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Effect of voluntary cooperativisation on livelihood capital of smallholder dairy farmers in the southwest of Bangladesh

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Abstract This study investigated the effects of voluntary cooperativisationas conducted by the Community-Based Dairy Veterinary Foundation (CDVF) on the livelihood capital of smallholder dairy farmers. An essential part of this cooperativisation was the provision of community-based paid extension service to the farmers by the cooperative. The sustainable livelihood approach was used to analyse livelihood capital. A simple random sampling technique was used to gather data from 255 respondents: including 15key informant interviews, 5 focus group discussions and 5 case studies. Almost all of the farmers felt that the paid service was profitable. Equal portion of farmers realised moderate (49.80%) and high gains (50.20%) from CDVF. Most significant improvements occurred in physical, financial and human capital resources. CDVF has increased production, and improved farmer-to-market linkage maximised profit and income. Farmers reinvested their improved income in physical assets development. Farmers gained considerable knowledge, skill, employment, voice, intensified social networks, green homesteads and livelihood security from the CDVF services. The complementary effect of all five forms of livelihood capital strengthened the assets pentagon of the participating farmers. Regression results affirm that gender, education, distance from CDVF centre, amount of extension communication, increased milk production and higher income are the determinants of farmers' improved assets base. CDVF needs to professionalise its management and corporate strategy, and their successful voluntary cooperativisation model needs to be promoted and encouraged by all including the State.

Keywords Livelihood assets · Empowerment · Public extension · Veterinary services · Vulnerability · Farm cooperatives

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Introduction

Traditional dairy farms are predominantly smallholder-based, with a herd size of 1 to 6 cows. The smallholder farmers of Bangladesh produce about 70 to 80% of the nation's dairy milk and the present per

capita milk consumption in Bangladesh is 52 g day^{-1} (Uddin et al. 2011). The daily requirement (250 g/day/person) indicates a need for rapidly-increased dairy milk production of the country. This need will increase with increasing population growth (Hemme 2010).

Consequently, the need for dairy extension service and efficient dairy production schemes will increase day-by-day (Uddin et al. 2016a).Despite the growing contribution of the dairy sector to the national economy and nutritional security, the dairy extension[1] needs of smallholder producers are not getting due attention from policymakers (Uddin 2015). Especially the State dairy extension has failed to offer a profitable market price to smallholder milk producers due to the existing policy of powdered milk importing (Uddin et al. 2016a). State extension policy cannot ensure quality feed and medicine at a fair price for smallholder dairy farmers of the rural community. Electricity subsidy policy favours only the processing plants, with only a 20% reduction in electricity cost (Uddin et al. 2011). Smallholder farms are treated as households which need to pay the high-rate electricity charge. Limited staff cannot ensure a need-based dairy veterinary service.

The dairy extension service is not specialised at the grass-roots level. It is a part of the common livestock services of the Ministry of Fisheries and Livestock (MoFL). The Department of Livestock Services (DLS) of the MoFL is responsible for serving the livestock farmers of Bangladesh. However, DLS is often criticised for inadequate and infrequent service delivery to the farmers. The service is neither demand-driven nor client-responsive (Uddin et al. 2016a). The mentionable services of DLS are Artificial Insemination (AI) and vaccination, and that only meet 6.5% and 10% of total national demand for those services, respectively.

[1] Under the national livestock extension policy of Bangladesh, dairy extension can be defined as a holistic set of services or systems which facilitates farming through an informal education process for farmers. It assists the access of dairy farmers, their organizations and other dairy market actors to obtain knowledge, information and technologies necessary to interact with partners in education, research and dairy business. It also assists them to improve their human and social skills and practice with a view toward improving animal healthcare, public health awareness, productivity, profitability and livelihoods as well facilitating behavioral change for these purposes.

Livestock extension service by NGOs is sporadic, as it depends on donor funds. The private sector, especially the dairy companies, offer some support but only to their contact farmers, where profit is the main target rather than the wellbeing of the farmers (Uddin et al. 2016a).

Over the last decade, the public extension has been increasingly facing criticism for delivering poor service (Haq 2011; Haq 2013; Uddin and Gao 2013; Uddin et al. 2016b; Rashid and Gao 2016 Fund shortage has been the chief cause of this problem. Most funds go for salaries of the staff, leaving only a tiny percentage for field functions (Uddinet al. 2016a; Birner et al. 2010).

The *Upazila* (Sub-district) Veterinary Hospitals (UVH) act as the nucleus of DLS' activities at the grass-roots level. Only one veterinary surgeon is assigned to a UVH for approximately 150,000 animals. Thus, service delivery at the grass-roots level is inadequate and infrequent. There is little evidence of market extension service delivery by public extension, which is very important for the flourishing dairy sector. Therefore, an alternative method of sustainable service delivery to the farmers is needed (Uddin 2015).

Uddin et al. (2016a) evaluated several approaches for the delivery of extension services and concluded that there are two options for facilitating smallholder dairy farmers with demand-driven services. The first one is increasing access to state extension service by recruiting sufficient extension workers. The second one is promoting farmers' organisation-based extension, which gives farmers affordable access to demand-driven services.

The Community-based Dairy Veterinary Foundation (CDVF) is a farmer-based organisation, structured like a cooperative, which is offering such an innovative service. Although community-based approach transform the social innovation for sustainable livelihoods (Castro-Arce and Vanclay 2020) and the ultimate goal of the extension is to improve the livelihoods of its clients, right now, CDVF has no robust impact monitoring system for their primary stakeholders' livelihoods. Livelihood as a basic concept is the people's capacity of maintaining living. It comprises capabilities, assets and activities for a means of living (Chambers and Conway 1992).

Livelihood study other than CDVF shows that it has moderately reduced vulnerability of the smallholder dairy farmers (Uddin et al. 2017). Uddin et al. (2016c)

in another study portrayed positive livelihood outcomes of farmers by CDVF. A recent study reviewed that as a farmer-based organizsation CDVF has positive effect on farmers overall livelihood with no specification on context, assets and outcomes (Uddin et al. 2016a). Lamentably little focus is found on influence of extension services on livelihood capitals of smallholder dairy farmers in farming decisions. However, it is obvious that the farming decisions and productivity of the composite crop-forestry-livestock system is significantly influenced by access to livelihood capitals (Yang et al. 2019). On the other hand, all over the developing world, the existing state politico-legal structure and process do not provide assurance of ample access to all required livelihood capitals (Sikor and Lund 2009). Agricultural extension and development research pays little attention in measuring the effect of services on access to and control over the livelihood capitals (Uddin 2015; Ayele 2019).

The idea of livelihood capital is central and starting point of poor people's livelihoods. Livelihood capital has immense influences on total livelihood and it helps building livelihood strategies for actions (Luqman et al 2018; Rubavel 2019). Access to livelihood capitals helps poor coming out of poverty (Lawal et al. 2011) and offers better livelihood outcomes (Nair et al. 2007). The most visible and illuminated component of some one's livelihoods is livelihood capitals (Rubavel 2019) and the invisible "black box" is the transforming structure and process. However, people gain better ability to influence the structure and process when they achieve better access to capitals (Carney et al. 2000). Therefore, understanding the status of livelihood capitals is imperative in an impact study.

Moreover, there is a shortage of scientific studies of paid extension, cooperativisation and their impacts on the livelihoods of the smallholder dairy farmers of Bangladesh. Therefore, this paper is concerned with how the CDVF voluntary cooperativisation model impacts on the livelihood capital of the smallholder dairy farmers and how its perceived effect varies with personal attributes, farm characteristics and the nature of extension delivery.

