GENDER AND TECHNOLOGY ADOPTION AMONG FARMERS IN BANGLASH

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Abstract

The present study provides a systematic estimate of male and female participation in agricultural production and usage of agricultural technology and examines their influence in the adoption of modern technology in three upazilas in Jamalpur district. The study was followed by the simple random sampling technique to select 190 sample of respondents for household survey through the semi-structured questionnaire. There has been a significant change with the livestock rearing activities which are 118.79% after adoption of new technology attains the highest rank. The second highest ranked decision is technical training on technology. Similarly, the third ranked decision is use of modern technology. The modern technology of respondents has a positive coefficient and it was 0.492.

However, our research showed that about 65.2% of the respondents were women as users of traditional agricultural machinery. Given these facts, our research has explained what keeps women's rates of modern agricultural technology adoption low.

Keywords: gender roles, agricultural technology, farming

JEL Classification: J11, J21, J22, J24 UDC: 005.591.6:631.153(549.3) 305-055.1/.2: 631 COBISS.SR-ID 28607497

Introduction

Technological progress is a prerequisite for the economic growth of countries, regions, and cities [1]. It allows efficient production of more and better goods and services. Adoption of agricultural machinery can significantly increase or reduce time spent in labour. Thus, through history, technology has proved to be extremely useful in the agricultural sector. One of the most important technological discoveries in agricultural history is the development high-yielding dwarf wheat and rice varieties, known as the 'Green Revolution' technology, that are coupled with adequate supplies of water, fertilizer, pesticides soil management and water control, and are adopted widely among nations. Bangladesh, being one of the most densely populated countries with highly unfavourable land-man ratio and widespread hunger, also pursued a policy of transforming agriculture through acceleration of technological development to keep up with the increasing population. In recent years, it is felt that the

productivity of this new agricultural technology is weakening and might pose a threat to the sustainability of economic development [2, 3].

Modern agricultural technology is an integral part of the green revolution model, which, among other things, promotes technological intensifications, contemporary farming and the use of new machines. On the other side, traditional agricultural technology, based on indigenous knowledge, traditional farming practices and local value systems, which has been accumulating among generations and over the years should also be considered. Technologies and techniques used by farmers, including a source of their leadership as well as methods of the most appropriate way of farming are also included [45]. Moreover, the availability of information is an important resource for women with potential for empowering them in terms of new attitudes [34-37].

Modern technologies have direct and indirect impacts on men's and women's access to income, including technologies, improving their quality of life through increase of production and productivity [4-7]. However, despite rapid technological development, there is a strong evidence that women's rates of adoption of agriculture technologies remains low in comparison to men [8-9]. Main challenges women face in access and adopting of agricultural technologies include socio-economic constraints, limited information, knowledge and skills, beliefs about gender roles, time constraints, etc. [10, 11]. Different preferences for technologies stemming from different tasks and responsibilities also greatly affect the process of the adoption of technology [12, 19].

Reducing gender gap is recognized as priority task to contribute to agricultural growth and development especially in developing countries [12-14]. Simultaneously, women's empowerment is broadly viewed as a key factor of achieving gender equality, improving productivity in agriculture, and advancing broader development outcomes [15, 16, 23].

Rural women's empowerment as well as agricultural technology adoption may have positive impact on technical efficiency, which can contribute to more efficient use of resources, better management of time and risks, increase of female farmers' productivity.

These production and quality improvements may lead to maximizing the returns to women's limited time, labor, land, and capital [15, 20]. In this regard, of great importance is recognizing the gender roles and priorities in the design of agricultural programs and initiatives, including development and introduction of improved technology [17, 10].

The conceptual framework of the study

The ways of women empowerment and reducing gender disparity regarding adoption of modern agricultural technologies has been widely investigated in the literature. There is also a growing body of research that directs special attention to a decision-making process and women's role in adopting of agricultural technology. However, the recent studies compare decision making linked to the agricultural activities by women with those by men, ignoring the majority of agricultural households in which are both involved in production [18, 19].

