Asian Journal of Agricultural Extension, Economics & Sociology

39(8): 68-79, 2021; Article no.AJAEES.70459
ISSN: 2320-7027

Gender Role in Agricultural Technology: A Case of Rural Bangladesh

Md. Shajahan Kabir[1*], Md. Monjurul Islam[2], Monzur Morshed[3] Shakawath Hussain[4] And Rahima Akther[4]

[1]Department of Rural Sociology, Bangladesh Agricultural University, Bangladesh.
[2]Department of Rural Development, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Bangladesh.
[3]BDO-WASH Professional Water and Sanitation for the Urban Poor (WSUP), Bangladesh.
[4]Faculty Member of Bangladesh Institute of Professional Management, Mymensingh, Bangladesh.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJAEES/2021/v39i830627
Editor(s):
(1) Dr. Roxana Plesa, University of Petrosani, Romania.
Reviewers:
(1) Anissa Gara, National Institute of Agronomy of Tunisia, Tunisia.
(2) Thinandavha Johannes Nesengani, University of Fort Hare, South Africa.
Complete Peer review History: https://www.sdiarticle4.com/review-history/70459

Original Research Article

Received 10 May 2021
Accepted 15 July 2021
Published 04 August 2021

ABSTRACT

This study analyzed the gender role in agricultural activities with respect to the change of technologies and determine their implications for improvement of household status in Netrokona district. The study followed the simple random sampling technique to select 300 sample respondents for household survey through the semi-structured questionnaire. Descriptive analysis such as, number and percentages, was used. Multiple regressions used in order to explore the relationship between the income and other factors. Both qualitative and quantitative data analysis techniques were utilized. Women perception index (WPI) was measured using rank ordered approach. The findings showed that there has been significant change occurred with the livestock rearing activities which are 116.79% after adoption in new technology. According to this study, male are involved in decision making in the following activities as reported by the respondents: sale of produce (84%), purchase and repair (78%), weed control (70%), land preparation (76%), spraying

**Corresponding author: E-mail: mskabir786@gmail.com;*

(65%) and planting (51%), where women respondents reported that they are mostly involves in harvesting 89%, processing 81%, manuring 48% and weed control 59%. Our research also shows that 78% and 73% of men have owned small equipment and thresher, Ox-plough, and power tiller where women own only 21 percent, 2 percent, and 5 percent respectively. It is evident that the perception regarding farming with adoption of new technology attain highest score and 2nd highest ranked perception is technical training on technology, similarly the 3rd ranked occupied is adoption in HYV where last rank score on use of indigenous technology. It means that most of them prefer modern technology in terms of productivity. The experience on modern technology of respondents has a positive coefficient and it was 0.492. Given these facts, our research has explained what keeps women's rates of modern agricultural technology adoption low.

Keywords: Technological change; gender roles; agricultural farming.

1. INTRODUCTION

Women and men may also have different priorities for technologies based on their different tasks and responsibilities: women tend to manage household kitchen gardens and small livestock while men have responsibility for commercial crops and large livestock [1]. while women are less likely to receive information on and adopt improved agricultural technologies in comparison to man [2,3].

To improve the agricultural production, some form of appropriate technology is necessary. Appropriate technologies in this context are defined as the latest scientific and technological development that have been adjusted to suit the local conditions to the highest possible degree [4].

Agriculture is the largest employment sector for 60 percent of women in Oceania, Southern Asia, and sub-Saharan Africa, and for 80 percent of women in least developed countries (LDCs) [5]. Women's activities in agriculture are characterized by a global gender gap in vulnerabilities, access to resources, and productivity (FAO, 2011) [6,7].

Gender-related effects of technology change are often important in determining the impact of adoption on poverty. Technology generation has tended to favour crops traditionally grown by men, who frequently have greater access to labour, markets, credit and other inputs than women to a degree that may impact negatively on the intra-household distribution of income and consumption [8]. In light of evidence that women's limited access to agricultural technology is an important constraint to women's agricultural productivity [9,10,11], increasing technology adoption among women farmers has emerged as a key strategy to close the gendered productivity gap in agriculture while also promoting women's empowerment and advancing broader welfare outcomes.

