

Research Application Summary

Ex-ante benefit-cost analysis of an animal production and forage centre for a smallholder dairy value chain in Zimbabwe

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Abstract

Many smallholder dairy schemes in Africa face sustainability constraints due to shortages of feed resources and poor productivity. Extension supported dairy animal production and forage centres constructed alongside the milk collection centres are possible solutions to these constraints. The objectives of this study were to (1) determine farmers' willingness to pay for construction and services provided by the centre, and (2) perform an *ex-ante* benefit-cost analysis of the centre in the smallholder dairy value chain. A cross-sectional survey was performed in four smallholder dairy schemes and a total of 185 smallholder dairy farmers selected by simple random sampling were interviewed using a pre-tested questionnaire. The results show that 78% of farmers indicated they would be willing to construct such a centre on their own, while 94% indicated they would be willing to pay for artificial insemination services provided by such a centre. The main advantages of the centre to the dairy enterprise would be ready access to feed, fodder and cost savings (82% of farmers). About 92% of farmers would prioritize feeding milking cows in order to increase milk production. *Ex-ante* benefit cost analysis indicate that such a centre would be profitable with a benefit: cost ratio of 5.4: 1. The implications of the results is that Governments should support alternative models of smallholder value chain development that includes establishing animal production and forage centres in the smallholder dairy value chain in order to improve milk production and productivity, and the contribution of smallholder dairy to the national economy.

Key words: Animal production and forage centre, smallholder dairy, value chain, Zimbabwe

Résumé

De nombreux projets de production laitière en Afrique sont confrontés aux contraintes de durabilité à cause de la pénurie de ressources alimentaires, et de la faible productivité. Les centres de services de vulgarisation de production et de fourrage d'animaux laitiers situés aux environs des centres de collecte du lait sont des solutions possibles pour faire face à ces contraintes. Les objectifs de cette étude étaient (1) de déterminer la volonté des agriculteurs

de payer pour l'installation des centres et des services fournis, et (2) d'effectuer une analyse ex-ante coûts-avantages du centre dans la chaîne de valeur laitière. Une enquête transversale a été conduite considérant quatre régimes laitiers des petits exploitants et un total de 185 producteurs laitiers sélectionnés au hasard ont été interviewés à l'aide d'un questionnaire pré-testé. D'après les résultats, 78% des agriculteurs ont indiqué qu'ils seraient prêts à construire un tel centre par eux-mêmes, tandis que 94% ont indiqué qu'ils seraient prêts à payer pour les services d'insémination artificielle fournis par le centre. Les principaux avantages du centre pour l'entreprise laitière seraient l'accès facile aux aliments et fourrage, et des économies sur les coûts (82% des agriculteurs). Environ 92% des agriculteurs considéraient l'alimentation des vaches laitières comme une priorité afin d'augmenter la production de lait. L'analyse ex-ante des coûts-avantages indique qu'un tel centre serait rentable avec un rapport bénéfice/coût de 5,4: 1. Les résultats devraient amener les gouvernements à soutenir des modèles alternatifs de développement de la chaîne de valeur des petits exploitants, incluant la création de centres de production animale et fourragère afin d'améliorer la production et la productivité du lait et la contribution des petites exploitations laitières à l'économie nationale.

Mots clés: Centre de production animale et fourragère, petite exploitation laitière, chaîne de valeur, Zimbabwe