Unlike other studies, our analysis included this aspect in the research. Namely, women often jointly with their spouses make production decisions in male-headed households [20], and vice versa – men also make such decisions together with their wives' female-headed households' [21]. Therefore, using gender of the household head as a gender indicator is not enough to describe overall details, like, for instance, the division of labour between women and men, gender roles, as well as gender-related politics in agricultural technology adoption.

Making decisions regarding technology adoption, by men and women in the same household, has been evaluated in several studies recently [23-25]. These studies present mixed evidence on gender-related differences in the process of adoption of agricultural technology. While some research points out that joint management has a positive impact on

technology adoption [23-24], other studies suggest there is no remarkable gender difference concerning this process [25].

There is a considerable amount of research studies that have empirically investigated gender differences in the adoption of agricultural technology by using the gender of the household head as an indicator [26-28]. Besides, gender roles vary greatly depending on the country or region [29, 30]. For instance, in southern Ethiopia, plots are mainly cultivated jointly by households, but only a few of them are farmed individually by men or women with relatively modest involvement of other family members. Apart from the gender division of labour, women's decisions related to agricultural technology adoption are also influenced by other gender-specific factors, such as social ties, landholding, access to extension services etc. [31, 32].

In Bangladesh, in recent times, the participation of rural women, in general, is increasing in agricultural work due to changes in values and norms [35]. According to Labour Force Survey in Bangladesh [38] about 49% of women were engaged in the agricultural activities.

Despite their important contribution, compared to men, rural women still do not have the same access to agricultural technologies. The other critical element besides agricultural technology is access to knowledge and resources as well as participation in the household decision-making process which represents a mixture of "access, capabilities and actions that shape whether women have influence over village life or decisions about their private life" [39]. Considering that the gender disparity creates obstacles and reduce the productive potential of women farmers by restricting their access to resources and decision-making opportunities, we were highly motivated to investigate this specific research area on the case of Bangladesh. Namely, it is a challenging task to draw common conclusions related to the issues of gender inequalities in agricultural technology adoption in rural Bangladesh.

Therefore, the study will provide an ideal setting for investigating gender role in agricultural technology adoption in a production system and livelihood improvement at the household level. In line with this, research is carried out to fulfil specific goals stated as follows:

- To evaluate male and female preferences for agricultural innovation.
- To analyse the factors that influence male and female adoption of agricultural technology.
- To examine the effects of technology adoption among male and female farmers.
- To identify the major problems in a gender differentiated technology and suggest approaches to close the gender gap in agricultural equipment service provision.

The study will benefit researchers and social thinkers who work on agricultural research as well as promoting and developing agricultural technologies for communities in Bangladesh.

In addition, the Ministry of Agriculture will benefit in terms of providing an extended service system. Farmers in Bangladesh, apart from the research area, will also benefit in areas with similar problems and challenges.

The concept of the study is based on traditional social and cultural value systems should help for recognition of women participation in household decision making and the use of modern agricultural technology (Figure 1).





As can be seen from our conceptual framework, gender role in Bangladesh is rooted in its tradition and patriarchal model of life. Taking it into account, the concept of this research is tested by regression analysis method.

Hypotheses

This paper draws its findings from testing the following hypothesis:

Hypothesis (H0). Households headed by women and men in the area do not represent noticeable differences regarding adoption and use of the various agricultural machinery [40].

Hypothesis (H1). Women's involvement in rural household decision making is extremely limited [41].

Hypothesis (H2). Socio-economic characteristics such as education and household headship have a significant influence on women's decision making [33].

Hypothesis (H3). Involvement of women in household decision making was negatively associated with family size in Bangladesh [42].

Materials and Methods

Sources of data

Two upazilas, namely Sarishabari and Jamalpur sadar (Figure 2) were selected purposively as the locale of study. The area is ideal for this kind of study, because it is 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. The data has been collected during the period February 2019-April 2019.

Contemporary environment and social ties, as well as other external factors such as government and donor agencies engagement, determine resource allocation and utilization in the above-mentioned district in the context of gender lines. To measure the variable, questions about the used technology, about who and why makes the technology purchasing and adoption decisions, including the manner in which plots are farmed, and the manner livestock are cared for (the seeds, pesticides, fertilizers, animal drugs, etc.)