A better understanding of the impact of new agricultural technology on the lives and livelihoods of the poor will help us find out at least some of the answers to these questions. The paper examines the evidence concerning the impact of technology change on agriculture improvement and highlights remaining areas of uncertainty, specifically issues related to the gender role in agricultural activities and their livelihood development. It also considers the dissemination of agricultural technology as a key aspect of an effective system.

Therefore, the present study attempts to contribute to the existing body of literature by estimating the extent of women's participation at different stages of crop production activities for major crop groups, and examining their influence in the diffusion of modern agricultural technology and participation in the hired labor market. The general objective is to find out the mechanism which influences the choice and use of agricultural technology along with gender perception and determine their implications for increased food production in the area of study.

1.1 Research Objectives

- To find out changes in income of the sample household due to adopting new technology
- To find out the gender preferences and use of agricultural technology in the area of study.
- To analyze the women perception about the technologies used in agricultural activities and derives benefits from them.

- To explore the relationship between the income and different factors of household activities
- To identify the current problems and suggested solutions in terms of gender differentiated technology.

1.1.1 Research questions were as followed

- What is the gender preferred agricultural technology?
- In which equipment is utilized and who controls their family resources and distribution equally?
- What are the implications for the increased adoption of agricultural technology?
- Who practices indigenous technology and what is the result of blending traditional and new technology?

1.1.2 Conceptual framework of the study

The ability of farmers to participate in and benefit from growth in the sector is linked to their ability to adopt new practices, solve problems and embed themselves dynamically in agricultural value chains. Male and female farmers need to be connected to the communication channels of the appropriate flow of information. Farmers currently access information through a complex web of social networks that include other farmers, family members, extension agents and input supply dealers. However, these networks lack the type of information that can help many farmers move into more productive strategies. Closing the gap in women's access to a range of technologies can allow them have more time spent on productive activities thereby improving their agricultural productivity and market returns.

The activity by which humans seek to change and or manipulate their environment. In anthropological terms, it is the total system of means by which a given group interacts with its environment. Knowing that technology include without: the use of tools, patterns of work, information or knowledge employed and organization of resources for productive activity. In this view, technology is more than just material culture. Modern agricultural technology embodied in the green revolution model, which promotes hybridization, modern farm methods and the use of farm inputs and equipment. Indigenous agricultural technology, which encompasses traditional farming techniques accumulated over generations, based on local value systems, a wide experience and knowledge of the environment, rituals and belief systems.

The knowledge is not static, but consists of dynamic insights and techniques, which are adapted to environmental and socio-economic circumstances. The variable was measured by asking the respondents about the kind of technology they use, why and who makes the decisions about the purchase and adoption of these technologies. Farming technology means the way agriculture activities is done. It includes methods by which land is cultivated and crops are harvested and also the way livestock is cared for. It includes the seeds, fertilizers, pesticides, medicines and the fodder for livestock. Tools and implements the farmers use, and their source of power are also included. Enterprise combinations, by which farmers seek to make the best use of their labor and land, should also be considered (Mosher,1966).

