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IMPACT OF DAIRY SUPPORT SERVICES AND STRATEGIES ON REDUCTION OF COST OF MILK PRODUCTION IN DIFFERENT DAIRY PRODUCTION SYSTEMS IN BANGLADESH: IMPLICATIONS FOR RURAL LIVELIHOOD IMPROVEMENT

M.M. Uddin[1*], T. Hemme[2], O.A. Ndambi[3], N. Sultana[1], and M.J. Khan[1]

[1]Department of Animal Nutrition, Bangladesh Agricultural University
[2]IFCN Dairy Research Center, University of Kiel, Germany,
[3]International Livestock Research Institute, Nairobi, Kenya

*Corresponding author: *mohammad.uddin@bau.edu.bd*

ABSTRACT

The objective of this study was to analyse the impact of set of dairy supporting policies within the framework of the government 'National Livestock Development Policy (NLDP)' on the potential for reduction of cost of milk production in small-scale dairy farmers under different production systems. This study further aims at identifying the link among increasing household income and rural livelihoods-thus reducing poverty. This study applies the method developed by the International Farm Comparison Network (IFCN). The underlying principle of this method is the application of the concept of 'Typical Farm Approach (TFA)' and Technology Impact Policy Impact Calculations (TIPI-CAL) model. Three typical farms from three production systems (e.g. extensive, intensive and traditional) were selected from three agro-ecological zones. The required data collection was done in two steps: first, the data were collected from three baseline typical farms (status quo) operating without policy by applying the 'Panel Approach'. In the second step, 10 different dairy supporting policy scenarios and technologies were simulated and applied in each of the base line farms in each production system and data were collected from 30 farms using the base farm as the status quo farm. The data were analysed by utilizing the extended version of TIPI-CAL (Technology Impact Policy Impact Calculations) model (TIPI-CAL software version 5.1). The results showed that improved dairy support services: improved veterinary services (IM-VHS), improved marketing access (IM-MKS), improved feeding and nutritional services (IM-FNS), community based fodder production system (CB-FPS), national breeding programme (NL-BRP) showed the highest impact on increasing milk productivity, decreasing milk production cost, increasing income from dairy and overall household income in all three production systems compared with base line farms. However, the magnitude of the impacts substantially differs among the production systems. This study also reveals that that there is a direct link among increasing income and reducing poverty since the household income increases as a result of implementing dairy support services to a level above the poverty line (1.9 US$/day equivalent to 147.96 BDT). This study results could be useful for prioritizing the policies on delivery of support services and technology and are expected to be helpful as a benchmark to implement the 'draft policy proposal' by the Ministry of Fisheries and Livestock (MOFL) in Bangladesh.

Keywords: *Dairy support policy, cost, milk production, rural livelihood, typical farm, poverty*

INTRODUCTION

The increased demand for milk and milk products because of burgeoning population growth, rapid urbanisation and rise in absolute income are considered an opportunity for increasing market demand for the small-scale dairy farmers (Delgado *et al*., 1999; Ahuja and Redmond, 2004). To exploit these opportunities, small-scale dairy farmers need to be more competitive by reducing the costs of milk production and thus increasing the profitability (Ndambi *et al*., 2009a). In addition, small-scale farmers need to be linked to the high-value market to gain significant higher economic benefits from the value-added products. But, small-

scale dairy farmers are facing multi-faceted problems: limited knowledge and skill; lack of access to market information; inefficient links between smallholders and market, lack of extension services, lack of inputs and technology, absence of a conducive policies targeting small-scale farmers and lack of favourable institutional framework (e.g. formal contract between producers and input suppliers and processor; stakeholder's interaction, etc.) (Birthal *et al.*, 2007; Shamsuddin *et al*., 2007; IAEA, 2010). Adequate policy support might play an important role to strengthen their market linkages (Birthal *et al*., 2007) in order to bring the smallholders in line with larger farmers for reduction of costs and profit by providing mechanisms to address those problems toward enhancement of production. The development of dairy industry, thus, depends on the ability of the small-scale farmers to improve their production systems, on appropriate policies, and on the rate of technology adoption at farm level. To tackle such complexities in farming system and its development, research is necessary that focus not only on productivity but also consider the production environment confronted by the farmers. This requires the use of a holistic appraoch (e.g. policy, technology adoption, institutions and farmers' participation) for dairy development because variations between cultures and economic circumstances define local options for further development of smallholder dairying (Falvey and Chantalakhana, 2001).

