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GENDER CONTRIBUTION IN PRODUCTION OF HIGH VALUE CROPS: EMPIRICAL EVIDENCE FROM PAKISTAN

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ABSTRACT

The present study estimated the impact of women's participation in farming activities on labour demand, production of high value crops, household income and the number of cattle kept per household in Pakistan. The study was carried out in the rice wheat area of the Pakistani Punjab. The cross-sectional data set was collected from 106 female respondents both participating and not participating in farming activities. The data was analysed by employing the propensity score matching approach to account for potential bias which may arise due to systematic dissimilarities among participants and non-participants. The empirical results indicate that households having women's participation were able to grow high value crops and have less demand for labour as compared to households having no women's participation. The results indicate that participating households have a higher income and were able to keep more cattle. The women's participation in farming activities in Pakistan needs to be encouraged to increase household income and reduce the poverty in rural areas.

Key words: Women's Participation; Labour Demand; Household Income; Propensity Score Matching; Punjab; Pakistan.

INTRODUCTION

Globally, rural females are actively involved in farming activities i.e. crop and livestock production and management, fish farming and forest management. They are equally involved in pre-harvest agricultural activities such as soil preparation, planting, weeding, and harvesting, and post-harvest activities such as the storage of food grains. In some parts of the world female participation in agricultural activities is higher than male participation. Literature proved that their involvement in agricultural operations varies from country to country and region to region due to the difference in social and cultural norms (FAO, 1999; FAO, 2002).

Agriculture is the backbone of Pakistan's economy and contributes about 22% to the Gross Domestic Product (GDP). The total cultivated area of Pakistan is 22.2 million hectares, of which 2.7 million hectares is comprised of horticultural crops. Agriculture is the main sector of employment where total labour force is 44.8%. The male labour force in this sector is 38.4% and the female labour force is 69.9% which is the highest compared to all other sectors and industries in Pakistan. Nearly 65.9% of Pakistan's population is living in rural areas that are directly and indirectly linked to agriculture for its livelihood (Government of Pakistan, 2013). In rural areas of Pakistan, women are actively involved in farming activities (Farhana *et al*., 2008).

In Pakistan rural women have a hectic life. Their work starts at dawn and ends at dusk. The daily routine begins with house cleaning, fetching drinking water, dish washing, laundry, care of children, tailoring and sewing clothes. She manages these activities very smartly. Even though rural women supply half of Pakistan's food production, her food security is always at risk. Women farmers are frequently ignored in development strategies and policies. In Pakistan, female farmers do not have access to adequate resources and they face constraints due to cultural, traditional and sociological factors (Jamali, 2009).

In Pakistan, the social and economic development of women is not only an issue about equalizing women and men, but it is also an issue of Pakistan's socioeconomic development. Equality and equity between men and women is an academic issue, but more important is the ground reality which indicates that nearly half of the population is lagging behind in all walks of life, because opportunities of access to education, choice of profession, health-care and decision making in farming activities are almost negligible for women. The discrimination on the basis of sex has proved counterproductive (Jamali, 2009). According to the International Center for Research on Women (2005), women in Pakistan own less than 3% of the land, which is low, considering the female participation in farming activities in rural areas.

Agricultural activities are the most important source of income for rural households in Pakistan and make up 70% of the total household income. The remaining 30% of the total household income originates from non-agricultural activities (Siddique *et al.*, 2009).

Rural women actively participate in activities related to livestock caring and management. Women in most parts of the world work better in livestock management compared to men. In small land holder

households, women earn income by raising livestock and they are more likely to spend it on food for the household. It is widely acknowledged that women perform most of the activities involved in livestock production and management. Women are responsible for milking animals and caring for the young stock and any sick animals (Agarwal *et al*., 1999). However, overall, research on gender responsibility in livestock is limited (Kechero, 2008). Hence in the current study, the focus is on the impact of female participation on labour demand, production of horticultural crops, household income and most importantly, the number of cattle kept by the household in Pakistan.

