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DETERMINATION OF FACTORS RELATED TO ADOPTION OF MODERN DAIRY FARMING IN SELECTED AREAS OF MYMENSINGH IN BANGLADESH

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Abstract: This study investigated the factors viz. age of wife, age difference, education level, family size, house wall and years of experience which influenced the adoption of modern dairy technology in selected areas of Mymensingh district. Probit and linear probability models were applied to identify the determinants. V1 (M) women were older, more educated and experienced, household members were higher, and residential status was good which indicated better economic condition, so they were more able to adopt modern dairy farming technology. The study has shown that in V1 (M), most dairy farmers (62%) have adopted modern dairy farming, followed by 38% of women in V1 (T) and 100% of women in V2 (T), who have practiced traditional dairy farming. Regression results showed that the education standards of wife and husband were 1.84 and 1.12, respectively, which was positive and significantly associated with the adoption of modern dairy farming. So, the higher education level of the wife and husband played an important role in the adoption of modern dairy farming. Thus, modern dairy farming technology adoption can be enhanced through improvement of the education system in rural areas.

Keywords: Adoption, modern dairy farming, rural women, technology.

Introduction

Bangladesh has established its sixth five year plan with the aim of developing an economy that has emerging technology in agriculture (Sixth five year plan, 2011 - 2015). One of the strategies of the plan is upholding agriculture as a main source of economic growth. The key tactic is to encourage the adoption of modern technology by the small-scale dairy farmer. Here, dairy cattle is the most versatile component in the dairy farming system in Bangladesh (Kamal, 2010). This farming system is mainly operated by private entrepreneurs at high cattle densities, such as 145 large cattle per square kilometer, compared with 90 for India, 30 for Ethiopia and 20 for Brazil (National Livestock Development Policy, 2007). The farmers in rural area are mostly poor and keep traditional and modern dairy cattle in order to produce milk for family consumption and sale. Traditional cattle are more common in Bangladesh, whereas crossbred cattle are the result of crossing traditional dairy cattle with different exotic breeds like Holstein Friesian, Sindhi, Shahiwal, and Jersey (Hamid *et al*., 2016). Traditional cattle rearing is being done in a very conventional style, which is simple but modern dairy cattle (crossbred) requires regular care, improved feeding, timely vaccination, proper cleaning and bathing (Yasmin & Ikemoto, 2015a). Modern dairy cattle must be artificially inseminated to propagate them, but it is not necessary for traditional cattle.

At present, government organizations, such as Department of Livestock Service (DLS), and several non-government organizations (NGOs) are providing facilities and services, such as artificial insemination, supplementary feed and medication to poor farmers in order to promote modern dairy farming and to increase milk production (National Livestock Development Policy, 2007). In addition, introduction of cattle crossbreeding programmes are one of the main strategies for improving dairy farming. These programmes were redesigned several times with

foreign technical assistance for establishing modern dairy farming in Bangladesh (Islam *et al*., 2002). However, the dairy sector in Bangladesh needs improved breed variety through genetic improvement for increasing milk yields. Likewise, the herd must have appropriate combination of genetically high potential breeds along with better feeding, management and healthcare in order to maximize profitability (National Livestock Development Policy, 2007). Cattle feed primarily by grazing on pasture, but in modern dairy farming their diet is normally supplemented with prepared animal feed (Encyclopaedia Britannica, 2019). Artificial Insemination (AI) facilities have also been extended to dairy cattle to sustain breed improvement efforts (Jabbar *et al*., 2005).