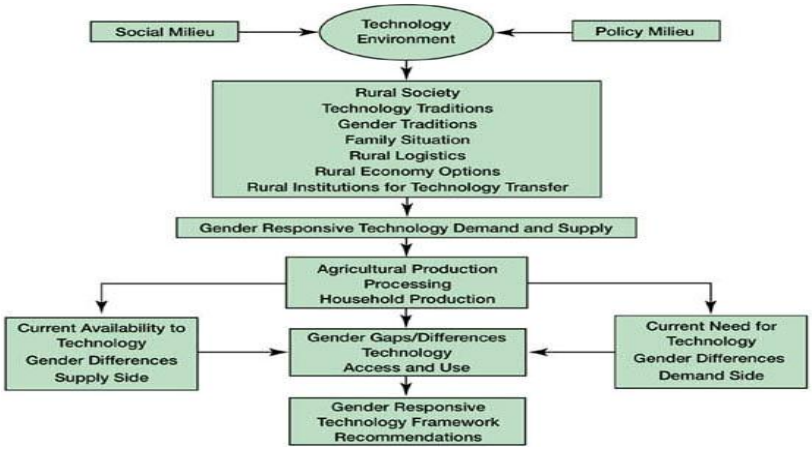

Fig. 1. Conceptual framework of gender line technology

1.2 Technological Innovations in Agriculture from a Gender and Social Perspective

Several research studies have shown that women's labour burden can increase with new agricultural technologies and innovations. This happens when women take on additional tasks, or when their current tasks become more burdensome, for instance, when fertilizer application requires more weeding, or more output to be processed – both tasks often done by women [8]. Along similar lines, it is pointed out that "an intervention that increases the amount of time women work in the field without considering childcare may improve food availability and diet, but hurt child welfare" [12]. Contrarily, in Bangladesh, the introduction of a mechanical thresher affected poor and landless women negatively, because it replaced their work as a thresher. As cultural restrictions prevented these women from leaving their homestead, they could not look for alternative employment opportunities, and thus lost an important income source [13].

1.2.1 Agricultural technology and gender alignment

Women's perception, use and adaptation of agricultural technology are shaped by their evaluation of risk. These decisions by women to reject particular technologies are often dismissed by others as proof that women are "resistant to change" or conservative, but such decisions are actually based on women's knowledge of their own environments, available resources, priorities and the risks they can afford to take. It is generally accepted that women have knowledge and skills in food production, processing and marketing and that this plays a crucial role in household livelihoods and food security. The national policy environment affects the ways in which women use, adopt and adapt to technologies. This is to say; women do not use and adopt technologies in a vacuum without influence from local and external factors.

The innovations that women make are based on their priorities in all aspects of their lives and particularly on their understanding of the risks which are improve this Woman and men from birth absorb the norms and values of the society around them. They learn the roles and responsibilities, skills, behavior and expectations which related to each sex and define for everyone and their position in society. The technology which they use, and the technical knowledge to which they have access to, are shaped through this process, and also the potential which they have, to extend their knowledge and skills in any direction. Similarly, although men and women live in the same place, each one will experience differently the economic, social, cultural, political and geographical environments around them.

2. METHODOLOGY OF THE STUDY

2.1 Study Area

Three sub-district, namely Netrokona sadar, Purbadhala and Durgapur of Netrokona district were selected as the locales of study. The areas are ideal for this kind of study, because they are characterized by diverse agro-ecological zones, which dictate the type of farming systems that prevail in the area. It is one area where allocation and utilization of resources along gender lines is determined by existing environmental factors and other external influences such as the active participation of government and donor agencies in agricultural activities in the area. Women and men involvement in agricultural production from Netrokona area has been selected consisting of user surveys and interviews, expert interviews, case studies. The interview schedule was pre-tested with 15 respondents and then final shape was given to the interview schedule with the experience of pre-test. The pre-testing facilitated the researcher to examine the suitability of different questions and status of the instrument in general. The final version of the instrument was revised on the basis of the pretest. Scientific research selection and measurement of variables constitute an important task. The hypothesis of a research constructed properly contains at least two important elements i.e. "dependent variable" and "independent variable". A dependent variable is that factor which appears, disappears the independent variables. An independent variable is that factor which is manipulated by the experimenter in his attempts to certain its relationships to an observed phenomenon. Area was selected purposively and the study was used the simple random sampling technique to select 300 (150 female and 150 male) sample respondents for household survey under this study. Primary data was collected through face-to- face in-depth interview, Focus Group Discussion (FGD) and Case study. The study intends to conduct a series of activities to collect effective and consistent data for both quantitative and qualitative analyses. The study envisions comprehending the trends of women's

participation in agricultural farming in Netrokona district which guided the researcher to adopt qualitative analysis like Focus Group Discussion (FGD), and formulation of Case Study as it required detailed exploratory information. Secondary data was collected through Journals, Reports, Books and Articles.