Without women's contribution, the production of high value crops is difficult in Pakistan. High value crops (HCV) are defined as crops that are typically perishable, that are of specific high-value, and that are sold through specialized markets (CGIAR, 2004). They can include livestock, dairy products, fish, fruit and vegetables. Diversification into high value crops could benefit poor farmers and landless labourers by increasing both production and employment. It could benefit the rural and urban poor through growth in the rural and urban non-farm economy and by making food available that is high in nutrients. Such diversification could empower the poor by increasing their access to decision-making processes, by increasing their capacity for collective action, and reducing their vulnerability to shocks through asset accumulation. The production of HVC can play a significant role in increasing household income and poverty reduction in Asian developing countries (Katinka and Lumpkin, 2006)

Pakistan is blessed with a diverse environment conducive to the production of all types of fruits and vegetables. The major horticultural produce of Pakistan encompasses only 1.081 million hectares, which is less than 7% of the net agricultural area of the country (Government of Pakistan, 2006). Pakistan sells a small proportion of its total harvest abroad. The share of horticultural produce in the total exports from Pakistan is hardly 1.5% (Aujla, *et al*, 2007). High-value fruit and vegetables provide many opportunities for both male and female farmers (AVRDC, 2007).

The production of high value crops increases the returns on land about tenfold compared to the return for cereal crops (World Bank, 2007). In developing countries the women normally lack the institutional support like agricultural extension services have been traditional male focused and male oriented and hence the women still largely depend on their husbands for information on farm inputs and other resources necessary for farm decision making (Rafferty, 1988). In Pakistan, women are deprived overall in socioeconomic situations as they have less opportunity for education, training, extension services and technology as compared to men (Hassan, 2008). Without females' active participation, the production of high value crops is difficult because of the intensive labour requirements.

The objective of the current study is to analyse the impact of female participation in farming activities on the production of high value crops, labour demand, household income and the ownership of cattle. The rest of the article is organized as follows: in section two, the conceptual framework and empirical model is presented; section three presents the data collection methodology; the empirical results are presented in section four; and in section five, the paper's conclusions are presented.

Conceptual Framework

Impact of women's participation in farming activities: The relationship for examining the impact of gender participation in farming activities on the production of high value crops, household incomes, labour demand and livestock keeping can be presented in the following reduced-form equation:

$$\cdot_i = \sim_1 \ddot{}_i + \sim_2 \text{¦}_i + \sim_3 g_i + \sim_4 \P_i + £_i \qquad (1)$$

Where $\cdot_i$ represents the women's participation in farming activities for the *i*th household and where $\cdot_i > 1$ if the females participate in farming activities and $\cdot_i = 0$ if females do not participate in farming activities. In the above equation, $\ddot{}_i$ represent the production of high value crops by the *i*th household and the probability of production of HVC i.e. $\ddot{}_i > 1$ if the household produces high value crops and 0 if otherwise. ¦_i represents the household income and the value $\text{¦}_i > 1$ if the household has higher income levels due to participation and 0 if otherwise. Similarly, g_i represents the demand for labour and the demand for labour i.e. $g_i < 1$ due to female participation in farming activities and $g_i > 1$ if it is otherwise. Finally, in the equation, the number of livestock kept by the household is represented as $\P_i$ and the value of $\P_i$ is supposed to be greater than 1 if households are able to keep more cattle and 0 if otherwise.

The ordinary least squares (OLS) estimates leads to biased estimates if the participants and non-participants are different from each other; hence, in the current study, to account for potential sample selection bias propensity score matching approach is employed.

Propensity score matching: Propensity score matching main advantage over random assignment is that it avoids the ethical considerations which arise when a potentially

beneficial treatment is denied to those randomly assigned out. Cost is also an important practical consideration when conducting evaluations.

Sometimes the advantages that random assignment offers in principle can diminish in practice due to data collection problems.

The propensity score matching follows that the expected treatment effect for the treated population is of primary significance. This effect may be given as:

$$\text{²}|_{I=1} = E(\text{²} \mid I=1) = E(R_1 \mid I=1) - E(R_0 \mid I=1) \quad (2)$$

where ² is the average treatment effect for the treated (ATT), R_1 denotes the value of the outcome for adopters of the new technology and R_0 is the value of same variable for non-adopters. As noted above, a major problem is that we do not observe $E(R_0 \mid I=1)$. Although the difference $[\text{²}^{e} = E(R_1 \mid I=1) - E(R_0 \mid I=0]$ can be estimated, it is potentially a biased estimator.

