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The Gendered Game

Effects of Experiential Learning on Decision-Making and Water Saving in India

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Abstract

This paper addresses two key questions related to gender equity, agricultural production, and sustainable natural resource management. First, given the importance of women's decision-making in agriculture for their own empowerment and better agricultural outcomes, what are effective ways to strengthen women's participation in agricultural decision-making? Second, is women's participation in agricultural decisions associated with more water-conserving production choices? We analyze these questions by examining the impact of a novel experiential learning intervention with games, debriefing, and crop water budgeting, designed to address groundwater depletion in India. Results of a randomized control trial in 472 communities indicate that playing the game significantly increased women's participation in choosing the crops their household grows in the post-monsoon season—specifically, their likelihood of deciding alone. Men who played the game were also more likely to make crop choice decisions alone, though the effect was smaller. Path analysis shows women's involvement in crop decision-making is associated with more water-conserving decisions: women who decide alone report their household grows significantly less water-consumptive crops and irrigates less land in the post-monsoon season, when groundwater is scarce. Even when women decide jointly with their husbands, households grow less water-consumptive crops, though the effect is smaller. By contrast, when men and women decide with other relatives, households cultivate more area overall, suggesting that the learning from the game is less effective when more people are involved in decisions. Experiential learning games are thus a promising strategy to strengthen women's agricultural decision-making, and this may also lead to more sustainable resource management.

Keywords: women's empowerment, sustainability, serious games, groundwater

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Introduction

Women's decision-making in agriculture has received considerable research and policy attention in recent years (Mohammed et al. 2025). Decision-making is a key aspect of empowerment (Kabeer 1999), with both an intrinsic value and potential economic benefits for households and communities (Anderson et al. 2021; Kabeer and Natali 2013; World Bank 2011). Inclusion of women in household agricultural decision-making can help ensure that women's unique knowledge and preferences are reflected in decisions, which can lead to better agricultural outcomes and resource conditions. For example, a cross-sectional study by Connors et al. (2023) found that in India, Burkina Faso, Malawi and Tanzania, households where women were more involved in agricultural production decision-making produced more varied food-group crops with higher nutrient density. Greater empowerment of women in decision-making of various forms has also been shown to predict greater technical efficiency on plots managed by women and by men (Seymour 2017), more efficient use of land fallowing and higher crop yields (Goldstein and Udry 2008), and more investments in land quality (for example, use of fertilizer and intensive tillage) (Dillon and Voena 2018).

A key question, then, is how women's decision-making ability can be strengthened, particularly through external interventions. A recent review of 12 agricultural development projects with explicit aims for women's empowerment found that only three had a significant impact on women's participation in agricultural and livelihood decision-making (Quisumbing et al. 2024). An evidence scan on programmatic approaches to increasing women's decision-making power found that most interventions focused on household- or community-level social norm change, or focused on technical training, building women's leadership skills, exposing women to positive role models, or providing mentoring (Petrulla et al. 2021). The study notes the need for more contextualized analyses of what works to increase women's decision-making power, including what are effective programmatic approaches and ways of measuring empowerment. While there is growing interest in gender-transformative approaches (GTAs) for women's decision-making and some promising results (Adida et al. 2025; Cole et al. 2020; Galiè et al. 2025; Quisumbing et al. 2022), many evaluations show little or no impact on empowerment outcomes, and highlight skill and cost constraints to scaling these approaches (Singh and Puskur 2023; Hillenbrand et al. 2024).

Experiential learning approaches, including games and debriefing, are showing promise in influencing decision-making toward more sustainable agricultural and natural resource practices (Bernal-Escobar et al. 2025; Den Haan and Van Der Voort 2018; Falk et al. 2023; Flood et al. 2018; Wouters et al. 2013). Compared to conventional training approaches, experiential learning is more engaging and can be more effective in active learning (Creutzig and Kapmeier 2020), which may have particular advantages for women, who often have less formal education and access to extension than men (Davis et al. 2012). For example, in Ethiopia, only 5 percent of women surveyed before the application of a groundwater game were aware of the ability to improve groundwater availability through soil and water management activities, compared to 35 percent of men, who were more exposed to government-led soil and water conservation programs (ElDidi et al. 2024).

However, there is relatively little evidence on the gendered impacts of experiential learning games, and particularly whether they can increase women's involvement in decision-making.

A second key question is how gender differences in decision-making affect the degree to which decisions made contribute to sustainability. This can shed light on the potential impacts of efforts to empower women on the environment. It is an especially important question precisely because of the ongoing climate crisis and necessity of solutions that can effectively promote sustainability.

Women and men make different crop choices for various reasons, including having different access to inputs, markets, and information; having different preferences and objectives for home consumption vs. market sale; and differential risk aversion patterns (Doss et al. 2018; Euler et al. 2024). Decisions can be made separately or as part of joint decision-making at the household level, with varying degrees of women's influence on the decision (Quisumbing and Doss 2021).

While it is often posited that women will be more resource-conserving than men, the empirical evidence is mixed and highly context-specific (Bell et al. 2023; Leisher et al. 2016; Masuda et al. 2022; Meinzen-Dick et al. 2014; Revollo-Fernández et al. 2016). In an earlier groundwater game intervention in India, women more frequently chose less sustainable, water-intensive crops during the game, aiming to deplete the hypothetical aquifer in order to end the game more quickly and return to their domestic responsibilities (Meinzen-Dick et al. 2016). This effect disappeared when games were scheduled at times more convenient for women, and players were allowed to rotate out without ending the game—suggesting that women are not in fact more supportive of unsustainable crop choices (Meinzen-Dick et al. 2018). Women that played a similar groundwater game in Ghana were more likely to choose water saving crops compared to men (Blackmore et al. 2026). In Ethiopia, women groups started off choosing more water consumptive crops than men, but gradually reduced water consumption as the game rounds advanced (ElDidi et al. 2024). Playing the game was also found to improve women's knowledge of crop water requirements and perceived importance of water conservation in Ethiopia. Additionally, beyond impacts on knowledge and attitudes, a recent study in India found that women's involvement in experiential games for surface water improved water management outcomes 2 years after the intervention (Steimanis et al. 2025).

In this paper, we examine whether a package of experiential learning games, debriefing, and crop water budgeting can strengthen women's participation in agricultural decision-making and to what extent playing the game affects men's and women's crop choices towards more water-saving behavior. We use impact assessment data from a randomized control trial (RCT) of a game designed to show the links between crop choice and groundwater availability in India.

In the next section we provide an overview of our experiential learning interventions and discuss the theory behind how they could affect women's participation in decision-making, as well as the likely outcomes of production decisions by women and men. The third section describes our impact assessment methods and hypotheses. We then present our results and discuss their implications in the conclusions.

Experiential learning intervention

We use a collective action groundwater game developed and piloted by the International Food Policy Research Institute (IFPRI) and Foundation for Ecological Security (FES). This game was designed to address the depletion of groundwater in areas where falling water tables have become a serious problem, and where local collective action could be effective in arresting this depletion. One of the key problems with groundwater governance is that, as an invisible resource, it is difficult to understand the resource dynamics and how individual actions can affect others and the sustainability of the resource. The game uses crop choice as a key factor that affects water consumption, and hence groundwater depletion.

To facilitate full participation of women and men in a context where women are often reluctant to speak in front of men, games took place in separate groups of only women and only men. Players were asked, in each round, to choose between a water-consumptive crop that yields a high return and a water-saving crop that yields a lower return, with the identity of each crop tailored to the local context. Each round represented a Rabi (post-monsoon) season, which is particularly dependent on groundwater. After each round, the facilitators recorded the individual crop choices, gave each player their respective crop earnings in play money, and calculated the aggregate groundwater use of all players. Each player's "earnings" were given privately in play money, while the effect on the water table (a limited resource affected by their decisions) was illustrated on a large flexi-banner that showed the image of a well with 50 units of water marked, as well as a large numeric table where total water withdrawals and remaining water level were written. After two practice rounds, the game proceeded with up to 10 rounds with no communication, followed by up to 10 rounds in which players could communicate.[i] The game was followed by a community-wide debriefing session to discuss how the games relate to real-life conditions in the community. Specifically, a facilitator showed actual community trends in groundwater levels, players discussed their experiences in the game, and the community discussed implications for their community. Next, a crop water budgeting exercise was held, showing how existing cropping patterns would affect anticipated post-monsoon water availability, as well as alternative crops that could be grown in case of scarcity.

An important objective of the overall project was to develop a scalable package of experiential learning tools to improve groundwater governance. The games were adapted so they could be implemented by community-resident resource persons with relatively brief training, rather than highly trained facilitators. Implementation costs per community were US$70 to $120, depending on accessibility, including the time of facilitators and participants, transport, materials, and training. This intervention package has now been scaled to over 6,500 communities in India (Meinzen-Dick et al. 2024).

