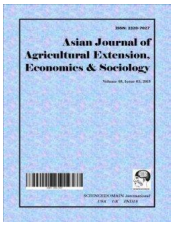

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Effects of Training on Smallholder Dairy Farmers' Income in West Shewa Zone, Ethiopia

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Authors' contributions

This work was carried out in collaboration between all authors. Author GS designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author SK contributed in the econometric analysis and author TK contributed in the discussion part. Author HK contributed interpretation of statistical analysis and research method. All authors read and approved the final manuscript.

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ABSTRACT

Evaluating the impact of training is important to ensure its effectiveness in the adoption of technologies and the income of smallholder farmers. The aim of this study was to assess the impact of dairy husbandry training on milk income. A cross-sectional survey was conducted in two districts of the West Shewa zone of Ethiopia. A total of 180 smallholder dairy households were selected as participants, based on stratified purposive and random sampling methods. The data collected were analyzed using descriptive statistics and linear regression analysis. Our findings show that milk incomes were higher for trained households than non-trained ones. The milk yield and the processed milk volume at the household level were significantly higher for trained dairy households. Based on the regression analysis, factors such as experience in dairying, training received, the area of land allocated to forage production, the number of lactating dairy cows owned, family size, and location all showed a positive and significant impact on milk income. In general, this study confirms that training is a key factor that brings change in the attitude of dairy farmers

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toward efficient utilization of inputs and services for improving dairy productivity and income. Therefore, in order to bring change in technology adoption, huge attention should be given in improving dairy farmers' perception and level of understanding through training.

Keywords: Training; dairy farmer; impact; milk income; milk yield; lactating dairy cow.

1. INTRODUCTION

Agriculture remains the backbone of the Ethiopian economy and it not only employs about 83% of the total population but also contributes about 90% of the total export earnings and 43% of the GDP [1]. Hence, the performance of Ethiopia's agricultural sector largely determines the performance of its entire economy. Encouraging rural development and sustainable agriculture is important to satisfy the demand of the increasing population for food. Ethiopia has the largest livestock population in Africa. Livestock is an important source of food, skin, manure, and stable incomes of smallholder farmers. The total annual national milk production in Ethiopia is estimated to be 4.1 billion liters [2] and smallholder farmers can benefit from the growing demand for dairy products through the income and employment generation opportunities this presents [3]. However, they lack the required technological, organizational, and institutional capacities [4].

Dissemination of improved husbandry practice through farmers' training is an important strategy for enhancing competence among the target audience and thus increasing adoption [5]. It has been also reported that imparting suitable training in improved dairy farming practices can enhance the rate of adoption of technologies in the resource poor families. A report by Murai and Singh [6] indicated that dairy farmers should be trained regularly so that they may develop the desired level of knowledge and skills in scientific dairy farming. To achieve this purpose, many foreign agencies have provided funds for large-scale agricultural training of farmers in developing countries [7]. However, there is no concrete evidence documenting the effectiveness of training on the dairy husbandry practice in Ethiopia. Thus, the hypothesis proposed in this study was that training in dairy husbandry practices brings about a positive change in the income of dairy farmers through awareness creation and the adoption of the practices learned. Therefore, the objective of this study was to assess the effects of dairy husbandry training on milk income under smallholder farmers' management condition.

2. MATERIALS AND METHODS

2.1 Study Area

This study was conducted in two districts of the West Shewa zone in Ethiopia. Adaberga district is located 64 km west of Addis Ababa, at an altitude of 2435 m above sea level. Chelia district is also located in the West Shewa zone and is 175 km west of Addis Ababa. It is situated at an altitudinal range of 1700-3060 m above sea level. In both districts, the farming system is characterized by crop-livestock production systems. Cattle are reared under the traditional management system, where the major feed resources are obtained from grazing and crop residues, with very limited supplementation.

2.2 Sampling Method

A cross-sectional survey was conducted in Adaberga and Chelia district during March 2017. The two districts were purposely selected, based on their access to training in dairy husbandry practice and ownership of lactating dairy cows. The data were collected from a total of 180 smallholder dairy farmers (90 from each district). Sixty of the participant smallholder dairy farmers (30 from each district) were trained on dairy husbandry practices. The remaining 120 smallholder dairy farmers (60 from each district) were randomly selected, based on the ownership of lactating dairy cows, from nearby villages that were not included in the training. This was done to avoid possible spillover effects that are likely to occur between farmers of the same village.