In the absence of experimental data, the propensity score-matching model (PSM) can be employed to account for this sample selection bias (Dehejia and Wahba, 2002). The PSM is defined as the conditional probability that a farmer adopts the new technology, given pre-adoption characteristics (Rosenbaum and Rubin, 1983). To create the condition of a randomized experiment, the PSM employs the unconfoundedness assumption, also known as conditional independence assumption (CIA), which implies that once Z is controlled for, technology adoption is random and uncorrelated with the outcome variables[i]. The PSM can be expressed as:

$$p(Z) = \Pr\{I=1 \mid Z\} = E\{I \mid Z\} \quad (3)$$

where I = {0,1} is the indicator for adoption and Z is the vector of pre-adoption characteristics. The conditional distribution of Z, given p(Z) is similar in both groups of adopters and non-adopters.

After estimating the propensity scores, the average treatment effect for the treated (ATT) can then be estimated as:

$$\text{²} = E\{R_1 - R_0 \mid I=1\} = E\{E\{R_1 - R_0 \mid I=1, p(Z)\}\} = E\{E\{R_1 \mid I=1, p(Z)\} - E\{R_0 \mid I=0, p(Z)\} \mid I=0\} \quad (4)$$

Several techniques have been developed to match adopters with non-adopters of similar propensity scores. Propensity score matching rests on two strong assumptions, i.e. the conditional independence assumption and the common support condition. There are a number of matching algorithms which can be employed to estimate the propensity score matching and the most common method employed is the nearest neighbour matching approach which is employed in the current analysis. As the main purpose of the propensity score matching is to balance the covariates before and after matching, hence a number of balancing tests have been employed in the current analysis such as a reduction in the median absolute bias before and after matching, the value of R^2 before and after matching and the p-value of joint significance of covariates before and after matching.

Data Collection Methodology: For the current study, a cross-sectional data set was collected through a field survey from the Punjab province of Pakistan. Three main districts from the rice-wheat cropping system (Sialkot, Gujranwala and Sheikhupura) were selected for the current survey. The rice-wheat is one of the major cropping systems covering an area of 1.8 million hectares. A detailed comprehensive questionnaire was prepared. Information on a number of issues was collected regarding village infrastructure, the socioeconomic characteristics of the household and, specifically, the gender participation in farming activities and its impact on crop productivity and household income. The data was collected through a field survey in December 2004. The data was collected from females both participating and not participating in farming activities. A stratified random sampling technique was used for the selection of farmers and, within the district, the selection of farmers was made at random. According to the survey, the majority of respondents were interviewed from Gujranwala district (44%), followed by Sialkot (23%) and Sheikhupura (33%) districts. In total, the information was collected from 106 female respondents. The data were collected from female respondents and due to social and cultural customs; it was not possible for male enumerators to interview female respondents. For that female enumerators were hired and were trained prior to data collection activity.

Description of Variables: The description of variables is presented in Table 1. The mean market distance was 5 kms, while the mean commercial bank distance was 4 kms. The non-government organization distance was 3 kms. The average age of the sample respondents was 44 years, while the education level was about four years of schooling. The highest education in the family was about nine years of schooling. Nearly half of the respondents (about 47%) belonged to a scheduled caste. There were, on average six adult members in a household and four children per household. About 73% of the households' females were participating in the farming activities and, in 27% of the households females were not participating in farming activities. The majority of the females (about 66%) belonged to a migrated family. Mean land holdings per household was about 20 acres, while operational land holdings were about 16 acres. About 35% of the households have their own tractors and 57% of the households have their own refrigerator. On average, 29% of the households have a bicycle while 10% of the

households have their own rotavator. Approximately 19% of the households have their own motorcycle; however, only 6% of the households have their own truck or car. Approximately 33% of the households have their own tube well. About 70% of the households own a TV and 38% of the households have a telephone. About 67% of the households own a washing machine, while 93% of the households own a sewing machine. Approximately 23% of the households have access to credit facilities. About 65% of the households have produced high value crops and approximately 24 litres of milk per day was produced by a farm household.

