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Improved Dairy Technology to Smallholders in the Central Highlands of Ethiopia: Experiences and Way Forward

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Abstract

Progressive achievements gained from introduction of dairy technology to smallholder farmers in the central highlands Ethiopia had brought significant changes in the income and improvement in the smallholder farmer standard of life. The numbers of crossbred dairy cows reaching the smallholders have increased. This study was initiated to show the farmers benefit gained from the full package of technology transfer to the smallholders in the high lands of Ethiopia. A total of 81 farm households (65 Male and 16 Female) were considered to use the improved dairy technology transfer at their level of managements . The Least squares Means Average daily milk yield ADMY were significantly varied at each district ($p<0.05$). Higher daily milk yields were obtained from Walmara (9.43 ± 0.29 kg/day) followed by Dire inchini (8.92 ± 0.41 kg/day) while lower yields were from Ginchi and Gohatsion (7.89 ± 0.41 & 6.62 ± 0.55 kg/day) respectively. Lactation Milk Yield (LMY) and estimated lactation length (LL) also significantly ($P<0.05$) varied between the studied villages. The overall milk price at the four districts was 12.00 Dire Inchini, 10.5 Walmara, 8.50 Gohatsion and 7.50,Eth birr respectively. The price of milk fluctuates from 7.50 to 12.00 Ethi birr. Eventhough farmers have tried to organize themselves into dairy cooperatives to overcome price fluctuations. The result of this study revealed that applications of full packages of improved dairy technology to smallholder realized a growing annual income for the smallholders. Farmers willing to acquire crossbred dairy cows are increasing and are far in excess of the current supply. Advanced smallholder farmers training and strengthening linkages between stakeholders could promote dairy production to dairy commercialization.

Keywords: Crossbred dairy, milk yield, smallholder, stockholders crossbred dairy, marketing

Introduction

The highlands of Ethiopia are densely populated and most of the rural people are dependent on crop livestock production system for their livelihood . The livestock sub-sector play a crucial role in the traditional subsistence farming, contributing substantially to the GDP, foreign exchange earnings and providing employment to a large section of the population. Ethiopia has given much priority to the development of dairy at farmer's level to increase the supply of milk. A number of crossbred dairy cows and local cows are raised in the central highland mainly around Addis Ababa. In spite of favorable environmental conditions and farmer's responsiveness to accept technology from research institutions, the possibility of availing improved dairy genotypes makes major difficulties to improve dairy production in the central highland.

Moreover, there is no encouraging improvement interventions made so far as far as technology transfer is concerned. From the general perception it could be noted that compared to other some east African countries the Ethiopian dairy sector in not well developed. Crossbreeding of indigenous breed with high producing exotic cattle has been considered as a practical solution to improve the low productivity of dairy cattle in Ethiopia (Tadesse, 2002). But this effort was not found to have brought significant changes in the dairy sector at National level. Tireless efforts had to be made to deal with the major bottlenecks. In order to design relevant dairy development strategies and implement target specific interventions for future development of the smallholder and commercial dairying, evaluation of the existing dairy production system is important. The research information generated verified and demonstrated can helps as a starting point for further development to be made in the nation dairy enterprise.

The result of various research efforts in Ethiopia had proved the viability of such technologies at smallholder farmer's level (IAR 2002). The Ethiopian Institute Agricultural Research (EIAR) has made progressive efforts to reach the smallholder with dairy technology packages consisted of crossbred cows/heifers, appropriate breeding methods and management practices to overcome the limitations. Feeds and feedings incorporated with forage development were among the major components in line with trainings and marketing aspects. Regional and federal research centers have shared from the achievements and had moved towards popularization and scaling up. This encouraged and allowed the small holder farmers to increase their income and improve their living standard (Tesfaye K and Yohannes G 2006, Shapiro *et al.*, 1998). Farmers who have used the dairy technology packages from four to five consecutive years have realized a growing annual income.

