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FACTORS DETERMINING THE SMALLHOLDER MILK PRODUCER'S PARTICIPATION IN CONTRACTUAL AGREEMENTS: THE CASE OF NORTH-WEST BANGLADESH

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ABSTRACT

Contract farming plays a significant role by establishing a bridge in order to link the milk farmers to market. The study aimed to state current institutional arrangement of dairy sector in Bangladesh. By using simple random sampling, a total of 90 (45 contract and 45without contract) dairy farmers from Chatmohar Upazila of Pabna District were interviewed. For determining the factor of farmers willingness to participate into contractual system was analyzed by conducting factor analysis. The highest factor loadings for the first dimension were found for the stable milk output price and access to training on dairy farming while timely payment for output has relatively factor loading on second dimension as well as the access to good quality inputs (drugs and feeds) higher in third dimension respectively. The most important reasons for unwillingness to participate in contract farming were under weighing of fat, lower milk price than the market price, distance to the location of milk collection centers, sell at home, rules and regulations of PRAN Dairy Ltd., & availability of dairy farmers etc. The result clearly shows that contract farming has the potential of raising income of the smallholder dairy farmers. It benefited the farmers through reducing different input costs and other relative costs related to dairy farming, which may be more in the informal markets or without contract arrangement. In addition, contract farming contributes for improving the income of dairy farm and reducing production costs by providing different services and technical advice by the contract firms.

Contribution/Originality: This study is one of the very few studies which have investigated contractual arrangement system of dairy farming in Bangladesh. This study contributes to the existing literature and provides comparison between the income of contracted and non-contracted dairy farmers.

1. INTRODUCTION

Bangladesh agriculture consists of crops, fishery, cattle and forests sub-sectors, which serve as the major source of human food. It provides the raw materials for industry and timber for construction. Agriculture plays a vital role in terms of export earnings for our economy. Bangladesh earns a lot of foreign exchange through the export of raw

and processed agricultural products. In 2018 fiscal year, the Gross Domestic Product (GDP) of Bangladesh expanded 7.90% compared to previous year (http://www.tradingeconomics.com).Agriculture sector contributes approximately 14.23% to the country's GDP and also employed about 40.60% of total labor force (BBS, 2019).For boosting up the macro-economic condition such as; creation of employment, poverty eradication, safe food and nutritional improvement etc., where this sector plays a great role. Therefore, the government of Bangladesh underscores the vital role of all the subsectors of agriculture sectors for providing the safe and nutritious food as well as employing a large portion of people with low income who are living in rural areas at a vulnerable condition.

In the economy of Bangladesh livestock sectors has a significant contribution with 1.54%of the Gross Domestic Product (GDP at constant prices). According to the estimation of DLS, livestock sector also employed 20% and 45% of the population engaged in indirect jobs and part-time jobs respectively (DLS, 2019)). Comprising cows and buffaloes, the dairy animals and the whole livestock sector occupies an important place for the national economy of Bangladesh. Not only have milk production, but also they had contribution in producing large amount of livestock manure, that acts as major inputs in for agriculture. Though, this sector growing rapidly but it also faces an acute shortage of dairy milk. According to the DLS, Bangladesh milk production stood at 94.06 Lakh Metric. Despite the impressive production, the annual milk deficiency is around 56.23 Lakh Metric Tons against a total demand of 150.29 Lakh Metric Ton (DLS, 2019). It is obvious that the formal milk market covers a very small share of the overall output. However, this problem can be solved by connecting smallholder's dairy milk farmers from remote areas to urban markets. Low volume of output and marketable surplus along with the limited access to larger markets constrained the market participation of smallholder milk producers. Milk middlemen (traders) usually buy the bulk products to supply in local and distance market, but perishability of milk and infrastructural problems limits their activities. By initiating different collective actions and implementation of institutional arrangements (i.e. contract farming) are necessary to overcome the problems of smallholder dairy producers in markets. Contractual system is such an initiative that can be fruitful for providing market access of smallholder dairy farmers in Bangladesh.

Contract farming facilitates the farmers in assessing required inputs and selling their output. However, it is typically applied to perishable agricultural products such as vegetables, fruits and milk that need to be processed. Considering possibility and restraints of contract farming, Minot (1986) found that in every situation contract farming has contribution in income improvement. By conducting some experiments throughout the African nations, Glover and Kunsterer (1990) and Little and Watts (1994) tried to establish a blueprint for assessing social impact of contract farming. As a driver of development, literature on contract farming is scattered through various disciplines. For smallholder's strategies on growing exportable crops and the relative efficiency of smallholder, there exists an agronomic literature (Beets, 1990; Netting, 1993). Binswanger and Rosenzweig (1986) revealed that, specific production conditions and labor regimes are linked with each contracted commodity that eventually affects potentiality of generating rural development. Public policy of India indicates its socio-economic importance which is being attached with significant concentration. In Rajasthan India, instead of independent production, contract farming was proved to be more profitable that benefited the farmers by deducting marketing cost along with transaction costs. Besides, milk farmers were benefited by various services and technical advices (i.e. training) from the contracting firms, who assure regular milk supplies from the farmers (Pratap, Jha, Tiongco, & Narrod, 2008). It also provides benefit to the contractors by establishing close connections with farmers and also by reducing uncertainties in the process of purchasing through predetermined price, time and quality (Glover, 1984; Key & Runsten, 1999; Singh, 2002). Thus, contract farming helps the subsistence farmers by starting and developing their own farms. (Goldsmith, 1985) has separated the pre-requisites for developing contractual arrangement in context of Perishability, Permanence and Variations in quality that signifies expensive system to assure that farmers should comply. Moreover, factor analysis was conducted to trace farmer's conception whether they were interested to enter into contractual arrangement for quail farming in western zone of Tamil Nadu (Chitrambigai, Pandian, & Shree,