Table. 1 Data and description of variables

Variable	Description	Mean	Std. Dev.
Market distance	Distance of market from household in kilometres	5.29	4.16
Commercial bank	Distance of commercial bank in kilometres	4.17	5.79
NGO distance	Distance of NGO in kilometres	1.23	7.80
Age	Age of the female respondent in years	43.59	13.51
Education	Number of years of education of the female respondent	4.22	4.08
Highest education	Number of years of highest education in the family	9.49	5.03
Cast	1 if farmer belongs to scheduled cast 0 otherwise	0.471	0.50
Adult	Number of adult family members	5.622	3.17
Children	Number of children in the family	4.16	3.80
Farming involvement	1 if farmer is involved full-time in farming 0 otherwise	0.73	0.42
Migrated	1 if the family is migrated family, 0 otherwise	0.66	0.48
Land holding	Land holding of household in number of acres	20.33	50.41
Operational land	Operational land holding in number of acres	16.88	43.27
Tractor	1 if household owns a tractor, 0 otherwise	0.35	0.52
Refrigerator	1 if household owns a refrigerator, 0 otherwise	0.57	0.50
Bicycle	1 if household owns a bicycle, 0 otherwise	0.29	0.57
Rotavator	1 if household owns a rotavator, 0 otherwise	0.10	0.31
Motorcycle	1 if household owns a motorcycle, 0 otherwise	0.19	0.39
Car	1 if household owns a car, 0 otherwise	0.06	0.30
Tube well	1 if household owns a tube well, 0 otherwise	0.33	0.27
TV	1 if household owns a TV, 0 otherwise	0.70	0.54
Telephone	1 if household owns a telephone, 0 otherwise	0.38	0.51
Washing machine	1 if household owns a washing machine, 0 otherwise	0.70	0.60
Sewing machine	1 if household owns a sewing machine, 0 otherwise	0.92	0.43
Credit access	1 if household has a credit access, 0 otherwise	0.23	0.56
High value crops	1 if household has planted high value crops, 0 otherwise	0.65	0.25
Milk production	Milk production in litres	23.52	174.4
District dummies			
Gujranwala	1 if farmer belongs to Gujranwala district, 0 otherwise	0.44	0.50
Sialkot	1 if farmer belongs to Sialkot district, 0 otherwise	0.23	0.42
Sheikhupura	1 if farmer belongs to Sheikhupura district, 0 otherwise	0.33	0.47

Empirical results

Determinants of women's participation in farming activities: The propensity score matching estimates regarding the determinants of women's participation in farming activities are presented in Table 2. The age coefficient is positive and significant at 10% level of significance, indicating that experienced females mostly participate in farming activities and vice versa. The education coefficient is negative and highly significant indicating that educated females participate less in farming activities, as they may participate in other non-farm activities such as teaching, sewing and knitting. The farmers belonging to a scheduled caste is positive and significant at 5% level of significance, indicating that scheduled cast females mainly participate in farming activities and vice versa. The migration coefficient is negative and non-significant, indicating that migrated females participate less in farming activities and vice versa. With respect to family size, both coefficients, i.e. the number of adult family members and the number of children) are positive and significant at 1% of significance, indicating that large family households mainly participate in farming activities, mostly due to the economic pressure faced by the family. The land holding coefficient is positive and significant at 5% level of significance, indicating that large households usually participate in the farming activities. The TV ownership is positive and significant at 10% level of significance. The

thresher ownership is positive and highly significant at 1% level of significance. The credit access is positive and non-significant. The tube well ownership is negative and non significant. The district dummies were also included in the model. The R^2 value is quite high i.e. 0.51 indicating that 51% variation in the dependent variable is explained by the independent variables. The LR i^2 value is 50.08 and is significant at 1%, indicating the robustness of the variables included in the model.

Table 2. Determinants of women's participation in farming (probit estimates).