Fig. 2. The Jamalpur district: study location

Sampling techniques

An updated list of technology adaptors farmers of the selected area was prepared by the help of the Agricultural extension officer (AEO). In total there were 1900 farmers (head from each household) in these selected areas which were considered as population of the study. Ten percent of the population was randomly selected by using a table of random Numbers. Thus, a total of 190 agricultural technology adaptors farmers constituted the sample size for the study.

Data collection methods: Primary data were collected by face-to-face in-depth interview.

Six Focus Group Discussion (FGDs) were conducted with the help of semi-structured questionnaire and each FGDs group were composed 6-10 respondents (both male, female).

Secondary data were collected through Journals, Reports, Books and Articles. Data were collected by the researcher himself from sample the selected farmers. The interview was conducted with the respondents individually in their respective houses. The researcher took all possible care to establish rapport with the respondents so that they would not feel any hesitancy while starting the interview. If the respondents felt any difficulty in understanding any question, the researcher took utmost care to explain and clarify the same properly. No serious difficulty was faced by the researcher in collecting data.

Data analysis techniques

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 was used to analyses qualitative data, it refers to the process of categorizing verbal or behavioral data to classify, summarize and tabulate the data.

Quantitative analysis was used to measure the extent to which the different sexes have adopted agricultural technology and the characteristics of the adopters. Quantitative analysis was focused on the characteristics of the respondents and measurement of the extent to which the different genders have adopted agricultural technology. Frequency distributions, cross tabulations, and averages were intensively used. Statistical data are presented in form of pie charts and bar graphs. Gender perception index (GPI) was measured using closed from questions in the interview schedule. The respondents were asked to give their opinion on nine 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 their perception score. The weights assigned were 0 for "strongly disagree", 1 for "disagree" and 2 for "neutral" 3 for "agree" 4 for strongly agree.

The weights of responses of all the indicators were added together to obtain the Gender perception index score (GPI).

Descriptive analysis such as, number and percentages, rank order was used. Pearson's product moment correlation coefficient (r) was used in order to explore the relationship between the selected variables.

The Pearson's Product Moment Correlation Coefficient follows:

The equation is $-Yi = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + \beta 5X5 + \beta 6X6 + \beta 7X7 + \beta 8X8$...ei where,

Yi = Income of respondents:

- **a.** X_1 = Education (Years of schooling),
- **b.** $X_2 =$ Family size (Number),
- **c.** X_3 = Farm size (acre),
- **d.** $X_4 =$ Experience of modern technology (Years),
- e. X_5 = Training on new technology (Number of days),
- **f.** X_6 = Technological support from NGO (yes/no),
- **g.** X_7 = Decision making ability to use the new technology (yes/no),
- **h.** $\beta 0 =$ Intercept $\beta 1$ to $\beta 8 =$ Regression co-efficient of the independent variables $\varepsilon =$ Disturbance term or error term.

Measurement of the variable

Yi = Income of respondents, Household income was the total financial return of a household from agricultural farm. The earnings from these sources were added together for computation of annual family income score. Annual household income was expressed in '000' Taka.

X1 = Level of education, Level of Education was measured as the ability of an individual respondent to read and write or the formal education received up to a certain standard. A respondent who did not know how to read and write his or her years of schooling score was given as "0" (zero), can sign only his or her years of schooling score was given as "0.5", 1 was given who attended to school for class one. If a respondent passed class v, his education level score was 5 and so on.

X2 = Family size, Family member was measured in terms of actual number of members in the family of a respondent. The family members included the respondent himself, his wife, sons, daughters and other dependents.

X3 = Farm size (acre), farm size of a respondent was determined as the total area of his/her land on which he continued his or her cultivation of crops during the period of this study. It included as area of land owned by him/her as well as those obtained from other by rented in, lease or other means. The cultivable land size of a respondent was measured in decimal by using the following formula:

$$Fs = Fa + F2 + F3 + F4 + 1/2 (F5 + F6)$$

Where,

 $\begin{array}{l} Fs = Farm \ size \\ F_a = Homestead \ area \ for \ farming \\ F_2 = Own \ land \ under \ own \ cultivation \\ F_3 = Fallow \ land \end{array}$

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 F_4 = Giving the land to other by share cropping (borga)

 F_5 = Land taken from other under share cropping (borga)

 F_6 = Cultivable area taken as lease by a respondent from others

X4 = Experience of modern technology was determined by total number of years used on modern technology.