The CDVF model

The Community-based Dairy Veterinary Foundation (CDVF), as a permanent organisation, has been offering paid extension services for more than seven years. But CDVF is more than just typical agricultural extension service for a fee: it is a total one-stop solution for poor farmers seeking to sell their milk.

The CDVF model was developed by the Department of Surgery and Obstetrics of Bangladesh Agricultural University (BAU) during 2005-2006. Through funding by the United States Department of Agriculture (USDA) and the International Atomic Energy Agency (IAEA), some farmers were organised in selected areas of Satkhira district and scientific dairy-veterinary services were provided to them.

Farmers' demand for the CDVF services in Satkhira was considerable. Considering the demand and the importance of quality services in increasing national milk production, the sustainability of the services was sought. Thus, paid services were provided to the smallholder dairy farmers at the end of the project's funding. In the year 2009, with the help of farmers' associations and certain faculties of BAU, the CDVF was developed and registered under the Societies Registration Act. From its inception to date, CDVF has offered paid services to the smallholder dairy farmers' groups.

Yet CDVF quickly progressed beyond the fee-for-service model. CDVF organised farmers into Common Interest Groups (CIGs) and associations. The purpose was to ensure the farmer-to-farmer extension of farm information and empower them in accessing and utilising quality services. CDVF offers advisory services, inputs on a fair price and breeding services. It also arranges training and field functions to educate and motivate farmers.

CDVF services are offered in two ways. A community veterinary assistant and a veterinary surgeon regularly visit the farms and homes of the farmers. A typical farmer-client gets one to two CDVF visits a month. The charge for regular visits is 1 BDT[2] for each litre of milk sold in a month. For example, if a farmer sells 300 L milk in a month; his service charge

[2] BDT is the currency of Bangladesh and popularly known as Taka. 1 USD = 84.66 BDT (source: https://www.xe.com/currencyconverter/convert/?Amount=1&From=USD&To=BDTOctober 31 2019).

could be 300 BDT. So, service charge increases with the increase of herd size and production and is thus "progressive", based on ability to pay.

The CDVF charge is paid by the processor,[3] not the farmer. From this concept, the CDVF rapidly became almost a collective bargaining organisation for farmers. CDVF signed a contract with a profitable nationally-known milk production and distribution company, Aarong Milk, whose products are in most little shops, especially in cities like Dhaka and Chittagong. The contract specified fair milk prices for farmers. The processor also offers bonus money to farmers, which usually goes to middlemen when the CDVF is not involved. The bonus is paid at three-month intervals. The amount of premium depends on the amount of milk sold (at a rate of 1 BDT/Litre^{-1}).

CDVF also offers emergency visits. The visitation fee for emergency visits is higher (100 BDT visit^{-1}). Still, CDVF's emergency service charge is less than that of other private animal health care services.

With the help of CDVF, the processor (Aarong) has employed milk collectors, who get 1.7 BDT for carrying each litre of milk to the chilling plant. CDVF also sells some essential inputs like feed, calcium supplement, vaccines, medicines etc. to the farmers (Fig. 1).

CDVF members sell about 15,000 L of milk each day throughout the country. Therefore, the per-day income of CDVF is about 15,000 BDT. The money earned from emergency visits, milk sales commission and input sales is used for the salary of the staff and office rent. A paid veterinary assistant and a veterinary surgeon can is all that is needed to offer CDVF services in a community if at least 200 organised farmers sell milk in that community. The processor, under contract with CDVF, does the rest of the work.

[3] The processor belongs to a private company, Aarong Dairy, which is one of the largest wholesale distributors of milk products in Dhaka and other large cities of Bangladesh.CDVF has an agreement with milk processors to buy milk from the farmers' associations at fair prices.

Methods

Conceptual approach of the study

The research process moves through two main phases—conceptualization and operationalisation before it reaches to the boundary of conclusion (Uddin 2015). Conceptually the study proceeds with the livelihood approach and later operationalised it with mixed-method research. The central preoccupation of livelihood approach is to understand how people of the varied geographical location make a living (Scoones 2009). Almost all, those who used the approached before, agreed that understanding livelihood capital limitations of the poor is crucial along with the risks they face and institutions and policies that shape the process (Hussein, 2002)."Capital" here means; **human capital; financial capital; social capital; natural capital; and physical capital. Human capital** can be health, nutrition, education, knowledge and skill, the capacity to work etc. **Financial capital** is income, savings, credit, wages etc. **Social capital is** composed of networks and connections with other farmers, relations of trust and mutual support, formal and informal groups, leadership etc. **Natural capital** is land and produces, water and aquatic resources, vegetation, biodiversity etc. **Physical capital** comprises transport, shelter, water supply and sanitation, energy, tools and equipment etc.

The influence of capitals and related factors can be found in the Sustainable Livelihood Framework (Serrat 2017). However, there is a little disagreement with using various SLF. Therefore, a flexible Sustainable Livelihood Framework (SLF) of DFID (2001) was matched with the farmers' livelihood as proposed by 'Secure Livelihoods Research Consortium' (Levine 2014). The starting point was "what farmers do" (which is different from others): followed by what influences their livelihood (context, assets, policies, institutions and structure); and what farmers achieve as a result (outcomes). To analyse the complex SLF the study had to follow the mixed-method approach for achieving triangulation (Sandelowski 2003) which provides a better understanding that a qualitative and quantitative study cannot do alone (Creswell and Clark 2006).

A structured interview schedule was prepared for quantitative data collection. In preparing the interview schedule, 2 FGDs were conducted with smallholder

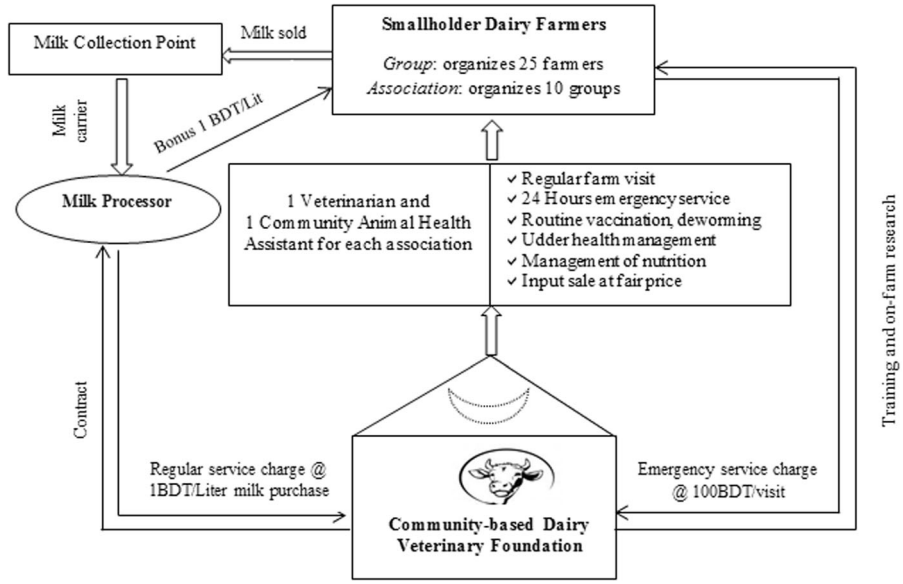

Fig. 1 Community-based dairy extension model of Bangladesh (CDVF model). Source: Adapted from CDVF in Uddin et al. (2016a)

dairy farmers before collecting the final data. The FGDs helped to prepare a checklist of farmers' types of livelihood capital, which were further accommodated in the interview schedule. Qualitative data were collected through in-depth interview of the key informants, using a semi-structured questionnaire. Moreover, five case studies and five FGDs were also conducted to identify and describe the trajectory of livelihood capital development. Each FGD consisted of ten smallholder dairy farmers, including both males and females. Case studies were recorded in story form.