2.2 Period of Data Collection

The research endeavors to study the extent of participant by the rural women and men those who engaged with small agricultural farming and using agricultural technology in the study area. The data has been collected during the period of February, 2020 to April, 2020.

2.2.1 Submission of interim and final report

Final report has been submitted after completion of the project work in September 2020.

2.3 Sampling Procedure

The three upazilla namely Purbadhala, Durgapur, Netrokona Sadar were selected purposively for these studies, which allowed a focus on different technologies using agricultural activities. Furthermore, during the research activity, emphasis was placed on capturing the diversity that exists in the community, based on age, gender and status. The survey method was also used to obtain generalized data on household composition, family size, marital status, and activity profiles. The method has the major advantage of facilitating the computation of summary statistics on a more representative basis. To more effectively tap gender specific information without regressing into generalities, the questionnaire included the Gender Analysis Framework.

2.3.1 Data analysis techniques

Women perception index (WPI) was measured using closed from questions in the interview schedule. The women were asked to give their opinion on 9 selected indicators, which were identified during pretesting of the questionnaire along with their extent of confrontation using integrated homestead farming technologies. A five point scale was used for computing the women perception score. Women perception index (WPI) = SA× 4 + A × 3 + N × 2 + D ×1+SD ×0, where SA = total number of women that expressed “strongly agree; A = total number of women that expressed “Agree”; N = total number of women that expressed “Neutral”; D= total number of women that expressed Disagree and SD = total number of women that expressed “Strongly disagree” on their perception.

Fig. 2. Map of Netrokona district

The weights assigned were 0 for "strongly disagree", 1 for "disagree" 2 for "neutral", 3 for "agree" 4 for strongly agree. The weights of responses of all the indicators were added together to obtain the women perception score.

Descriptive analysis based on number percentages rank order, was used. Pearson's product moment correlation coefficient (r) was used in order to explore the relationship between the concerned variables. Both qualitative and quantitative data analysis techniques were utilized. Qualitative techniques included detailed description of people's attitudes and feelings towards resource allocation, and its use and benefits derived from it on the basis of gender context. Content analysis helped to make sense of the massive information gathered through participatory approach. Quantitative analysis was used to measure the extent to which the different sexes have adopted agricultural technology and the characteristics of the adopters. This analysis required intensive use of frequency distributions, cross tabulations, means and averages.

2.3.2 The multiple regression models were as followed:

The equation is - $Y_i = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \ldots. + \varepsilon_i$

Where, Yi = Income of household respondent

Independent variables: Level of education($X_{1)}$ (Years of schooling), Size of family ($X_{2)}$ (Number), Land holding size (acre) ($X_{3)}$ New technology using experience years ($X_{4)}$ Training attainment on new technology (Number of days ($X_{5)}$ NGO's support on modern technology yes/no ($X_{6)}$ Decision making ability yes/no ($X_{7)}$ β0 = Intercept,β1 to β8 = Regression co-efficient of the independent variables,ε = Disturbance term or error term.

3. RESULTS AND DISCUSSION

The study investigated the use of integrated homestead farming technologies for their socioeconomic development.

3.1 Education Background of Respondents

A large portion of those respondents who had some form of formal education had received primary education 52%. A good number of farmers had also received secondary education 26.67%. About 6% of the respondents had no formal education, % no education. The distribution of respondents by level of formal education is shown in Table 1.

Table 1. Education status of the Respondents

Education	Number	% Total
University	2	0.67
College	45	15.00
Secondary	80	26.67
Primary	156	52.00
None	17	5.67
Total	300	100

Source: Sample survey 2020

3.2 Economic Activity of Respondents Household

Majority of the respondents practice farming as their major economic activity. They were mainly engaged in crop and vegetables production. The distribution of the respondents by main economic activity performed is shown in Table 2.