Adoption of modern dairy farming can be measured in terms of the number of smallholder dairy farmers who adopt modern technologies (Chelkeba *et al*., 2016). Various studies on adoption of modern dairy farming have been undertaken in different parts of the world where improved dairy farming technologies were reported more specifically and a small number of those studies have been discussed here: Bekuma *et al*. (2018) stated that the dairy technology in Ethiopia was disseminated through different organizations with the aim of improving output, increasing incomes and consequently improving the livelihoods of the smallholder farmers. Jaisridhar *et al*. (2013) reported that education status, herd size, frequency of contact, information utilization pattern and information seeking behavior are significantly correlated with scientific farming among dairy farmers of Tamil Nadu. In addition, Kaaya *et al*. (2005) found that age of the farmer was positively associated with adoption and application of Artificial Insemination technology. Lemma *et al*. (2012) revealed that level of education and experience in dairy farming had positively associated with the adoption of modern technology. According to Kaaya *et al*. (2005) and Quddus (2013) increasing awareness through regular training and practices on improved livestock technology is anticipated to improve adoption. Adoption of modern dairy farming is based on crossbred cows is known to be high yielding and give higher income (Bayan, 2018). Consequently, this will diminish the poverty (Yasmin & Ikemoto, 2015a). Acceptance of modern dairy farming has facilitated rural women to get out from disempowerment situation (Yasmin & Ikemoto, 2015b). Dairy farming is is increasingly popular among rural women in Bangladesh due to the low costs of rearing dairy animals on personal homesteads. Dairy farming is gender specific work. It is traditionally rural women's work. This farming operation may be one of the best ways for these rural women to utilize their limited resources and develop skills that will contribute to their empowerment. In the recent years, rural women's participation in dairy farming ha grown because it is a viable subsidiary occupations for the unemployed rural poor women to increase their income earning capacities (Kulandaiswamy, 1986). Rural women's involvement in dairy farming provides them with not only income but also experience in decisionmaking, and hence it will enhance women's empowerment. In addition, women's income earning potential from dairy farming will improve their position in the family and society, and as a result they will have raised bargaining and controlling power over the use of household resources for family welfare. In this way also dairy farming is supposed to empower women (Yasmin & Ikemoto, 2015b). However, very little information is available on the socio-economic status of small-scale dairy farmers (Hossain *et al*., 2005; Datta *et al*., 2018; Yasmin & Ikemoto, 2020) as well as women participation (Yasmin & Ikemoto, 2015a) and empowerment in small-scale dairy farming (Yasmin & Ikemoto, 2015b) for poverty reduction in Bangladesh. So, it is crucial to determine the adoption of modern dairy farming through improved technologies. At present, modern dairy farming technologies, quality feeds and feeding practices, milk processing technologies and modern health management practices are the technologies disseminated. Regardless of the diffusion of these modern dairy farming technologies, improved socioeconomic status, more involvement in dairy farming activities for

poverty reduction and more empowerment for small-scale dairy farmers, there is not enough information on the determinants influencing the adoption of modern dairy farming technology among the small-scale dairy farmer in Bangladesh. Therefore, this study aims to find out the determinants which are associated with a farmer's adoption of modern dairy farming in selected areas of Mymensingh district.

Materials and Methods

Selection and Description of the Study Areas

Two villages in Mymensingh district were selected for the study, Salakandi, denoted as V1, and Binpara, denoted as V2. Salakandi is situated behind Bangladesh Agricultural University (BAU) campus area and had started to become urbanized, with traditional culture evolving, and enjoying electricity and developing infrastructure. Binparaor is a more traditional village lacking in modern technology and infrastructure with male dominated society.

Women in Salakandi who rear modern cattle are denoted as V1 (M) while those who rear according to traditional methods are denoted as V1(T). All women in Binpara use traditional methods are denoted V2(T).