To identify whether learning from the interventions carried over into real-life behavior, we conducted follow-up surveys of those who played the game to ask about the extent to which they participated in decisions about what crops to grow in the Rabi season, what crops their household grew, and the area of cropland they cultivated.

Falk et al. (2023) lay out a framework for examining how the action situation created in the game relates to the real-life context. Those who play the game may become more involved in crop decision-making in real life because they gain confidence from the experience of making choices in the game, and this effect may be stronger for women who are not otherwise as involved in decision-making. Additionally, women in particular may gain credibility in decision-making with their families and community members who know that they have participated in the games. It follows that in real-life decision-making, the effects of learning from the game are likely to materialize differently depending on whether a man or woman from the household participated in the game, and this would affect both crops grown and area irrigated.

Impact assessment methods

We use data from the Experiential Learning for Groundwater Governance in India study (International Food Policy Research Institute (IFPRI) et al. 2025). This was an RCT conducted in four districts from three states of India: Andhra Pradesh (2 districts), Karnataka (1 district), and Rajasthan (1 district). In these districts, there were a total of 683 habitations (named, distinct clusters of houses that constitute the local community) that met an inclusion criteria of having at least 10% of land irrigated, being of interest to FES for future interventions involving experiential learning for water management, and having not had interventions to date. The sample was stratified by preexisting FES data on availability of surface irrigation because surface irrigation can decrease pressure on groundwater by providing an alternative source of water and increasing recharge to groundwater.

The study used systematic sampling based on share of land irrigated (from 10 to 100) to obtain at least 75 habitations per strata, resulting in a sample of 472 total habitations. Habitations were randomly sampled into treatment and control groups using a stratified randomization procedure, with strata defined by state and availability of surface irrigation. Two-thirds of the sample were assigned to treatment and one-third to control, as shown in Appendix Table 1.

To select individuals, focus group discussions (FGDs) were held in both treatment and control communities. These FGDs sought at least 10 female and 10 male members of households using groundwater for irrigation, but it was not always possible to get gender-balanced FGDs. In treatment habitations, the listed, groundwater-using household members were asked who would be willing to return (usually the next day). Among those who were willing to return (and thus shortlisted), the group of men were randomly assigned a serial number from 1-10, and the groups of women were randomly assigned a serial number from 1-10. Those with numbers 1-5 were then selected to participate in the game. Others beyond number 5 were welcomed to attend the game as observers, along with other community members. Only one person per household was selected (either a woman or man).

Game players were asked to attend the game the whole time, but if they had to leave, one of the other shortlisted individuals of the same gender (starting with number 6, then 7, then 8, etc.) could fill in for them. Other community members could also participate in the game if the shortlisted candidates were not available.

Those game players with shortlist numbers 1-3 were selected for an individual survey before the game. Prior to being interviewed, they were asked if they could stay until the end of the game; if they indicated this being a problem, the next-lowest ranked player (e.g., 4, 5, etc.) would be asked to play the game and would be interviewed instead.

In control habitations, the listed groundwater-using household members were similarly asked who would be willing to return the next day. Among those who were willing (and thus shortlisted), the group of men and the group of women were each randomly assigned numbers, (1-10), and those with numbers 1-3 (both men and women) were given the individual survey; no games were administered. Although balance tests confirmed good comparability between treatment and control communities (habitations), there were imbalances between treatment and control individuals at baseline, which may have arisen because of slight differences in the way they were recruited. To deal with this, in the endline survey, we drew a new sample of individuals from those groundwater-using households who participated in an FGD at endline. To ensure comparability to individuals who agreed to take the time to play the games in the treatment communities, we asked who is willing to come back the next day to complete an individual survey and participate in an activity taking approximately two hours (the same time the games required). The activity was viewing a video related to community development but not strongly related to the outcome variables of interest in our study. From those willing to come back, we randomly assigned numbers and selected women and men with numbers 1-5 return the next day for the individual interviews and then watch the film. We interviewed #1-3 in the ranking of men and #1-3 of women, as in the treatment communities. In treatment habitations at endline, we attempted to track down all individuals who were interviewed in treatment communities at baseline and up to three additional men and three women who participated in a second round of games in treatment communities during a mid-line period if original players were not available. Balance tests showed that this approach provided a sufficiently balanced sample of treatment and control individuals.

Our analysis compares endline outcomes in the treatment group with endline outcomes in the control group, guided by a pre-analysis plan *[see anonymized version attached for review]*. As a first step, we assess the impact of our intervention on agricultural decision-making modalities. In the survey of individual women and men respondents, we asked, “Who decides which crop to grow?” with answer categories I alone; jointly with spouse; jointly with other family members; jointly with other community members; spouse alone. We conducted multinomial logit of these responses on treatment, with “I alone” as the default category. Because the analysis examines intra-household gender dynamics, observations from respondents who did not reside with an adult of the opposite sex were excluded. This reduced the analytical sample by less than 2.5%. We control for individual (age, education), household (size), and community characteristics (groundwater conditions, water access, water harvesting structures, presence of water rules) and district. Next, we assessed the causal effect of the interventions on and the correlation of the decision-making modalities with two water management outcome variables which were also collected in the endline survey of individual respondents:

- ***Crop water requirements*** = ln water requirement of main crop grown by household in last Rabi season in cubic meters per hectare as estimated by community resource persons.
- ***Cultivated area***= ln Total area cultivated by household in last Rabi season in hectares, if household cultivates at all in Rabi.

We first address this using Ordinary Least Squares (OLS) analysis of each of these outcomes on treatment and the control variables specified above, with separate regressions for women and men. We then assess the impact pathways from treatment to intermediate decision-making modalities, and subsequently from these decision-making modalities to water use, through path analysis within the generalized structural equation modeling (GSEM) framework. Path analysis is well suited for evaluating direct and indirect effects of an intervention, particularly when combining categorical and continuous outcomes in mediation and moderation pathways. The variables for different modes of participation of women and men in decision-making thereby act as mediators in the model. The answer option indicating that the respondent's spouse makes decisions independently — without involvement from the respondent — served as the reference category and comparator for examining patterns of individual or joint engagement. We also control for individual (age, education), household (size), and community characteristics (groundwater conditions, water access, water harvesting structures, presence of water rules) and district.

We estimated the mediation effects through modes of decision-making using a three-equation GSEM: multinomial logit for modes of decision-making, and Gaussian log-link for ln crop water requirement of main crop in Rabi season and ln cultivated area in Rabi season. We calculated average marginal effects for the direct treatment effects on modes of decision-making after the GSEM multinomial logit equation. This reports the average change in predicted probability (in percentage points) of each decision mode across all sample observations, holding covariates at their actual values. For the log-transformed continuous outcomes, we interpreted unstandardized coefficients as approximate percentage changes in the geometric mean of the original variables using the transformation 100×(exp^β−1), holding all other covariates constant.

Since decision-making processes or behaviors may systematically differ between women and men, we estimate separate GSEM models for women and men to permit the identification of gender-specific pathways, mediators, and treatment effects.

We report a summary of the patterns of these models providing the complete models in Appendix tables. Tests of the difference in treatment effects between specific mediators are performed using a linear hypothesis test. In addition, we calculate the direct, indirect and total treatment effects on the two water management outcome variables.

Results

Effects of treatment on decision-making roles

Descriptive statistics show that over two-fifths of both male and female respondents make agricultural decisions jointly with their spouse (Figure 1; Appendix Table 2). More than one fifth report making decisions together with other family members. Approximately one third indicate that either they or their spouse decide independently. Consulting other community members is rare. For both men and women, there are minimal differences between the treatment and control groups in the prevalence of joint decision-making. However, for both men and women, the proportion who report making decisions individually is higher in the treatment group than in the control group, while the spouse making decisions alone is correspondingly lower in the treatment group.