Above Table 2 shows average yearly income was 264000 Tk, 167000tk and 189000 Tk respectively cereal crop, vegetables and poultry rearing activities. Crop producer average income was high among the the above mentioned farming, this indicates, therefore, that there is a wide disparity among farmers in the study area on the amount of money they earned per year from involvement in crop production. Annual income has changed in 56.76% of cereal crop producers' and annual income has changed in 68.66 % of vegetable production (Fig. 3). And there has been significant change in income generation occurred with the poultry rearing activities which are 116.56% after implementing new technology in their production process. The above table reveals that there is a big contribution of other sources of income which has great influence on technological adoption by purchasing new equipment's, invest more on HYV seed, fertilizer etc.

3.2.1 Trends in gender variables in agricultural technology

The above Fig 3 shows that about 53% of female headed households adopt and use more indigenous implements in land preparation compared to 28 % of male headed households. The bar diagram indicated that there is enough evidence that implement of agricultural technology between female and male headed

households is not the same. It is also revealed that male-headed households are the greater adopters and users of newly adopted equipment in land preparation 55% of male and 36% of female headed households do same.

3.2.2 Preference and use of indigenous agricultural technology

Level of access to the technology in question on among women and men, depending on costs involved. In general, farmers male and female show their preference for a wide range of indigenous methods and implements. These are digging sticks, fencing stick, strip grazing, and broadcasting. Indigenous breeds in livestock production. The main reasons being that: they are cheaper to acquire and maintain, and withstand the betterment for the environment.

The above Fig. 4. Revealed that men are regular decision makers on breaking the land, weeding, marketing, and land preparation. Conversely, women are regular decision makers in issues to do with planting, clearing, and packing. However, the women are consulted more by men regarding land preparation. The study also revealed some gender differences in the decisions about the timing of agricultural activities.

Focus group discussion shows that women have greater preference and use of indigenous agricultural technologies than men. About 64.2% respondents mentioned women as users of indigenous agricultural technologies. Only 24.8% of respondents mentioned men as having greater preference and use of these types of technologies, compared to women. Respondents (16.0%) felt that both sexes prefer and use indigenous agricultural technologies. It is therefore clear that women tend to use indigenous packages.

3.2.3 Indigenous agricultural technologies

The study revealed that there is gender differential in the knowledge of agricultural technology. Women in the study area use indigenous agricultural technologies more than men. Therefore, they can be perceived to have knowledge of various aspects of indigenous agricultural technologies. They know how to use and produce them, knowledge on the origin of the technology, and the merits and demerits of the technology. It is confirmed by 65% of respondents that they kept indigenous breeds. In the various farm operations, trends in respect to the use of indigenous agricultural technologies have been observed as follows:

Table 2. Agricultural production changes in annual income of the household due to adopting new technology

Production activities	Average Yearly Income(Tk)	Number of farmers	Change in % (between 5 years)
Cereal crop production	264000	131	56.76
Vegetables production	167000	93	68.86
Poultry rearing	189000	76	116.79

