.04**	-0.02	-0.24***	0.01	0.01
	(0.08)	(0.02)	(0.03)	(0.07)	(0.29)	(0.83)	(0.10)	(0.02)	(0.03)	(0.15)	(0.02)	(0.04)	(0.07)	(0.01)	(0.01)
N	132	1604	560	135	1609	564	135	1609	564	135	1609	564	135	1609	564
R^2	0.355	0.256	0.217	0.305	0.023	0.065	0.416	0.037	0.095	0.428	0.032	0.065	0.230	0.046	0.081
NNM															
Woman belongs to SHG	0.06	0.00	-0.01	-0.13*	-0.09	-1.35**	0.30***	0.01	0.06**	-0.25**	0.02	-0.03	-0.07	-0.00	0.01
	(0.12)	(0.02)	(0.02)	(0.08)	(0.35)	(0.61)	(0.12)	(0.02)	(0.03)	(0.10)	(0.02)	(0.03)	(0.12)	(0.02)	(0.02)
N	132	1604	560	135	1609	564	135	1609	564	135	1609	564	135	1609	564
MDD[2]	0.23	0.23	0.19	0.22	0.22	0.16	0.23	0.23	0.21	0.22	0.22	0.14	0.23	0.20	0.18

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

[1]Since only a small subset responded to these questions, we could not perform this analysis for the PRADAN areas separately.

[2]The MDD was calculated for the full sample of matched women (N=1726), assuming equal distribution into the 24 clusters (n=72 per cluster), an ICC of 0.33, and assuming an increasing outcome. Since in several cases we have significantly fewer women, these MDDs can be treated as the upper bounds.

Table 8:OLS and NNM estimates of the association between SHG membership and agricultural outcomes

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)
PANEL A: ALL STUDY AREAS						
OLS						
Woman belongs to SHG	0.03	0.08**	0.09*	0.01	0.01*	-0.01
	(0.04)	(0.04)	(0.05)	(0.01)	(0.01)	(0.02)
N	1676	1676	1676	1676	1676	1676
R^2	0.230	0.268	0.319	0.181	0.033	0.141
NNM						
Woman belongs to SHG	-0.022	0.048	0.014	0.004	-0.004	-0.013
	(0.063)	(0.056)	(0.103)	(0.016)	(0.012)	(0.021)
N	1676	1676	1676	1676	1676	1676
PANEL B: PRADAN AREAS						
OLS						
Woman belongs to SHG	0.043	0.073	0.109	0.023*	0.008	0.015
	(0.053)	(0.052)	(0.071)	(0.014)	(0.009)	(0.024)
N	950	950	950	950	950	950
R^2	0.259	0.292	0.351	0.214	0.052	0.184
NNM						
Woman belongs to SHG	0.063	0.030	0.093	0.023	0.010	0.011
	(0.056)	(0.057)	(0.081)	(0.015)	(0.008)	(0.026)
N	950	950	950	950	950	950

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

Appendix

Table A.1: Full list of variables used as covariates in the probit for nearest-neighbor matching and OLS models

Covariates	Definition
Respondent woman	
Age	Respondent adult woman's age in years
Age-squared	Square of respondent adult women's age in years
Has some or all primary education	Whether the respondent has completed class 5/primary school
Has more than primary education	Whether the respondent has completed a class or degree above class 5/primary school
Married	Whether the respondent woman is married
Ag or non-ag day laborer	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 the respondent woman currently possesses or has access to disposable income over which she has full control
Talks to own family other than household	Whether the respondent woman communicates with her own family members more than once a month
Fetches water from distant source	Whether adult woman in household is responsible to fetching water and the water source is outside 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
PCA of asset ownership	Wealth index with range 0-1 computed from data on household asset ownership
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	
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 of the village
Distance from the bank	Distance from nearest public or private bank in kilometres
Distance from village to nearest town	Distance from village to nearest town in kilometres
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 5: Probit model of propensity score estimation

Variables	**Probability of being an SHG member**
Respondent woman's age	0.16***
	(0.03)
Respondent woman's age squared	-0.00***
	(0.00)
Has some or all primary education	0.15
	(0.10)
Has more than primary education	0.17*
	(0.10)
Married	0.21
	(0.20)
Ag or non-ag day laborer	-0.05
	(0.08)
Housewife	-0.08
	(0.09)
Has money of her own	0.07
	(0.07)
Talks to own family other than household	0.06
	(0.07)
Fetches water from distant source	-0.00
	(0.08)
Number of work hours per day	0.01
	(0.01)
Mother-in-law lives in household	-0.14
	(0.09)
Husband lives in the household	-0.08
	(0.16)
hhsize	0.02
	(0.02)
Number of children under 5 in household	0.02
	(0.05)
Household head is SC	-0.13
	(0.20)
Household head is ST	-0.18
	(0.18)
Household head is OBC	0.07
	(0.19)
Amount of farmland owned	0.00
	(0.01)
PCA of asset ownership	0.08**
	(0.04)
Household belongs to poorest wealth quintile	0.50***
	(0.17)
Rain is the main source of irrigation for crops	0.14

	(0.10)
Ability to borrow from multiple sources	0.08
	(0.10)
Village population	-0.00
	(0.00)
Average education of women	-0.07*
	(0.03)
Average land owned by a household	0.09*
	(0.05)
Average wealth index in village	-0.02
	(0.09)
Village has at least one government primary school	0.27**
	(0.11)
Village has electricity in all areas	0.10
	(0.09)
Distance from the bank	0.06*
	(0.03)
Distance from village to nearest town	-0.00**
	(0.00)
Livestock loss due to an unexpected event was experienced in village in the last year	-0.05
	(0.11)
Crop loss due to an unexpected event was experienced in village in the last year	-0.20
	(0.15)
Number of observations	1676

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 where the man was present for the WEAI and those where he was not

Household or respondent woman characteristic	Man present (N=1675) Mean (SD)/%	No man (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 fuel used for cooking:			
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