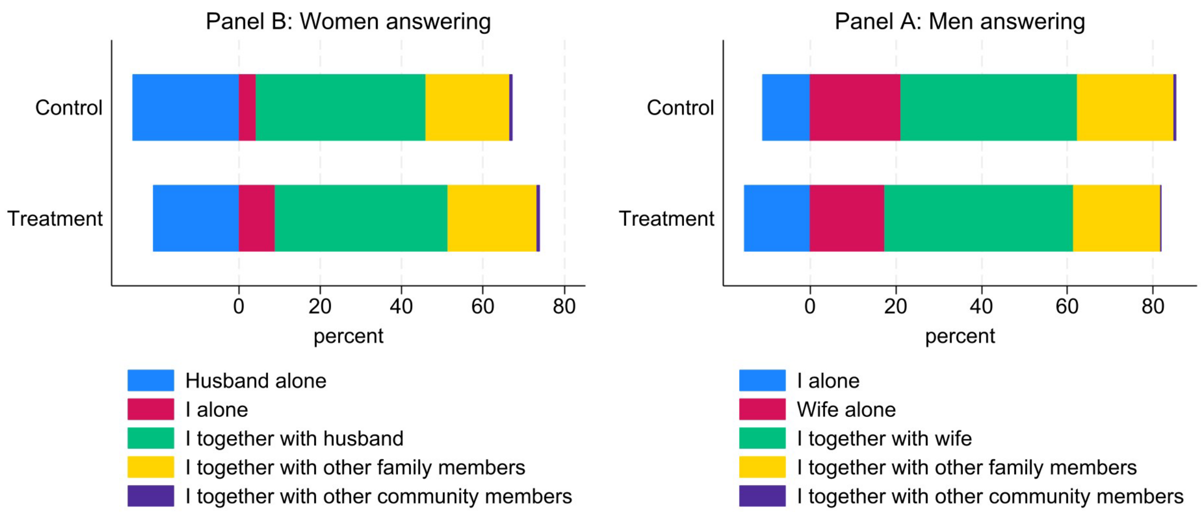

Figure 1: Responses of women and men on who makes decisions about crop choice, showing higher proportion of sole decision-making by those who played the game.
Source: Authors' analysis of individual survey data

Multinomial logit results show that, controlling for individual-, household-, community-, and district-level variables, playing the game significantly decreased the likelihood that the husband or wife of respondents takes decisions alone, and that a female respondent decides with the husband or other family members compared to the reference category of "I take decisions alone". Effectively, this means that our intervention increased the likelihood that individuals made decisions alone about what crops to plant, rather than leaving the decision to their spouse (Figure 2, Appendix Table 3). This shift is larger in magnitude for women.

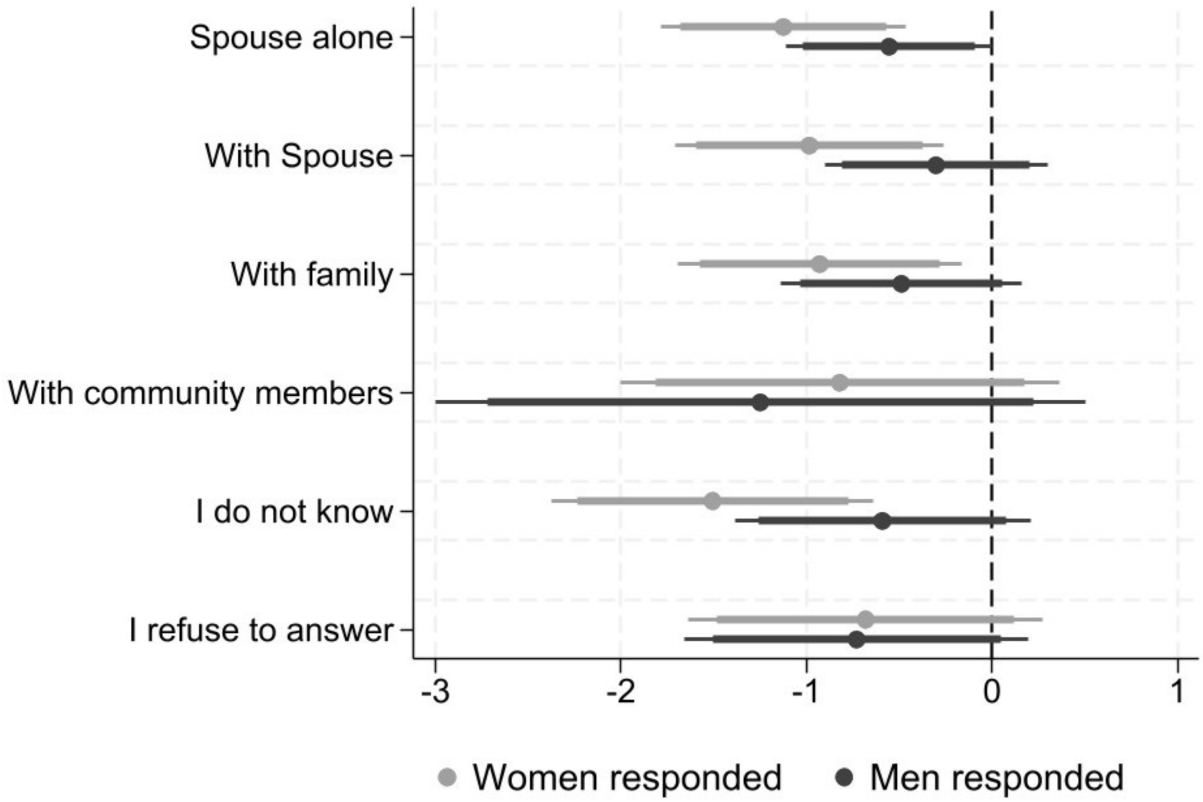

Figure 2: Multinomial logit results showing higher proportion of sole decision-making by those who played the game, with a stronger effect for women than for men.

Notes: Model controls for respondent characteristics (age-category and education-category), village water context (indicator that groundwater tables fell over the past five years; share of households in the community with access to groundwater for irrigation in the Rabi season; number of months in which water is insufficient for the whole village; indicator that the community has ponds, tanks or weirs; indicator that any water-related rules were mentioned by the key informants), household composition (ln number of adults in the household), and district fixed effects. Narrow line shows 95% confidence interval; heavy line shows 90% confidence interval.

Source: Authors' analysis of individual survey data

Direct effects of treatment on water management outcomes

Ordinary Least Squares (OLS) regression results shown in Figure 3 and Appendix Table 4 show no direct effect of treatment on either choice of less water-consumptive crops or the area cultivated in the Rabi season for women or men, after controlling for the specified covariates. In the next section we analyze whether impacts on women and men are statistically significantly different using out GSEM model.

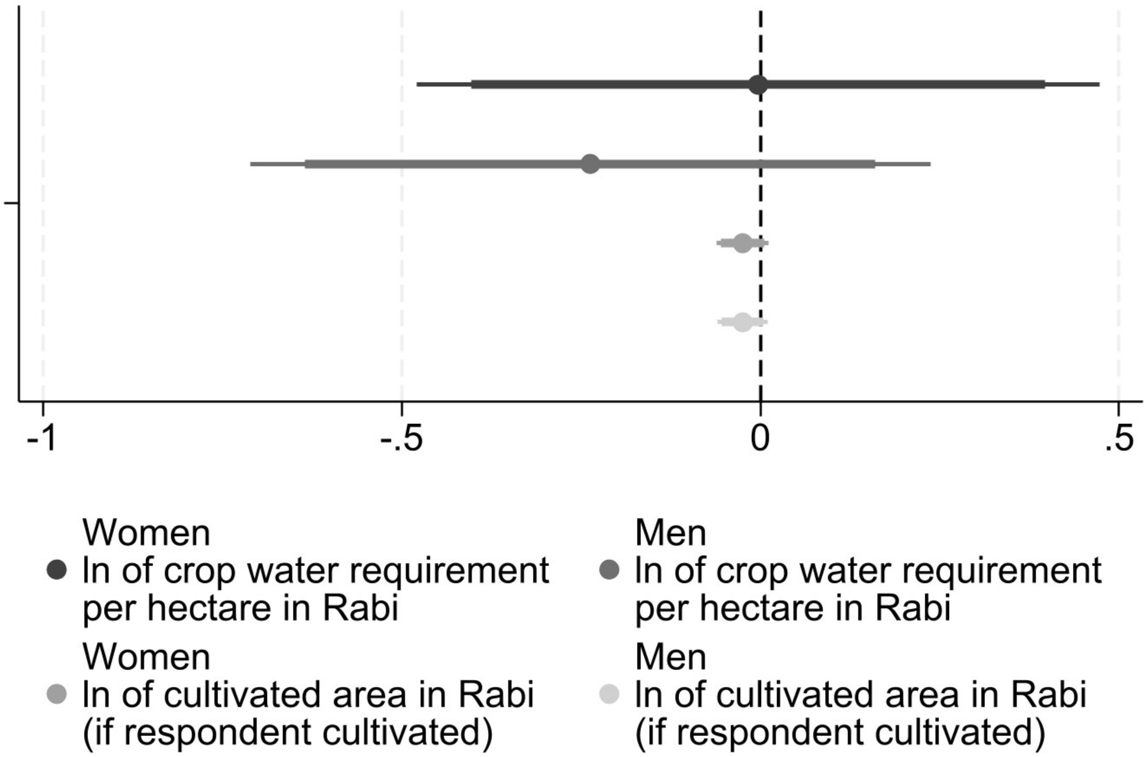

Figure 3: OLS results show no direct effect of treatment on Rabi crop water requirements or cultivated area, for women as a group or men as a group.