Variable	Coefficient	t-values
Constant	-4.32**	-2.07
Gujranwala	0.31	0.92
Sialkot	1.73**	2.02
Age (years)	0.37*	1.72
Caste (dummy)	0.59**	2.14
Migrated (dummy)	-0.40	-0.46
Education (years)	-2.43***	3.19
Adult (number)	0.64***	2.40
Children (number)	0.60***	2.61
Land holding (acres)	0.34**	1.99
TV (dummy)	1.31*	1.85
Thresher (dummy)	2.32***	4.62
Credit access (dummy)	2.73	1.43
Tube well (number)	-1.33**	-2.14
Number of observation	92	
LR i^2	50.08	
Prob> i^2	0.00	
Pseudo R^2	0.51	

Note: The results are significantly different from zero at ***, **, * 1, 5 and 10 percent level respectively.

Impact of women's participation in farming activities: The propensity score matching results regarding the impact of gender participation in farming activities are presented in Table 3. Propensity score matching is an alternative method to estimate the effect of receiving treatment when random assignment of treatments to subjects is not feasible. Propensity score matching (PSM) refers to the pairing of treatment and control units with similar values on the propensity score, and possibly other covariates, and the discarding of all unmatched units (Rubin, 2001). For the balancing property to hold it is important to have large data sets. The empirical analysis is carried out by employing two different matching algorithms i.e. nearest neighbour matching (NNM) and mahalanobis metric matching (MMM). As pointed out by Heckman *et al*. (1998) that poor data can be responsible for introducing at least as much bias as can the choice of evaluation technique, hence two different matching algorithms are employed to check the robustness of the results. The impact of female participation in farming activities was estimated regarding the labour demand, the production of high value crops, household income and the number of cattle kept by the household. The high value crops (HVC) are the perishable crops having intensive labour requirements and also higher cash returns. The HVC was included as dummy outcome variable 1 if the farmer has planted one of the HVC (fruits or vegetables) and 0 otherwise. In the case of propensity score matching, the most important parameter of interest is the average treatment affect for the treated (ATT). The ATT results regarding gender participation in farming activities are negative and significant for labour demand in the case of NNM, while negative and non-significant in the case of MMM, indicating that households having female participation in farming activities have fewer labour requirements, as compared to households having no female participation in the farming activities. This negative labour demand can be regarded as the opportunity cost of female participation in farming activities. Most of the high value crops (HVC) are labour intensive crops and require a lot of labour from sowing until harvesting and households having active female participation have an advantage in the production of high value crops as compared to households having no female participation in farming activities. The results for production of high value crops are positive and significant both in the case of NNM and MMM, indicating that households having female participation in farming activities are able to produce high value crops, as compared to households having no female participation in farming activities. Households producing HVCs have a clear advantage as they are more valuable than other

agricultural products, which can increase the rural household income; therefore, the impact of female participation on household income was estimated and the results for household income are positive and significant both in the case of NNM and MMM, indicating that households having female participation in farming activities have higher incomes (in the range of 2000-2400 Pakistani rupees) compared to households having no female participation. Similarly, female participation in farming activities has a positive impact on the number of cattle kept by the households, compared to households having no female participation. The results for the number of cattle kept by households are positive and significant both in the case of NNM and MMM, indicating that participating households on average keep 1-2 more cattle, compared to non-participating households. The critical level of hidden bias Γ is also reported. The critical level of hidden bias varies in the range of 1.25 to 1.30 and to a maximum of 1.95-2.00. The critical level of hidden bias e.g. 1.25 indicates that participants and non-participants in the farming activities differ in their odds of participation up to a level of 25%. This does not mean that their remains a hidden bias in the estimates. This only indicates the level up to which the participants and non-participants will differ from each other. The number of treated and number of controls are reported in the table.

Table 3. ATT results of impact of women's participation on production of high value crops (PSM estimates)

Matching algorithm	Outcome	ATT	t-values	Critical level of hidden bias (Γ)	Number of treated	Number of control
Nearest Neighbour	Labour Demand (dummy)	-0.345*	-1.95	1.65-1.70	24	82
Matching	High value crops (dummy)	0.564**	2.35	1.75-1.80	24	82
	Household Income (Rs.)	2371.64*	1.88	1.95-2.00	24	82
	Cattle Ownership (number)	2.674**	1.98	1.75-1.80	24	82
Mahalnobis	Labour Demand (dummy)	-0.165	-1.37	-	21	75
Metric Matching	High value crops (dummy)	0.411**	2.03	1.45-1.50	21	75
	Household Income (Rs.)	1954.04*	1.68	1.65-170	21	75
	Cattle Ownership (number)	1.198**	1.72	1.25-1.30	21	75

Note: The results are significantly different from zero at ***, **, * 1, 5 and 10% level respectively. ATT stands for average treatment affect for the treated.