Cost of milk production especially the estimation of cash and economic costs is the key indicator for sustainable dairy farming (Van Chalker, 2005) as well as the means of measuring overall economic competitiveness both factor and product market, locally and internationally (Thorne, 2004). Therefore, to remain competitive, dairy organizations and farmers must strive to reduce costs at farm level (Koonawootrittriron *et al*., 2012).

Furthermore, the cost is associated with profit and the higher profitability is associated with less likelihood of leaving dairying (Brag and Dalton, 2004). The Farm Accountancy Cost Estimation and Policy Analysis of European Agriculture (FACEPA) 2008 considered that comparison of the product cost structure between farms (in the same region or in different ones) could lead to greater efficiency in the production process of individual farms, and thus in addition, the benchmarking process could be used for different time periods. The importance of using farm costs and calculation for policy formulation is also increasing over time, as the policy makers can decide to what extent the farmers should be supported. In this regards, the cost calculation is considered a "help tool" that supports the decision-making process on future investment on the farms, develops strategies within and among the competitors nationally and internationally, and thus, facilitates the evaluation of the competitiveness of the dairy sector.

As the cost of milk production is the key driver for profitable dairy farming (Uddin *et al*., 2010) this might also be linked with higher income. Reducing cost might be a good option for increasing profit, more household income and thus, might play key role in improving rural livelihoods. This study aims to apply set of dairy policies on the farm level in order to find whether the adoption of improved dairy support services would reduce the cost of milk production or not. Therefore, the objective of this study was to analyse the impact of set of dairy supporting policies within the framework of the government 'National Livestock Development Policy (NLDP)' on the potential for reduction of cost of milk production in small-scale dairy farmers under different production systems. This study further aims at identifying the link among increasing household income and rural livelihoods-thus reducing poverty.

RESEARCH METHOD

Choice of Policy approaches

There are several methods and approaches available for analysing the impact of agricultural policy on farm level. Most of the methods are based upon the principles that apply to developed countries. The replication of those methods in the developing countries, like, Bangladesh, would be problematic due to distinct differences of dairy production systems, (e.g. complexity of the production environment and different production environment). The applications of particular tools are solely determined by the country to be analysed (Ndambi *et al*., 2009). In this case, TIPI-CAL model is suit for analysing dairy development policy in Bangladesh because it was built and validated for global

application. The TIPI-CAL model has been applied in three prominent areas: the Baseline approach, where the impact of a single policy is analysed on one typical farm type over a period 10 years; the Static approach, where the impacts of several policies on several farm types are compared for a single year; and the Dynamic approach, where several policies are studied on one typical farm type for ten years (Ndambi *et al*., 2009). This study uses the concept of Static approach (SA) because this study analyses several policies in several typical farms in a single year.

Method of analysis

The methodological procedure on policy scenario development and its simulation at farm level on analysing milk yield, cost of milk production, household income (off-farm and income from dairying) and comparing household income with poverty line was done following the method of International Farm Comparison Network (IFCN) developed by Hemme (2000). The underlying principle of this method is the application of the concept of 'Typical Farm Approach (TFA)' and Technology Impact Policy Impact Calculations (TIPI-CAL) model. Three typical farms from three production systems (e.g. extensive, intensive and traditional) were selected from three agro-ecological zones. The required data collection was done in two steps: first, the data were collected from three baseline typical farms (status quo) operating without policy by applying the 'Panel Approach'. The background information of the base line farms is depicted in Table 1.

In the second step, 10 different dairy supporting policy scenarios and technologies were simulated and applied in each of the base line farms in each production system and data were collected from 30 farms using the base farm as the status quo farm (Table 2). However, the detailed methodology that was applied in this study is also found in their previous work (Uddin *et al*., 2012) and the cost of milk production was estimated following the method of Hemme *et al*. (2014).

Data analysis

The background information of the baseline farms and the description of base line farms and policy scenarios are depicted in Table2. The data were analysed by utilizing the extended version of TIPI-CAL (Technology Impact Policy Impact Calculations) model (TIPI-CAL software version 5.1).