However; the disseminations of technology was limited by inadequacy of exotic breeds and their crosses. On the other hand the dairy technology generation and transfer is capital intensive and a long time venture which ends up with limited results in low area coverage. Despite the existing limitations, more farmers in the central highlands still demand for improved high-grade dairy cows. As result of higher population pressure the demand for milk and milk products is higher in the central highlands, urban and peri urban areas where urbanization is expanding. The increasing situation of urbanization and population growth is urgently requiring the expansion of specialized large scale dairy enterprise setups. Future surplus in milk can be realized through investment in better technological options to improve both traditional dairy farms and commercial dairy production. The objective of this work is therefore to show the achievements gained from

the technology transfer and suggest ideas from the lessons learned for further improvement in dairy production at smallholders.

Material and Methods

Description of the study areas

The scaling up of improved dairy technology was conducted at four districts (*warada*) namely Walmara, Ginchi, Dire Inchini and Wara Jarso in the central highland of Ethiopia. The districts were selected based on demand raised from the farmers and local administrators and conformation made by rapid appraisal done by team of researchers from all disciplines. The altitudes of the districts are almost similar ranging from 2800 to 3000 masl at a medium range of around 2400 masl. The study areas receive annual rainfall 1100 mm; average temperature minimum: 6°C, maximum: 24°C (3°24'N to 14°53'N and 33°00'E to 48°00'E). The study areas experiences bimodal rainfall pattern, wet (June to September) and the dry (October to May) while February to April is a short rainy season. The annual temperature ranges from 18 ^{0}c to 24 ^{0} C and the rainfall records between 1100 to 1200 mm. The districts are located 40 to 140 km west and 170 km to the North of Addis Ababa.

Animals and Management Pre and Post-dispatch to Farmers

Based on the recommendations made from the research findings by the centre (HARC), 81 crossbred calves received 3 kg of colostrums per day for 4 days after birth and a total of 260 kg of whole milk for 90 ± 2 days until weaning. F_1 crossbred calves are allowed to suckle during the pre-weaning period and are fed on native grass hay free of choice. They are supplemented with concentrate mixture composed of wheat middling, wheat bran, noug cake (Guizocia abyssinica) , and salt, based on body weight change until mating. All crossbred calves are kept in door under similar management conditions. Prior to distributions to farmers all animals were fed grass hay free of choice and were supplemented with 1.5 – 2 kg of concentrate for 90 days until the average age was 180 ± 5 days. Selections are made based on post weaning daily growth rate on the bases of individual and parental information. Based on their breeding value best performing heifer are retained for future breeding activity, and the better once are dispatched to the selected farmers as technology transfer Cows are allowed to graze for eight hours during the day time and are supplemented with concentrate based on their physiological states at night.

Farmer selection

A total of 81 smallholder dairy farmers, (65 Male and 16 Female) were

selected and trained from walmara , Dire inchini Ginch and Warajarso districts. Farmers were selected based on the criteria set by a team of researchers and relevant stockholders. The criteria set were supported by local administration and technical staff responsible for selecting enlightened farmers for the scaling up improved dairy technology. Suitability of the selected sites for dairy production, accessibility, commitment of farmers to have available resources to buy the crossbred cows /heifer and to adhere to the working conditions were some the criteria. Farmers are obliged to establish an improved pasture of a recommended forage variety, enough to sustain the animals all year-round. Farmers are also committed to handle the animals according to the given recommendations and refrain from either using for purposes unrelated to the study or selling them until after the study had ended. Other stockholders like, district livestock production and marketing agency have agreed to take responsibility to assist the farmers on their immediate needs like medical and artificial insemination (AI) service delivery etc. on time.