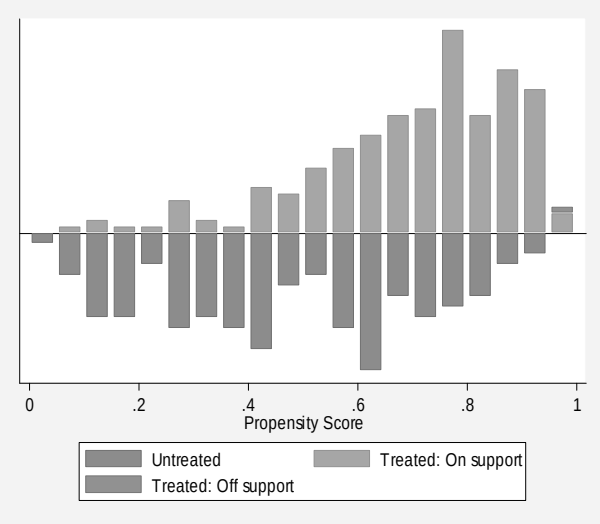
As the main purpose of the propensity score matching is to balance the covariates before and after matching, a number of balancing tests are employed and the results are presented in Table 4. Figure 1 indicates the covariate balancing by imposing the common support condition as the matching can only be performed over the common support region. The tests employed for covariate balancing are median absolute bias before and after matching. The value of R^2 before and after matching and the joint significance of covariates before and after matching. The median absolute bias before matching is quite high – up to a maximum of 23 – and is quite low after matching and is a minimum of 4. This indicates that, after matching, the covariates have been balanced and the percentage bias reduction is in the range of 59-81%, indicating that, after matching, the covariates have been balanced. According to Rosenbaum and Rubin (1983), after matching, the median absolute bias should be less than 20% and that is the case for both the matching algorithms i.e. NNM and MMM. The value of R^2 is quite high before matching and is quite low after matching, indicating that participants and non-participants are similar after matching and there are no systematic differences between them. Similarly the p-value of joint significance of covariates is low before matching and is high after matching and that after matching the participants and non-participants are quite similar. The results of the matching estimates are inline with the previous studies like Ali and Abdulai (2010); Ali and Sharif (2011); Ali and Sharif (2012); Ali and Khan (2013) and Ali and Erenstein (2013).

The covariates balancing can also be seen in Figure 1. The common support condition has been imposed as matching can only be performed in the region of common support. In the figure above the line are the participants and below the line are the non-participants.

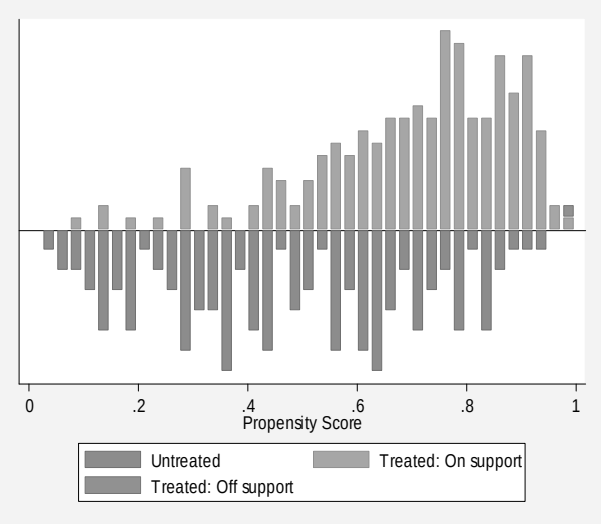
Table 4. Indicators of covariates balancing before and after matching.