Background

The agricultural sector in Zimbabwe supports the livelihoods of approximately 70% of the population, and contributes approximately 18% of GDP (ZimStat, 2013). The dairy subsector is an important component of the agricultural sector, with dairy produce contributing about 3% of the value of agricultural production at 2012 prices (ZimStat, 2013). Most of the contribution of the dairy subsector comes from large scale commercial farms, with smallholder farms contributing 5% of total milk marketed through formal channels (DDP, 2010). The low contribution of smallholder farms has been attributed particularly to low productivity and limited access to feed resources during the dry season. In Zimbabwe, studies by Francis and Sibanda (2001) highlight problems of low productivity due to inadequate availability and poor quality of feeds and expensive commercial feeds as the main constraints limiting smallholder dairy production. Mupeta (2000) documented the constraints facing smallholder production, with particular reference to feed resources. Mutukumira *et al.* (1996) study showed that only 14% of the households in the smallholder dairy schemes grew more than one hectare of fodder. As such, shortage of feed and transport were cited as the major constraints faced by smallholder dairy farmers in the semi-arid areas (Chinogaramombe *et al.*, 2008). Masama *et al.* (2005) conducted a study in order to develop an inventory of feed resources available on farm. The results of the study showed that farmers kept inadequate amounts of feeds of poor nutritional quality for feeding dairy cows year-round. The research findings highlighted the need for innovative, cheaper feed resource management systems that are developed to ensure sustainable viability of smallholder dairying (Masama *et al.*, 2005). Studies by Gomez *et al.* (2007) in Central Peru showed that the feeding programme for lactating and growing females on forage that was exchanged for labour and purchased concentrates did not theoretically or practically meet the needs of the cows. Shamsuddin *et*

al. (2007) showed that fodder availability increased milk production and decreased incidence of disease. Studies by Alejandrino *et al.* (1999) and Suzuki *et al.* (2006) also cite feed resources or feeding regimes as the major constraints limiting smallholder dairy. The question that arises in the context of smallholder dairy value chain is how feed and forage resources can be made available to farmers in order to improve the viability of smallholder dairy. Kabirizi *et al.* (2009) performed a study in Uganda to assess the profitability of improved forage technologies and factors affecting the use of improved forage technologies among smallholder farmers in Soroti district in eastern Uganda. The results also showed that profitability and improved cattle breeds had complimentary effects on the decision to use improved technologies. Gwiriri *et al.* (2016) study in Zimbabwe concluded that the use of forages can be a cost effective feed level intervention to optimize income in small-scale dairy by reducing the cost of producing a litre of milk.

This study focuses on the production constraints and the formulation of new economic models of smallholder dairy development given advances in new farming techniques and technologies to enhance the contribution of the subsector to national economic development. The concept of forage and animal production centres have been received (Titterton and Maasdorp, 1997). The objectives of the study were to (1) determine farmers' willingness to pay for construction and services provided by the centre, and (2) perform an *ex-ante* benefit-cost analysis of the centre in the smallholder dairy value chain.

Study description

The study sites were four dairy schemes purposively selected on the basis of type of farming system, agro-ecological natural region (NR) location, and performance in terms of daily deliveries of milk to the milk collection centre, and linkages to processors. The selected schemes were Chikwaka (NRII, communal farming system, delivering less than 200 litres per day, milk collection centre processing), Nharira-Lanchashire (NRIII, communal and small scale commercial farming system, delivering about 200 litres per day, milk collection centre processing), Marirangwe (NRII, small scale commercial farming system, delivering about 400 litres per day, linked to private processor), and Rusitu (NRI, resettlement farming system, delivering about 600 litres per day, linked to private processor). The lists of all members of the smallholder dairy schemes were obtained from the milk collection centre and these formed the sampling frames for the survey. Simple random sampling was used to select the sample of farmers included in the study. The total number of households interviewed in the four smallholder dairy schemes was 185 farmers. This sample provides a cross section of farmers in order to understand the dairy value chain under different farming systems, agro-ecological potentials and varying scheme performance levels.

The benefit-cost methodology (Gittinger, 1992) was used to assess the investment in the animal production and forage centre. The performance of the dairy farmers and viability was assessed on the basis of gross margin analysis. Two scenarios of with and without the animal production and forage centre, and the incremental benefits and costs were assessed in the financial *ex-ante* benefit-cost analysis. The feasibility of the centre was also assessed on the basis of farmers' willingness to pay for the services to be provided by the centre. The

benefits and costs were discounted over a 10 year period. Estimated costs of constructing such a centre were obtained from the Ministry of Public Construction and National Housing. The major costs of constructing such a centre would be the cost of offices, sheds, staff housing and irrigation infrastructure for 10 hectares of forage crops. It was assumed this would serve 100 smallholder farmers in the dairy scheme.