The conceptual link of using socio-demographic factors (independent variables) in livelihood study has been adopted from SLF research operation map (Levine 2014). The map says that power relation is made up of identity (eg. age, gender, education, experience), context, process, trends (eg. income, milk production, extension media), institution, policies (eg. CDVF, Market, Paid Service) and access to livelihood capitals (assets bundle) which is further filtered through individuals' perception and determines the livelihood strategies and outcomes. Finally those determinants were regressed to precisely identify and generalise the effect of CDVF services on livelihood capitals of smallholder dairy farmers. The similar approach can also be found in a livelihood diversification research in Nepal (Gautam and Andersen 2016).

Locale, sampling and population

From the four zones where CDVF operates, the southwest zone, including Satkhira District, was selected purposively, as this zone has the highest number of CDVF milk-producing and marketing associations.

Satkhira has, as its southern border, the Bay of Bengal and, as its western border, India. Satkhira Sadar Milk Producing and Marketing Association (SSM-PAMA) was purposively selected for this investigation as this is the Association for the capital of the District, probably the largest market for milk in the District.

SSM-PAMA consists of about 1275 smallholder dairy farmers. These SSM-PAMA members have been considered as the population to be studied. Then, 20% of the population was selected by a simple random sampling method. Thus, the sample size was 255. Fifteen additional vital informants were identified by snowball sampling (following Hoque (2012) that could not be accessed otherwise (Mack et al. 2005). These key informants were five leaders of smallholder dairy groups, five key persons of the milk processor, including milk carriers, machine operators (fat testing and chilling), managers, and five key extension personnel including community veterinary assistants, community veterinarians, and the Regional Manager

and Executive Director of the CDVF. Although it is their programme and they might be held to have a conflict of interest which makes them less than objective, some extension personnel were considered key informants because of their complete knowledge about dairy veterinary services and farmers' problems as well.

Variables and measurements

The effect of CDVF services on farmer-clients' livelihood capital was the dependent variable of the study.

Farmers' perceived effect of CDVF services on their livelihood capital was measured using a 5 point Likert scale- Highly Increased (HI), Increased (I), Unchanged (UC), Decreased (D) and Highly Decreased (HD) with a corresponding score of 4, 3, 2, 1 and 0. The scale was checked with 25 items taking 5 from each of 5 forms of livelihood capital, following Pandey (2005). Thus, the effect of the CDVF services on any given farmer's livelihood capital was expressed on a scale of 0 to 100.

The use of Likert scale a tool to assess the effectiveness of an extension programme has been taken from Goswami and Paul (2011). Due to the lack of robust data from earlier years, perception of the respondent farmers and key informants was accepted to compare the past and present situations.

The Likert effect score of all the sample farmers was then classified into three low, medium and high based on the possible range 0 to 100. The missing class (Low) was then removed from the list. The classification was done to squeeze the 255 data into a generalisable form which makes better sense.

Although the higher number of the rating scale is more precise for quantitative estimation, it is equally complex to describe each and every point. In this study, it is difficult to give a meaning explanation of changing all 25 indicators of five capitals using the five-point effect scale (Highly increased to Highly Decreased). Therefore, the five-point is further reduced to three-point (Increased-Unchanged-Decreased) merging the extreme-end answers for easy and quick interpretation.

Farmers' socio-economic characteristics such as age, gender, education level, length of paid service, the distance of community extension centre from the farm, extension communication frequency, daily milk production, and household income were the independent variables. Here, the independent variables are diversified in nature and cannot be measured through a single scale. Hence, appropriate scales were developed for their valid measurement.

As the study aimed to assess how personal attributes, farm characteristics and the nature of extension delivery influence the effect on livelihood capital, those determinants were regressed with five-point Likert scale scores.

Data collection and analysis

Data were collected by two researchers, along with two trained research assistants. Data were collected in March- June 2015. The computer software SPSS was used to analyse the quantitative data. Descriptive statistics such as frequency, percentage, mean, mode, standard deviation, were used to interpret the data. Multiple Linear Regression model was employed to assess the relationship between dependent and independent variables. The dependent variable (perceived effect of CDVF on livelihood capital) was measure at ratio level (5 point scale with 25 criteria), and independent variables were also measured in ratio level therefore simple linear model was applied.

A thematic approach was used to analyse the qualitative data from FGDs and case studies. FGDs and case studies provided a considerable amount of descriptive data that could not be accommodated in a Table or Box. Therefore, the researchers combined the qualitative and quantitative data and described them from the insights. However, some of the key points of KIIs and case studies have been highlighted.

Results

Socio-demographic features of the smallholder dairy farmers

The average age of the smallholder dairy farmers was 40 years. Among the 255 respondents, only 25 were female. The education level of the respondents varied in the range of 0–15 years of schooling. Their average education level was six years of schooling.

Farmers have been receiving paid community-based extension services for 1 to 5 years. This, of

Table 1 Descriptive statistics of the socio-demographic features, Source: Authors' calculation from field data

Socio-demographic characteristics of the farmers (Measuring Unit)	Range Observed	Mean	Mode
Age (Years)	20–80	39.58	40
Gender (Male = 1, Female = 0)	[a]	[a]	1
Education Level (Year of schooling)	0–15	5.8	2
Length of Community-based Paid Extension Service (Years)	1–5	2.8	2
Distance of Community Service Point (km)	0.5–12	5.8	3
Communication with Community Paid Extension Providers (Frequent = 3, Now & then = 2, Seldom = 1, Never = 0)	[a]	[a]	2
Milk Production (LitreDay^{-1}Farm^{-1})	1–50	11.6	7
Annual Family Income (000′ BDT)	76–1221.5	153.8	122

[a]Gender and Communication were categorical variables. Therefore, no mean and range were added

Table 2 Distribution of farmers according to effect of CDVF services on their livelihood capitals, Source: Authors' calculation from field data

Category	f (n = 255)	%	Observed Range	Possible Range	Mean	SD
Medium effect (34–66)	127	49.80	42–93	0–100	65.48	10.59
High effect (> 66)	128	50.20				

Classified data into three based on possible range 0 to 100.[Low (0–33) was not observed]

course, varied mostly with the needs of their dairy cattle.

The community extension centre provides support up to 12 kms away from the CDVF centre. However, most respondents' farms were within 3 kms of the extension centre.

Most of the farmers communicated with CDVF in person. The wealthy and educated farmers usually informed with community veterinarians by cell phone.

Many of the farmers' association leaders had smartphones and were on social media like Facebook, Skype, Imo etc. However, CDVF does not yet offer services via the internet.

The daily average milk production was 11.6 L/farm^{-1}. The number of milking cows per household ranged from 1 to 4, most of which were cross-breeds. The farmers' present average family annual income from all activities was 154,000 BDT, which is equivalent to US$5.40/ day^{-1}/family^{-1} (Table 1).

Effect of CDVF services on livelihood capital

The mean of perceived effect of CDVF on the livelihood capitals of the farmers was 65.5 in a possible range of 0 to 100. In case of overall impact, it is surprising that no farmer experienced a low impact on livelihood (0–33). It is consistent with the concept of voluntary cooperativisation that organises demand-driven services to ensure the better effect on livelihood (Uddin et al. 2016a; Uddin et al. 2016c) by minimizing the vulnerability. On the other hand, the portion of the farmers for medium (49.8) and high effect (50.2) was almost equal (Table 2). However, when that means data was segmented capital-wise, it showed that farmers perceived that the most significant effect of CDVF extension services was on physical capital (M = 13.9), followed by financial (M = 13.8), human (M = 13.7), social (M = 12.8) and natural (M = 11.3) capital (Table 3). The current asset pentagon looks like as follows (Fig. 2).