Notes: Model controls for respondent characteristics (age-category and education-category), village water context (indicator that groundwater tables fell over the past five years; share of households in the community with access to groundwater for irrigation in the Rabi season; number of months in which water is insufficient for the whole village; indicator that the community has ponds, tanks or weirs; indicator that any water-related rules were mentioned by the key informants), household composition (ln number of adults in the household), and district fixed effects. Narrow line shows 95% confidence interval; heavy line shows 90% confidence interval.

Source: Authors' analysis of individual survey data

Path analysis: involvement in decision-making affects water outcomes

Path analysis using GSEM shows a more nuanced picture of the relations between treatment, water use, and women's involvement in crop decision-making.

The first step of the GSEM results confirms the Mlogit results; treatment significantly altered the decision-making dynamics within households, especially for women game players. Post-estimation marginal effects calculations indicate that, holding all other variables constant, playing the game which simulated crop choice and its effect on groundwater levels decreased the probability that husbands of respondents take decisions alone by 4 percentage points relative to the reference group of women made crop choices independently. (Figure 4. The GSEM results further show that treatment significantly reduced the relative odds of women reporting that they "decide with their husband" or "decide with their family" rather than belonging to the reference category of "woman deciding alone." However, these effects translated into only very small and statistically insignificant changes in the predicted probabilities, with differences of less than one percentage point. These findings suggest that the primary effect of the treatment was to shift decision-making authority from husbands deciding alone to women deciding alone, rather than to alter or reduce joint decision-making arrangements (See full model in Appendix Table 5). Among men, the effects of the games on decision-making roles are weaker. The post-estimation marginal effects from the first-step GSEM model indicate that men who participated in the game intervention were 3.2 percentage points less likely to report that their wives make decisions alone, rather than the male respondent reporting to decide alone. Treatment effects on the likelihood of men participating in joint decision-making with their wives, family, or community were not significant (Appendix Table 5).

In addition, to explore gender differences more systematically, we calculated a combined model of all participants irrespective of their sex and included interactions between treatment and sex as well as between decision-making mode and sex. The treatment significantly increased the likelihood of participants taking decisions alone, irrespective of sex. Independent of treatment status, men were more likely than women to take decisions alone or together with other family members. The interaction terms between treatment and sex were not statistically significant for any decision-making mode, suggesting no evidence that the treatment effects differed between men and women (Appendix Table 5).

Turning to the second stage of the GSEM, women who report that decisions are made by their husband alone, jointly with their husband, or jointly with the family also report significantly higher crop water requirements and larger cultivated areas than women who report deciding alone. These findings suggest that women who decide alone tend to cultivate smaller areas and select crops with lower water requirements. Men reporting joint decision-making with their wife, family, or other community members cultivate significantly larger areas than men reporting sole decision-making, although there is no significant difference in the crop water requirements on the area they do cultivate in Rabi, suggesting that they are reducing cultivated area but not changing cropping patterns.

The combined model for women and men reveals additional gender-specific patterns. Regardless of decision-making mode, Across both sexes, respondents who reported that decisions were made by the spouse alone or jointly with the spouse, family, or community also reported cultivating more water-intensive crops and larger areas than respondents who reported deciding alone. This pattern suggests that sole decision-makers tend to cultivate smaller areas and adopt less water-intensive cropping systems (Appendix Table 5).

Post-estimation, coefficients for the log-transformed outcomes were exponentiated to express differences in expected geometric means. Compared with households in which women reported deciding alone, households in which women reported that their husband decided alone were associated with 409% higher expected crop water requirements and 6.7% larger cultivated areas, conditional on other variables in the model. Similarly, households in which women reported making decisions jointly with their husband or jointly with the family were associated with 223% and 495% higher expected crop water requirements, respectively, as well as approximately 6.4% and 14.2% larger cultivated areas, respectively. These results indicate a strong association between women's sole decision-making and the cultivation of crops with substantially lower water requirements and, to a lesser extent, smaller cultivated areas.

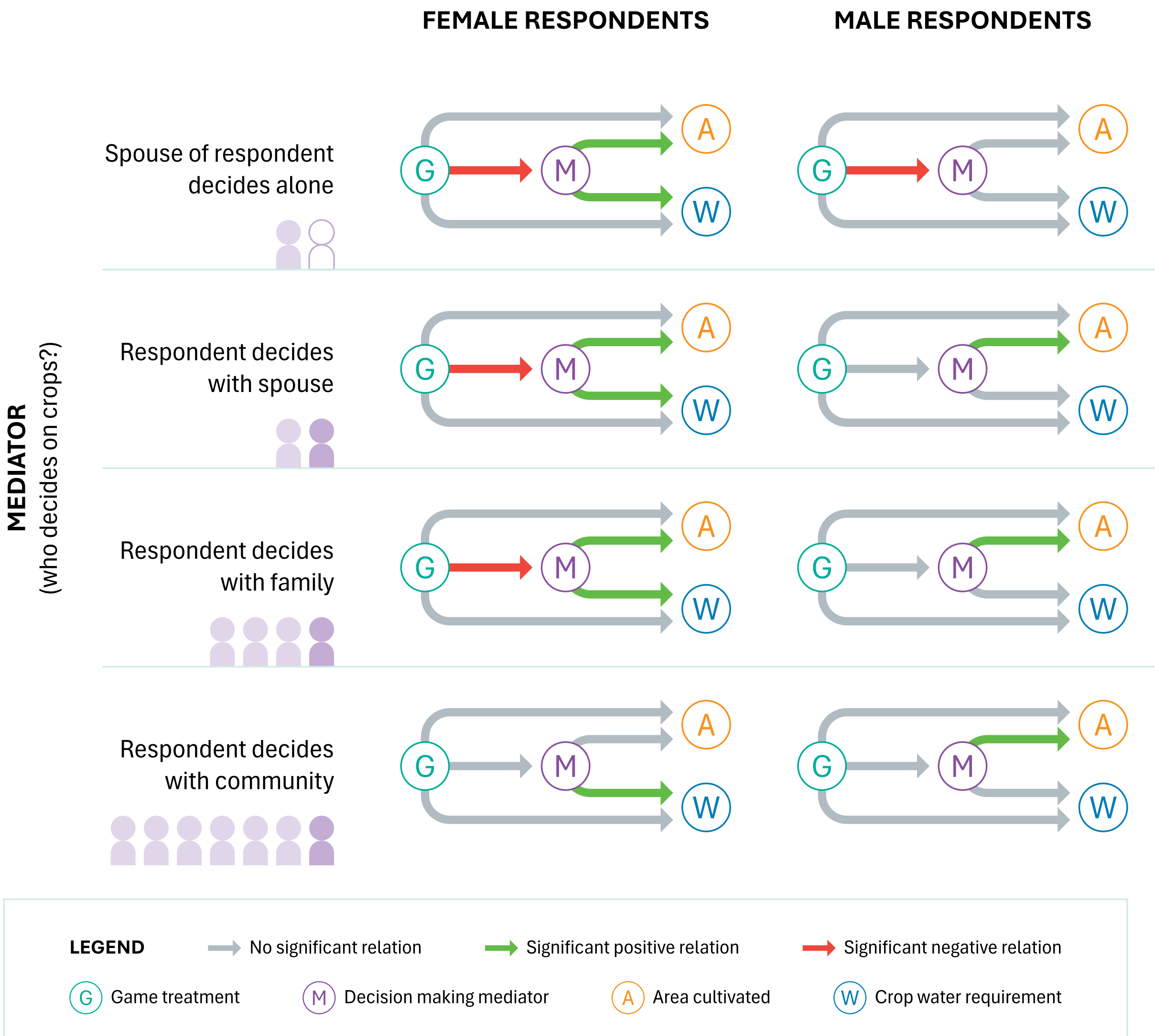

Figure 4: Direct contribution of intervention on respondent's decision-making and direct association of decision-making on water management outcomes. Note: relations estimated using GSEM; both stages of the model control for respondent (age, education), household (size), and community characteristics (groundwater conditions, water access, water harvesting structures, presence of water rules). See full model in Appendix Table 3. Source: Authors' analysis of individual survey data.

Among men, joint decision-making was consistently associated with larger cultivated areas. Relative to the reference category of men reporting sole decision-making, men who reported making crop decisions jointly with their wife cultivated 8.1% larger areas, while those reporting joint decision-making with their family or other community members cultivated 11.4% and 16.8% larger areas, respectively.