2013). Profitability of the non-participated farmers in dairy contractual arrangements depends on marketed surplus, management and institutional factors but its profit was lower in comparison with participation in any contract (Barua, Alam, Sabur.S.S., Rahman, & DAS, 2017; Barua., Alam, Rahman, Farid, & Koiry, 2018). For taking benefits from market access or participation, the farmers can choose between whether they should remain at the subsistence level or whether they want to be specialized in an individual enterprise by generating pertinent skills and selling excess to the market (Barret, 2010). Amrouk, Poole, Mudungwe, and Muzvondiwa (2013) identified the contracting arrangements as the way for shifting to market from subsistence level, where products and services are exchanged frequently. Market access not only enables the smallholders for buying and selling, rather it is considered a tool of prosperity (Barret, 2010). By considering production efficiency and income effect, Saigenji and Zeller (2009) explored potentiality of contract farming in North-western Vietnam and stochastic frontier model indicated that, contract farming gained more proficiency compared to non-contractual farming. However, logit model revealed that, membership of association played a significant role behind the farmer's decision to participate in contract. Saichy (2013) used the qualitative approach and found that both incomes as well as farm management skills were improved in Savannakhet, Lao PDR. Miyata, Minot, and HU (2007) examined the factors which were unobservable, while applying selective models of contractual arrangements and income models for the purpose of obtaining better findings. In contract farming the guarantor assures farmers to purchase all their produce grown according to pre-determined volume and attributes (Watts, 1994). In Bangladesh, Milk Vita, BRAC and several dairies have established contractual arrangement for benefiting the milk farmers (Jabbar, Raha, Rahman, & Talukder, 2009). In addition, this study suggested the formation of several small collective groups to increase smallholder's competitiveness. Therefore, the importance of an institutional forms including contracting arrangement for enhancing market access and participation by smallholders in dairy markets can be appreciated in the context of the recent sharp rise in commodity prices including dairy products globally as well as in Bangladesh. The impact of higher international price is easily and directly transmitted to the urban consumer market due to high dependence on imported powdered milk but high consumer price is not easily transmitted to the producers if liquid milk market is not well organized as in Bangladesh. From 2004 PRAN dairy ltd. started its processing activities in small scales. Since then company gradually initiating some institutional agreement through negotiation with small scales dairy producers for meets up national milk consumption. As the maximum dairy milk producers are smallholders, therefore there exist problems of how they can be linked up with the market. By forming different producer groups, collective actions, or contractual agreements, this type of problem can be checked. However, as our knowledge, there is scanty of particular study that describes how the smallholder's dairy milk producers can actually be benefited from contracting in North-west region of Bangladesh.

Given this backdrop, the goals of the study is to ascertain the forms of market institution which will help the smallholder milk producers to raise their family income and improve their livelihood. But the specific objectives are as to present state of 'institutional arrangements' in PRAN dairy ltd. in Bangladesh, to identify the factors enhancing the decision of participation and non-participation in the dairy contractual system, to compare income effects of contracting system in dairy and analyze the capacity of contracting as market access tool.

2. METHODOLGY

2.1. Selection of Sample and Sampling Technique

Due to time and resource constraints it was not possible to interview all population in the survey area. In order to develop a contractual agreements being practiced in the Chatmohar Upazila (three villages i.e. Poilanpur, Boroshalika, and Gunaigachha village) of Pabna district, the farms or enterprises involved in contract and non-contract arrangements constituted the sample for detailed survey. These include PRAN Dairy Ltd. and selected milk producers. Forty five formal contract farms of PRAN and 45 non-contract individual farms were randomly selected. The total sample size of the study was 90.

2.2. Preparation of Interview Schedule

In conformity with the objectives of the study, survey schedule was designed for collecting data from the contract and non-contract dairy farmers and PRAN Dairy Ltd. The farmers schedule was intended to collect data on, household demographics, Production activities, marketing practices and associated problems encountered by the milk farmers. Besides, the interview schedule for PRAN Dairy Ltd. included the questions on forward and backward linkage activities for contracted input/product/ services, mode of contract, and marketing channel of PRAN Dairy Ltd. for the milk or milk products etc.