2.3 Data Collection Procedure

A semi-structured questionnaire was prepared and face-to-face interviews were conducted to collect the primary data. Secondary information was also collected from the district agricultural office and development agents. The information collected includes demographic characteristics (family size, age, sex and educational status of the household head) and socioeconomic characteristics (experience in dairying, veterinary

and extension services obtained; area of land allocated to forage production; access to feed and to market; milk sold, consumed, processed, lost, and yield; dairy income; and the price of milk and milk products).

2.4 Training on Dairy Husbandry Practice

A two-day intensive training was provided to 60 participant smallholder dairy farmers on dairy husbandry practices (forage production and feeding, hygienic milk production, milk processing, animal health, and record keeping) in May 2016. In addition to the dairy farmers, three agricultural experts from each district attended the training so that they could assist the trained dairy farmers at the household level after the training, and visit them for regular follow-up. The training was provided at Holeta agricultural research center, where the participants were given a practical demonstration on each component of the training.

2.5 Data Analysis and Calculation of Milk Income

The field data were analyzed to obtain the descriptive statistics and multiple linear regression analysis was used to assess the factors influencing milk yield and milk income. Linear regression assumes a linear relationship between the dependent and independent variables. It is implicitly specified as;

$$Y=f(x_1, x_2, x_3,\ldots\ldots\ldots\ldots xn)$$

The effect of training on the milk income of participant dairy households in the study area was modeled explicitly as:

$$Y = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8 + u$$

Where Y = Milk income; x_1= TRA; x_2 = AGE; x_3 = EDU; x_4 = EXP; x_5 = FOR; x_6 = COW; x_7 = FAM; x_8 = LOC; b_0 = Constant term; b_1 to b_8 = Estimated coefficients of the independent variables; u = Error term.

Both the continuous and dummy variables included in the regression analysis are defined in Table 1.

The major feed resources (forage and crop residue) are obtained from their own farmland, as well as from the communal grazing lands. In addition to these, they also used their own family's labor to produce and manage feed production and grazing lands. Because of this the cost of production is assumed to be opportunity cost of labor for forage production and cost of concentrate. Opportunity cost of family labor for forage production was calculated based on the reported average market wage rate of labor in the study area. Therefore milk income was calculated as the difference between milk revenue and cost of milk production.

Milk revenue = [price of milk (ETB/kg) * milk volume (kg)] + [price of butter (ETB/kg) * volume of butter (kg)] + [price of cheese (ETB/kg) * volume of cheese (kg).

Table 1. Definition of variable and measurements

Variables	Type	Definition and measurement
Independent variables		
Training received [TRA]	Dummy	1 if trained, 0 otherwise
Age [AGE]	Continuous	Age of the HH head in years
Education [EDU]	Dummy	1 if the HH head attended formal school, 0 otherwise
Family size [FAM]	Continuous	Number of HH members
Experience [EXP]	Continuous	Number of years of involvement in dairy production
Frequency of extension service [FREXT]	Continuous	Number of visits by extension agent in the 10 months following the end of training
Market distance [MADIS]	Continuous	Walking distance to the nearest market (customer)
Cross breed cow [COW]	Continuous	Number of crossbred milking cows owned by the HH
Location [LOC]	Dummy	1 if Chelia, 0 otherwise
Forage land [FOR]	Continuous	Size of land allocated for forage production in ha
Dependent variable		
Milk income	Continuous	Amount of money obtained after deducting the variable cost from milk revenue (milk and milk products) in ETB

HH: Household; ETB: Ethiopian Birr

Total cost of production = [price of concentrate (ETB/kg) * volume of concentrate (kg)] + opportunity cost of family labor for forage production].

Opportunity cost of family labor for forage production was calculated at the rate of 16 ETB/ man-day (4 ETB/0.1 ha of land).

3. RESULTS AND DISCUSSION

3.1 Characteristics of Participant Dairy Households

Table 2 shows the demographic and socioeconomic characteristics of participant dairy households. Trained smallholder dairy farmers have, on average, more experience in dairying and the frequency of obtaining extension services is significantly higher (P<.01) than that of non-trained dairy farmers. In addition, trained dairy farmers also obtained more veterinary services (P=.06) than non-trained participants. According to the respondents, 32% of the trained and 21% of the non-trained dairy farmers attended formal school. This shows that the literacy level is 34% higher for trained households, which helped them to more easily adopt the lessons learnt, compared with non-trained dairy farmers.

