



Participatory smallholder dairy value chain development in Fogera *woreda*, Ethiopia: Experiences from IPMS project interventions

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Abstract

Market-oriented smallholder dairy in Fogera has an opportunity for growth because of growing urban population in the district itself as well as in the wider Bahr Dar–Gondar milkshed. IPMS in 2005 introduced a participatory market-oriented dairy value chain development approach with partner organizations. IPMS together with its partners also identified gaps in the dairy value chain through Participatory Rapid Appraisal (PRA) and also designed interventions involving key value chain actors. This approach included increased use of knowledge capturing and sharing by the extension services. Major production interventions were the development of communal grazing areas through clearance of noxious weed called *Hygrophilla auriculata* and introduction of area enclosure, backyard fodder development and increased use of rice crop residues. Input service supply interventions included community-based trypanosomosis control and bulls stations. IPMS and its partners also provided the required support for establishment of two milk processing marketing cooperatives.

Communal grazing area development is now practised in 16 villages (PAs) and harvested biomass production was estimated at 7 to 11 t of DM/year. As a result of the cut-and-carry system, the proportion of legumes increased, thus improving its nutritive value. The increased availability of the rice straw and bran resulting from rice value chain development in Fogera has also impacted dairy production. Urea treatments of rice straw as well as supplementary feeding with rice bran were demonstrated in 13 PAs. An on-farm experiment conducted by an MSc student indicated doubling of daily milk yields. However, use of straw could be increased further if urea for the treatment of straw could be made available in the dry season.

Trypanosomosis control introduced in infested areas has significantly reduced the number of infected animals and the program is now institutionalized by regional, district and NGO partners. The introduction of bull stations resulted in increased number of improved Fogera breed cows and crossbreed with Holstein-Frisians. However, the number of improved dairy cows is still low and the District should consider the recently introduced mass insemination approach with the help of hormones.

Marketing and processing of milk in urban and peri-urban areas through formation of small cooperatives has started; however, impact is still limited due to lack of business orientation, and alternative marketing outlets for individual producers. While some linkages were made with the larger Bahr Dar milkshed, more attention needs to be paid to this market once milk production increases.

A household survey conducted in 2009, which assessed the combined impact of all interventions, showed significant differences in milk quantities sold by adopter and non-adopter households in the urban areas and doubling of butter production/sales in the rural areas. It is noted that this additional butter sales benefits rural women since they manage the production and sale of butter.

Key words: Milk production, *Hygrophilla auriculata*, milk marketing, Fogera breed, Simada breed, Farta breed, crossbreeding, smallholder, urban and per-urban dairy production system, participation, value chain.

1 Introduction

The IPMS project, funded by the Canadian International Development Agency (CIDA), was established to assist the Ministry of Agriculture and Rural Development in the transformation of smallholder farmers from a predominantly subsistence-oriented agriculture to a more market-oriented (commercial) agriculture.

The project adopted a 'participatory market-oriented commodity value chain development' approach which is based on the concepts of innovation systems and value chains. Crucial elements in the approach are the focus on all the value chain components instead of only a production technology focus as well as the linking and capacitating of value chain partners and the assessment, and synthesis and sharing of knowledge among the partners.

The project introduced this approach in 10 Pilot Learning *Woredas* (PLWs) in Ethiopia with the objective of testing/adopting the approach so that it can be promoted nation wide. An integral part of the approach is the identification of marketable commodities and the value chain constraints and interventions. This was accomplished through a participatory process in all PLWs.

This case study focuses on the development of smallholder market-oriented dairy development in Fogera *woreda* with the objective of i) documenting diagnostic results and value chain interventions, ii) providing proof of results (proof of concept), challenges and lessons learned to be considered for scaling out.

Following the introductory section, the following sections are included. Section 2 deals with methods and approaches used in the study, while Section 3 presents background information, including description of the PLW and the history and diagnosis of smallholder dairy development. Section 4 presents value chain interventions like extension, production, input supply, as well as marketing and credit issues. Section 5 dwells on results and discussion on production/income, input supply/marketing, gender/environment/labour use, organizational and institutional aspects, while Sections 6 and 7 deal with challenges and lessons learned, respectively.