The model further allows us to examine the mediating role of decision-making in linking the intervention to Rabi season water use. The treatment exerted an indirect effect on both crop water requirements and cultivated land area through the mediator "husband decides alone". The estimated indirect effect, calculated as the product of the average marginal effect of treatment on sole decision-making and the percentage change in outcomes associated with sole decision-making, was statistically significant, as was the corresponding total effect (the sum of direct and indirect effects). Indirect and total effects through the mediators "decide jointly with husband" and "decide with family" were in the same direction but reached significance only at the 10% level. These findings suggest that treatment-induced shifts in women's decision-making roles, particularly away from husband-only decision-making and towards women's sole decision-making, were associated with an overall treatment effect on water management outcomes. However, the mediation results should be interpreted as evidence of pathways of association rather than as causal relation (Appendix Table 7).

To further examine the underlying mechanism, we estimated models including interactions between treatment and decision-making categories. We do not find evidence that the relationship between decision-making and agricultural outcomes differs between treatment and control groups, suggesting that the association is stable across groups. This pattern is consistent with a compositional effect, whereby the treatment shifts which women report making decisions alone. At the same time, behavioral responses cannot be ruled out, as women induced to take decisions alone may gradually adopt practices similar to those already observed among women with decision-making autonomy. Because decision-making is measured post-treatment, these mechanisms cannot be fully disentangled.

We do not find a mediating role of decision-making modes for male respondents.

Discussion

The robust findings that women are significantly more likely to report that they made decisions about crop choice after playing a game that simulated the effects of crop choice on groundwater levels indicate that such experiential learning is a promising strategy to increase women's decision-making in agriculture. Further qualitative work is needed to explore how this comes about—whether women who were not involved in decision-making now participate jointly with husbands or family, and those who participated in decisions gain confidence to take the lead and report sole decision-making. Having participated in the game may also increase other household members' confidence in the participant's agricultural decision-making and crop choice, given their new experience. Observations of the field teams supports the idea that the experience in the games give women confidence in choosing crops. During rounds of game play where discussion was allowed among players, many women were heard to create scenarios about why they needed crops that gave high income in some years, and even offering to forgo planting any crop in some years to allow the water table to recharge.

Results also show that when men play the game, they are also more likely to make decisions alone, though the effect is weaker than for women who play the game. This suggests that experiential learning games can empower players in real-life decision-making. One implication is, if women's involvement in decision-making and joint intrahousehold decision-making is a desired goal, involving only men in the game intervention can harm joint decision-making, while involving women in games as participants can improve their ability to be involved in decisions and intra-household decision-making. However, women's sole decision-making is not necessarily the goal; even women themselves may prefer joint decision-making. Further research could involve spousal pairs in the games to see if that strengthens joint decision-making.

Results from the GSEM show that women's involvement in decision-making also leads to more water-conserving decisions: women who report deciding alone indicate that their households grow significantly less water-consumptive crops and cultivate less area in the Rabi season, when groundwater is scarce. Even if women who played the game decide jointly with their husbands, their households grow less water-consumptive crops (though the effect is weaker). By contrast, when men and women decide jointly with other family members, households cultivate more area in the Rabi season, perhaps suggesting that the learning effects from the game are diluted when more people are involved in the decisions. As one woman participant in Karnataka noted, to have a stronger impact "the water information should be communicated to all the people of the village."

Conclusions

The findings of this experimental study suggest that experiential learning games can be an effective—and scalable—entry point for strengthening women's participation in agricultural decision-making. Results of this relatively "light touch" intervention were seen in cropping decisions several months later. More research is needed on the mechanisms involved, especially whether women's participation in the intervention built their confidence or recognition of their knowledge by others in their families and community. Further work is also needed to identify long-term impacts and broader household and community participation in the games, debriefing, and whether other interventions may be needed for structural and normative changes. Although the effect is weaker, the fact that men's participation in the game also increased the likelihood that they make decisions alone suggests that the relative ease of engaging men and frequent assumptions that they are the main decision-makers to influence should not lead to a focus on men and exclusion of women from the games. Adapting the game to involve both spouses, or to explicitly address different intra-household decision-making arrangements, could further advance this field.

Involving women is not only good for women's empowerment, but also for sustainable groundwater resource management. Women who made decisions alone cultivate less area, with lower water requirements, and overall, men reported cultivating crops with higher water requirements and larger cultivated areas than women. Further attention to gender in decision-making can help achieve resource management goals.

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Appendices

Appendix Table 1: Sample of communities (habitations) by treatment and strata

Water infrastructure used for irrigation	Treatment or Control	Andhra Pradesh	Karnataka	Rajasthan
No	Treatment	52	50	53
	Control	26	26	27
Yes	Treatment	57	51	51
	Control	29	25	25
Total		164	152	156

Appendix Table 2: Descriptive statistics on “Who decides which crop to grow in your household?”

	Women		Men	
	Control	**Treatment**	**Control**	**Treatment**
I alone (%)	10.94	14.91	3.34	7.91
Spouse alone (%)	21.14	17.24	26.29	21.27
Jointly with spouse (%)	41.22	44.19	42.03	42.65
Jointly with other family members (%)	22.50	20.64	21.12	22.39
Jointly with other community members (%)	0.63	0.27	0.75	0.79
I do not know (%)	2.10	1.75	4.74	2.81
Refused to answer (%)	1.47	1.01	1.72	2.19
Total N	951	1885	928	1782

Appendix Table 3: Multinomial logit results for decision-making

	(1) Women's model	(2) Men's model
I decide alone	Reference	
Spouse decides alone – I do not participate		
Treatment assignation (1=treated)	-1.125***	-0.555*
	(0.337)	(0.282)
Age category of respondent	-0.140	0.058
	(0.136)	(0.094)
Education level category of respondent	0.014	0.051
	(0.088)	(0.068)
Ln of number of adults in household	1.379***	1.263***
	(0.305)	(0.202)
The community has ponds, tanks or weirs (according to key informants)	1.151*	-0.008
	(0.551)	(0.456)
Groundwater tables fell over past 5 years (according to focus group)	-0.511	-0.477
	(0.595)	(0.444)
Share of households in community with access to groundwater for irrigation in Rabi season	0.021*	0.010
	(0.008)	(0.006)
No. of months when water is insufficient for the whole village (according to key informants)	0.101	-0.109
	(0.073)	(0.068)
Any water related rules mentioned by key informants during baseline survey	0.365	0.006
	(0.224)	(0.227)
District: Anantapur	-3.760***	-2.917***
	(0.926)	(0.826)
District: Chikballapur	-1.706*	-3.863***
	(0.861)	(0.788)
District: Chittoor	-2.941*	9.604***
	(1.498)	(1.282)
Constant	0.761	3.137**
	(1.138)	(1.123)
I decide jointly with spouse		
Treatment assignation (1=treated)	-0.986**	-0.302
	(0.370)	(0.306)
Age category of respondent	-0.125	0.029
	(0.146)	(0.100)
Education level category of respondent	0.006	0.188**
	(0.089)	(0.073)
Ln of number of adults in household	1.298***	1.058***
	(0.309)	(0.189)
The community has ponds, tanks or weirs (according to key informants)	0.969+	-0.146
	(0.575)	(0.436)
Groundwater tables fell over past 5 years (according to focus group)	-0.765	-0.688
	(0.602)	(0.487)
Share of households in community with access to groundwater for irrigation in Rabi season	0.014	0.004
	(0.009)	(0.006)
No. of months when water is insufficient for the whole village (according to key informants)	-0.000	-0.166**
	(0.076)	(0.060)
Any water related rules mentioned by key informants during baseline survey	0.452+	0.280
	(0.266)	(0.235)
District: Anantapur	-6.217***	-5.623***