Research application

The results of the study show that 78% of farmers indicated they would be willing to construct such a centre on their own, while 94% indicated they would be willing to pay for artificial insemination services provided by such a centre and 91% would be willing to purchase feed that would be available through the centre (Fig. 1). About 92% of farmers would prioritize feeding milking cows from the feed made available through the centre in order to increase milk production (Fig. 2). The farmer perceived main advantages such a centre would provide to the dairy enterprise would be ready access to feed, fodder and cost savings (82% of farmers) (Table 1).

The animal production and forage centre was modelled on the basis of parameters. The parameters for with and without the centre were based on the results of the survey and assumptions of the potential of milk production based on the breeds currently used by smallholder farmers (Table 2). The total cost of constructing the animal production and forage centre was estimated at USD200, 000. The cost is based on use of local materials which brings down the cost of construction down to about 25% of the cost of using urban materials. The yearly recurrent expenditure was estimated at USD75, 000. Using a discount rate of 15% over the 10 year period, the benefit cost-ratio was 5.4:1. The main additional benefits were the projected milk yields as a result of access to feed resources while the main additional costs were the extra feeding costs in order to achieve the milk yields, the investment in the centre and the recurrent expenditure. It was also projected that since

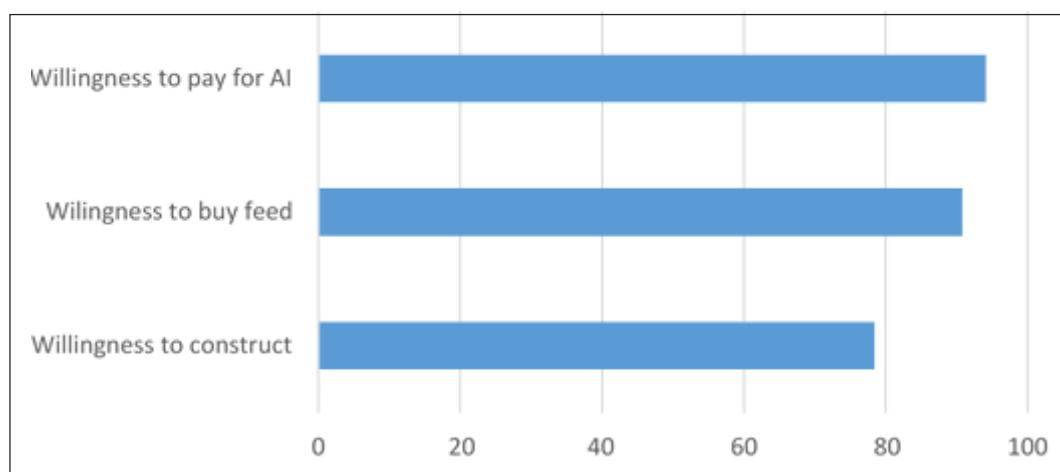


Figure 1. Percent of farmers reporting willingness to construct and pay for services (n=185)

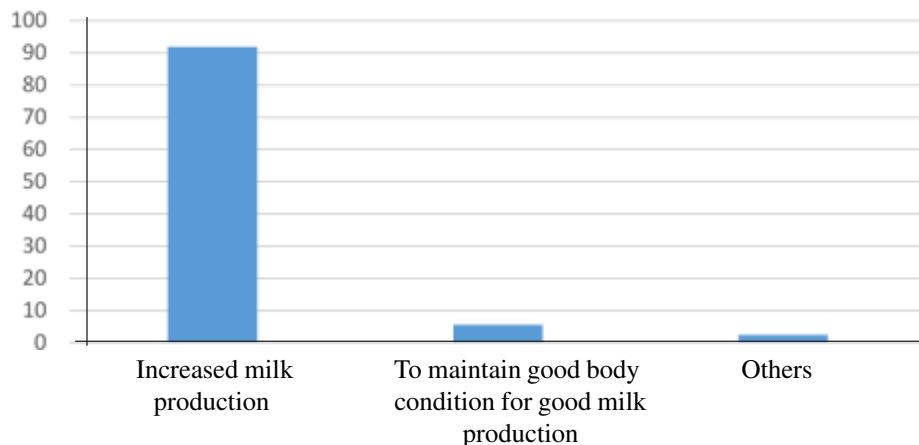


Figure 2. Reasons for prioritizing cows in milk for feeding with feed from the centre (n=185)