V2 (T) is eight kilometers away from an artificial insemination center located in Bangladesh Agricultural University in Mymensingh (Figure 1). It is important to note that in terms of modern dairy farming the difference between V1 and V2 is that V1 is very near Artificial Insemination (AI) center. Before the establishment of the AI center, there was no significant difference between the two villages based on informal discussions with villagers. In V1's 260 families, 70% of them (184 families)

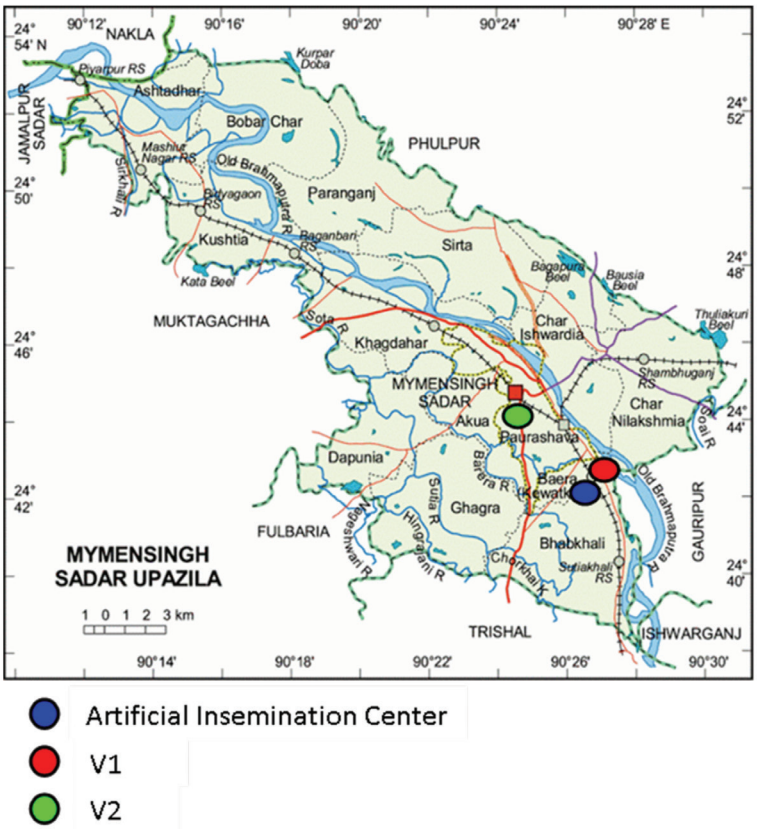

Figure 1: Location of Salakandi (V1) and Binpara (V2) in the Mymensingh district

reared dairy cattle. Among them, 50 households were selected for this study. In V2, 110 out of 125 families were engaged in dairy farming. In V1, they practiced both traditional (local cow) and modern (crossbred cow) but in V2, they reared only traditional cows. Most of the V1 (M) started dairy farming with their own capital, more than 40% used loans and a very small number of respondents inherited their herds. Most of the V1 (T) farmers started with their own money, more than 30% farmers took loans support and a few inherited the herd. For V2 (T) farmers, most of them started with the help of NGOs and loans (Yasmin & Ikemoto, 2020). The respondents in both villages were asked on the types of cattle they had, such as crossbred or local cattle, whether they use the Artificial Insemination center, how they cared for newborn calves, cleaning of animals and the sheds , care of sick animals, and process of selling surplus milk. V1 (M) respondents were more involved in such activities.

Selection of Sample

Small-scale dairy farm owners constituted the population of the present study. In V1, total population was 1100, on the other hand, in V2, the total population was 700. In each village, 50 households were randomly selected for interview. Popularity of rearing small-scale dairy farming by rural women is increasing in these two study sites.

Period of Data Collection

The field research was performed from February to May in 2014. Data was collected by direct observation of women interviewees and through interview questionnaire responses. All collected data was entered into Microsoft Excel.

Analytical Techniques

Descriptive statistics were used on the general characteristics of the respondent in the study areas, frequency and percentage have been used to determine the rate of adoption level of modern and traditional dairy cattle. Regression models were used for identification of technology adoption determinants. Probit model and linear probability model are used for this purpose. Only V1 samples are used for this estimation since households in V2 villages do not have access to modern farming technology. Just for comparison, however, linear probability model is also estimated with V1 and V2 samples.