Source: Sample survey 2020

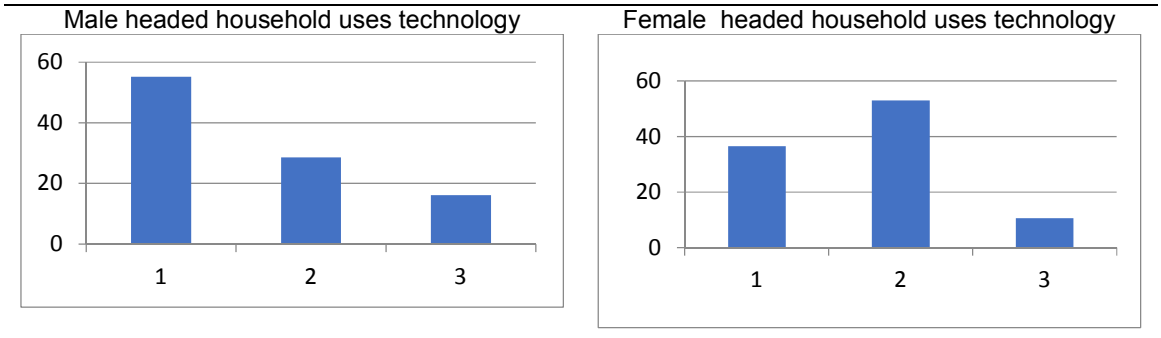

Fig. 3. Gender identified uses of technology in sample households

Source: Sample survey 2020; *Above Fig. 3. indicating the below components; 1. Newly adopted equipment in land preparation; 2. Traditional equipment for land preparation; 3.Use of newly adopting technology*

Activities	
1	Soil cultivation
2	Breaking the land
3	Weeding
4	Planting
5	Manuring
6	Harvesting
7	Packing
8	Marketing

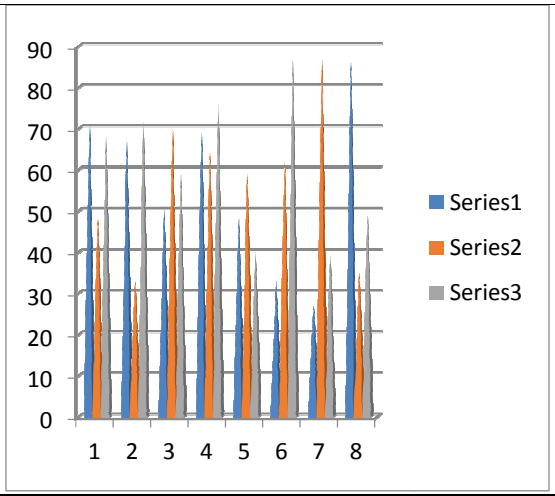

Fig. 4. Percentage of decision-making by sample households (average)
Source: Sample survey 2020; 1. Male 2.Female 3.Both

Activities	
1	Land preparation
2	Planting
3	Manuring
4	Weed control
5	Spraying
6	Harvesting
7	Processing
8	Purchase and repair
9	Sale of produce

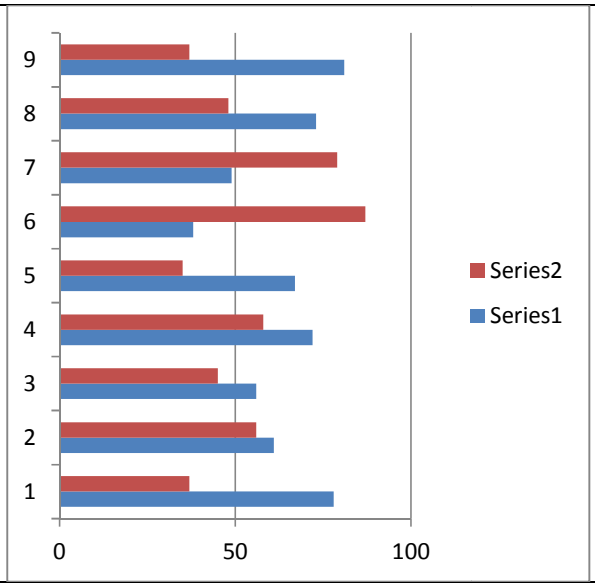

Fig. 5. Percent of labor in agricultural activities (average)
Source: Sample survey 2020; 1. Male engaged in agricultural operation; 2. Female engaged in agricultural operation

According to this study, male are involved in decision making in the following activities as reported by the respondents: sale of product (84%), purchase and repair (78%), weed control (70%), land preparation (76%), spraying (65%) and planting (51%), where women respondents reported that harvesting 89%, processing 81%, manuring 48% and weed control 59%.

3.2.4 Ownership of farm equipment

Our research also shows that 81%, 78percent, and 73 % of men have owned small equipment and thresher, Ox-plough, and power tiller where women own only 21 percent, 2 percent, and 5 percent respectively. Therefore, women argued that men have more access to advanced technology, and they derive more benefits from it than women. The sale of agricultural products is usually decided upon by men. Since they make most of the important decisions on the farms which require finances, it is more likely that they keep most of the returns from their farms. Hence, they benefit more from the farm technologies than women.