3.2 Factors Influencing Milk Income

A regression analysis was used to determine the extent to which the socioeconomic factors of the respondent dairy farmers influenced milk income (Table 3). Factors such as experience in dairying, area of land allocated to forage production, the number of crossbred milking cows owned, family size, training received, and location have shown significant and positive effect on income. On the other hand, age of the household head has shown negative effect (P=.02) on income.

Table 2. Characteristics of trained and non-trained smallholder dairy farmers

Variables	Total sample (n=180)	Trained (n=60)	Non-trained (n=120)	p-value
Age	42.99	44.12	42.43	0.13
Sex	0.78	0.78	0.78	0.45
Marital status	0.93	0.92	0.94	0.26
Education	0.24	0.32	0.21	0.06*
Family size	6.0	6.0	6.0	0.31
Experience	16.06	18.83	14.68	0.00***
Extension service	0.83	0.88	0.81	0.10*
Frequency of extension service	2.06	2.72	1.73	0.00***
Number of milking dairy cow	2.00	2.00	2.00	0.40
Veterinary service	0.41	0.5	0.38	0.06*
Market distance	1.29	1.35	1.26	0.33
Annual milk income	8,611	10,422.44	7,705.9	0.00***

**** and * indicates significant difference between trained and non-trained farmers at 1% and 10% level, respectively. Source: Own survey data (2017)*

Table 3. Regression analysis of factors affecting milk income

Variables	Coeff.	SE	p-value
Training received	1720.59	664.99	0.01**
Age	-104.26	43.69	0.02**
Education	763.57	736.88	0.30
Experience	87.97	49.31	0.08*
Forage land	1778.5	713.73	0.01**
Crossbred cow	3761.82	470.11	0.00***
Family size	269.14	126.88	0.04**
Location	1894.31	681.32	0.01***
Cons	4775.13	1539.52	0.00

****, ** and * indicates significance difference at 1%, 5% and 10% level, respectively*
Adjusted R2 = 0.39. Prob. > F = 0.000. Number of observations=180
Source: Own survey data (2017)

In this study, the average annual milk income of trained dairy farmers was higher than that of non-trained dairy farmers by Ethiopian birr (ETB) 2,716.54. Training is one of the predictors of milk income and for every additional training received; annual milk income is likely to increase by ETB 1,721. Our finding is supported by a study in India, which indicated that training increased net income by 2,608 Indian rupee per animal per year [8]. Similarly, a study by Muluken and Sassi [9] indicated that the training participants obtained a positive and significant gain in farm income. The area of land allocated to forage production is another predictor that has also shown a positive impact on milk income. For a hectare of additional land increase in forage production, annual milk income increased by ETB 1,778.5. In line with our findings, previous studies indicated that farm size was positively related to the profit margin of farm income [10]. Similarly, the number of crossbred milking cows owned has shown a positive and significant effect on milk income.

In this study, significant variation in milk income due to location was observed. Milk income was higher in Chelia district than Adaberga district, despite higher milk production in Adaberga. This may be associated with higher milk price in Chelia (ETB 15 /l) compared to Adaberga (ETB 11.9 /l). Fresh milk in Adaberga is directly supplied to cooperatives that decide its selling price. This shows that fresh milk supply to cooperatives enables farmers to get access to the market, but with a tradeoff in the price received. Our finding is in agreement with that of a previous study by Chagwiza et al. [11], which indicated that cooperatives are weak in offering a better price but strong in facilitating technological transformation. Our findings also indicated that the age of the household head had a negative effect on milk income. This indicates that younger dairy farmers are more efficient in adopting the practices learnt, as well as in managing the dairy farms, than the older ones. In general, dairy farmers with an asset, such as land allocated to forage production, are more willing to implement the skills and knowledge obtained from the dairy husbandry training.

In this study, it was observed that training brought about an attitudinal change toward the uptake of information that created awareness on the importance of forage production and concentrate supplementation for improving milk yield and milk income. In line with this study, Noor and Dola [12] indicated that training increased the perception and performance of trained farmers. The amount of concentrate supplementation per cow per day was higher for trained dairy farmers. The results of this study also agree with a previous study, which indicated that training improved feed provision from 50% (control) to 93.8% (trained group) in Malawi [13]. In the present study, it has also been observed that milk loss was positively affected by the distance to the market and milk yield.