Table 1. General description of the typical farms in three regions in small-scale dairy farmers

Farm description (Typical farm name)	Unit	Farming systems		
		BD-2DP	BD-4SG	BD-2KG
Farming systems	text	Small-scale extensive	Small- scale intensive	Small- scale traditional
Cows number	no.	2	4	2
Breed	text	Local	PMC and cross bred with Holstein and Jersey	Local
Milk yield	kg ECM/cow/year	721	1408	741
Land base	ha/animal	0.25	0.06	0.13
Labour input	LU	1.03	2.10	1.36

LU = Labour Unit (1 LU = 2100 hours)
The number associated with the code indicates the number of cows
PMC = Pabna Milking Cows
Source: Uddin et al. (2010)

Table 2. Description of different policy scenarios that was simulated and applied to analyse the impact of these scenarios in this study

Base line farms		
	Descriptions	Production systems
BD-2 DP	Bangladesh two cows farms from Dinajpur	Extensive
BD-4SG	Bangladesh two cows farms from Sirajgonj	Intensive
BD-2KG	Bangladesh two cows farms from Kishorgonj	Traditional

Policy scenarios		
Policy areas	Policy scenarios (PS)	Descriptions
Feeding management	PS 1	*CB-FPS* (Community-based fodder production systems)
	PS 2	*KW-IMG* (Knowledge on improvement feed management)
	PS-3	*PR-UFL* (Promotion to use fallow land)
	PS 4	*TE-UMS* (Technology to use urea-molasses straw)
Animal health management	PS 5	*CB-VCL* (Community-based veterinary clinic)
Animal breeding management	PS 6	*NL-BRP* (National livestock breeding programme)
Dairy development programmes	PS 7	*ES-COP* (Establishment of cooperatives)
Delivery of improved dairy support services	PS 8	*IM-VHS* (Improved veterinary health care services)
	PS 9	*IM-MKS* (Improved marketing services)
	PS 10	*IM-FNS* (Improved animal feeding and nutrition services)

RESULTS AND DISCUSSION

Milk productivity

The impact of dairy policies on milk production has been depicted in Figure 1. The delivery of improved veterinary services (IM-VHS) showed the highest impact on increasing milk yield by about 23% in intensive and traditional dairy production system. On the other hand, the policies on community participation in fodder production (CB-FPS) in extensive and intensive (20%) while this impact is different in traditional system where the improved marketing system (IM-MKS) is responsible for increasing milk yield (16.7%). This is due to the fact that the current marketing system is not well developed in this system and the farmers has to travel at least 6 km to go to the nearest milk market (Uddin *et al*., 2014).

The positive impact of the dairy supporting policies in this study are comparable with the study done by Othman *et al*. (2010) who also found an increase of milk yield by 32.06% as a result of implementation of livestock support policies on farm levels. An increased milk yield might bring the opportunity for farm household to increase household consumption of milk (especially for the children) which improves the household health status, and increase sales. Correlation coefficient of 55, 60 and 62% between milk yield and household income were obtained for extensive, intensive and traditional production systems, respectively, implying that provision of supporting policies on milk yield is also beneficial for improving the household income as milk yield is directly related to cash income (Conroy, 2005). This indicates that adoption of technology and support services on farm level have potential to increase milk productivity but it is highly influenced by the adopters' characteristics.