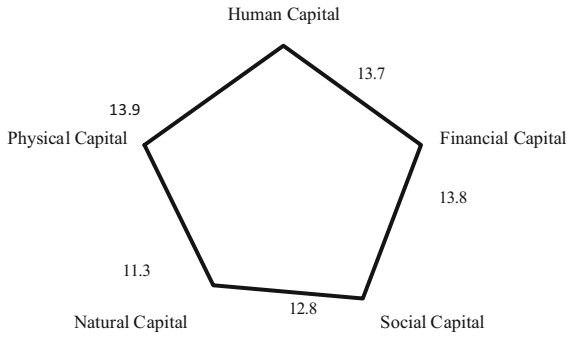

Fig. 2 Effect of CDVF's CPE services on different capitals of farmers' asset pentagon. Source: Developed by authors using research data

Effect on human capital

Table 3 and Fig. 3 show that CDVF has considerable implications in increasing smallholder dairy farmers' knowledge, skill, employment and health. Due to raising awareness and financial ability, schooling opportunity of their children has increased. Regular consultations with community veterinarians and training have developed farmers' knowledge of and skill in dairy farming. An experienced farmer said:

> Now I, due to CDVF training and consultation, can easily understand the health condition of a cow, merely by observing it. As a result, many of our member farmers come to me for advice. For example, when the cow stops chewing, I understand that gas has formed in the cow's stomach. When the cow salivates and stops chewing, it indicates food poisoning or mouth disease. I learned from the veterinarian that mastitis (swelling of the udder) is caused by infectious bacteria, while we had always thought that it was the result of a snake's bite.

CDVF has created an opportunity for profitable employment in dairy farming. It has also created employment for other jobless people in smallholder farm families, who had been engaged in unpaid and low-paid jobs. A small farmer, who has also been serving as a milk carrier, said:

> Now, my wife looks after the cows, and I work as a milk carrier at a chilling station. I helped her in buying feed, medicines, calling the doctor and selling milk. Before, she had nothing to do except the household chores.

However, CDVF did not engage a significant number of milk carriers. Throughout the country, only 90 carriers are needed.

Nonetheless, as a result of CDVF intervention, the subsistence small-scale dairy farm has been turned into a commercial dairy farm, which has made a significant contribution to improving livelihoods of the rural poor. The quality service of CDVF has

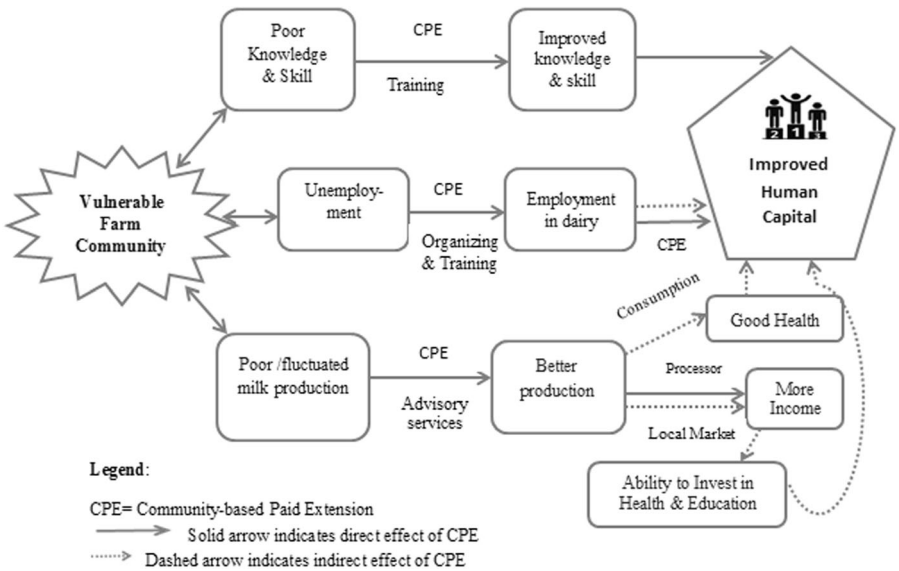

Fig. 3 Effect of CPE services on Human Capital of Smallholder Dairy Farmers. Source: Developed by the authors based on FGD

dramatically reduced the vulnerability of smallholder dairy farmers and increased total milk production. The additional milk production has created a scope for family consumption of the milk too. In the morning, farmers sell sufficient milk to the processor. Therefore, the cows' evening milk is being used for family consumption. However, before CDVF intervention, the evening milk was also sold in the local market to raise enough income to meet the family's needs. The increased milk consumption has brought a positive impact in overall health improvement of farmers' families.

In an FGD, another farmer narrated his experiences of human development in the following ways:

> The community dairy extension service has increased milk production and farm income by linking us with profitable milk markets. Due to the increase in income, I have increased the family health expenditure budget.

Effect on financial capital

CDVF intervention has had significant effects on increasing family income. Income increased due to increasing milk production and creating the opportunity to sell milk in more-profitable market channels (statements 8 and 9 in Table 3).

A key informant at a processing plant disclosed that the price of per unit of milk depends on the fat content of milk. For example, if the fat content is 4.5%, the price will be 45 BDT/Litre^{-1}. If the fat content is 3.5%, the price will be 35 BDT/Litre^{-1}. Fat is measured by digital fat testing (DFT) machine. So, the dairy farmers-milk processor linkage has added value to the milk price. The result of case analysis 1 revealed that farmer-market linkage arranged by CDVF gives a more-fair amount than that of the outside market, where adulterated milk is being sold without quality control. As a result, milk in the external market is cheaper. Moreover, when milk was sold to milkmen on monthly payment basis, they sometimes cheat by selling the milk and then running away without making the monthly payment (according to Anwara, a 36-year-old female farmer).

During Ramadan (*Islamic month of daytime fasting*), the milk price in local markets goes up. This is because Muslims fast in the daytime but then have parties ("*Iftar")* at night: milk is in high demand for their empty stomachs at party time. At that time, some farmers break the contract with the processing company and divert the milk to the local market to get a higher price. So, the deals do not inhibit the farmers but rather provide a safety net that assures 12 months of income in a year.

At the farm level, there is no equipment for milk processing. Farmers sell raw milk to nearby community milk collection points of the processor. The proximity of milk collection points to farms has saved the valuable time of the farmers, who no longer have to transport their milk to the factories. The guaranteed market access has also reduced the uncertainty of selling milk. Therefore, the income and profit of the farmers dealing through CDVF have increased significantly. The additional money is re-invested in productive assets for more financial return: as a result, the financial assets of the smallholder dairy farmers have been strengthened (Fig. 4). The community veterinarian explains the economic development of smallholders through CDVF as follows::

> Many people are [now newly] engaging in small-scale dairy farming,[after]seeing the [improved] incomes of their neighbours. As a result, economic opportunity has been created in the community. With the increase of revenue, capacity for loan repayment has also been increased [making microcredit and other finance available where it was not before]. The farm women even make some extra money by selling cow dung sticks, which are used as [a cheaper] fuel[in place of wood, since there are so many cows around now and thus so much dung].

However, although there were demands for credit, CDVF could not directly intervene to supply credit or access it from any other source for the farmers. Access to credit from micro-credit organisations did ensue, as a by-product of cooperativisation, due to its increased financial assets and security, which created a credible repayment capacity among the farmers.