3.3 Milk Yield and the Proportion of Milk Sold and Processed by Respondent Dairy Farmers

Fig. 1 shows milk yield, milk sold, and milk processed by participant dairy farmers. The result indicated that significantly higher (P<.01) milk yield was obtained for dairy households that underwent training compared to non-trained dairy households. Average milk productivity per cow per day from a crossbred dairy cow was significantly higher for trained dairy farmers, 6.75 liter (l) than it was for non-trained dairy farmers, 5.19 l. The amount of milk processed by trained dairy households was also significantly higher (P<.01), when compared with non-trained dairy households. This study indicated that milk processing is an important source of income for smallholder farmers. Out of the total milk production in the study area, 60-67% was sold as fresh milk and 16-24% was processed into butter and cottage cheese. A previous report by Central Statistical Agency [14] indicates that, of the total annual milk production in rural areas, 7% is sold and 8% is used to produce butter and cottage cheese, which is lower than the findings of this study. According to the respondents, one of the major reasons for processing milk at household level was to supplement income by selling processed dairy products such as cottage cheese and butter. In addition to this, 11-22% of the respondents indicated that the processing increases the shelf life of the product.

3.4 Effect of Training on Feed Production, Utilization and Animal Health

Table 4 shows data collected from participant dairy farmers on area of land allocated to forage production, status of improved forage production, and concentrate provision, amount of concentrated provided, isolation of diseased animal and mastitis treatment. The area of land allocated to forage production by trained dairy farmers was 44.83% higher than that of

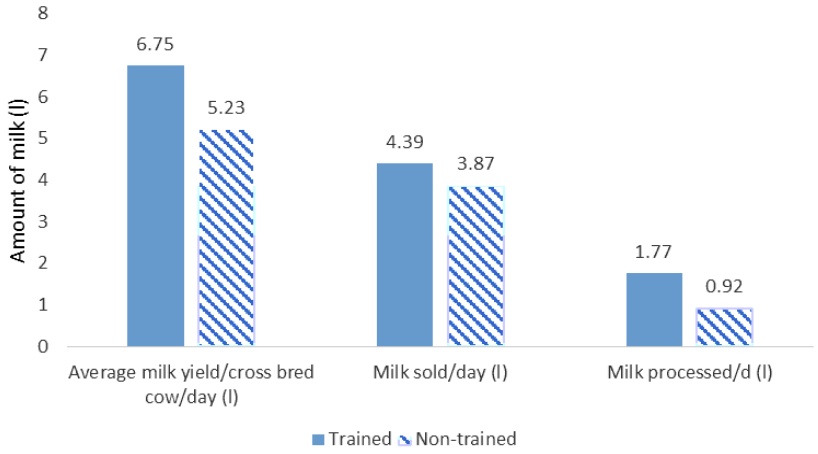

Fig. 1. Average milk yield, milk sold and milk processed by participant dairy farmers
**** indicates significance difference at 1% level, l: liter*
Source: Own survey data (2017)

Table 4. Effect of training on forage land allocation, forage and concentrate utilization, and animal health

Variables	Trained	Non-trained	p-value
Forage land (ha)	0.58	0.32	0.00***
Improved forage (%)	57	54	0.38
Concentrate provision (%)	57	46	0.08*
Amount of concentrate (kg)/cow/day	2.25	1.66	0.01***
Isolation of diseased animal (%)	82	67	0.02**
Mastitis treatment (%)	55	38	0.01**

****, ** and * indicates significant difference between trained and non-trained farmers at 1%, 5% and 10% level respectively. Source: Own survey data (2017)*

non-trained farmers. Similarly, the amount of concentrate supplementation per cow per day was significantly higher by 26% for trained dairy households.

The proportion of respondents who used concentrate was also higher for the trained households (*P*=.01). Animal health is one of the major constraints identified in the study area and the result indicated that training significantly (*P*=.01) increased treatment of mastitis by 30.9% for trained households, when compared with the non-trained ones. Similarly, isolation of diseased animals was also 18.29% higher (*P*=0.02) for trained dairy farmers.

4. CONCLUSIONS

Trained dairy farmers obtained higher milk yield and milk income than non-trained dairy farmers. Training increases the utilization of inputs and services due to the adoption of lessons they had learnt during the training. In general, this study confirms that training on dairy husbandry is a key factor that brings about a change in the attitude of dairy farmers towards the effective utilization of resources that enhance milk yield and Net Farm Income. Therefore, greater emphasis should be laid on improving knowledge and perception of dairy farmers through continuous training and follow-up.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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