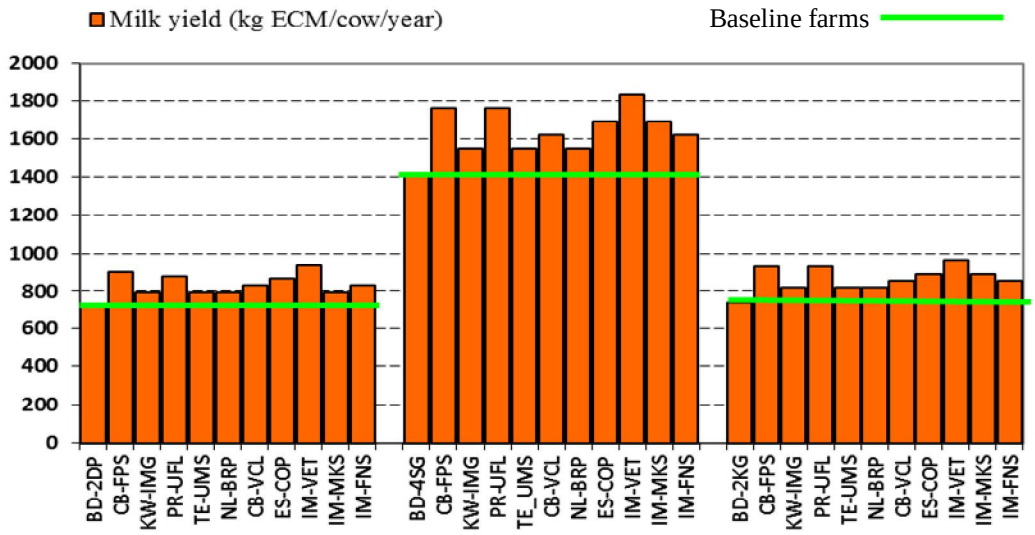

Figure 1. Impact of dairy supporting services on milk productivity in different dairy production systems

Cost of milk production

The 'cost of milk production only' refers to the cost related only to milk production. The estimation is modelled on the Profit and Loss (P&L) account. The cost is derived by subtracting the expenses for Non-milk returns from the P&L account. The P&L account is related to the total returns of the dairy enterprise including milk and non-milk returns (cattle returns and coupled direct payments).

The cost of milk production in baseline farms and the effect of policy scenarios on cost of milk production is depicted in Figure 2. All of the policy scenarios were found to have effect on the reduction of the cost of milk production in all three production systems. Similar with milk yield, IM-VET is highly linked with reduction cost of milk production; however, the level of reduction varies

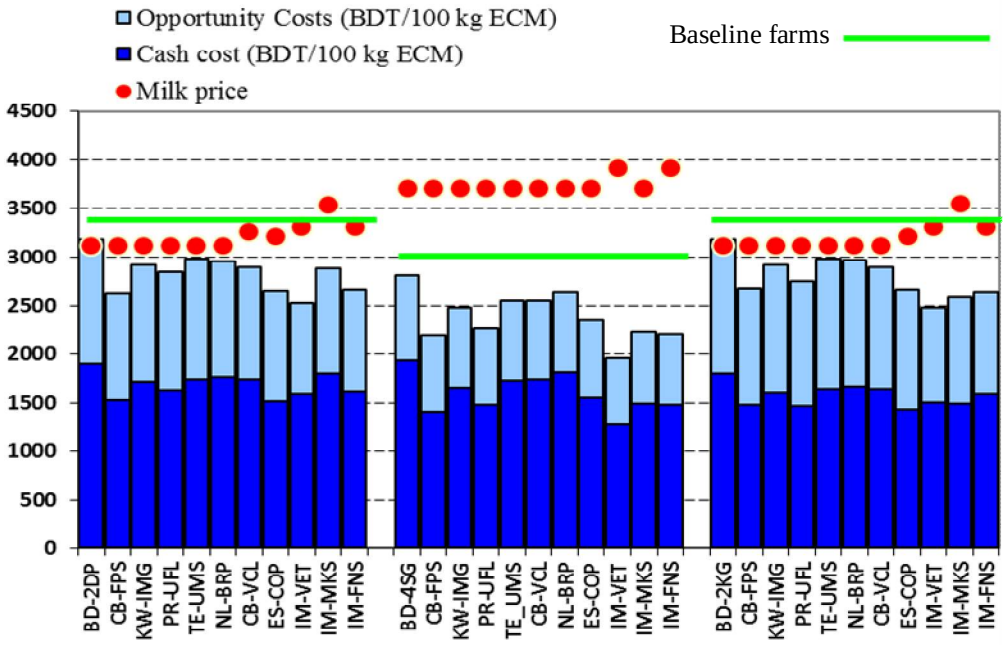

Figure 2. Impact of dairy supporting services on cost of milk production in different dairy production systems

significantly. The highest cost reduction is found for intensive production system (-43.1%) followed by traditional (-28.2% and extensive system (-25.8%). The CB-FPS is the second determinants for reducing cost in milk production in intensive (-27.9%) and extensive system (-20.8%) while the IM-MKS is for traditional system (-22.8%).