2.3. Interviewing the Selected Respondents

For the present study primary data were gathered during the month of September, 2015. Before data collection, each respondent was given a brief introduction about the nature and motive of the study and the researcher curtained them of confidentiality of the information. Secondary data were collected from DLS (Department Livestock Service), FAO reports, BBS (Bangladesh Bureau of Statistics), published and unpublished documents of the Government of Bangladesh, and other organizations and many other related sources.

2.4. Summarization, Tabulation and Analysis of Data

The raw data of each schedule were edited cautiously in order to detect errors and omissions for the purpose of avoiding incoherent information. A factor analysis was conducted to trace out the most influential factors behind dairy farmer's participation in contractual arrangement. Stepwise regression was used to explain the effects of contracting on income of dairy farmers. SPSS software was used for data analyses.

2.5. Analytical Techniques

2.5.1. Factor analysis

Factor analysis can be used as an effective tool for examining relationship among variables. It enables the researchers by investigating concepts which cannot be easy to measure rightly by breaking down large number of variables into less explicatory factors. Factor loading is the vital part for factor analysis. Factor loading denotes simple correlation between the variables and the factors under study. Principle Component Analysis (PCA) method was utilized to get the factor loading. To trace the most important factors behind the dairy farmer's choice to go for contract farming, is the principal purpose of proposing PCA. The principle component model can be written as follows-

$$Z_i = a_{i1} X_1 + a_{i2} X_2 + a_{i3} X_3 + \ldots\ldots\ldots + a_{ip} X_p$$

Where,

Z_i - Magnitude of the variable.

a_{ip} - The factor loading of variable i on factor p.

Xp-The amount of association in magnitude of indicators, the uncorrelated trait measured by factor 'p' which is possessed by variable.

i - Factor loading with reference to indicators 1, 2, 3 . . . p.

p - A set of common factors (1, 2 . . . p).

ai p X p - Factor co-efficient or loading of variables i on factor p.

Principal components with Eigen values greater than or equal to one was retained for determining the number of components in the present study. At the time of selecting variables from the various extracted dimensions, greater and positive values from rotated component matrix (Varimax rotation method) was selected from their respective dimensions.

2.5.2. Stepwise Regression Model

The following type of Stepwise regression model was estimated for explaining the effects of contracting on income of dairy farmers.

$Y = \alpha + \beta X_i + e$

Where,

Y= dependent variable (income).

X_i = explanatory variables (including contracting system).

α = intercept.

β = Co-efficient.

e = error term.

2.5.3. Hypothesis, Variable Selection, and Definition

2.5.3.1. Factors Influencing Farmer's Income

For recognizing the best fitted equation, various set of independent variables were used in different combinations which is shown in Table 1. Based on a set of hypothesis for the purpose of determining the effect of this variables on the household income of both contract and non-contract dairy farmers are described in below.

2.5.4. Age of the Respondent (Age)

Age is continuous variable and measured in years. For making important decision, age of the respondent farmer behaves as important element. However, it was hypothesized that, compared to older farmers, young farmers are more entrepreneurial in nature and therefore they find contract farming as more profitable initiative or arrangement.

2.5.5. Education of the Respondent (Education)

In this study, education of respondent denotes to the number of years a respondent spent in school. It is measures in binary variable (Literate=1 and Illiterate =0). It was perceived, that the educated respondent has higher probability to participate in contract farming than illiterate and hence probability of higher income of the household.

2.5.6. Household Size (HH size)

Other things remaining the same, household size largely determines the volume of income of the dairy farmers. Therefore, it may be an important determinant whether a farmer receives higher income or not. It is continuous variable. It was perceived that, larger household size lowers the income of the farmers because he or she has to spent more of his/her earnings. Lower the household size, higher the income of the dairy farmers.

2.5.7. Number of Cattle/Herd Size (Cattle)

In the study herd size was the number of dairy cows available on a farm. It is measured in continuous variable. The size of the dairy herd determines the total volume of output produced and available for sale. The volume of output available for sale may also influence the income of the farmers.

2.5.8. Land holding (Farm Size)

It was presumable that, probability of participation in contract agreement might be more among farm households with large scale holding of land and it was measured in continuous variable.

2.5.9. Borrowing (Credit)

It is measured in dummy variable whether getting loan (Yes=1) and others (No=0).Credit can ease capital constraint to acquire dairy cows and build cowshed. Credit also meets regular operational expenses for inputs and services.

Table-1. Description of the stepwise regression model variables.

Variables	Sub-factors	Description
Dependent variable (Income Tk/Year)	Continuous Variable	
Age	Continuous Variable	Number of years
Education level	Binary Variable	1 = Literate, 0 = Illiterate
Household Size	Continuous Variable	The number of family member of the household
Herd Size(Cattle)	Continuous Variable	The number of dairy cows
Land Holding (Farm Size)	Continuous Variable	
Borrowing	Binary Variable	1=Yes, 0=No
Contract	Dummy Variable	1=Yes, 0=No

3. RESULTS AND DISCUSSIONS

3.1. Formal Production-Marketing Contract of PRAN Dairy Ltd. with Milk Producers

Program for Rural Advancement Nationally, commonly known as PRAN, a leading agro processing firm in Bangladesh. PRAN operates its business through focusing on low- and middle-income consumers. During FY 2004, PRAN has started its operation on a small scale primarily with ultra-high temperature (UHT) milk. Its innovations have been included by introducing dairy hubs in order to modernize dairy farming through identifying some of the constraints on dairy farmers while enhancing the availability of local processed milk. (http://www.pranfoods.net).