Probit model is as follows:

$$P(y=1) = \Phi(a+b_1x_1+b_2x_2+b_3x_3+....+b_ix_i+....+b_nx_n) \quad [1]$$

Here, the dependent variable (Y) is a binary dummy variable for the adoption of modern dairy farming and independent variables ($x_1...x_n$) are age of wife, age difference between husband and wife, education level of wife, education level of husband, household size, house wall (mud or concrete brick cum mud), and years of experience in dairy farming. Here, the house wall variables (mud wall and mud/concrete brick wall) are a proxy for household assets. Comparing with the base category (wall made of concrete brick only), mud wall is for the poorest and mud/concrete brick wall is for middle-income earner. This variable has been collected to realize the women's economic status.

Linear probability model is as follows:

$$y= b_o+b_1x_1+.....+ b_nx_n+ u$$

Estimating the equation:

$$\hat{p}\ (y=1|x) = \hat{y} =\hat{b_o}+ \hat{b_1}x_1+.....+ \hat{b_n}x_n \quad [2]$$

Here $\hat{y}$ is the predicted probability of having y =1 for the given values of $x_1....x_n$. Table 1 represents the description of the variables.

Result and Discussion

Descriptive Statistics of the Variables

It is important to identify the determinants of the adoption of modern dairy farming. Descriptive statistics of the variables like age of wife, age difference between husband and wife, education of wife and husband, household size, house wall is made by mud, mud/concrete, experience in dairy farming etc. used for the regression is given in Table 2.

Table 1: Description of the variables

Variable	Description
Modern dairy	1=household rearing crossbred cattle
Age_wife	Wife's age (years)
Age_dif	Husband's age minus wife' age (years)
Edu_wife	1=wife completed primary school or above
Edu_hus	1=husband completed primary school or above
Hh_size	Number of household members
Mud wall	1=house wall is made of mud
Mud/Con wall	1=house wall is made of mud and concrete brick
Experience	Years of experience in dairy farming (years)

Table 2: Descriptive statistics of the variables

Variable	V1		V2
	Modern	Traditional	Traditional
Modern dairy	1	0	0
Age_wife	40.9 (8.2)	35.3 (8.4)	32.3 (9.0)
Age_dif	6.7 (3.0)	8.3 (4.1)	9.1 (3.6)
Edu_wife	0.97	0.42	0.20
Edu_hus	0.77	0.37	0.30
Hh_size	4.4 (1.1)	4.5 (1.0)	4.9 (1.3)
Mud wall	0.10	0.26	0.82
Mud/Con wall	0.52	0.63	0.18
Experience	2.6 (0.6)	2.2 (0.9)	1.9 (0.7)
V1	1	1	0
No. of samples	31	19	50

Note: Standard deviations are in parentheses.

Age is a key characteristic to designate the respondent condition and can provide a hint about the situation of rural women. Age difference between husband and wife may negatively affect the decisionmaking power of women when the difference is high. Usually, an old-aged husband follows traditional rules, custom and they disrupt the young wife's decisionmaking power. But a small gap between the age of husband and wife may facilitate their mutual understanding and help women make rational decisions on breed selection. For this reason, age difference between husband and wife variable has been taken as one of the determinants for adopting modern dairy farming technology. Likewise, education facilitated rural women to acquire valuable information to resolve problems in their everyday life. Consequently, they were able to access innovative techniques on farming. For this reason, education has been chosen as a factor in the decision making on type of dairy farming. Large family size may be

important as the determinant for the adoption of modern dairy farming technology because larger families may participate more in the modern dairy farming activities. Structure of the house indicates rural women's living situation. Pucca/ concrete brick building indicates people are in a better situation in the rural society or better economic status. Thus, it is important to know whether this variable may have an impact on the adoption of modern dairy farming. Many years of experience in dairy farming may help the rural women to make rational decisions for adopting modern dairy farming technology.