Due to increased production and market access, savings, as well as incomes of small farmers, are growing. The Treasurer of the Milk Marketing Association, who is also a small farmer, disclosed rough statistics of farm expenditure and savings:

> About 60% of total milk sales are spent on farming expenses, and 40% is profit. The capital

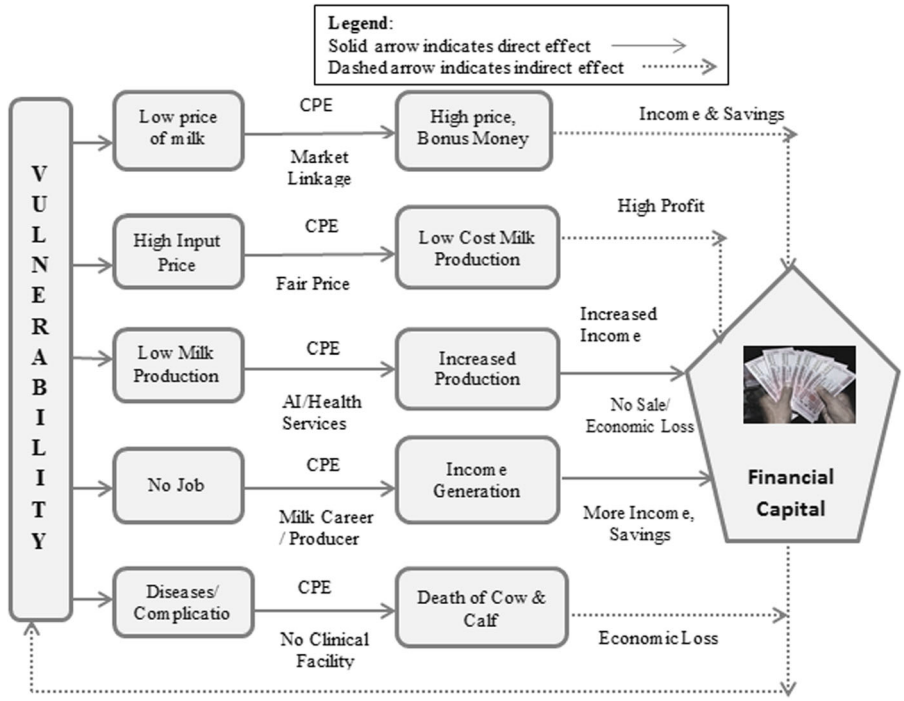

Fig. 4 Effect of CPE services on Financial Capital of Smallholder Dairy Farmers Livelihood. Source: Developed by the authors based on FGD and case studies

is [borrowed and] reimbursed from the sale of bulls and heifers [for meat].

Effect on social capital

CDVF has made a significant contribution to developing the social capital of farmers by combining them into cooperatives (Table 3). CDVF has established a strong social network in the community: increased organisational affiliation; enhanced relationship and trust in the family and society are by-products. The activities of foundation, association and groups have increased farmers' cosmopolitanism and leadership skills. It was reported that CDVF services had brought satisfaction and recognition among the farmers. A farmers' association leader said:

> My group members respect me and consider my suggestions valuable. They consult me before asking the veterinarian. So, it's my pleasure to work for them. I always raise my voice for them against the erroneous measurement of milk [so I support them as well as they help me.

The FGD results revealed that CDVF services also have tertiary effects in community development. Due to income and employment opportunities, property crimes have decreased. Community people stand beside one another during crises, such as food shortages, economic crises and health emergencies or climate disasters. As a result, in cooperative communities, enlightened by the CDVF model, poor village people are more secure than before.

Effect on natural capital

CDVF services have had both direct and indirect impact on the natural capital of dairy farmers (Table 3). The number of dairy cattle in farmers' communities has increased through breeding and reproductive health care services for animals. As a result, the production of cow dung has been increased, which serves as excellent organic manure and provides, as noted above, another source of income by selling it as a cheap alternative to firewood. Some farmers are using this manure for homestead gardening as a side business. It is well-known among agriculturalists that organic agriculture promotes nutrient recycling,

Table 3 CPE's effects in changing livelihood capitals of smallholder dairy farmers, Source: Authors' calculation from field data

Sl. No	Livelihood of capitals of dairy farmers	Extent of capital change			Likert Mean	Rank
		HI IN Increased	UC Un-changed	DE HD Decreased		
	Human capitals	–	–	–	**13.7**	**III**
1	Knowledge on dairy farm management	213	30	12	3.0	2
2	Skill of dairy farming	216	33	6	3.0	3
3	Employment in dairy farm	106	118	31	2.3	4
4	Health status of family member	74	159	22	2.2	5
5	Schooling opportunity of children	217	35	3	3.2	1
	Financial capitals	–	–	–	**13.8**	**II**
6	Access to credit	158	44	53	2.5	5
7	Capability of loan payment	202	40	13	2.8	2
8	Price of milk	222	15	18	2.9	3
9	Family annual income	236	13	6	3.0	1
10	Savings in family	157	74	24	2.6	4
	Social capitals	–	–	–	**12.8**	**IV**
11	Relationship and trust in family	187	50	18	2.4	3
12	Relationship and peace in community	137	68	50	2.3	5
13	Organisational affiliation	159	86	10	2.7	2
14	Network in society	203	44	8	3.0	1
15	Social security	119	79	57	2.4	4
	Natural capitals	–	–	–	**11.3**	**V**
16	Fertility and productivity of soil	102	77	76	2.1	2
17	Checking soil erosion	45	153	57	1.9	5
18	Nutrient recycling	67	160	28	2.2	3
19	Vegetation intensity in homestead	219	25	11	3.0	1
20	Water conservation	68	147	40	2.1	4
	Physical capitals	–	–	–	**13.9**	**I**
21	Herd size of cattle	180	39	36	2.7	4
22	Housing quality	200	52	3	3.0	1
23	Furniture and equipment	195	53	7	2.9	2
24	Sanitation quality	194	53	8	2.9	3
25	Storage and transportation tool of milk	124	118	13	2.4	5

HI, highly increased, *IN,* increased, *UC*, unchanged, *DN*, decreased, *HD*, highly decreased, *CI*, capital index

water-holding capacity and the fertility and productivity of soil, so the value of the land is enhanced for farming. Farmers are now seeing this and learning it through experience, as can be shown by the intensified level of vegetation around their homesteads and in their villages.

However, it is also true that natural capital is the least-improved form of livelihood capital among the effects of CDVF intervention. The chief limitation on the improvement of natural capital is that the farmers use cow dung as fuel instead of as manure. CDVF has created an opportunity for natural capital development by better organic fertilisation of the fields. Still, farmers must be made aware of this opportunity and encouraged to avail of it.