In survey period, PRAN Dairy has 123 milk collection and chilling centre's where around 1.5 lakh liters of liquid milk is collected a day. Hence the aim of PRAN Dairy Ltd. was stated as follows:

"To generate employment and earn dignity and self-respect for our compatriots through profitable enterprises".

In addition to the above aim, PRAN Dairy Ltd. also included the provision of various services for farmers;

a) Distribution of chopper and milking machine among the farmers without free of cost.
b) Low charge of vaccination, drugs and AI services for upgrading local breeds.
c) Free of charge medical care for all cows with emergency services for 24 hours daily.
d) Extension services to increase the raw milk production.
e) Training arrangement for the member farmers in order to get known with better animal husbandry practices and up-to-date knowledge on dairy farming.
f) Provide collateral-free low interest loans from Karmasangsthan Bank, a state-owned specialized bank. PRAN Dairy Ltd. collects the loan's repayment installments from the earnings and deposits of farmers those with Karmasangsthan Bank.
g) Bear transportation or carrying costs Tk. 2.70 per liter (excluding the price of milk).

Based on these services the agreement between PRAN and contracting milk producer is very easy. In order to participate in contract the farmers need to reside in PRAN's operating areas. To continue the agreement, a farmer should supply at least 20 liters of milk a day and supply milk throughout the year. For milk collection, there exists a common centre called dairy hub, where individual farmer bring their milk. At this point, milk collector agent records the daily amount of milk and also quality (fat percent) in the record book of farmers. Based on the fat percentage of raw milk, price was fixed and payment was made weekly to the farmers. Besides PRAN also purchases milk from agents. Farmers do not receive any additional extension services for selling milk to the agents. Agents

also have their own milk collection centers where they employ people. Institutional arrangements (contract farming) of PRAN dairy are traced by following Figure 1;

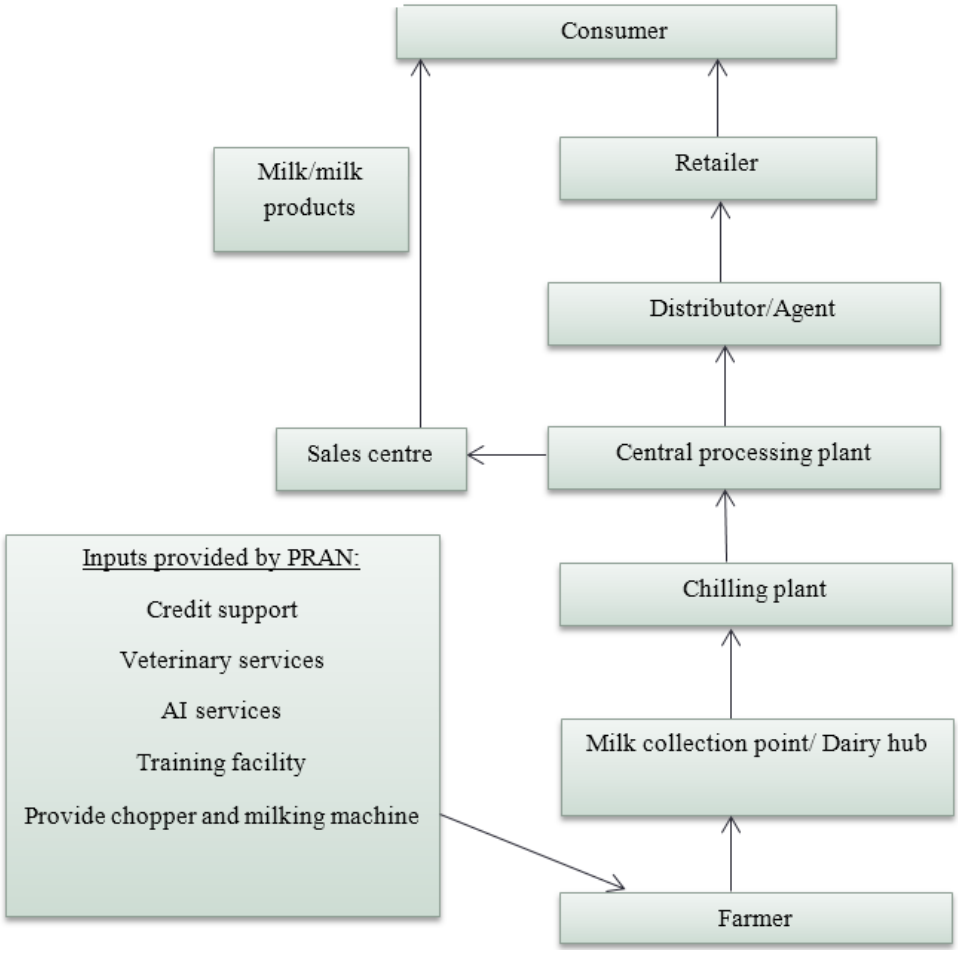

Figure-1. Components of vertically integrated operations of PRAN Dairy Ltd.