X5 = Training on new technology was determined by total number of days of training received by the respondents from any organization on technology related in their entire lifetime.

X6 = Technological support from NGO, if farmers take get support from NGO regarding technology adoption support = 1, if not = 0

X7 = Decision making ability to use the new technology, if women farmers take decision alone = 1 not = 0

Results and discussion

The demographic profile of respondents below shows that the total sample included 55 percent male and 45 percent female respondents (Table 1).

Tuble 1. Demographic 1 Toffie of Respondents						
Gender		Total	% Number			
1.	Male	105	55.27			
2.	Female	85	44.73			
Total		190	100			

Table 1. Demograph	hic Profile	of Respon	ndents

Involvement of the respondents in agricultural crop production is about 66.84%, where 18.94% are involved in vegetable production, and 14.21% in livestock rearing (Figure 2).

Average yearly income was 154000 tk, 138000tk and 163000 tk respectively. Livestock rearing average income was high among the three groups, however there is a wide disparity among rural women in the Jamalpur district on the amount of money they earned per year from engagement in livestock rearing.

The gender dynamics around ownership, access, control, are key issues when it comes to income and assets. Contemporary gender conditions can contribute to resolving differences in male and female relationship to income and assets, but also to technology. Furthermore, comprehending these relationships is necessary for a better understanding of which factors improve or worsen women's and men's access to agricultural technologies including the benefits stemmed from their use.

Our research findings revealed that annual income has changed for 58.76% in agriculture cereal crop production and for 65.86% in vegetable production (Figure 3). And there has been significant change that occurred with the livestock rearing activities which are 118.79% after adoption of new technology (AI and beef fattening).

The research also showed that there is enough evidence of differences in the use and adoption of agricultural technology between men- and women-headed households. Findings also indicated that men-headed households are more significant adopters and users of modern equipment for land preparation, 55% male- and 36% of female-headed households, respectively. About 53% of women-headed households adopt and use indigenous tools in land cultivation compared to 28% of men-headed households.

Source: Field survey 2019



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

Preference and use of traditional agricultural technologies: FGDs findings show that women prefer the use of traditional agricultural technologies more often compared to men – about 65.2% respondents indicated women as users of traditional agricultural technologies, while men were mentioned by only 22.8% of respondents. Respondents (12.0%) were of the opinion that both male and female prefer and use traditional agricultural technologies.

Therefore, it is obvious that women are more inclined to use indigenous knowledge.

The number of factors has been evaluated to reveal the differences in preferences and implementation of traditional agricultural technologies proposed by the following percentage of respondents:

- 1. Very few types of machinery equipment are more convenient for women, while other are suitable for men (44%).
- 2. The amount of energy to be used in a particular technology (21%).
- 3. Rural women have greater access to traditional technology than modern ones (29%).
- 4. The use is determined by the level of technological knowledge (18.0%).
- 5. The levels of gender involvement in agriculture production depending on other non-farm activities (65%)
- 6. Availability of indigenous agricultural technologies compared to modern ones is more significant (36%).

The findings of the study show that decision-making regarding agricultural production is made in cooperation between women and men (57.1%). Hence, 42.9% of the respondents mentioned that decisions on agricultural production process are made by a single individual.

Majority of the respondents (57.7%) declared that decisions regarding planting, harvesting and livestock care are taken by a single individual.

The above data revealed that men are usually regular decision-makers regarding breaking the land, weeding, marketing, and land preparation currently in Bangladesh. Reversely, women make decisions primarily in matters related to planting, clearing, and packing.

However, women are often consulted with men about land preparation. The study also explored the existence of some gender differences in the decision-making ability about the timing of management practices in farming.

As mentioned by the respondents, males are involved in decision making process in the activities as follows:

sale of produce (81%), purchase and repair (73%), weed control (72%), land preparation (78%), spraying (67%) and planting (61%) (Figure 4).