	(1) Women's model	(2) Men's model
	(0.906)	(0.814)
District: Chikballapur	-3.746***	-5.798***
	(0.846)	(0.783)
District: Chittoor	1.241	14.388***
	(1.304)	(0.796)
Constant	3.731**	5.503***
	(1.166)	(1.051)
I decide jointly with other family members		
Treatment assignation (1=treated)	-0.929*	-0.489
	(0.391)	(0.331)
Age category of respondent	-0.061	0.165
	(0.154)	(0.105)
Education level category of respondent	-0.002	0.013
	(0.101)	(0.081)
Ln of number of adults in household	1.238***	0.875***
	(0.320)	(0.201)
The community has ponds, tanks or weirs (according to key informants)	0.746	-0.210
	(0.579)	(0.486)
Groundwater tables fell over past 5 years (according to focus group)	-0.878	-0.910^{+}
	(0.637)	(0.484)
Share of households in community with access to groundwater for irrigation in Rabi season	0.029***	0.021**
	(0.009)	(0.006)
No. of months when water is insufficient for the whole village (according to key informants)	-0.016	-0.226***
	(0.079)	(0.064)
Any water related rules mentioned by key informants during baseline survey	-0.036	-0.599*
	(0.299)	(0.288)
District: Anantapur	-7.180***	-6.906***
	(0.967)	(0.905)
District: Chikballapur	-3.990***	-5.772***
	(0.861)	(0.782)
District: Chittoor	-4.690**	8.459***
	(1.497)	(1.071)
Constant	3.451**	5.992***
	(1.219)	(1.107)
I decide jointly with other community members		
Treatment assignation (1=treated)	-0.821	-1.249
	(0.604)	(0.895)
Age category of respondent	0.321	0.361
	(0.301)	(0.311)
Education level category of respondent	0.478**	0.438^{+}
	(0.153)	(0.225)
Ln of number of adults in household	1.131*	2.335***
	(0.576)	(0.502)
The community has ponds, tanks or weirs (according to key informants)	1.418^{+}	-0.230
	(0.807)	(0.967)
Groundwater tables fell over past 5 years (according to focus group)	-1.096	-1.535
	(0.754)	(0.990)
Share of households in community with access to groundwater for irrigation in Rabi season	0.018	0.004
	(0.012)	(0.014)
No. of months when water is insufficient for the whole	-0.072	-0.410***

	(1) Women's model	(2) Men's model
village (according to key informants)	(0.097)	(0.123)
Any water related rules mentioned by key informants during	-0.101	-0.829
baseline survey	(0.657)	(1.243)
District: Anantapur	-5.639***	-4.818**
	(1.136)	(1.565)
District: Chikballapur	-4.757***	-7.210***
	(1.016)	(1.603)
District: Chittoor	-1.764	-3.118**
	(1.745)	(0.989)
Constant	-1.665	0.928
	(1.693)	(1.355)
I do not know		
Treatment assignation (1=treated)	-1.507***	-0.591
	(0.443)	(0.406)
Age category of respondent	-0.230	-0.252
	(0.206)	(0.200)
Education level category of respondent	-0.146	0.067
	(0.124)	(0.130)
Ln of number of adults in household	0.475	0.049
	(0.392)	(0.341)
The community has ponds, tanks or weirs (according to key	1.215+	-0.658
informants)	(0.671)	(0.622)
Groundwater tables fell over past 5 years (according to	-0.566	-0.077
focus group)	(0.645)	(0.454)
Share of households in community with access to	0.011	-0.005
groundwater for irrigation in Rabi season	(0.010)	(0.010)
No. of months when water is insufficient for the whole	0.049	-0.099
village (according to key informants)	(0.083)	(0.074)
Any water related rules mentioned by key informants during	0.310	0.671
baseline survey	(0.403)	(0.492)
District: Anantapur	-5.354***	-4.885***
	(1.016)	(0.975)
District: Chikballapur	-1.791*	-3.528***
	(0.903)	(0.853)
District: Chittoor	-0.080	12.388***
	(1.442)	(1.116)
Constant	1.923	4.197**
	(1.376)	(1.489)
I refuse to answer		
Treatment assignation (1=treated)	-0.682	-0.731
	(0.487)	(0.472)
Age category of respondent	-0.297	-0.131
	(0.247)	(0.290)
Education level category of respondent	0.167	0.360**
	(0.141)	(0.129)
Ln of number of adults in household	0.628	-0.611
	(0.458)	(0.557)
The community has ponds, tanks or weirs (according to key	1.016	-0.109
informants)	(0.799)	(0.878)
Groundwater tables fell over past 5 years (according to	-0.184	0.480

	(1) Women's model	(2) Men's model
focus group)	(0.658)	(0.594)
Share of households in community with access to	0.011	0.000
groundwater for irrigation in Rabi season	(0.011)	(0.009)
No. of months when water is insufficient for the whole	-0.056	-0.287***
village (according to key informants)	(0.090)	(0.081)
Any water related rules mentioned by key informants during	0.151	-1.878+
baseline survey	(0.480)	(1.066)
District: Anantapur	-5.585***	-5.168***
	(1.101)	(1.332)
District: Chikballapur	-2.423**	-4.067***
	(0.906)	(0.865)
District: Chittoor	-14.380***	-2.717**
	(1.358)	(0.885)
Constant	1.693	4.828*
	(1.623)	(1.908)
Observations	2657	2784

Appendix Table 4: OLS results for direct treatment effect on water use

	(1) Women - ln crop water requirement per hectare in Rabi	(2) Men - ln crop water requirement per hectare in Rabi	(3) Women - ln of cultivated area in Rabi	(4) Men - ln of cultivated area in Rabi
Treatment assignation (1=treated)	-0.003	-0.237	-0.025	-0.025
	(0.243)	(0.241)	(0.018)	(0.018)
Age category of respondent	0.006	0.035	0.003	0.001
	(0.090)	(0.087)	(0.007)	(0.006)
Education level category of respondent	0.037	0.073	0.003	0.006
	(0.072)	(0.067)	(0.006)	(0.005)
Ln of number of adults in household	0.415^{+}	0.152	0.050**	0.031*
	(0.218)	(0.200)	(0.018)	(0.015)
The community has ponds, tanks or weirs (according to key informants)	0.827**	0.013	0.052*	0.009
	(0.295)	(0.308)	(0.023)	(0.022)
Groundwater tables fell over past 5 years (according to focus group)	-0.414	-0.034	-0.024	-0.025
	(0.344)	(0.315)	(0.024)	(0.024)
Share of households in community with access to groundwater for irrigation in Rabi season	0.027***	0.030***	0.002***	0.002***
	(0.004)	(0.004)	(0.000)	(0.000)
Number of months when water is insufficient for the whole village (according to key informants)	0.058	0.080^{+}	0.003	0.002
	(0.045)	(0.042)	(0.003)	(0.003)
Any water related rules mentioned by key informants during baseline survey	-0.699**	-0.675**	-0.055***	-0.033*
	(0.223)	(0.217)	(0.015)	(0.016)
Household has access to private well	1.969***	2.152***	0.087**	0.120***
	(0.404)	(0.350)	(0.028)	(0.025)
District: Anantapur	-1.725***	-1.411***	-0.054^{+}	-0.038
	(0.399)	(0.412)	(0.032)	(0.033)
District: Chikballapur	-2.523***	-2.425***	-0.167***	-0.179***
	(0.304)	(0.292)	(0.022)	(0.024)
District: Chittoor	-1.072**	-0.631^{+}	-0.045	-0.060*
	(0.364)	(0.359)	(0.028)	(0.027)
Constant	1.813*	2.540***	0.076	0.174***
	(0.726)	(0.719)	(0.048)	(0.052)
Observations	2562	2683	2581	2704

Appendix Table 5: GSEM results full model

Generalized structural equation model estimates for effects of treatment on women's and men's participation in household decision-making and on households' crop choices and cultivated area in Rabi season

	(1)	(2)	(3)
	Women only	Men only	Full sample
Reference category	I decide alone		
Spouse decides alone			
Treatment assignation (1=treated)	-1.125*** (0.337)	-0.555* (0.282)	-0.986** (0.312)
Gender of respondent (1=Male)			-1.475*** (0.371)
Interaction Treatment x Male			0.448 (0.404)
Age category of respondent	-0.140 (0.136)	0.058 (0.094)	0.030 (0.084)
Education level category of respondent	0.014 (0.088)	0.051 (0.068)	0.070 (0.057)
Ln of number of adults in household	1.379*** (0.305)	1.263*** (0.202)	1.226*** (0.181)
The community has ponds, tanks or weirs (according to key informants)	1.151* (0.551)	-0.008 (0.456)	0.401 (0.456)
Groundwater tables fell over past 5 years (according to focus group)	-0.511 (0.595)	-0.477 (0.444)	-0.418 (0.368)
Share of households in community with access to groundwater for irrigation in Rabi season	0.021* (0.008)	0.010 (0.006)	0.012* (0.006)
Number of months when water is insufficient for the whole village (according to key informants)	0.101 (0.073)	-0.109 (0.068)	-0.043 (0.055)
Any water-related rules mentioned by key informants during baseline survey	0.365 (0.224)	0.006 (0.227)	0.123 (0.183)
District: Anantapur	-3.760*** (0.926)	-2.917*** (0.826)	-3.056*** (0.654)
District: Chikballapur	-1.706* (0.861)	-3.863*** (0.788)	-2.971*** (0.604)
District: Chittoor	-2.941* (1.498)	9.604*** (1.281)	-2.447^{+} (1.307)
Constant	0.761 (1.138)	3.137** (1.123)	2.996** (0.940)
Jointly with spouse			
Treatment assignation (1=treated)	-0.986** (0.370)	-0.302 (0.306)	-0.846* (0.349)
Gender of respondent (1=Male)			-1.455*** (0.345)
Interaction Treatment x Male			0.569 (0.375)
Age category of respondent	-0.125 (0.146)	0.029 (0.100)	0.020 (0.089)