Data collection

Data were collected from 2008 to April 2014 from selected districts namely walmara, Ginchi, Dire Inchinin and Grar Jarso. Data from 6 to 27 accessible farmers from each of the districts were carefully collected, recorded and used considered for analysis. Data from un accessible sites were not included. The parameters recorded were daily milk yield, lactation milk yield, lactation length and the price of milk sold. The data on milk production was collected monthly during visits to farmer's house and summarized on quarterly basis based on early, mid, and late lactation (milk suckled by calves before and after each milking was not taken into account), while the lactation milk yields were summarized for the period the cow stayed in milk. The price of milk was taken once in a month from the collection centre by asking the farmer.

Data analysis

The least squares procedures of SAS 2003 was used to analyze the data in which the four districts were considered as independent variable on average, minimum and maximum daily milk yield. Lactation length and lactation milk yield were also taken as dependent variables over the districts.

Result and Discussion

Milk Production Performances

Daily milk yield

The milk production performance of improved crossbred dairy cows at smallholder level of the districts is presented in Table 1. The least squares means of average daily milk yields (ADMY) of crossbred dairy cows for the districts showed significant ($p<0.05$) variation. The highest daily

milk yield was obtained from Walmara district (9.43 ± 0.29 kg/day) and lowest milk production was at Garar Jarso (Gohatsion) (6.62 ± 0.55 kg/ day) (Table 1). This resultis in agreement with on station finding of Sendros et al, (1987) who reported that Freissian Boran (FB) crossbred cows on average produced four to five times more milk than indigenous cattle breeds (). However results of on-farm evaluation of crossbred dairy cattles owned by smallholder farmers around Holetta, Debre Zeit, Arsi and Bako showed that their level of milk production was lower than that of on-station yield even under better input supply (Gryseels and De Boodt, 1986; Kiwuwa et al., 1983; Tesfaye et al, 1995).This could be caused by low awareness that farmers had during those demonstration periods. Since the genotype, the exotic blood level inheritance and the breed type were the same, the variability in milk production from this study could be due to management factors applied by different farmers at each districts. The current result confirmed that in the central highlands of Ethiopia, because of the applications of appropriate technology to the proper target group and favorable environmental and climatic conditions, crossbred dairy cows can continue to out-yield pervious crossbred dairy cows, provided that appropriate improvement interventions and tailored trainings are made to their level of management.

Table 1. Least square means ± se of average daily milk yield (ADMY) of crossbred cows for the four districts

Districts /locations	n	DMY ± se (kg)	Max (kg)	Min (kg)
Walmara	27	9.43 ± 0.29^{a}	10.65	6.98
Dire Ichni	14	8.92 ± 0.41^{ab}	9.71	7.92
Ginchi	14	7.89 ± 0.41^{b}	9.32	5.78
Wara Jarso	6	6.62 ± 0.55^{c}	8.00	4.87

$^{a\text{-}bc\ within}$ columns means with the different superscripts are significantly different from each other ($P<0.05$)

Lactation milk yield (LMY) and estimated lactation length (LL)

Lactation length

The estimated lactation milk yield (LMY) and lactation length (LL) of crossbred cows in the four districts are presented in Table 2. The lactation milk yield varied significantly ($P<0.05$) between the districts. Comparatively higher lactation milk yield was recorded at Walmera district followed by Dire Ichni and Ginchi districts (Table 2). Walmara district had better access to inputs, service delivery and purchase of concentrate feeds, medications for their animals and better access to milk collection centre. Because of their experience, farmers in Walmera manage their animals better than those in the rest of the districts. Artificial Insemination (AI) and

animal health services at the district are also in a better position than the rest of the districts. The demand for milk and milk products were initiated form the community in. Dire Inchini area and were implemented as a scaling up of dairy technology transfer The lowest total lactation milk yield was recorded at Wara Jarso (Gohatsion) district. This could be due to the limited access to improved dairy technologies in terms of trainings, inputs and comparatively low management level applied in addition to the less number of improved genotypes for smallholder farmers.