It was found that in V1 (M), the average age of wife was 40.9. On the other hand, in V1 (T) and V2 (T), average age of wife was 35.3 and 32.3, respectively. In V1 (M), rural women who rear dairy cattle are relatively older than V1 (T) and V2 (T). V2 (T) women are the youngest group. This result is affirmed by Prasad et al. (2017) who reported that 50% of dairy farmers were belong to the middle (20 - 40 years) aged group, 22% of the farmers were belong to the senior (40 – 60 years) age group, 16% belong to advanced (above 60 years) of age and 12% were belong to young (15 - 20 years) age group. Ram *et al*. (2018) also stated that the majority (62.5%) of the dairy farmers were from the middle aged group.

Another variable, age difference between husband and wife was 6.7 in V1 (M), 8.3 in V1 (T) and 9.1 in V2 (T). Age difference was higher in V2(T) than V1 (M) and V1 (T). This study found that in V1 (M), women completed primary education (0.97) or above but on the other hand in V1 (T) and V2 (T), it was 0.42 and 0.20 respectively. Level of education of the wife was not good in V2 (T). Rural women in V1 (M) have higher educational status than V1 (T). This finding is supported by Rajadurai *et al*. (2018) who found that 80.10% women were literate and according to Ram *et al.* (2018), women were educated up to primary level. Education of husband was found to be 0.77 in V1 (M), 0.37 in V1 (T) and 0.30 in V2 (T). Education level of husband was poorer in V1 (T) and V2 (T) than V1(M).

It was found that average family size was 4.4 in V1 (M), 4.5 in V1 (T) and 4.9 in V2 (T) respectively. Size of family was comparatively larger in V2 (T) than V1 (M) and V1 (T). According to Ram *et al*. (2018), the majority of the farmers have medium-sized families (five - six members).

In case of mud wall, it was found from the study that household is made of mud was 0.10 in V1 (M), 0.26 in V1(T) and 0.82 in V2(T). So, it is revealed from the analysis that in V2 (T), more house walls are made of mud than V1 (M) and V1 (T). This specifies that their housing condition is not good. House wall is made of both mud and concrete brick was 0.52 in V1(M), 0.63 in V1 (T) and 0.18 in V2 (T) respectively. We can see that in V2 (T), very few houses are made of mud and concrete brick. Rais *et al*. (2013) found that 36.8% and 23.3% of farmers were living in pucca and katcha house respectively in their study. According to Yasmin and Ikemoto (2020), household income reflects the economic status of the respondent. The total household income was 254,865 Taka/year in V1 (M) and 141,108 Taka/year in V1 (T). The total household income of V1 (T) was lower than V1 (M). Thus, it indicated that V1 (M) women's housing condition was comparatively good because of their higher economic status.

Results of the study showed that in V1 (M), the years of experience in dairy farming was 2.6, which were comparatively higher than V1 (T) and V2 (T). In V2 (T), their experience was comparatively low because the majority of the young aged group had just started dairy farming. Due to the long experience in dairy farming, V1 (M) women more gathered more technical knowledge than V1(T) as well as V2 (T) women Mulugeta and Amsalu (2014) found in their study most of the respondents (60%) have long farming experience and this helped them to make rational choices which positively impact farming activities.

Adoption Level of Modern and Traditional Dairy Cattle

Before starting small-scale dairy farming, the condition of rural women in V1 and V2 were not much improved (based on interviews). From each village, 50 respondents were selected randomly. Among the 50 in V1, 62% of women adopted modern dairy farming, which is denoted as V1(M), while the remaining 38% practiced traditional dairy farming that is represented as V1(T). In V2, 100% of women were involved in traditional dairy farming, designated as V2(T) (Figure 2).