	(1)	(2)	(3)
	Women only	Men only	Full sample
Education level category of respondent	0.006 (0.089)	0.188** (0.073)	0.133* (0.060)
Ln of number of adults in household	1.298*** (0.309)	1.058*** (0.189)	1.096*** (0.171)
The community has ponds, tanks or weirs (according to key informants)	0.969+ (0.575)	-0.146 (0.436)	0.248 (0.468)
Groundwater tables fell over past 5 years (according to focus group)	-0.765 (0.602)	-0.688 (0.487)	-0.665 (0.427)
Share of households in community with access to groundwater for irrigation in Rabi season	0.014 (0.009)	0.004 (0.006)	0.006 (0.006)
Number of months when water is insufficient for the whole village (according to key informants)	-0.000 (0.076)	-0.166** (0.060)	-0.124* (0.057)
Any water-related rules mentioned by key informants during baseline survey	0.452+ (0.266)	0.280 (0.235)	0.306 (0.223)
District: Anantapur	-6.217*** (0.906)	-5.623*** (0.814)	-5.637*** (0.642)
District: Chikballapur	-3.746*** (0.846)	-5.798*** (0.783)	-4.992*** (0.597)
District: Chittoor	1.241 (1.304)	14.388*** (0.795)	1.971+ (1.157)
Constant	3.731** (1.166)	5.503*** (1.051)	5.680*** (0.964)
Jointly with family			
Treatment assignation (1=treated)	-0.929* (0.391)	-0.489 (0.331)	-0.754* (0.367)
Gender of respondent (1=Male)			-1.230*** (0.359)
Interaction Treatment x Male			0.256 (0.393)
Age category of respondent	-0.061 (0.154)	0.165 (0.105)	0.118 (0.095)
Education level category of respondent	-0.002 (0.101)	0.013 (0.081)	0.031 (0.069)
Ln of number of adults in household	1.238*** (0.320)	0.875*** (0.201)	0.974*** (0.187)
The community has ponds, tanks or weirs (according to key informants)	0.746 (0.579)	-0.210 (0.486)	0.095 (0.489)
Groundwater tables fell over past 5 years (according to focus group)	-0.878 (0.637)	-0.910+ (0.484)	-0.839+ (0.434)
Share of households in community with access to groundwater for irrigation in Rabi season	0.029*** (0.009)	0.021** (0.006)	0.022*** (0.006)
Number of months when water is insufficient for the whole village (according to key informants)	-0.016 (0.079)	-0.226*** (0.064)	-0.161** (0.059)
Any water-related rules mentioned by key informants during baseline survey	-0.036 (0.299)	-0.599* (0.288)	-0.379 (0.263)

	(1)	(2)	(3)
	Women only	Men only	Full sample
District: Anantapur	-7.180*** (0.967)	-6.906*** (0.905)	-6.755*** (0.717)
District: Chikballapur	-3.990*** (0.861)	-5.772*** (0.782)	-5.083*** (0.598)
District: Chittoor	-4.690** (1.497)	8.459*** (1.069)	-3.955** (1.274)
Constant	3.451** (1.219)	5.992*** (1.107)	5.687*** (1.012)
Joint with community			
Treatment assignation (1=treated)	-0.821 (0.604)	-1.249 (0.895)	-0.682 (0.618)
Gender of respondent (1=Male)			-1.779* (0.781)
Interaction Treatment x Male			-0.599 (0.958)
Age category of respondent	0.321 (0.301)	0.361 (0.311)	0.416^{+} (0.231)
Education level category of respondent	0.478** (0.153)	0.438^{+} (0.225)	0.522*** (0.118)
Ln of number of adults in household	1.131* (0.576)	2.335*** (0.502)	1.531*** (0.383)
The community has ponds, tanks or weirs (according to key informants)	1.418^{+} (0.807)	-0.230 (0.967)	0.479 (0.633)
Groundwater tables fell over past 5 years (according to focus group)	-1.096 (0.754)	-1.535 (0.990)	-1.182^{+} (0.607)
Share of households in community with access to groundwater for irrigation in Rabi season	0.018 (0.012)	0.004 (0.014)	0.009 (0.009)
Number of months when water is insufficient for the whole village (according to key informants)	-0.072 (0.097)	-0.410*** (0.123)	-0.268** (0.082)
Any water-related rules mentioned by key informants during baseline survey	-0.101 (0.657)	-0.829 (1.243)	-0.423 (0.601)
District: Anantapur	-5.639*** (1.136)	-4.818** (1.565)	-5.021*** (0.947)
District: Chikballapur	-4.757*** (1.016)	-7.210*** (1.603)	-5.994*** (0.770)
District: Chittoor	-1.764 (1.745)	-3.118** (0.987)	-1.323 (1.576)
Constant	-1.665 (1.693)	0.928 (1.355)	0.830 (1.279)
Do not know			
Treatment assignation (1=treated)	-1.507*** (0.443)	-0.591 (0.406)	-1.357** (0.418)
Gender of respondent (1=Male)			-1.977*** (0.405)
Interaction Treatment x Male			0.801 (0.493)
Age category of respondent	-0.230	-0.252	-0.147

	(1)	(2)	(3)
	Women only	Men only	Full sample
	(0.206)	(0.200)	(0.145)
Education level category of respondent	-0.146 (0.124)	0.067 (0.130)	-0.026 (0.090)
Ln of number of adults in household	0.475 (0.392)	0.049 (0.341)	0.208 (0.255)
The community has ponds, tanks or weirs (according to key informants)	1.215+ (0.671)	-0.658 (0.622)	0.188 (0.548)
Groundwater tables fell over past 5 years (according to focus group)	-0.566 (0.645)	-0.077 (0.454)	-0.335 (0.435)
Share of households in community with access to groundwater for irrigation in Rabi season	0.011 (0.010)	-0.005 (0.010)	0.001 (0.007)
Number of months when water is insufficient for the whole village (according to key informants)	0.049 (0.083)	-0.099 (0.074)	-0.073 (0.062)
Any water-related rules mentioned by key informants during baseline survey	0.310 (0.403)	0.671 (0.492)	0.344 (0.356)
District: Anantapur	-5.354*** (1.016)	-4.885*** (0.975)	-4.873*** (0.738)
District: Chikballapur	-1.791* (0.903)	-3.528*** (0.853)	-2.917*** (0.655)
District: Chittoor	-0.080 (1.442)	12.388*** (1.115)	0.426 (1.306)
Constant	1.923 (1.376)	4.197** (1.489)	4.355*** (1.180)
Refuse to answer			
Treatment assignation (1=treated)	-0.682 (0.487)	-0.731 (0.472)	-0.518 (0.468)
Gender of respondent (1=Male)			-1.385** (0.469)
Interaction Treatment x Male			-0.217 (0.547)
Age category of respondent	-0.297 (0.247)	-0.131 (0.290)	-0.146 (0.196)
Education level category of respondent	0.167 (0.141)	0.360** (0.129)	0.278** (0.094)
Ln of number of adults in household	0.628 (0.458)	-0.611 (0.557)	0.068 (0.368)
The community has ponds, tanks or weirs (according to key informants)	1.016 (0.799)	-0.109 (0.878)	0.298 (0.758)
Groundwater tables fell over past 5 years (according to focus group)	-0.184 (0.658)	0.480 (0.594)	0.125 (0.485)
Share of households in community with access to groundwater for irrigation in Rabi season	0.011 (0.011)	0.000 (0.009)	0.003 (0.008)
Number of months when water is insufficient for the whole village (according to key informants)	-0.056 (0.090)	-0.287*** (0.081)	-0.208** (0.072)
Any water-related rules mentioned by key	0.151	-1.878+	-0.482