2 Methods and approaches

To start the development of a commodity, IPMS used a *woreda* level participatory market-oriented value chain planning approach aimed at identifying i) main farming systems, ii) potential marketable crop and livestock commodities at farming system level, iii) constraints, potentials and interventions for each value chain component and iv) value chain actor assessment with potential (new) roles and linkages. Different value chain actors were involved and consulted in this planning exercise. Secondary biophysical and socio-economic data were collected, followed by open-ended interviews with focus groups and key stakeholders. The results were presented in a stakeholder workshop in which priority marketable commodities were decided upon together with key intervention areas and partners.

This initial rapid assessment was followed by some more detailed studies on selected commodities. Such studies were conducted by partner institutions and/or students and or IPMS staff using formal surveys, interviews and observations.

To implement the program at *woreda*, Peasant Association (PA) and community levels, the project facilitated different knowledge management and capacity development approaches and methods to stimulate the introduction of the value chain interventions by the actors concerned. The various value chain interventions are documented by the project staff in the six monthly progress reports and the annual M&E reports.

To quantify the results from individual and/or combination of interventions, the project established a baseline and measured/documentated changes. The project also used several data sources to establish the baseline and to document changes and results.

i) Baseline information

To establish a baseline, the project used data from a formal baseline study and data from some special diagnostic studies. The initial PRA study also contributed to the quantitative and qualitative baseline information.

Amongst others, the formal baseline study used PA level interviews and records to collect information on irrigated area coverage and the number of households involved in irrigated agriculture. This

information was used to compile *woreda* level information on irrigated acreage (by crop) and households.

ii) Documenting changes processes and results

The project mainly used as sources of information regular documentations of change processes and results, including six monthly progress reports, annual M&E reports, MSc thesis research, records kept by the OoARD, personal observations and diaries. In some PLWs, staff also monitored changes in production/productivity for a few selected farmers on a regular basis.

In 2009, the project also developed a set of guidelines for the PLW staff to systematically collect relevant information for the case studies including history, changes in extension services, value chain interventions (production, input supply, marketing and credit), results, challenges and lessons learned. Part of the information was obtained from the previously mentioned baseline and other sources and specially arranged i) key informant interviews, ii) a commodity stakeholder workshop and iii) a household level survey.

The stakeholder meeting was organized to establish the evolution of the roles and linkages of the value chain actors.

The formal household survey conducted in 2009 obtained data from selected sample households in 11 PAs (Hagere Selam, Woji, Aember Zuria, Zeng, Woreta Zuria, Kedest Hanna, Kuhar Michael, Tihua Zakena, Abuakokit, Shena, Nabega and Abua). The survey data consist of relevant production and marketing information on vegetables including area allocation, production costs and inputs use, level of production, and marketed surplus. In selecting the sample households, with the aim of getting some idea about the effect of the different interventions, a distinction was made between households who had adopted/benefited from the various interventions and households who did not. In both sample groups, both wealth and gender criteria were considered to get a representative distribution of sample households.

Following the collection of all relevant information, a write shop was organized to present information in a systematic manner. Drafts of the PLW-specific commodity case studies were then reviewed by HQ experts.

3 Background to smallholder dairy development in Fogera

3.1 PLW description

Fogera PLW is found in the South Gondar Zone of the Amhara Regional State (Figure 1). The *woreda* is located at 11°46 to 11°59 latitude and 37°33 to 37°52 longitudes. The *woreda* capital, Woreta town, is found at a distance of 625 km from Addis Ababa and 55 km from Bahir Dar, the regional capital. There are 30 rural *kebeles* and 5 urban *kebeles* in the *woreda* and Woreta and Aember are the major towns. The total human population of the *woreda* is 233,529, of which 206,717 is rural population. There are 42,746 agricultural households in the PLW.