Fig. 4. Percent of Male engaged in agricultural operation Source: Field survey 2019

On the other side, women respondents reported that they mostly did harvesting (87%), processing of product (79%), manuring for own crop field (45%) and weed control (58%) (Figure 5).



Fig. 5. Percent of female engaged in agricultural operation Source: Field survey, 2019

The study also shows that 82 percent, 79 percent, and 72 percent of men have owned small equipment and thresher, Ox-plough, and power tiller while women own only 20 percent, 2 percent, and 5 percent respectively (Figure 6).



Fig. 6. Gender access to modern agricultural technology Source: Field survey, 2019

Thus, it can be concluded that men have greater access to modern agricultural technology compared to women. Keeping in mind that men usually make decisions about the sale of agricultural products, and, generally, decisions on farming issues which require finance, it can be assumed that they most probably keep more returns from the farms than women. Hence, their benefits from the use of farm technologies are more significant.

The Pearson's Product Moment Correlation Coefficient

The equation is $-Yi = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + \beta 5X5 + \beta 6X6 + \beta 7X7 + \dots$ ϵi

by using new technology						
Variables	Coefficient	P-value				
Constant	6275.45	.522				
Education (X ₁) (Years of schooling)	.300	.040**				
Family size (X ₂) (Number)	.16	.03**				
Farm size (X_3) (acre)	.140	.382				
Experience of modern technology (X_4) (Years)	.492	.000***				
Training on new technology (X ₅) (Number of days)	.290	.040**				
Technological support from NGO (X_6) (yes/no)	.20	.34				
Decision making ability to use the new technology(X_{7})	.204	.042**				
(yes/no)						
Where, Y_i = Income of respondents						
β_0 = Intercept; β_1 to β_7 = Regression coefficients of the	Observation = 190					
independent variables; and ε = Disturbance term or error term						

 Table 2. Pearson's Product Moment Correlation Coefficient for factors influencing income by using new technology

Discussion

Findings of this research are in line with those of previous studies regarding education [46] and income [47-52] in Bangladesh.

Family size of respondents has a positive coefficient which is 0.16 and it is highly significant.

The respondents' experience in modern technology has a positive coefficient and it is 0.492. It was highly significant at 1percent level, which is evidence that more experienced respondents had a greater income.

The training on a new technology of respondents has a positive coefficient and it is 0.290.

It is significant at 5 percent level. It means that rural farmers training facilities have a great impact on their income. Further, decision-making abilities to use new technology also shows significant role on farmer's income in the study area and the coefficient is .204.

Technological supports from NGOs are not significant because they are free and farmers are not interested to accept it easily.



Fig. 7. Effects of Modern Technology on Women in Agriculture Source: field survey 2019

The above data shows that 79 percent of the respondents noticed that soil quality is deteriorating due to modern technology though more food is produced, 88 percent agreed with the statement of remarkable increase of efficiency in production. A number of (87 percent) respondents reported workload has decreased. The adoption and use of different kinds of agricultural technologies do not depend on the gender of the household head. This is another null hypothesis which suggests that there are no noticeable differences in men- and womenheaded households when it comes to adoption and use of the various agricultural technologies almost equally and the agricultural technologies adopted and used in men-headed households, are similar to those used in the households headed by women (Figure 8).



Fig. 8. Gender perception index of respondents (GPI). (n=190) Source: Field survey 2019

In Bangladesh, mainly due to cultural constraints, women are often less engaged in the decision-making process. This research study was primarily focused on the analysis and synthesis of the pattern of respondents' involvement in decision making process as well as their perceptions in terms of agricultural technology inclusion. The level of gender involvement in the decision-making process has been measured by nine different scores given on the basis of the decision-maker. The results are shown in the above figure. It is obvious that the decision related to farming by adopting new technology reached the highest score of 823. The 2nd highest ranked decision is technical training on technology. Similarly, the 3rd ranked decision is adoption in HYV where the lowest rank score is on the use of indigenous technology; meaning that most of them prefer modern technology in terms of productivity. In rural society, most of the decisions about farming are predominantly made by men. The only exceptions are the decisions related to selling or buying some homestead products (like chicken, ducks, eggs, etc.), which are usually made by women. Therefore, comparison with other surrounding countries (India, Pakistan and Nepal) shows that in Bangladesh women play an insignificant role in the household decision-making process and have limited access and control over household resources in terms of physical and financial assets. Further, heavy domestic workloads, limited mobility, lack of education and cultural issues contribute to women's vulnerability [53-56].