Effect on physical capital

Both Table 3 and Fig. 5 confirm that CDVF services have a substantial impact on increasing the physical

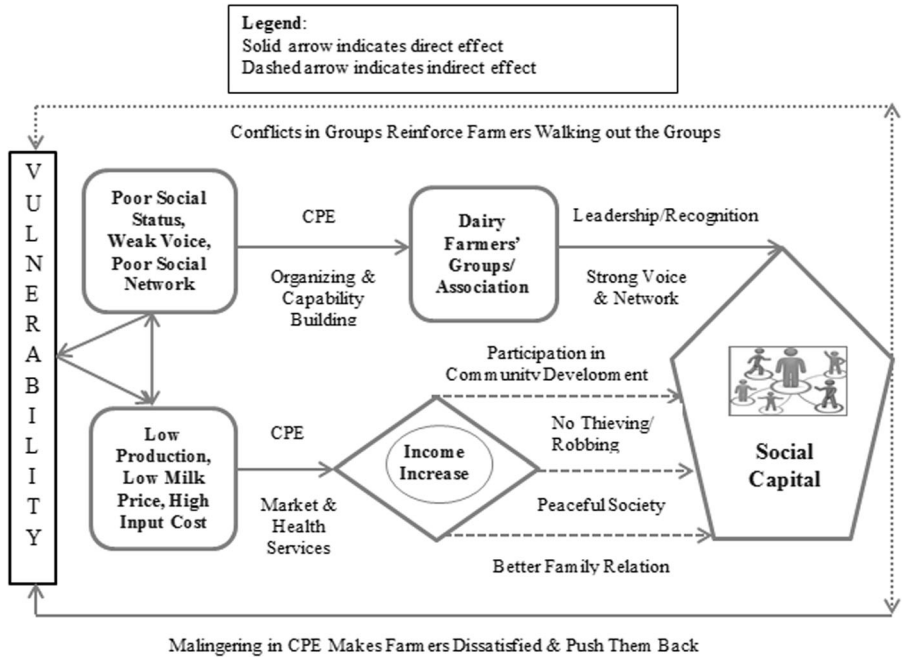

Fig. 5 Effect of CPE services on Social Capital of Smallholder Dairy Farmers Livelihood. Source: Developed by the authors based on FGD

assets of the smallholder dairy farmers. As a result of income maximisation, farmers enjoyed a significant improvement in housing and sanitation, furniture and equipment and the number of good dairy cattle as well.

A farmers' group leader, as a key informant (Barek, 45), explained the thinking of dairy farmers on their physical capital. Farmers think that the houses for their cattle should be as good as their own. So, instead of bamboo-wooden barns, farmers are building cement buildings to house animals. They are buying electric pumps for their household water supply, motorbikes for transport, mobile phones for communication, TVs for recreation and so on, thus raising both their, and their cattle's, standard of living (Fig. 6).

Before CDVF's intervention in the community, milk was transported to distant markets in plastic containers: often, the milk was spoiled on arrival. Therefore, CDVF has convinced the buyers to supply hygienic metallic pots and provide low-cost transport to collection points. Metallic containers keep the milk temperature lower for a longer time and thus minimise spoilage loss.

Relationship between farmers' characteristics and effect of CDVF services on livelihood capital

The regression results in Table 4 show that, out of eight determinants, six characteristic significantly influenced livelihood capital. The β weight indicates that education level has most significant contribution (β = .412) to livelihood capital followed by daily milk production (β = .368), distance of community extension centre (β = − .167), annual household income (β = 160) and extension communication frequency (β = 119) and gender (β = − .05).

Gender and perceived effect of CDVF services on livelihood capitals have a significant negative relationship ($P < 0.05$). Regression coefficient (B = − 1.79) for gender further shows that in contrast to the female, male farmers gained almost double effect of CDVF services on their livelihood capital enhancement. This means that women farmers perceived less impact of CDVF services on their livelihood capital compared to the men.

The education level of farmers and the perceived effect on livelihood capital also show a significant positive relationship (B = 1.23, $P < 0.05$). It means that 1 unit increase in education level experienced 1.23

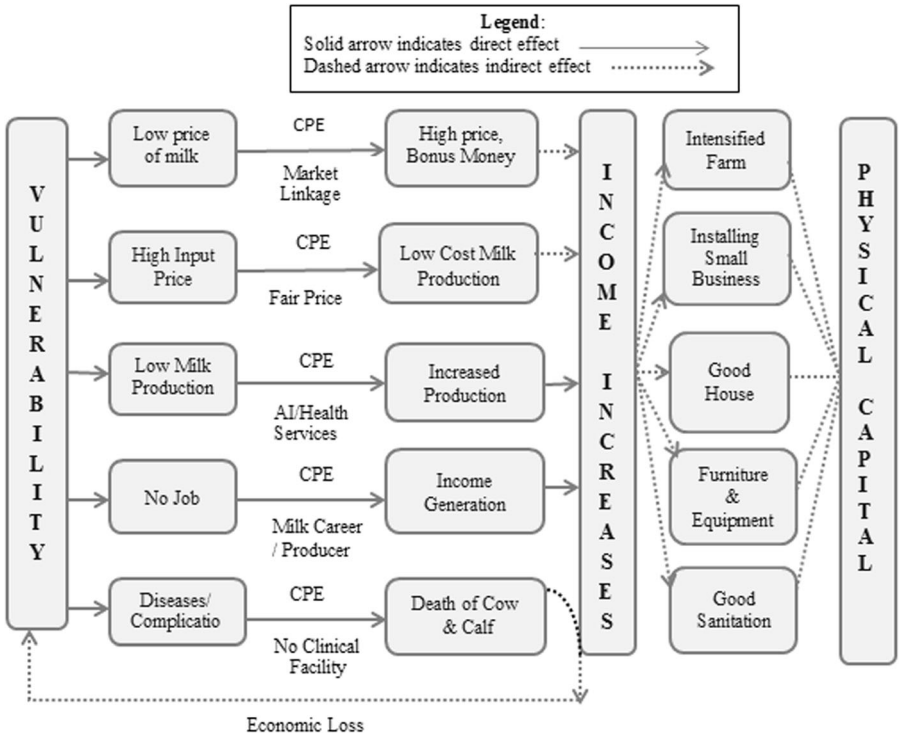

Fig. 6 Effect of CPE Services on Physical Capital of Smallholder Dairy Farmers. Source: Developed by the authors based on FGD

Table 4 Regression results for the determinants of effect on livelihood capitals, Source: Authors' calculation from field data

Variables	B	SE	Beta	T	Sig
(Constant)	35.40	3.79		9.33	.000
Age	.010	.026	.010	.383	.702
Gender	− 1.79	.868	− .050	− 2.06	.041
Education level	1.23	.115	.412	6.08	.000
Length of paid extension service	.293	.264	.034	1.10	.269
Distance of community extension centre	− .603	.146	− .167	− 4.13	.000
Communication frequency with paid extension	2.06	.522	.119	3.94	.000
Daily milk production	.376	.040	.368	3.90	.000
Annual household income from all sources	.016	.003	.160	5.08	.000

$R = .929$, $R^2 = .863$, Adjusted $R^2 = .858$, $F = 171.80$, $P = .000$

units increase in livelihood capitals. Educated farmers see more effects because they are more enlightened and better decision-makers.

Distance from community extension centre and perceived effect of CDVF services on livelihood capitals depict a significant negative relationship ($B = -.603$, $P < 0.05$). This means that 1 unit increase distance caused 0.603 unit decline in the perceived effect of CDVF services. There are time and convenience limits in buying and delivering the service in distant places. The remote farmer had less scope of physical contact for veterinary and market services. This result is consistent with Budak et al. (2010).

CDVF's CPE services and effect on livelihood capital of the smallholder dairy farmers have a highly positive significant relationship ($B = 2.06$, $P < 0.05$). Regression coefficient means that 1 unit increase in CDVF contact caused an almost double increase in livelihood capital of farmers. It is reasonable to assume that benefits will surely depend on the cost of the service, where service is provided on a fee basis:

as CDVF services give a lot more profit for a little more expense, compared to alternatives, the farmers feel richer using them.

Daily milk production and perceived effect of CDVF services on livelihood capital of smallholder dairy farmers also yield a significant positive relationship (B = .376, $P < 0.05$). One unit increase in milk production brought 0.376 unit increase in livelihood capitals. It is true that the farmers who have higher milk production have more scope of generating income and household consumption, so the larger-producing farmers feel that CDVF benefits them more.