Table 1. Farmer perceived advantages of animal production and forage centre

	Chikwaka	Marirangwe	Nharira-Lancashire	Rusitu	Total
Number of farmers interviewed	50	35	50	50	185
Access to feed, fodder and cost savings	81.7	60.0	93.3	95.9	81.5
Knowledge, advice and training	12.2	2.0	3.3	4.1	5.7
Save on transportation costs	0.0	34.0	0.0	0.0	9.6
Other reasons	6.1	6.0	3.4	0.0	3.2

Source: Smallholder dairy survey (2015)

Table 2. Parameters used with and without animal production and forage centre benefit-cost analysis

Parameter	Without	With
Number of cows milked	2	3
Lactation length (days)	275	292
Lactation yield per cow per year	3520	5840
Milk sales (litres per year)	7040	17520
Milk price (USD/litre)	0.5	0.5
Total variable costs of production (USD/year)	3267.10	4847.85
Gross income (USD)	3520	8700
Gross margin (USD/litre)	0.04	0.22

Source: Assumptions and Smallholder dairy survey (2015)

farmers would have access to artificial insemination, the number of milking cows would also increase as farmers benefit from access to improved genetics through artificial insemination.

Discussion

The proposed forage and animal production centre will cater for two constraints that have been identified as limiting smallholder dairy; feed resources and management (Cain *et al.*, 2007; Chinogaramombe *et al.*, 2008; Kabirizi *et al.*, 2009). The objective of the centre will be to improve management of smallholder dairy production in terms of nutritional and animal management, respectively. The objective of the forage section of the centre will be to develop a centre where forage is produced and conserved under management. The bagged and ensilaged forage is then sold to farmers at lowest cost possible. The centre will be manned by qualified personnel, trained up-to diploma level. The animal production section of the centre will also be manned by qualified personnel to provide correct synchronization of the animals on heat and artificial insemination for the benefits to be realized. Since farmers have indicated willingness to pay for the services provided by the centre, this means such a centre can be sustainable without outside financial support. However, there is need for initial investment financing to put up the centre as most of the smallholder communities lack capacity in terms of the required initial capital outlay. Repayment of forage purchased by farmers will be through deductions factored into the milk sold to the milk collection centre. In terms of marketing, milk will be sold in the rural areas, with the surplus processed into sour milk depending on the requirements of the community. The smallholder dairy schemes can also be linked to dairy value chains that supply the urban markets due to the increased production.

The results show that the proposed animal production and forage centre is profitable as shown by the benefit-cost ratio. Providing full time extension support to smallholder farmers is expected to result in increased milk yields achieved by smallholder farmers. Most of the smallholder farmers currently milk cross bred cows. Access to artificial insemination will lead to improved breeds of cows and have the potential to improve milk yield to levels comparable to those achieved by their large scale commercial counterparts, provided farmers have access to appropriate feed resources and improved breeds. Ngongoni *et al.* (2006) highlighted that milk yield from exotic cows found in the smallholder sector were below the potential breed averages of those found in the large scale commercial. Therefore, with access to feed and improved management provided for through the proposed centre, it is expected that this potential can be improved. It was therefore assumed milk yields would increase by more than 50% from the current average yields of 12.8 litres per cow per day recorded in the survey. This will increase the potential milk yield closer to the milk yields achieved by large scale commercial farmers reported by Ngongoni *et al.* (2006). The upgrading of feed and animal management as provided for in the animal production and forage centre has been shown to be profitable and viable and this therefore constitutes a new model for smallholder dairy development in Zimbabwe and the whole of the Southern Africa region.

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