Matching Algorithm	Outcome	Median absolute bias (before matching)	Median absolute bias (after matching)	(Total) % bias reduction	Pseudo R^2 (un-matched)	Pseudo R^2 (matched)	p-value of LR (un-matched)	p-value of LR (matched)
Nearest	Labour demand	22.30	4.23	81.03	0.501	0.023	0.056	0.236
Neighbour	High value crops	24.65	7.88	68.03	0.476	0.046	0.074	0.654
Matching	Household income	19.76	5.55	71.91	0.442	0.065	0.098	0.349
	Cattle ownership	22.19	6.99	68.49	0.398	0.028	0.032	0.593
Mahalnobis	Labour demand	26.44	8.94	66.10	0.392	0.064	0.005	0.949
metric	High value crops	23.68	7.94	66.63	0.732	0.071	0.083	0.522
matching	Household income	20.05	5.76	71.27	0.654	0.062	0.096	0.228
	Cattle ownership	18.47	7.45	59.64	0.682	0.057	0.063	0.472

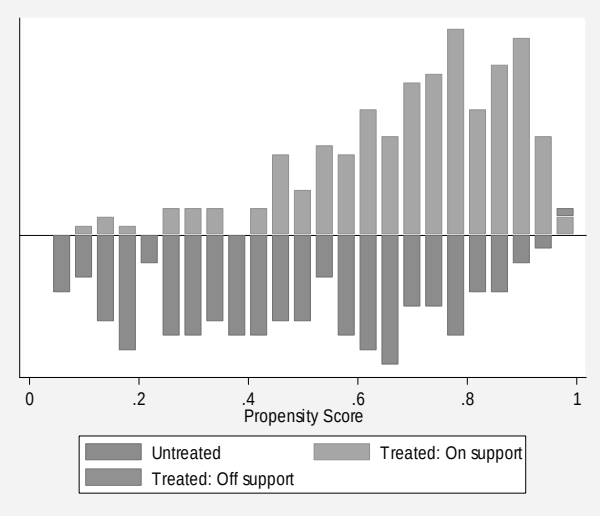
Note: Nearest neighbour matching (2) results are reported for caliper 0.05, while mahalanobis metric matching results are reported for caliper 0.6.



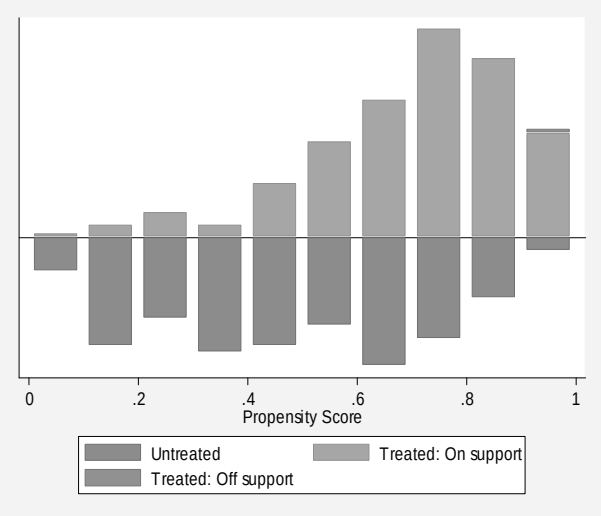
Effect on labour demand



Effect on production of high value crops



Effect on household income



Effect on the number of cattle

Figure 1. Propensity score distribution and common support for propensity score

Note: Treated on support indicates the individuals in the participation who find a suitable match in the non-participation group, while treated off support indicates the individuals in the participation group who do not find a suitable match in the non-participation group. The untreated are the individuals who do not find a suitable match in the participation group.

Conclusion: It can be concluded from the empirical results that women's participation in farming activities has a positive and significant impact on household welfare. From the empirical results, it can be concluded that, without female participation the production of high value crops is not possible in Pakistan and may result in the decrease of household incomes to a considerable extent. However, women's participation in farming activities can increase the household income as much as 2000-2400 rupees. This increase in household income due to women's participation can help to reduce poverty in rural areas. The participating households had fewer labour requirements compared to non-participating households. The participating households kept more cattle. Overall, the study results indicate the positive impact of female participation in farming activities on rural household welfare in Pakistan. The policy implication of the study is that females needs to be encouraged to participate in farming activities and, for that to happen, social and institutional support is a prerequisite. As migrant females and those belonging to non-scheduled caste face barriers regarding participation in farming activities. Their participation needs to be encouraged at village level, which can help to increase the household income and, hence, can be helpful in decreasing rural poverty.

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