The estimated high lactation milk yield observed in most of the study districts could be due to the fact that cows were subjected to stay in milk for prolonged lactation period, which is the demand created by the farmer for more production and more income from milk. On the other hand the variations in lactation length could be attributed to extended milking days without timely drying off to increase annual milk income, lack of heat detection practices and poor AI delivery system in the study area. The current result had comparable lactation length with crossbreds in some parts of the central highland (Mulugeta & Belayneh 2013. Similar extended lactation length (LL) of crossbred cows was reported (Enyew *et al.,* 2000). In this study the overall average lactation milk yield was 3415±242.75 kg, ranging between 2986.50 and 4025.35 kg differs from on station performances of crossbred dairy cows simply because of extended lactation length. The overall lactation length (LL) in month for crossbred cows in urban and per urban (Niguse and Yoseph, 2014) areas and some other at on station results did not exceed the range of 10.9 ± .01 – 11.0 ± 0.1 months equivalent 320 to 330 days unlike the the present on-farm results. The lactation period recorded in this study are greater than those of Mohammed et al., 2009, Adisu, 2010, Million and Tadele, 2003, and that of IAR (year is missing) who reported an average lactation period of 321, 292, 279, and 229 respectively. The similarity and the differences in lactation lengths of crossbred cows at the on farm condition could be due to the interests of the farmers to keep the cow in milk for longer period. In some cases pregnant cows are milked by the farmers because of the great demand for milk. Practically cows are milked up to seven months of pregnancy stage provided it is properly fed and well managed.

Table 2. Least square means ± se average lactation Milk yield (LMY) and Lactation length (LL) of crossbred cows at the four districts

Districts /locations	N	LMY± se (kg)	LL
Walmara	27	4025.35 ± 173.30^{a}	432.14 ± 11.72^{ab}
Dire Ichni	14	3486 ± 240.67^{ab}	388.92 ± 16.27^{b}
Ginchi	14	3164.57 ± 240.67 ^{b}	403.14 ± 1.27^{ab}
Wara Jarso	6	2986.50 ± 318.38 ^{b}	450.87 ± 21.53^{a}

$^{a\text{-}b\ within}$ columns means with the different superscripts are significantly different from each other (P<0.05)

Milk marketing

In the central highlands of Ethiopia milk and milk products are important sources of economic wellbeing to the smallholders. Women farmers cover their household expenses from sale of milk and milk products. Fresh milk is sold at milk collection centers and or at farm gates. The price of milk fluctuates based on the fasting and non fasting periods. The overall milk price during fasting season at Walmara, Ginchi, Gohatsion and Dire Inchini was 10.5, 7.50, 8.50 and 12.00 Ethiopian birr respectively (table 3). From the data it can be noted that the price of milk across the four district ranges from 7.50 to 12.00 Ethiopian birr. Farmers on average can collect 50 to 100 Eth Birr per day from a single crossbred dairy cow from the four districts studied. The price of milk is paid to the farmers every two weeks. Except Walmara the other districts are out of reach to cooperatives and other milk collector schemes. Farmers who are far from the capital city (Addis Ababa) like Ginchi and Gohatsion had no options to negotiate and dispose their product to preferred collector. The price of milk is decided by the collector for such a smallholder farmers who are forced to sale their milk at the price offered by any milk collector. In most cases, the milk price in the central highlands does not differ much from one another. The distance from farmers' house to the milk collection scheme, also seem to have reasonable impact on milk marketing system. Farmers at Dire Inchini (30 kms away from Ambo) have organized themselves and established dairy cooperatives (Fig 3 right) at the town and opened milk collection and distribution centre (café) and sale milk to consumers at 12.00 Eth Birr per litter per day. During the fasting season milk are collected and kept for yogurt (*irgo)* production. A cup of yogurt is sold at 6 Eth Birr, which means a kg of yogurt is approximately sold for 18 Eth Birr.