In addition, a comparison of the cost of milk production only and the milk price affords a good perspective of the profitability of the farms. Producing milk at a competitive cost is the overall goal of a sustainable dairy production system. This is also highly linked with increasing overall household income. In an era of an increasing feed price and a fluctuating milk price, the global dairy industry is becoming more and more competitive while farmers face difficulties to adjust their production system to keep a competitive position. This implies that it is necessary for farmers to understand the global, changing and dynamic input and output market. The results of this study have shown a number of important implications both for dairy farming for different regional and national level dairy industry.

Household income

The household income model indicates that off-farm income plays a vital role in determining the household income (household income is the sum of income from off-farm and income from dairying). The contribution of different policy scenarios on the household income is depicted in Figure 3. The proportion of off-farm and income from dairying are 68 and 32%, 37 and 63% and 72 and 28% for extensive, intensive and traditional system, respectively. CB-FPS and IM-VET has the highest potential for increasing the household income in extensive and intensive dairy production systems. However, the baseline farm can reach up to 24% more income which is mainly possible due to ensuring of IM-VET services in intensive production systems. In contrast, the IM-MKS has the potential to increase household income in traditional production system.

This study reveals that even with the limited alternatives jobs for dairy farmers and low average wage rates implies that off-farm income plays substantial role in total household income (Uddin *et al.*, 2012). Simultaneously it also reveals that dairy has the potential to increase income for poor once the supporting policies are identified, prioritized and implemented on farm level (Kasirye *et al.*, 2006; FAO, 2010).

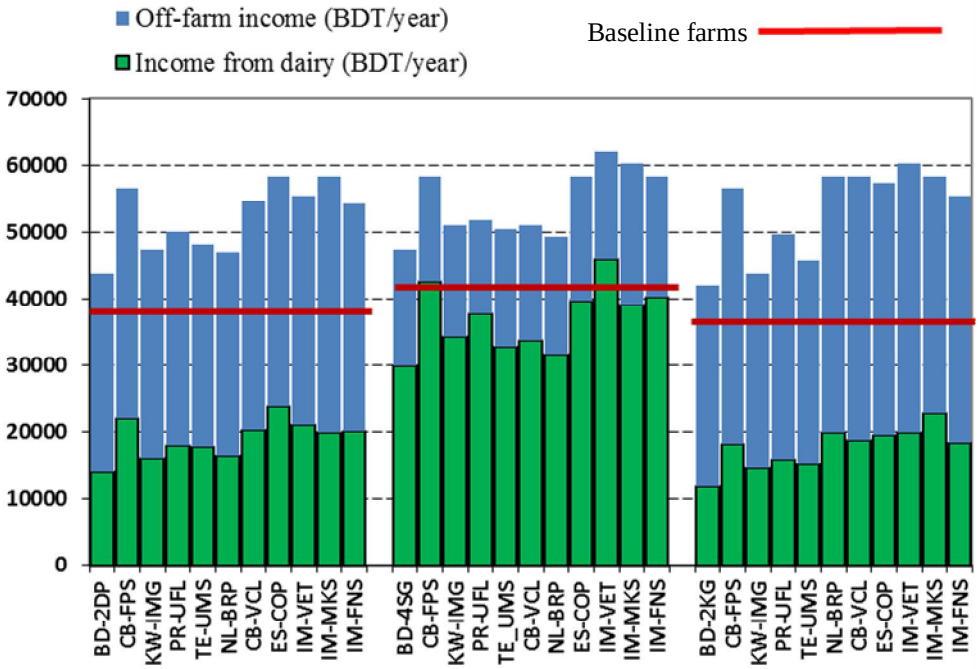

Figure 3. Impact of dairy supporting services on total household income (dairy income and off-farm income) in different dairy production systems

The strategy for dairy development lies on the fact how much dairy only contributes to the household income. The baseline farms showed that intensive dairy farming contribute double (63%) than extensive (32%) and traditional (28%) system. The highest impact is observed for IM-VET and CB-FPS. The share of income from dairying (%) compared with total household income is shown in Figure 4.

The rural livelihood improvement has the objective to uplift the income level to at least 1.9 US-$ per day[1]. Policy without targeting the livelihoods of the farmers have adverse effects on rural livelihoods as it is found in Hemme and Uddin (2009) who found that an increase of export subsidy by 5€ per 100 kg Skimmed Milk Powder (SMP) adversely affect the livelihoods of 7 million farmers in Bangladesh and 0.45 million farmers in Germany. Therefore, policy that favours to increase household income per day bears tremendous significance to reduce rural poverty and it might be well accepted by the farm community and donor agencies.