3.2.5 Women perception about agricultural technology related decision making process

In Bangladesh, women are often less concerned in the decision-making process even at the family level. In this study, an attempt was made to analyze the pattern of women's participation in decision -making process and, their perceptions regarding agricultural technology inclusion. The level of gender participation in decision making has been calculated by nine different scores given on the basis of the decision- maker

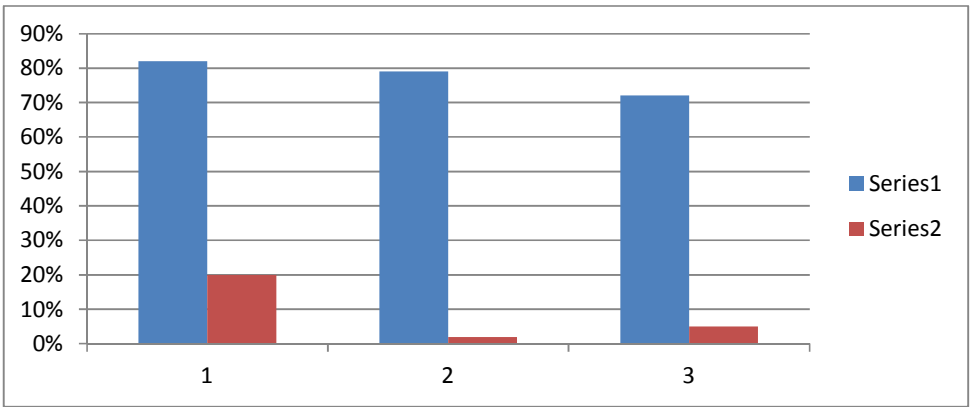

Fig. 6. Percent of own equipment in agricultural activities

Source: Sample survey 2020; 1. Male owner of machinery (Thresher, ox-plough, power tiller); 2. Female owner of agricultural machinery (Thresher, ox-plough, power tiller)

3.2.5.1 Women perception index of respondents (n=150)

Serial No	Contents of decision	Extent of perception					Perception index	Rank
		Strongly agree	Agree	Neutral	Disagree	Strongly disagree		
1	Farming with adoption new technology						823	1
2	Use of indigenous technology						554	9
3	Integrated farming						814	4
4	Using HYV Seeds						816	3
5	Technical training on technology						817	2
6	Invest on modern technology						811	5
7	Product selling by male						679	8
8	Repairing machinery						777	7
9	Hired machinery						787	6

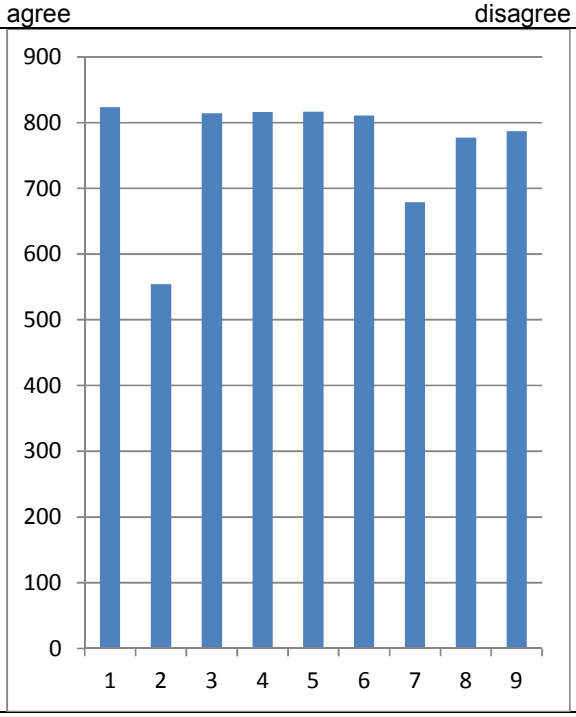

Fig. 7. Women perception index (WPI)