Gender-based challenges for agricultural technology

- Lack of technical knowledge on farm equipment and machine.
- Most of the machinery and equipment are male friendly.
- High price of HYV of machinery/equipment.
- Societal barriers due to being female.
- Lack of family and community support.
- In some instant physically unfit.

Suggested approaches to close the gender gap in machinery service provision

- Improve the local availability of agricultural technologies and create market facilities.
- Enhance women's control regarding the technology's benefits.

- Carry out a gender and value chain analysis encompassing male and female roles, responsibilities, and activities on specific crops.
- Observe the effects of agricultural technologies on labour and time-use from the gender perspective.
- Build institutional arrangement where women are allowed all kinds of facilities.
- Design training strategy and technical facilities that consider women's time constraints.

In addition, it may enhance the development of technologies which will contribute to reducing women's workload burden, increase agricultural incomes, save costs and time, and generally improve the quality of life for farm families and communities. Finally, the gathered data and information could also be generalized to areas that share similar characteristics, with the assumption that the appropriate technology will be directed to the right demographic audience during program output realization.

Conclusions

Overall development of the socio-economic situation of Bangladesh fully depends upon the development of the rural areas. Rural women in Bangladesh are facing adverse conditions in terms of social oppression and economic inequality [57, 58]. Namely, they are deprived of many human rights [59]. Their discrimination cannot be separated from the problems of rural Bangladesh [60, 61]. In line with this, it is necessary to support initiatives aimed at gender equality and women's empowerment in rural Bangladesh [62, 63] because [64] the woman is an essential part of society in its public and private fields, and its present and future.

As to the farming activities in the study area, both men and women are engaged in the decision-making process related to the various farm management issues, such as farmer's purchases, marketing, and farming techniques. Women are also participating in crop and vegetable production, post-harvest activities and preservation techniques, livestock and poultry rearing, and other activities. It is also discovered that certain decisions in the household are made by men while others by women or women headed households. The use and adoption of various agricultural technologies in the context of gender-related issues and access to these technologies are closely linked. Compared to men, rural women have limited access to advanced agricultural technologies in farming and consequentially use more traditional technologies. Furthermore, it has been confirmed by the study that rural women face physical and economic constraints in terms of access to modern techniques of farming.

According to our research results, we can recommend the following measures as follows:

- Address specific resources for gender capacity-building to leading gender focal points and gender facilitators, as well as to their operational counterparts and specialists.
- Encourage awareness among consultants or the field operating team about the significance of addressing gender-related issues to develop technology and promote innovation that benefits both men and women.
- Build the capacity of different stakeholders and the field operating team on tools and methods for achieving gender equality.
- Raise awareness among researchers and decision-makers of the importance of mainstreaming gender in order to help develop the adoption of technology and promote innovation.

Limitations of the study and possible future research avenues

The results presented in this study should be considered in the light of a number of limitations. At the first-place sample is a relatively small. We pretended to have more respondents, but it was impossible to achieve this goal, because it was difficult to find farmers in rural areas who were ready to participate in interviews. Future research can be carried out on a larger sample and other locations with a similar methodological approach. Comparing results from different locations, we can get better insight into the whole issue throughout the country. In addition, further research in gender and adoption of agricultural practices and technologies would be useful in the areas such as understanding changes in gendered innovation processes in relation to changes in women's access to knowledge and resources as well as participation in the household decision-making process.

Acknowledgments

Ministry of Science and Technology, Government of the People's Republic of Bangladesh and the Ministry of Education, Science and Technological Development, the Republic of Serbia.

Conflicts of Interest

The authors declare no conflict of interest.

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Article history:

Received 26 September 2020 Accepted 15 November 2020