Similarly, annual household income and perceived effect of CDVF services on livelihood capitals of the farmer has also shown the significant positive relationship (B = .016, $P < 0.05$). This reveals that 1 unit increase in annual household income caused .016 unit increase in livelihood capitals. It has been seen in several sections of this article that CDVF has a direct contribution to maximising household income. Increased income makes people better able to develop financial and physical assets, buy more welfare service, and tackle the future's uncertainties. Of course, if CDVF makes you more productive, you perceive that CDVF is beneficial.

However, the regression result shows that age is not a strong determinant in predicting the effect of CDVF services on livelihood capital of the smallholder dairy farmers. Length of paid service also did not show a significant relationship with impact on livelihood capitals. Length of service will not exert any effect if it is applied on a limited scale.

Yet these results show a limitation of the use of perceptions in the regression, as it shows that different farmers' are perceiving the same objective reality differently, based not on the fact but their characteristics. This confuses real effect with perceived effect, and the regression is getting only seen impact. Perhaps the qualitative evidence, farmers talking about what they *have* as opposed to what they *observe*, is more valuable for the research.

Farmers' problems in accessing CDVF services

Farmers faced several problems in accessing services from CDVF (Table 5). About 78% of farmers mentioned that the connected processor's agents hide a fraction of fat while measuring the milk with their digital fat-testing machines. As the fat amount in milk decreased, the price of milk declined accordingly. This is a significant problem faced by the majority of farmers. CDVF needs to monitor Aarong Milk (the processor)'s compliance with its agreement, or they will not improve their members' livelihood.

Beyond this significant complaint, a minority of farmers raised other objections about CDVF's impact on their livelihood. A quarter (26.3%) of the farmers claimed that CDVF could not play a vital role in increasing the price of milk, although the amount of milk in local markets had increased. Perhaps this

Table 5 Problems confrontation of the farmers in accessing CPE services, Source: Authors' calculation from field data

RankSl. No	Name of the problems	Farmers responded	
		No. (255)	%
1	Cheating of contract milk buyer in measuring milk and fat	198	77.7
2	Weak role of CPE in increasing the price of milk when price in local market increases	67	26.3
3	Busy veterinarian	65	25.5
4	Infrequent regular visit	56	22.0
5	Emergency visit is expensive (100 BDT visit^{-1})	55	21.6
6	Buyer is less interested to CPE	53	20. 8
7	Inexperienced veterinarian	50	19.7
8	Contract buyer refuse to take milk when supply is high	48	18.9
9	Biasness of the veterinarian	40	15.7
10	Input sell motive of veterinarian	38	14.9
11	No capacity of CPE to process milk by itself	35	13.7
12	Absenteeism of veterinarian in the community	5	2.0

complaint overlaps the complaint noted in the previous paragraph, about Aarong short-fatting their milk reports. About the same (25.5%) proportion of the farmers alleged that the veterinarian was very busy most of the time. Therefore, these farmers sometimes did not get sufficient medical care for their cattle.

Another minority of farmers (22.0%) were unhappy with the frequency of CDVF field visits. Although emergency service was available, some farmers (21.6%) found it expensive (at 100 BDT visit^{-1}). These were usually low-income households. More than 20% of the farmers perceived that the processor does not want to work through CDVF. It is reported from the case analysis 5that farmers are misguided by the processors not to sell through CDVF. The processors prefer to deal directly with farmers to deprive them of the bargaining power that they gain through CDVF.

A few farmers complained that the CDVF veterinarian (2.0%) is often absent from the community (Table 5). What is more important than the number of farmers complaining is the frequency of absence of the veterinarian, asthe consequence of lack could be significant. While this data is not available in a correct way, if the absence were persistent and caused significant harm to animals, one would think that a higher percentage of farmers would complain about it. Those who did complain were quite dissatisfied.

When the executives of CDVF were interviewed, they confirmed the authenticity of the absenteeism problem. Although the absenteeism of veterinarians in Satkhira zone is minimal, it is a significant problem in Mymensingh zone. Talented veterinarians cannot concentrate on this low-paid job. Therefore, they seek better-paying jobs, especially in the civil service. It appears that most of the absent veterinarians could be found in the nearby dorm of Bangladesh Agricultural University, in Mymensingh, preparing for public service examinations.

Case Study No. 5 showed that keeping 200 farmers organised in the long-term is always a challenge, where veterinary services are poorly delivered, and milk sales are uncertain. Without a robust CDVF users group and strong market linkage, the service will become unsustainable.

Despite the problems in the existing CDVF model, the majority of farmers expressed that membership is, overall, profitable for them (69.8%). Despite their limitations, CDVF services are still better than dealing with processors and markets directly and availing of free public extension services, in terms of availability and accessibility. The great advantage and core competency of CDVF are that cooperativisation, contracts and working through a common processor can ensure milk sales of farmers to a broader and more-reliable market than the State, which merely provides free extension, can.

Discussion

Effect of CDVF services on livelihood capital

The effect of community-based extension services on livelihoods of smallholder farmers is widely addressed in the literature (*See e.g.* Swanson & Rajalahti, 2010; Rathod et al. 2012; Uddin et al. 2016a). However, how such extension services affect farmer-livelihoods varies significantly.

CDVF services have made the enormous contribution to human capital development. The direct effect of CDVF was observed in knowledge, skill, employment and food security development of the farmers. The indirect, tertiary effect was in the education of the children.

CDVF had a wide-ranging impact in the communities because it was offering a comprehensive package of services to farmers, who have become members of the CDVF cooperative. Voluntary cooperativisation increased farm family income: this provided money to invest in the farmers' children, through better education, and to do many other things in the village.

Dercon et al. (2008), in this regard, assessed that one extension visit could reduce headcount poverty by 9.8 percentage point and can increase consumption growth by 7.1 per cent. Berhanu and Pender (2004), in this connection, mentioned that community organisation significantly expanded the alternative livelihood strategies for the rural poor. Mekonnen (2013) stressed that community extension services transform subsistence agriculture to market-oriented agriculture and boost farm production, consumption growth and labour employment. However, the literature's findings that paid extension alone reduces poverty is incongruent with Rao and Natchimuthu (2015) who found that Indian cooperative farmers were only interested in purchasing breeding and veterinary service and ignored advisory services. This study shows that the

cooperative has to include social cooperativisation, cooperativisation of marketing and training for farmers, as CDVF does. Making enough money through cooperativised marketing, 80% of farmers are not so resistant to paying a small amount for advisory services.

The direct effect of CDVF services on the financial capital of livelihood was revealed in income enhancement. If other things remain constant, the income of smallholder dairy farmers is a function of milk production, milk price and healthy herds. Output varies with breeds, health condition of cows and feeds quality, which is further influenced by adequate extension support (Uddin et al. 2016a). Increased production, with the help of CDVF, has ensured increased income because CDVF's contracted marketing has assured a fair price for milk and a profitable milk marketing channel. Collateral employment opportunities, while limited, have also boosted the incomes of farmers who could take them up. Additional revenue has also opened the scope of credit access because CDVF marketing improved the payback capacity and savings of the farmers.

Alek, a 45-year-old farmer (Case Study 4) found a complementary effect between financial and physical capital development. Both forms of capital helped one another for growth. CDVF's advice and services in rearing cross-breed cows increased his milk production and income, which he invested in a small grocery and household infrastructure development. Later, revenue from both sources was used to establish a rice mill.

Elias et al. (2013) and Mekonnen (2013), also found that stated that community-based extension services offer formal market access; reduce the cost of production, and increase production and income in a sustainable way. The community-based paid extension is not only contributing to increase production and income (Anderson and Feder 2007; Waddington et al. 2010), but also to improve multifaceted aspects of rural livelihood. CDVF cooperativisation intensified the social network and organisational affiliation of the smallholder dairy farmers through group mobilisation. It also enhanced trust at the family and community levels. Similar to human capital, confidence and peace as social capital are also inter-linked with financial capital. Accordingly, this study concord with Vidya and Katoch (2011) that community-based organisation offers intensified social networks which, in turn, brings access to other required resources.