Link between cost of milk production and household income and rural livelihoods

The impact of various policy scenarios were simulated for estimating the potential of increasing household income to level above the poverty line[2] which is depicted in Figure 5. It is clearly evident that the household income in all three base farms was below the poverty line (Figure 5) which has been increased through adoption of dairy supporting policies at the farm level. The highest increase in household income was observed for IM-VET (12.5%) in intensive production systems. The supporting policies that were able to uplift the income to above the poverty line were found for CB-FPS (4%), CB-VCL, IM-MKS and IM-VET.

Cost of milk production is the main component of the dairy chain, and is therefore used as core indicator for benchmarking dairy farms worldwide. In this way, estimating costs of milk production can be used to understand the competitiveness of the dairy production in different regions and production systems (Hemme *et al*., 2014). As it is seen in the figure 2 that the IM-VET causes the highest cost reduction, this stands true while it is linked with increasing household income. This has also reflected that this kind of services has high potential to reduce cost and increase rural livelihoods and thus reducing poverty.

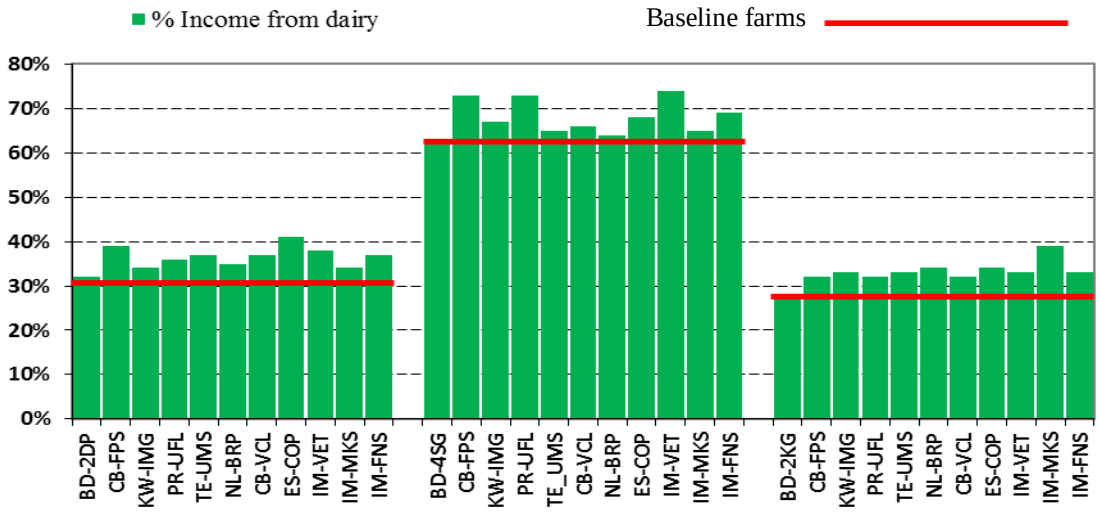

Figure 4. Share of dairy income (%) to the total household income in different dairy production systems

[1] The poverty line is called International poverty line defined according to Millennium Development Goal objectives of having an income of at least 1.96 USD per day.

[2] In October 2015, the World Bank defines the International Poverty line to US$ 1.90/day/person which is equivalent to 148.96 BDT/day/person (*Source*: Bangladesh bank, 1 US$ = 78.4 BDT)