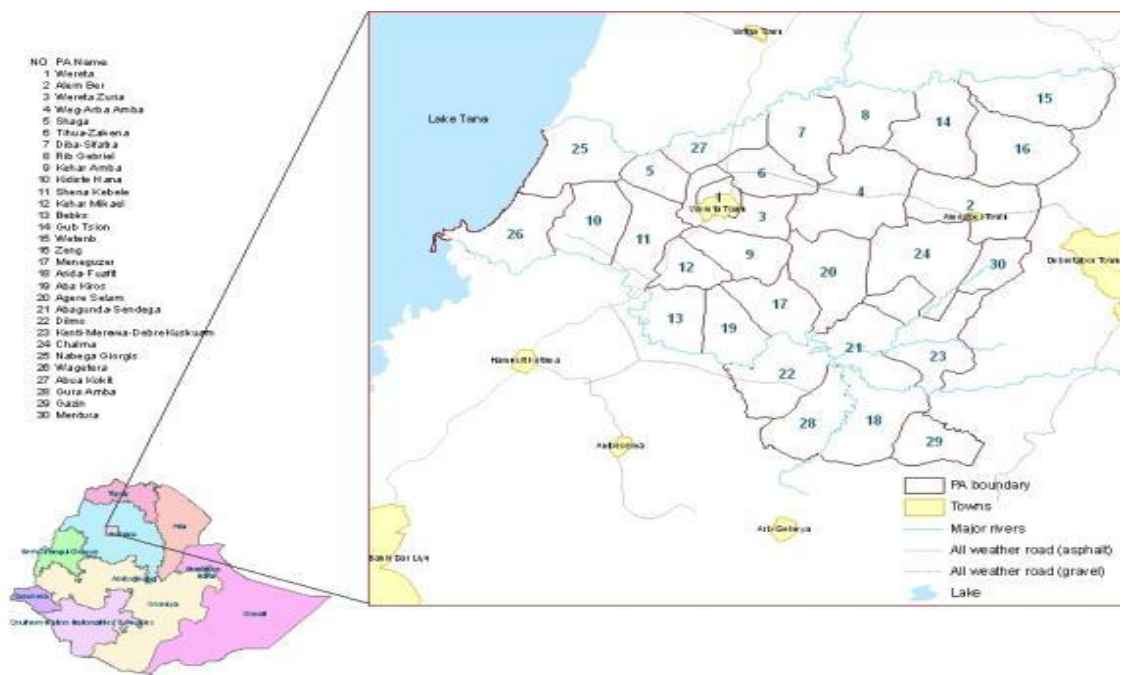


Figure 1. Map of Fogera PLW.

Altitude of the PLW ranges from 1774 to 2410 masl and is predominantly classified as *Woinadega* agro-ecology. Based on existing digital data, mean annual rainfall is 1216.3 mm and ranging from 1103 to 1336 mm. Belg and Meher are two cropping seasons, with short and long rainy periods. Belg rain (February to April) is important for the re-growth of grasses, shrubs and some indigenous trees and supplements livestock feed. Meher (long rainy season) is used as the only cropping season. Fogera is one of the eight *woredas* bordering Lake Tana and has an estimated water body of 23,354 ha. There are two major rivers, Gumara and Reb, which are of great economic importance to the *woreda*. These rivers are mainly used for irrigation during the dry season for the production of horticultural crops, mainly vegetables. Some farmers also use water pumps to produce vegetables, cereals and pulses. The total land area of Fogera *woreda* is 117,405 ha. Flat land accounts for 76%, mountain and hills 11% and valley bottom 13%. Average land holding per household is about 1.4 hectare with a minimum and maximum of 0.5 and 3.0 hectares, respectively. According to the WOoARD, the dominant soil type in the Fogera plains is black clay soil (ferric Vertisols), while the mid and high altitude areas are predominantly orthic Luvisols.