According to Quddus (2012), only 35% farmers adopted crossbred cows and others upgraded indigenous stock with exotic breeds. Furthermore, Gunaseelan *et al*. (2017) found that 41.67% of the farmers had a medium level of adoption of improved dairy management practices, followed by low (35.00%) and high (23.33%). In this study, the adoption level is high might be due to the fact that the awareness level of rural women is increasing and another reason might be that high-yielding modern varieties of cattle earned more income so that they might change their situation. As V1 is situated near the university, farmers had access to information related to breed, feed, management and healthcare support from the university teachers, veterinary doctors, scientists and projects. Sometimes university professors would visit and provide training on modern dairy farming AI facility, vaccination of cattle, motivate rural people to rear modern breeds to improve their situation and try to solve their dairy cattle related problem. According to Fita *et al*. (2012), the ability of the dairy farmer to generate more income from dairy farming largely depends on the effective adoption of improved dairy farming practices that increases productivity. Small-holder dairy farmers benefit from crossbred dairy cattle because of their higher yields than traditional dairy cattle (local cattle). Rural women get information from NGOs through village organizations (VO). NGOs provide loans to buy cows and supply semen of Holstein Friesian to inseminate traditional dairy cattle, enabling villagers to upgrade their livestock. On the other hand, V2 (T) women rear only traditional dairy cattle even now. Their socio-economic condition is not good and many NGOs are working specially for rural women's development. They support rural women by providing loan and giving information about dairy farming. With the help of NGO, many women in V2 (T) have started to rear traditional dairy cattle to earn income to improve their livelihoods. Traditional dairy farming requires low cost and less knowledge. However, they do not have a chance to get crossbred cattle since V2 is far from the AI center and modern dairy farming (crossbred cattle) has not been introduced to this village.

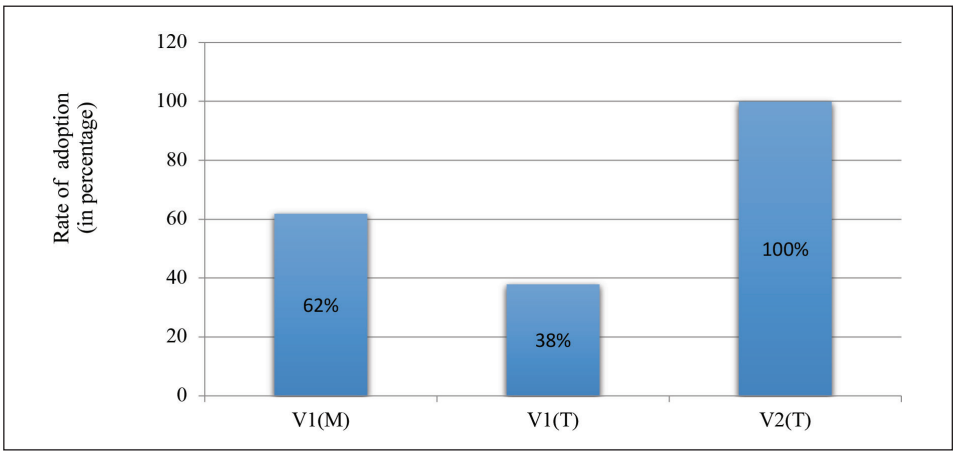

Figure 2: Adoption of modern and traditional dairy cattle

Table 3: Determinants of adoption of modern dairy farming

Variable	V1 only	V1 and V2
	Probit Model	Liner Probability Model
Age_wife	0.04 (0.04)	0.00 (0.00)
Age_dif	-0.10 (0.07)	-0.01 (0.01)
Edu_wife	1.84 (0.58)***	0.27 (0.09)***
Edu_hus	1.12 (0.49)**	0.13 (0.07)*
Hhsize	-0.55 (0.24)**	-0.02 (0.03)
Mud wall	-1.16 (0.81)	-0.26 (0.14)*
Mud/Con wall	-0.72 (0.47)	-0.21 (0.11)*
Experience	0.62 (0.43)	0.06 (0.05)
V1	NA	0.26 (0.10)**
Constant	-0.94 (1.57)	0.06 (0.21)
Pseudo R2/R2	0.50	0.63
Num. of Samples	50	100

Note: Robust standard errors are in parentheses. *significant at 10%; **significant at 5%; ***significant at 1%.