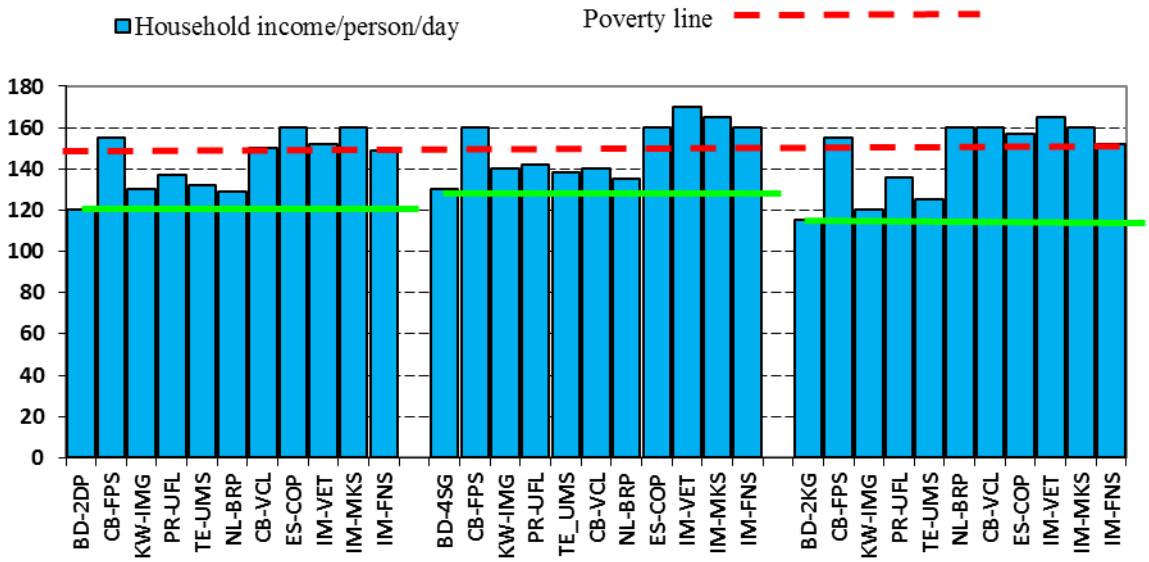

Figure 5**.** Impact of dairy supporting services on rural poverty only in different dairy production systems

Implication for the design of sustainable poverty reduction strategy locally and internationally

In Bangladesh, the empirical findings of this study are of great significance to the sustainability of the dairy production as well as improvement of rural livelihoods. This is because dairy production systems in Bangladesh, like many other tropical farming systems, especially in South Asian countries, are faced with enormous problems in securing adequate inputs and support services due to a weak infrastructure, high transaction costs leading to high factor and low output prices. Lack of a suitable policy framework is considered as a potential barrier for improvement of the dairy value chain (Jabbar *et al.*, 2010), which drives the dairy farmers far below the international competitive level. Providing a conducive policy framework can increase the level of farm profit and the livelihoods of dairy farmers as shown by Garcia *et al.*, (2006) and Hemme and Uddin, (2009). This requires the development of national policies targeting small-scale producers to have similar access to technologies and support services which might be helpful for economic, social and political development as it is observed in the case of participation of women and development in Benin by improving productivity and efficiency (Kinkinginhoun-medagebe *et al*., 2010).

The study results showed that improvement of veterinary services, milk market and nutrition services play a profound role in reducing cost of milk production and increasing household income. It should be taken into consideration that those technology and service related policies will only be adopted once farmers perceived it as advantageous (Batz *et al*., 2003) and cost effective for their farming systems. The adoption of new technology (e.g. improved services and fodder production) is highly influenced by the relative utility of the new technology, initial costs and its payback period (Batz *et al.*, 1999). The results obtained from this study are quite helpful to the process of priority setting by the development organization while designing policy and technology packages for improvement of dairy production in the country' poverty reduction strategy (ADB, 2001).

CONCLUSION

This study results reveals that adoption of dairy supporting services and policies is of highly beneficial to the overall cost reduction strategy in milk production. Among 10 policies, four most important policies are IM-VET, CB-FPS, IM-MKS, IM-FNS are of highly potential for productivity, cost reduction and increasing household income. Comparing with production systems, traditional and extensive systems are more responsive to the policies perhaps the resource endowment and input and

output markets not favouring especially milk marketing system is relatively poor in traditional system. This study also provides that in-sights that the more the income from dairying, the less from off-farm income which implies that policies and strategies should focus on improving dairy farming. The government poverty reduction strategy could be beneficial from this study as this study clearly showed the positive impact of cost reduction with increasing household income to a level of poverty line (1.96US$/day/person). Therefore, adopting new policy and technology would provide more utility as it is in line with the classical utility theory. In addition, the extensive and traditional farming systems are dominated by marginal farmers, which are the centre of poverty reduction focus. Nevertheless, these findings could be used as benchmark in order to design strategy for prioritizing policy and technology adoptions on farm level for further development of dairy sector.

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