	(1)	(2)	(3)
	Women only	Men only	Full sample
informants during baseline survey	(0.480)	(1.066)	(0.444)
District: Anantapur	-5.585*** (1.101)	-5.168*** (1.332)	-5.107*** (0.910)
District: Chikballapur	-2.423** (0.906)	-4.067*** (0.865)	-3.519*** (0.650)
District: Chittoor	-14.380*** (1.358)	-2.717** (0.883)	-14.373*** (1.202)
Constant	1.693 (1.623)	4.828* (1.908)	4.211** (1.490)
Ln Crop Water Requirement			
Treatment assignation (1=treated)	0.011 (0.233)	-0.324 (0.242)	-0.004 (0.234)
Gender of respondent (1=Male)			1.409*** (0.380)
Interaction Treatment x Male			-0.301 (0.188)
Decision-making			
Spouse alone	1.627*** (0.384)	0.459 (0.370)	1.682*** (0.359)
Jointly with spouse	1.175** (0.411)	0.730+ (0.402)	1.203** (0.383)
Jointly with other family members	1.785*** (0.452)	0.639 (0.457)	1.811*** (0.429)
Jointly with other community members	2.289* (0.987)	2.330+ (1.387)	2.346* (0.976)
I do not know	-1.572*** (0.381)	-2.716*** (0.392)	-1.527*** (0.354)
Refused to answer	-1.374** (0.450)	-3.109*** (0.403)	-1.335** (0.438)
Age category of respondent	0.020 (0.090)	0.045 (0.087)	0.033 (0.071)
Education level category of respondent	0.069 (0.073)	0.121+ (0.068)	0.097+ (0.055)
Ln of number of adults in household	0.339 (0.231)	0.062 (0.210)	0.198 (0.205)
The community has ponds, tanks or weirs (according to key informants)	0.769** (0.291)	0.011 (0.312)	0.380 (0.278)
Groundwater tables fell over past 5 years (according to focus group)	-0.417 (0.328)	-0.050 (0.315)	-0.229 (0.291)
Share of households in community with access to groundwater for irrigation in Rabi season	0.025*** (0.004)	0.029*** (0.004)	0.027*** (0.004)
Number of months when water is insufficient for the whole village (according to key informants)	0.064 (0.045)	0.097* (0.043)	0.081* (0.041)
Any water-related rules mentioned by key informants during baseline survey	-0.737*** (0.217)	-0.706** (0.217)	-0.724*** (0.187)
District: Anantapur	-1.643*** (0.398)	-1.641*** (0.441)	-1.631*** (0.369)

	(1)	(2)	(3)
	Women only	Men only	Full sample
District: Chikballapur	-2.392*** (0.317)	-2.214*** (0.337)	-2.304*** (0.285)
District: Chittoor	-1.177** (0.374)	-1.242** (0.386)	-1.208*** (0.341)
Interactions of decision-making and gender			
Spouse alone x Men			-1.269** (0.436)
Jointly with spouse x Men			-0.468 (0.368)
Jointly with other family members x Men			-1.187** (0.392)
Jointly with other community members x Men			-0.116 (1.583)
I do not know x Men			-1.173** (0.391)
Refused to answer x Men			-1.775*** (0.462)
Constant	0.832 (0.802)	2.302** (0.821)	0.849 (0.721)
Ln Cultivated Area			
Treatment assignation (1=treated)	-0.025 (0.018)	-0.029 (0.018)	-0.027 (0.018)
Gender of respondent (1=Male)			0.059* (0.026)
Interaction Treatment x Male			-0.000 (0.015)
Decision-making			
Spouse alone	0.065* (0.032)	0.026 (0.023)	0.075* (0.030)
Jointly with spouse	0.062* (0.031)	0.078** (0.025)	0.081** (0.030)
Jointly with other family members	0.133*** (0.034)	0.108*** (0.029)	0.145*** (0.033)
Jointly with other community members	0.113 (0.071)	0.155* (0.079)	0.124^{+} (0.071)
I do not know	-0.084** (0.030)	-0.127*** (0.023)	-0.072** (0.028)
Refused to answer	-0.065^{+} (0.034)	-0.147*** (0.024)	-0.057^{+} (0.032)
Age category of respondent	0.003 (0.007)	0.001 (0.006)	0.002 (0.005)
Education level category of respondent	0.004 (0.006)	0.009^{+} (0.005)	0.006 (0.004)
Ln of number of adults in household	0.046** (0.017)	0.026^{+} (0.015)	0.036* (0.015)
The community has ponds, tanks or weirs	0.051*	0.009	0.029

	(1)	(2)	(3)
	Women only	Men only	Full sample
(according to key informants)	(0.022)	(0.022)	(0.020)
Groundwater tables fell over past 5 years (according to focus group)	-0.021 (0.022)	-0.020 (0.024)	-0.021 (0.021)
Share of households in community with access to groundwater for irrigation in Rabi season	0.002*** (0.000)	0.001*** (0.000)	0.002*** (0.000)
Number of months when water is insufficient for the whole village (according to key informants)	0.004 (0.003)	0.004 (0.003)	0.004 (0.003)
Any water-related rules mentioned by key informants during baseline survey	-0.054*** (0.015)	-0.033* (0.016)	-0.043** (0.013)
District: Anantapur	-0.026 (0.031)	-0.013 (0.035)	-0.018 (0.029)
District: Chikballapur	-0.143*** (0.022)	-0.142*** (0.025)	-0.143*** (0.021)
District: Chittoor	-0.032 (0.027)	-0.082** (0.030)	-0.058* (0.026)
Interactions decision and gender			
Spouse alone x Men			-0.051+ (0.028)
Jointly with spouse x Men			-0.014 (0.025)
Jointly with other family members x Men			-0.043 (0.027)
Jointly with other community members x Men			0.025 (0.100)
I do not know x Men			-0.054* (0.026)
Refused to answer x Men			-0.091** (0.029)
Constant	0.007 (0.055)	0.106+ (0.057)	0.024 (0.051)
Unexplained variation in Ln of water requirement of main Rabi crop	14.605*** (0.352)	15.216*** (0.334)	14.950*** (0.306)
Unexplained variation in Ln of cultivated area in Rabi season if household cultivates at all	0.078*** (0.008)	0.083*** (0.004)	0.080*** (0.005)
Observations	2657	2784	5541

Standard errors in parentheses. $^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendix Table 6: Indirect and total treatment effects on households' crop choices and cultivated area in Rabi season in GSEM models estimating effects of treatment on women's and men's participation in household decision-making and water management decisions

(standard errors in parentheses, $^{+}$ p < 0.1, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$)

Mediator	Effect Type	Women only	Men only
	Direct effect on ln crop water requirement of main crop	0.011 (0.233)	-0.324 (0.242)
	Total indirect effect across all mediators on ln crop water requirement of main crop	-3.218 (3.115)	0.177 (3.368)
	Total effect across all mediators on ln crop water requirement of main crop	-3.207 (3.118)	-0.147 (3.391)
	Direct effect on ln cultivated area	-0.025 (0.018)	-0.029 (0.018)
	Total indirect effect across all mediators on ln cultivated area	-0.180 (0.222)	-0.102 (0.213)
	Total effect across all mediators on ln cultivated area	-0.205 (0.223)	-0.131 (0.214)
Spouse of respondent decides alone	Indirect effect on ln crop choice	-1.830* (0.776)	-0.255 (0.253)
	Total effect on ln crop choice	-1.819* (0.809)	-0.579 (0.353)
	Indirect effect on ln cultivated area	-0.073+ (0.044)	-0.014 (0.016)
	Total effect on ln cultivated area	-0.099* (0.047)	-0.043+ (0.024)
Respondent decides with spouse	Indirect effect on ln crop water requirement of main crop	-1.158+ (0.640)	-0.221 (0.256)
	Total effect on ln crop water requirement of main crop	-1.147+ (0.673)	-0.545 (0.350)
	Indirect effect on ln cultivated area	-0.061 (0.040)	-0.024 (0.025)
	Total effect on ln cultivated area	-0.086+ (0.044)	-0.052+ (0.031)
Respondent decides with family	Indirect effect on ln crop water requirement of main crop	-1.659+ (0.874)	-0.313 (0.321)
	Total effect on ln crop water requirement of main crop	-1.648+ (0.904)	-0.637 (0.403)
	Indirect effect on ln cultivated area	-0.123+ (0.064)	-0.053 (0.039)
	Total effect on ln cultivated area	-0.148* (0.066)	-0.081+ (0.043)
Respondent decides with other	Indirect effect on ln crop water requirement of main crop	-1.879 (1.372)	-2.912 (2.682)
	Total effect on ln crop water requirement of main crop	-1.868 (1.383)	-3.236 (2.705)

Mediator	Effect Type	Women only	Men only
community members	Indirect effect on ln cultivated area	-0.093	-0.194
		(0.088)	(0.178)
	Total effect on ln cultivated area	-0.118	-0.223
		(0.090)	(0.178)

Endnotes

[i] The complete protocol of the game is available at:

https://gamesforsustainability.org/practitioners/#groundwater-game

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