Gross annual income of farmers in the studied districts ranges between 38,000 & 35,000 Eth Birr at Dire Inchini and Walmara from a single improved crossbred cow. The use of improved technologies specifically improved dairy cows are well understood to result in better income for the users of the technologies:- Improved cross breeds, forage and management practices**.** Nega Wubeneh (2006) had reported that milk output can be increased on average by 21% with the existing technology through training dairy farmers on better production techniques. Hence there is significant scope to increase output without costly investments to boost milk production in Ethiopia to meet the rising demand for dairy milk and milk products.

Table 3. Estimated means ± se Milk price (Eth Birr) / day from single crossbred cow for the different districts

	Districts			
Income variables	Walmara	Ginchi	Gohatsion	Dire Ichni
	N =27	N= 14	N = 5	N= 14
Milk price (Eth Br)	10.50	7.50	8.50	12.00
Daily Milk yield (kg)	9.42±0.20	7.89±0.41	6.62±0.54	8.92±0.41
Daily income (Eth Br)	98.97±3.24	51.14±4.56	56.31±5.96	107.14±4.50
Monthly income(Eth Br)	2969.16±97.35	1775.89±135	1689.37±178	3214.28±135.20
Estimated annual income	35630.00±1168	21310.74±162	20272.50±214	38571.42±162

Farmer's perceptions

Benefited farmers from the technology have witnessed that with the use of dairy technology they have improved their living standards. They have indicated that they collected more milk above their families' requirements and have started to tack surplus milk to market. Additional income was generated from the sale of milk and milk products. More opportunities were created for the farmers to buy additional crossbred cows and to expand their farm to dairy commercialization. The demand for additional improved crossbred heifers /cows was exclusively high in the highlands. The price of a single pregnant crossbred heifer was around 40,000.00 Eth Birr (1900 USD) at the smallholder farms around Holetta and North Shoa Degem and Fitche area.

Farmers appreciate the success of dairy technology transfer in the central highlands and its applications of appropriate technology and tailor made training for proper target groups and demand to extend the approach further. Currently, more farmers in the highlands are willing to replace the local cows with better yielding improved breeds because of increased milk production and additional income gained from the technology. This opportunity could ultimately lead the dairy sector to intensification of dairy production system which could lead to maximization of smallholders income and save the import substitution for the nation at large.

Conclusion

The result of this study revealed that applications of full packages of improved dairy technologies (improved crossbred dairy cattle, feed, management and training) for smallholder farmers' increased their annual income and awareness and knowledge gained from training had assisted the farmers to keep more number of crossbred dairy cow thus leading to additional income. The scaling up of dairy technology, smallholder farmers have enabled to targeting to large scale commercial dairy production system. Benefited farmers have developed confidence on handling and management of crossbred dairy cows and are demanding for high grade crossbred cows. The demand for crossbred cows

is increasing and is far in excess of the current supply.

The current achievements of dairy scaling up technology transfer process on the livelihood of farmers in the central highlands of Ethiopia could significantly contribute to the increasing national demand for improved dairy cattle to increase milk and milk products and saving foreign currency spent on importation of powder milk. The experiences gained from these exercise can created better opportunities for Research and higher learning institutions to move beyond traditional on station research undertaking alone to on-farm breeding and cross breeding programs. These may draw the attention of policy in broadening partnership and priority setting as to where should the investment go for technology generation and scale up.

Recommendations

To further advance the technology, there is a need to establish farmers training institutions (Dairy training Institute and Agricultural Training center) to gain more experiences and knowledge on dairy cattle breeding and management aspects. Improving the facilitation of extension system for dairy technology transfer at district and smallholder community levels is suggested, so as to improve linkages and sharing of ideas between stockholders and within the community.

Coordination of dairy improvement at all levels; strategy to strengthen and support the stallholder's knowledge use of media (radio) in line with production and management programs could maximize good practices.

Use of feeds and feedings, forage production should be stimulated to enable the farmers and upgrade their level of dairy production and management.

The current investment opportunity and attractive milk price, could suggest that there is a scope for extending a similar approach to other sites where the technology is not addressed. This could support to increase the number of crossbred animals and thereby to reduce the demand-supply gap of improved dairy breeds.