3.2. Factors Influencing the Decision of Participation in the Dairy Contractual System

Maximum milk producers in Bangladesh are smallholder and landless, so an interest of this study is to examine if such farmers are participating in contractual dairy production and marketing activities to improve their livelihood. As the demand for dairy is rapidly growing, it is assumed that smallholder participation in contractual system will help them in capturing the better market share. In order to explore this question, this section provides information about the willingness to participate and non-participation in contractual system of dairy and what factors determining this. For identifying the influential factors into dairy contract farming system, PCA (principle component analysis) was employed. Seven factors were identified as influential factors which are as follows:

i) Assured buyer of output.
ii) Access to good quality inputs (drugs and feeds).
iii) Timely payment for output.
iv) Good price for output.
v) Access to veterinary services.
vi) Access to training on dairy.
vii) Stable price for output.

Factor analysis was used to explain those factors. The results and their interpretations are described below.

3.3. Communalities

Table 2 revealed communalities before and after extraction. The initial assumption of principal component analysis indicated that all variances are common; therefore, before extraction the communalities are all 1. The communalities in the column labeled 'Extraction' reflect the common variance in the data structure. So, from the table it can be seen that 80% of the variance associated with output is common, or shared variance. The result revealed that, highest 80.1% of the variance in 'input' was accounted for while lowest 55.5% of the variance in 'training' was accounted for.

Table-2. Communalities before and after extraction.

Factor code	Initial	Extraction
Output	1.000	0.800
Input	1.000	0.801
Payment	1.000	0.648
Price	1.000	0.745
Veterinary	1.000	0.587
Training	1.000	0.555
Stable	1.000	0.593

Note: Extraction Method: Principal Component Analysis (Varimax rotation method).

Here,

Factor code 'Output'= Assured buyer of output

Factor code 'Input'= Access to good quality inputs (drugs & feeds)

Factor code 'Payment'= Timely payment for output

Factor code 'Price'= Good price for output

Factor code 'Veterinary'= Access to veterinary services

Factor code 'Training'= Access to training on dairy

Factor code 'Stable'=Stable price for output

3.4. Scree Plot

The chart determines how many factors or components to be retained. Where the curve starts to be flattened, is the point of interest. From the Figure 2 it can be observed that, the curve begins to be flattened between factors 3 and 4. Note that factor 4 has an Eigen value less than 1; therefore, only three factors have been retained.

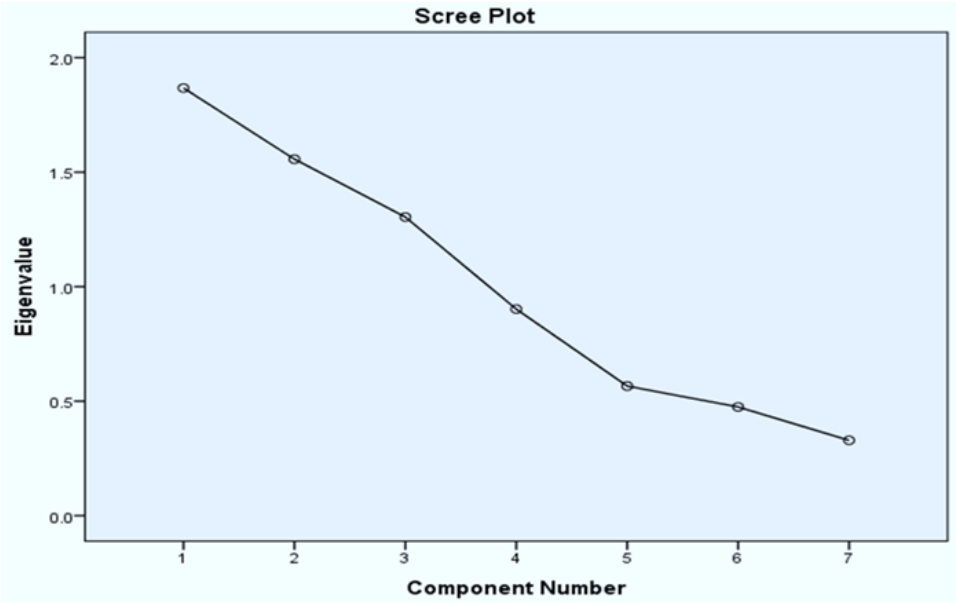

Figure-2. Scree plot.

3.5. Rotated Component Matrix

Table 3 contains the rotated factor loadings (factor pattern matrix). Correlation between the variables and factors as well as how these variables are weighted for each factor, can be well understood from the factor pattern matrix. Possible values of this correlation ranges from -1 to +1.The results of the rotated component matrix and the factor loading are presented in Table 3. In the principle component analysis, three dimensions were extracted and considered for drawing interpretation. The interpretations are as follows.

Table-3. Factors influencing the farmers to participate in the dairy contractual system.