The relation between farmers' characteristics and change in livelihood capital

Women farmers perceived less effect of CDVF services on their livelihood capital than male farmers did. Their limited social networks, and movement restrict access to technology, inputs and fair market at distant places (Pervez et al. 2015). Male farmers, on the other hand, have more technological exposure, input access, market information and scope of learning scientific knowledge for profitable dairy farming.

Similarly, educated farmers perceived the better effect of CDVF services on their livelihood capital than less-educated farmers. Knowledgeable people understand the value of purchased scientific solutions and can put the instructions into action accordingly (Uddin et al. 2016b). They have more abilities to replicate a job even after a long time by reading the written action guidelines. Mekonnen (2013) remarked that educated farmers are better able to use agricultural technology, access information and benefit from institutional services, which help them to improve their livelihoods. Thus, more-educated farmers enjoyed more benefits from the same increase in income.

The positive relation between milk production, annual income and change in livelihood capital also proves livelihood theory discussed in earlier sections. All different forms of livelihood capital increase with the increase in financial capital. Poverty causes shortfalls everywhere. Money creates solutions everywhere. CDVF creates money earnings, which make solutions, and thus increases human, social, physical and other capital.

CDVF services and its sustainability

CDVF is an active dairy cooperative in Bangladesh which supplies paid community-based extension services as a part of its package of services to members. Yet CDVF is still rather unique in Bangladesh. Is it sustainable in the long-term?

The sustainability of the CDVF system entirely depends on continuous buying of milk by the contract-processor (Aarong Dairy). Each processor works in a separate community for accessible collection of milk.

Therefore, any betrayal by any processor may lead to disruption of the service. Sometimes, this happens, when processors refuse to buy milk from some farmers (Table 5). When farmers start counting up losses like that, they start downgrading the value of continued membership. Uddin et al. (2016a, b, c) also found that the willingness of the Bangladeshi farmers to pay for extension service is greatly influenced by farm profit.

CDVF's overdependence on Aarong Dairy is a strategic weakness and actually a bad policy. Aarong is a excellent network, but there are other processors and wholesalers in Bangladesh with whom CDVF could contract as well as Aarong Dairy. Diversification is strategically-wise because it would protect CDVF from any misbehaviour by Aarong and also make its services more sustainable.

Another option, with or without diversification, is for CDVF to vertically-integrate by establishing its milk processing plant and selling ready-to-drink milk directly to retailers. This is what the New Zealand Dairy Cooperative did in the 1950s and became a virtual monopoly, even exporting powdered milk like Anchor, a well-selling brand in Bangladesh. However, it is advised to approach this option slowly and to start diversification of private contractors first.

Many CDVF members might correctly observe that farmers should produce, scientists should process, and businessmen should market. At least CDVF should start by build diversified, optimised and reliable networks of partners beyond the farm.

Conclusion and recommendations

The analysis of findings reinforces the conclusion that, directly and indirectly, CDVF service has beneficial effect in developing livelihood capital of the smallholder dairy farmers: especially in physical, financial, and human capital. Knowledge and skill development of the dairy farmers and employment creation for jobless people are the direct effects of CDVF services on human capital, while improvement in health and education are the indirect, long-run livelihood outcomes. Similarly, higher milk prices and income are the direct effects of CDVF services on financial capital, whereas savings, access to credit and creditworthiness are the indirect effects. Intra-village social mobilisation and social net working are the immediate benefits of CDVF services and improved social order, peace and security in the family and community are the indirect effects.

It can be concluded that CDVF services do not have any direct effect on natural capital but have an indirect and far-reaching impact on sustainable livelihood promotion nutrient recycling and productivity of the soil. Furthermore, CDVF service has an immediate impact on farm structure and equipment, whereas better housing and sanitation quality of the farm household are the ultimate outcomes of CDVF intervention.

Although generalisation is difficult from perception based study CDVF can be pronounced a success. To make it work even better, the some policy recommendations are offered.

Recommendation for policy implication

(1) Although men and women are equal integral assets for development and educated and illiterate farmers of both genders are equally important, in this study educated, male dairy farmers enjoyed disproportionately positive effects of CDVF services on their livelihoods. Therefore, CDVF should include, within its package of services to members, literacy education and up skilling of farmers, with an emphasis onwomen farmers.

(2) CDVF should not continue to set up itself and its members to be strategically vulnerable by over depending on one company to process and market all of its products. CDVF should diversify its partners on both the processing and the marketing sides to create stability and more opportunities. CDVF has the potential to sell a lot of milk: many milk processors and wholesalers might well be interested in partnering like Aarong has done if approached correctly.

(3) Long-distance is a barrier in responding to farmers' emergency calls immediately. Both delayed extension contact and response time increase the vulnerability of the farmers. Therefore, extension communication frequency with the farmers should be improved through multiple media like mobile phone calls, Facebook, email etc. along with farm and home visits in person. CDVF should offer free call service for their clients to increase communication frequency, as call charges can be recouped from the usual milk sale commission (1 BDT/Litre^{-1}/Day^{-1}).

(4) The smallholder dairy farmers who had higher milk production and household income achieved more

significant livelihood effects. So, CDVF should look for low-cost technologies such as feed, vaccines, semen, farm implements etc. so that smallholder dairy farmers can reduce costs of production without compromising yields. Arranging farmer-to-market links at the community level should be a priority task of CDVF in achieving sustainable service as well as sustainable livelihoods of the farmers. Sustainability of the service depends on the participation of sufficient farmers in the association. On the other hand, the involvement of the farmers depends on offering a profitable milk market.

(5) CDVF is client-responsive and demand-driven, which has brought positive effects on farmers' livelihood capitals. CDVF is unusual, not typical enough. The State could offer incentives and support for voluntary agricultural cooperatives, as well as monitoring and publicising their effects. The State could experiment with paid extension services, sharing the revenue with participating extension agents, bearing in mind that it would create a "two-tier" extension scheme where the more you paid, the better extension you got, and the free service might be run down even further in such a programme.

(6) CDVF is rapidly becoming a large, successful business organisation that is still run on a shoestring like a village meeting. That is the long road to organisational hell. CDVF needs to consider its funding mechanism and perhaps increase the farmers' contribution from their huge milk lake of revenue. Veterinarians and other professional staff need compensation commensurate with that they could get in the civil service, including pensions and allowances, to retain good ones and not be left with the droppings. CDVF needs more professional staff to take on issues that they cannot now: like monitoring their livelihood effects on members; corporate strategy like how their product should be processed and marketed; acquisition of donations and perhaps investment capital; and inspecting partner activities to stop them short-changing members on milk sales.

Recommendations for further study

The study was conducted in a limited area of Satkhira zone; therefore, other zones of CDVF can be included in further study for a strong generalisation of the result. Moreover, this study focused only on livelihood capitals, so, the holistic approach of livelihood can be taken under analysis and investigation in future research. Finally, this study recommends true experimentation of the impact with primary data of after before situation instead of recalled data from the CDVF smallholder dairy farmers.

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Author contributions MEU and GQ conceived of the research and formulated the research design, AKMKP and MEU has harmonised the conducted data collection, completed the statistical analysis and data interpretation, and finally drafted the manuscript. GQ approved and reviewed the draft manuscript.

Compliance with ethical standards

Conflict of interests The authors declare no conflict of interest.

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