Source: Sample survey 2020

Table 3. Multiple regression models for factors influencing on income by using new technology

Variables	Coefficient	P value
Constant	5275.45	512
Level of education($X_{1)}$ (Years of schooling)	.300	.040**
Size of family ($X_{2)}$ (Number)	.16	.03**
Land holding size (acre) ($X_{3)}$ (acre)	.140	. 382
Technology using experience ($X_{4)}$ (Years)	.492	.000***
Training attainment on new technology (Number of days ($X_{5)}$ (Number of days)	.290	.040**
NGO's support on modern technology ($X_{6)}$ (yes/no)	.20	.34
Decision making ability ($X_{7)}$ (yes/no)	.204	.042**
Where, Y_i= Income of household	Observation =300	
β_0 = Intercept; β_1 to β_7 = Regression coefficients of the independent variables; and ε = Disturbance term or error term		

****,** and * denotes significance at 1%, 5% and 10% respectively*

The result has been presented in above Fig. 7. It is evident that the perception regarding farming with adoption new technology attain highest score 823. The 2nd highest ranked decision is technical training on technology which implies that in the case of adoption of new technology through various institutional and non-institutional supports and convinced both sexes. Similarly, the 3rd ranked decision is adoption of HYV and last rank score is use of indigenous technologies, it means most of them prefer modern technology in terms of productivity. In traditional agriculture, practically all agricultural decisions are predominantly made by male members. The only exceptions are the decisions concerning whether or not chicken and /or duck will be sold or bought and who will sell homestead produce, which are exclusively made by women.

Factors affecting on income of rural farmers
The multiple regression models
The equation is $Y_i = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \ldots + \varepsilon_i$

Several previous studies in Bangladesh regarding education and income support our findings. Family size of respondents has positive coefficient is 0.16 and highly significant.

The experience on modern technology of respondents has a positive coefficient 0.492 and highly significant at 1 percent level. So, this factor reveals that respondents who were more experienced had ample income. The training on new technology of respondents has positive coefficient is 0.290; it is significant at 5 percent level. It means that rural farmer's income is greatly influenced by their training facilities. In addition decision-making abilities to use new technology have also a significant role on rural farmer's income in the study area a coefficient is .204.

Gender-based challenges for female agricultural machinery service

- Lack of knowledge about new technology
- Lack of technical knowledge /training
- High price of the machine/equipment
- Men friendly equipment/ machinery
- Lack of cooperation family and community
- Lack of institutional credit

Suggested solutions to close the gender disparity in technology service facilities provision

- Subsidies on agricultural machinery
- Increase credit facilities
- Women's recognition by sensitizing men and society
- Enhanced joint ownership of resources
- Improve women's networks to boost up technical support
- Enhanced training facilities

4. CONCLUSIONS AND RECOM-MENDATION

The research paper, by systematically documenting gender roles in agricultural production, modern technology adoption decisions, and women role in technology adopting, shows discrimination against women for their decision making despite the significant role that they play in the agricultural sector. Technologies to support resilience and adaptation to mind settings change by male

farmers can promote women's empowerment. The transformation of gender relations in addition to increased agricultural production.

Finally, it can be concluded that Bangladesh needs agricultural technologies that are labor-intensive and provide equal opportunities for men and women. Therefore, a decentralized agricultural policy of agricultural sector which employ more women would be a first step toward the goal of achieving gender equity on one hand and economic development on the other.

4.1 Recommendations

- Allocate specific resources for gender capacity-building to their operational counterparts.
- Raise awareness among the field operating team about the importance of addressing gender issues to generate technology and promote innovation that benefits men and women.
- Build the capacity of the field operating team on tools and methods for gender mainstreaming in various activities.
- Ensure the availability of gender mainstreaming toolbox for the field operating team. It is also advisable to develop and implement guidelines for the implementation of activities with gender considerations.

CONSENT

As per international standard or university standard, Participants' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
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