			Dimensions		
Sl. No.	**Factor codes**	**Factors**	**I**	**II**	**III**
1	Output	Assured buyer of output	-0.062	-0.878	0.158
2	Input	Access to good quality inputs	0.270	0.464	0.716
3	Payment	Timely payment for output	-0.334	0.705	0.197
4	Price	Good price for output	0.131	0.162	-0.838
5	Veterinary	Access to veterinary services	-0.764	0.047	-0.037
6	Training	Access to training on dairy	0.701	-0.172	0.186
7	Stable	Stable price for output	0.714	0.077	-0.278
		Eigen values	1.867	1.557	1.304
		Variation (%)	26.677	22.239	18.631
		Cumulative variation (%)	26.677	48.916	67.547

Note: Extraction Method: Principal Component Analysis (PCA).
Rotation Method: Varimax with Kaiser Normalization.

First Dimension: At the first dimesion, factors loading ranges from -0.764 to 0.714. Out of seven variables, stable (stable price for output) has higher factor loading (0.714) followed by training (access to training on dairy) with factor loading of 0.701, means that the stable price for output is the most important factor in first dimension which influences farmers participation decision in the dairy contractual system. This dimension explained 26.68 percent variation.

Second dimension: The next (second) dimension illustrated 22.24 percent of variation. Factor payment (timely payment for output) had higher factor loadings (0.705) in this dimension.

Third dimension: Main factors identified in this dimension are input (access to good quality inputs) and payment (timely payment for output) where the factor loadings are 0.716 and 0.197, respectively. This dimension explained 18.63 percent variation. In third dimension, factor access to good quality inputs is the important factor that influences farmers' participation in the dairy contractual system.

3.6. Factors Affecting the Decision of Non-Participation in the Dairy Contractual System

In spite of yielding higher profits, there are some main reasons behind dairy farmer's unwillingness to participate in contractual agreements which are described as follows.

3.6.1. Under Weighing/Reporting of Fat

One most important reason reported by the farmers was under weighing fat content by the milk collector agents. Sometimes collector agent's intentionally entering low fat percent of milk or sometimes avoiding writing fat percent in the record book of the farmers.

3.6.2. Low Price of Milk

Another important reason reported by the farmers was lower price of milk compared to market price. In contractual system, the price was defined by the fat percent contained in the milk. Higher the fat percent, higher the price of milk. Most of the farmers received lower price than the market price of milk. That's why they are not willing to join the contractual system.

3.6.3. Sell at Home

The non-contract farmers sell their milk in two different ways. One is selling to the farmers who are in a contract and another way is to sell their milk to their nearby markets. In case of selling milk to the farmers who are in a contract, the non-contract farmers can easily sell their milk from their individual houses. Though, some non-contract farmers have no transportation costs, so they are not willing to join the contract.

3.6.4. Distance of Milk Collection Center

Most of the milk collection centers are 3 to 4 kilometers away from the house of non-contracted farmers. Because of high transportation cost and distance, the farmers are not willing to participate in the contract system of dairy.

3.6.7. New Concept

Being a new concept in the region, maximum milk farmers were stagnant in the process of criticizing the merits and demerits of contract farming.

3.6.8. Other Business

Most of the farmers reported that, they adopted different types of other businesses with dairy farming. The farmers are day laborers, owner of tea stalls, rickshaw puller and engaged in other income sourcing activities which affecting the farmers decision of non-participation in the dairy contractual system.

3.6.9. Rules of PRAN Dairy Ltd.

As per rule of PRAN Dairy Ltd., a farmer must have to supply minimum 20 liters of milk every day and have to supply milk throughout the year. The farmers who are not fulfilling these criteria cannot continue with the contract. This is one of the reasons for non-participation of the dairy farmers in contractual agreement.

3.6.10. Availability of Dairy Farmers

About 88.89 percent of the sampled farmers are engaged in agriculture mainly in dairy production. As the dairy farmers are high in number in the study area so farmers have no bargaining power. The PRAN Dairy Ltd. imposes many rules and regulations to dominate the dairy farmers. That is why the farmers are not willing to join the contract.

3.6.11. Transportation Problem

Most of the sampled farmers have not a cycle or van of their own. Due to the perishability of the milk farmers need to sell their milk as soon as possible, but they cannot continue because of limited availability of transportation, high transportation cost or no transportation system of their own.

3.7. Comparison of Income Effect and Capacity of Contract Farming as Market Access Tool

On the basis of the farm surveys with the dairy farmers, the variations between contracted and non-contracted farmers are described by using descriptive statistics and t-test. At last, findings from the econometric analysis (stepwise regression model) examine differences in the traits of contracted and non-contracted dairy farmers as well as its impact on household income and analyzing the capacity of contract farming in market access.

3.8. Explanation of Contract and Non-Contract Dairy Producers

There are two groups of sampled farmers - contracted and non-contracted farmers. Forty five farmers contracted with PRAN Dairy Ltd. and forty five non-contract farmers were selected and interviewed. Descriptive analyses of the contract and non-contract groups are given as follows:

Table-4. Descriptive statistics of contract and non-contract dairy farmers.