Appreciable effort made in introducing and scaling up technologies and practices to communities and lessons learned from the present study could serve as a milestone for the on-farm crossbred dairy improvement program at national level.

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References

Enyew Negussie, Branna ng E, Benjaw, K. and Rottman, O. J. 2000. Reproductive performance and herd life of cross bred dairy cattle with different levels of European inheritance in Ethiopia. In: Livestock production and the environment implications for sustainable livelihood Proceedings of the 7t h conference of the Ethiopian Society of Animal Production, held in Addis Ababa, Ethiopia, 26 - 27 May 1999.Ethiopian Society of Animal Production (ESAP), Addis Ababa, Ethiopia. pp. 65 76

Gryseels G and de Boodt K 1986 Integration of crossbred cows (Boran and Friesian) on smallholder farms in the Debre Zeit area of the Ethiopian highlands ILCA Highlands Programme Report ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia

Kiwuwa, G. H., J.C.M. Trail, M. Yesuf Kurtu, G. Worku, F.M. Anderson and J. Durkin, 1983. Crossbred dairy cattle productivity in Arsi Region, Ethiopia International Livestock center for Africa (ILCA). Research report No. 11, PP. 1-29.

Mohammed Yousuf Kurtu and H.O. de Waal. 2009 Herd management, milk production and reproduction of Urban dairy farms in the Harar milk shed Ethiopian Journal of Animal Production (ESAP) vol 9 (1): 57 - 73

Mulugeta Ayalew1 and Belayeneh Asefa 2013 Reproductive and lactation performances of dairy cows in Chacha Town and nearby selected kebeles, North Shoa Zone, Amhara Region, Ethiopia World Journal of Agricultural Sciences Vol. 1(1), pp. 008-017, February 2013 Available online at http://wsrjournals.org/journal/wjas ISSN 2329-9312 ©2013 World Science Research Journal

Nega Wubeneh. 2006 Technical Efficiency of Smallholder Dairy Farmers in the Central Ethiopian Highlands, Poster paper prepared for presentation at the International Association of Agricultural Economists Conference, Gold Coast, Australia, and August 12-18, 2006

Neguse Fekadu and Yoseph Makasha. 2014 Assessment of milk production and reproductive performances in urban and secondary town dairy production in Adama milk shade East Shoa zone, Oromia National Regional State, Ethiopia. International Journal of Agricultural Science pp 105 - 110

Sendros Demeke, Beyene Kebede, Tesfaye Kumsa, Taye Bekure and Hailu G Mariam 1987. Preliminary result of cattle crossbreeding (European and zebu study. 1. Milk production performance of F1 cows. In: *Proceedings of the First National Livestock Improvement*

Conference, 11-13 February 1987, Addis Ababa. JAR, Addis Ababa. pp. 61-65.

Shapouri, B and S. Rosen. 1992. Dairy imports in sub-Saharan Africa. In: Dairy Marketing in Sub-Saharan Africa. Proceedings of a Symposium held at ILCA, Addis Ababa Ethiopia, 22-30 November1990.

Shapiro, B.I., Gebru, Gebru., Desta, S., Negassa, Asfaw., Nigussie, K., Aboset, G. and Mechal, H. 2015 *Ethiopia livestock master plan.* ILRI Project Report. Nairobi, Kenya: International Livestock Research Institute (ILRI)

Tesfaye Kumsa 1995. On farm dairy performance of F1 crossbred cows at highlands and mid altitude and mid-altitude zones. Ethiopian society of animal production (ESAP) Proceedings of the third annual conference of the Ethiopian society of animal production (ESAP), held in Addis Ababa, Ethiopia, 27 -29 April 1995 pp 115 - 122

Tesfaye Kumsa and Yohannes Gojjam 2006 in the proceedings of scaling and out Agricultural technology in Ethiopia: an International Conference , 9-11 May 2006, Addis Ababa, Ethiopia.