Determination of Adoption of Modern Dairy Farming

Probit models were used to estimate the effects of different factors on the determination of adoption of modern dairy farming. Only V1 samples are used for this estimation since households in V2 villages cannot adopt the modern dairy farming technology due to the inaccessibility. For comparison, however, linear probability model is also estimated with V1 and V2 samples. The results of regression analysis are shown in Table 3.

The coefficient of education of wife is found to be positive and significantly related with the adoption of modern dairy farming in the regression model. Because of high literacy rate of women, they can easily recognize the benefits of modern technology of dairy farming and are more concerned about rearing modern dairy cattle. Education of husband also played an important role for the adoption of modern dairy farming. Educated husbands would motivate their wives to rear modern dairy cattle and helped them adopt modern technology. In addition, household size has significantly negative effect on the adoption of modern dairy farming. Considering that most of the sample households were nuclear families, a larger household may take up more of the wife's time for housekeeping. The house wall variables (mud wall and mud/concrete brick wall) are supposed to capture household assets; comparing it with the base category (wall made of concrete brick only), mud wall is for the poorest and mud/concrete brick wall is for the middle. The regression result showed negative coefficients for the both. They were not statistically significant in the case of V1 only regression, but they were significant in the case of V1 and V2 regression. The results implied that relatively poor households tend not to adopt modern dairy farming.

The adoption of modern dairy farming found a positive and significant relationship with education of wife and husband. This finding is supported by Quddus (2013) and Rahman & Gupta (2014), who stated that farmers having higher education are more likely to adopt dairy technologies. Moreover, secondary and higher educated farmers were 9.7 times more likely to adopt improved technologies compared to illiterate farmers (Quddus, 2012). Household

size is found to be negatively related with adoption of modern dairy farming. People now do not like to stay with extended families, and household now tend to be nuclear. This finding is not in line with Dehinenet *et al*. (2014) and Howley *et al*. (2012) who reported that members of large families are interested to adopt dairy technology because they have more labor to call on. In this study, farming experience had positive and significant relationship with the adoption of dairy technology. Long experience in dairy farming motivated rural women to adopt modern dairy farming. This finding is affirmed by Quddus (2013) and Dehinenet *et al*. (2014) who explained that adoption of dairy technology is certainly associated with dairy farming experience. The determinant house wall is made by only mud indicates that this type of household are in the low-income group and the house wall that is made by mud and concrete indicates that they are in the middle-income group. This study found that mud wall and mud/ concrete variable are not statistically significant in V1 regression, but found significant in V1 and V2 regression. The results implied that relatively better income households tend to adopt modern dairy farming. This finding is supported by Quddus (2012) who stated that the level of technology adoption in dairy farming is highly significant and dependent on farmer's economic condition. Moreover, Rahman and Gupta (2014) also found positive and significant association between annual gross income of the dairy farmers and adoption of dairy farming technology.

Conclusion

V1 (M) dairy farmers seem to be more developed economically than V1(T) and V2 (T) because farmers in V1(M) can choose modern technologies of dairy farming. This study identified the determinants of adoption of modern dairy farming by using probit and linear probability models. It was found from the regression analysis that higher educational level of wife played a vital contribution to the adoption of modern dairy farming. Highly educated women can identify the modern dairy farming technology and are more interested to rear modern dairy cattle. The result also found that higher educational level of husband also contributed to the adoption of modern dairy farming technology. Educated husbands inspired their wives to rear modern dairy cattle and facilitated them to receive modern technology. The government should focus on the development of education in rural areas so that residents are more up to date to receive modern technology. The private sectors as well as entrepreneurs should also take part in the improvement of the dairy sector of the country.

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