Variable	Group	N	Mean	Std. Deviation	Std. Error Mean
Age	Contract	45	38.27	11.361	1.694
	Non-contract	45	39.62	11.703	1.745
Education	Contract	45	0.64	0.484	0.072
	Non-contract	45	0.71	0.458	0.068
HH size	Contract	45	5.13	2.138	0.319
	Non-contract	45	4.49	1.079	0.161
Cattle	Contract	45	2.98	1.406	0.210
	Non-contract	45	1.98	1.076	0.160
Farm size	Contract	45	3.00	1.430	0.213
	Non-contract	45	2.47	1.057	0.158
Borrowing	Contract	45	0.64	0.484	0.072
	Non-contract	45	0.49	0.506	0.075
Income (Tk./year)	Contract	45	243575.33	146444.488	21830.655
	Non-contract	45	132947.11	77313.660	11525.240

Table 4 shows that mean age of the contract farmers is 38.27 years which is slightly lower than age of non-contract milk producers (39.62 years). Average age of dairy farmers implies that contract farmers are younger as compared to the non-contract farmers and also the contracted farmers are more innovative and they are willing to join the contracting system. Contract and non-contract dairy producers have the mean incomes of Tk. 243575.33 and Tk. 132947 respectively. This indicates that the income of contracted dairy farmers is higher than the non-contracted dairy farmers. How much of the data is distributed around both sides of the mean can be well measured by standard deviation. Here, the standard deviation was higher to the dependent variable (income of contract farmers) that is Tk. 146444.48. This means that the income of the contract farmers largely distributed to their mean. In this case the standard deviation of non-contract is Tk. 77313.66. The more reliable mean for contract farmers are 0.484 for borrowing and 0.484 for education of the respondent. Again the more reliable mean for non-contracted farmers are 0.506 for borrowing and 0.458 for education of the respondent. However, among the independent variables the standard error of borrowing (in case of contract farmers) is 0.072, which explicate that this mean is relatively close to the true mean of overall population. Again, in case of non-contract farmer's standard error is relatively small in borrowing which is 0.075.

3.9. Comparison of Contract and Non-Contract Dairy Farmers

The sample of 90 dairy producers consists of forty five (45) contracted and forty five (45) non-contracted farmers. The characteristics of contracted and independent farmers are shown in Table 4.

Table-5. Features of contract and non-contract/independent dairy milk producers.

Variable	Levene's test for equality of variances		t-test for equality of means		
	F	Sig.	T	Sig (2-tailed)	Mean difference
Age	0.015	0.901	-0.558	0.579	-1.356
Education	1.774	0.186	-0.671	0.504	-0.067
HH size	10.525	0.002	1.805*	0.075	0.644
Cattle	5.582	0.020	3.788***	0.000	1.000
Farm size	1.041	0.310	2.011**	0.047	0.533
Borrowing	3.934	0.050	1.491	0.140	0.156

Note: *, **, *** indicates significant at the level of 10%, 5% and 1% respectively.

From the Table 5 three variables are found to be significant. They are: household size (HH size), number of cattle (Cattle) and dairy land (Farm size). These mean that the variables are significantly different in two groups-contract and non-contract.

3.10. Factors Affecting Contractual Arrangement on Income of Dairy Farmers

The econometric analysis (stepwise multiple regression models) was carrying out using the sample of contract, non-contract and overall impact dairy farmers. Different variables were expected to income of the dairy farmers these are age of the respondent, education level, family size, and number of dairy cows, farmland holding size, borrowing and contract. For analyzing the factors that affect the income of those who are involved in contractual arrangement or not, Stepwise multiple regression models were utilized. Existence of multicollinearity problem was checked by calculating VIF (variance inflation factor). No significant problem of multicollinearity was found. Durbin-Watson test indicated that there was no autocorrelation problem. Three variables (number of dairy milking cows, education and borrowing) were found significant for participation and non-participation at contractual arrangement from the out of seven variables, while contract variable was found significant for examining the overall impact of dairy farming. The coefficient of multiple determinations (R^2) for three conditions were 0.59, 0.71 and 0.67 respectively and adjusted R^2 was 0.56, 0.68 and 0.65 respectively. This denotes that 67% of the variation in the dependent variable is explained by the explanatory variables for impact on contractual arrangement. Furthermore, the adjusted R^2 of 65% is significant and it has consolidated the goodness fit of the model. Hence, its econometrics is significant and reliable. The results from the estimated econometric model are given in Table 5.

Table 6 showed that, literacy (education) level of the respondent has a positive effect on income of the dairy farmers and is significant at 5% and 1% probability level for three situations. But it should be mentioned that income of the contract farmers is higher (Tk.43, 849.913) than non-participation in contractual arrangement. The results of overall impact of the income effect of the contractual arrangement indicted that Tk. 73095.50 will higher for literate farmer than the illiterate farmer. This result is plausible and suggests educated farmer gets the higher income than the illiterate farmer because educated farmer are more conscious about the participation at contractual system. However, (Jabbar et al., 2009) study found that, better educated milk producers had lower intend to participate in contractual arrangement.

In addition to that, herd size (number of dairy cows) had a significant and positive impact on income of the dairy farmers and is significant at 5% and 1% probability level for participation and non-participation and overall impacts of contractual arrangement situations of investigated dairy households. This results also conformity with the (Jabbar et al., 2009). Moreover, the statistically significant and positive relationship between two (participation and non-participation) aspects illustrate that income of the contract farmers is higher (Tk.10, 739.087) than non-participation in contractual arrangement. The result also elaborates that one-unit change in the number of cattle (dairy cows), the income of the contract on an average was increased by Tk.10, 739.087 per year per dairy farm rather than the non-participation in contractual arrangement. Higher the number of cattle (dairy cows), higher the income of the respondent. The borrowing of dairy farming has a positive impact on the dairy producer's income and is significant at 5% and 1% probability level for participation and non-participation of sampled dairy farms. The result suggests that as change in the borrowing status of the contractual respondent on an average income was increased by double the amount Tk. 80023.385 per year rather than non-participation. The results also indicated that the more income family gets the loan easily from the different sources. Furthermore, overall impact of the income of the dairy farmers for participation in contractual system of PRAN dairy ltd was increased by Tk. 55334.016 per year rather non-participation of samples farmers and this contract variable significant at 1% probability level.

Table-6. Stepwise regression results on contractual arrangement on income of dairy farmers.

Variables	Factors affecting income of contract farmers				Factors affecting income of non-contract farmers				Impact of contractual arrangement on income of dairy farmers			
	Co-efficient	Std. Error	Sig. level	VIF	Co-efficient	Std. Error	Sig. level	VIF	Co-efficient	Std. Error	Sig. level	VIF
Constant	-34686.349	41778.970	0.411		-8454.596	15744.49	.594		-47863.99	20053.46	0.019	
Education	92275.098**	35478.340	0.013	1.388	48425.185***	15064.68	.003	1.115	73095.500***	19084.18	0.000	1.237
Herd size(dairy cows)	56157.610***	12246.581	0.000	1.395	45418.523***	6426.845	0.000	1.119	51726.057***	7125.239	0.000	1.408
Borrowing	80023.385**	31279.618	0.014	1.079	35055.565***	13130.44	0.011	1.031	54264.749***	16571.87	0.002	1.049
Contract (1=Yes, 0=No)									55334.016***	18097.75	0.003	1.274
Number of Observation		45				45				90		
Durbin Watson		1.98				2.029				1.956		
F statistics		23.56***				32.943***				49.162***		
R Square		0.594				0.707				0.668		
Adjusted R Square		0.564				0.685				0.653		

Note: Dependent Variable: Income (Tk. /year).
, * indicates significant at the level of 5% and 1% respectively.

3.11. Markets Access

More regulated "formal" markets and "informal" markets with few rules and regulations were identified in the study area. Maximum smallholder's dairy farmers can easily access the informal markets because they do not need to be worried for paying tax and are often off-record. Generally, in these markets there exist no traceability, no formal grades, hardly do they follow standard measures, and prices are set through demand and supply combinations, trader cartels, and local customer loyalties to specific sellers.

However, those milk producer's participation in PRAN dairy contractual system then they follow the Formal markets. These markets can establish a linkage between the more competitive smallholder farmers with PRAN Dairy Ltd. Formal market extends the smallholder farmer's potential for growth and development. The PRAN dairy ltd (formal markets) provides an opportunity for small dairy farmers to create a link with consistent income source and with clear market information coming from the buyers.

4. CONCLUSION AND RECOMMENDATIONS

In dairy sector, contractual farming is emerging in Bangladesh whose economic significance are getting momentous in the modern food policy. The study indicated that contract system is more profitable as compared to non-contract or independent dairy farming in case of income.

Contract farming in dairy also keeps its contribution for improving milk yield and reducing production costs. It has also increased competition in local milk markets. Factor analysis explained the associated factors that influence dairy farmers in participating in contract system. Among seven variables, stable price for output, timely payment for output and access to good quality inputs are the most important factors which influence farmer's participation in the dairy contractual system. In spite of providing higher profits, not all the dairy farmers participated in it.

Under weighing or reporting of fat, lower price of milk than the market price, distance to the location of milk collection centers, sell at home, different rules of PRAN Dairy Ltd., availability of dairy farmers are the main reasons for their unwillingness to participate in contractual system.

From the empirical findings of this study, the following steps may be taken to put forward for formulation of different policy with a view to improve the existing situation of the dairy farmers;

1) Different rules of contract firms to engage the milk producers must be easier for the stallholders to take participate more in the arrangement.
2) Public policy need to increase awareness among small milk producers about the possibilities of market access through collective or group action and by initiating regulatory actions to provide incentive and encouragement to processing enterprises.
3) Contract farming would be the most effective way of integrating smallholder dairy farmers into local markets by a contractual arrangement by setting up more milk collection points near to the dairy farms for accessing the formal markets.
4) Diversify and better integrate of farm businesses in order to extend the number of smallholder's participation in contractual system. Besides, Governments and Non-government institution should develop subsidized inputs and better livestock extension services for uplifting living standard of farm households.

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