Fogera is one of the surplus producing areas growing diverse annual and perennial crops such as cereals (teff, maize, finger millet, rice), pulses (chick pea, lentil), oil crops (noug, rapeseed, linseed, groundnut), vegetables (onion, pepper, tomatoes), spices (fenugreek, basil, coriander) and fruits (papaya, guava). The potential of the PLW for livestock production is high, including fish and honey production. According to Fogera WOoARD (2004), the major local livestock resources are cattle (157,128), goats (27,867), sheep (7607), chicken (246,496), beehives (21,883), donkey (13,189), mule (339) and horse (8). Improved (cross) breeds include heifer (22), young bull (10), cow (22), and calf (3). Fogera *woreda* is the home of the Fogera cattle breed, which is highly productive indigenous milk animal in the country and also known for its meat production and traction power.

3.2 History and diagnosis of smallholder dairy development

Cattle are mainly kept for traction and milk production. According to various studies conducted in the *woreda* and WOoARD, 2008 report, more than 70% of the household in the *woreda* owned one or more dairy cows.

Livestock production systems in Fogera are predominately extensive. Despite the genetic potential, according to Zewdu (cited by Belete 2006), the daily yields of Fogera dairy cattle ranges from 1.39 to 4.63 litres, and the average milk yield in the second lactation from 14 cows was only about 761 litres under free grazing. In general the dairy production in the *woreda* is predominantly smallholder subsistence systems and can be classified into three (Belete 2006): rural, peri-urban and urban dairy systems. Rural smallholder dairy production system is the largest and it accounts for around 23,034 number of the milking cows of Fogera, Simada, Agew, Worie and their crosses breeds. This rural system produces milk which is used for home and calf consumption and as well as home produced butter. As shown in subsequent thesis research by Belete (2006), butter sold in rural markets amounts to about 104 t/year with 38 t in the dry season and 66 t in the wet season. The second is urban dairy system at Woreta with 194 (78%), 55 (22%) of local and crossbreed, respectively. This system produces fluid milk which was sold in the urban market through direct sales. The peri-urban dairy system is located at AleMBER, which has about 107 local cows and 22 crossbreeds and also targets the fluid milk market.

The project in collaboration with local stakeholders conducted a Participatory Rapid Appraisal (PRA) and participatory planning stakeholder workshop in 2005. Some of the key constraints identified in the dairy value chain were:

- Although the Fogera cattle breed is highly productive, the number of pure Fogera cattle is decreasing due to uncontrolled breeding and crossbreeding with local small framed animals such as the Simada. During the dry season, there is transhumance mode of production from other *woredas* such as Derra and Libo. As a result, there is genetic dilution and disappearance of Fogera cattle. However, there has been a national effort to rehabilitate and conserve the Fogera cattle breed. The Andassa Research Centre has a Fogera cattle improvement and conservation project through community-based breeding system.
- Availability of adequate and quality feed is increasingly becoming a limiting factor in dairy and livestock production. Fogera *woreda* used to have vast productive grazing land that would usually be flooded by overflows of Gumara and Rib River and from Lake Tana during the rainy season. The flooding which covers the whole Fogera Plain during the rainy season had inhibited crop cultivation before the introduction of rice production to the plain. The wetland was thus a

primary source of dry season feed for livestock in the *woreda*, as well as from neighbouring *woredas*. Rice and finger millet straws are major crop residues used for animal feed. Chickpea straw is available but the farmers believe it causes diarrhoea in ruminants. Similarly, fresh (green) maize stover is not used as green feed by some farmers due to the belief that it causes bloating and breathing problem. Grass peas are used for fattening animals and are considered to have a medicinal value. As the plain is currently covered by lowland rice, there is need to improve the utilization of rice residues for animal feed and to change popular perceptions with regard to crop residue utilization.

- In addition, the free and uncontrolled grazing system has resulted in severe degradation of the grazing lands. Moreover, a noxious weed, *Hygrophilla auriculata*, locally known as Amikela, has invaded most of the remaining grazing lands. According to Ashagre (2008), around 10,000 ha of communal grazing land was covered by *H. auriculata* (Amikela). Rehabilitation and collective management of communal grazing area is thus important.
- Disease and parasite also hinder dairy development. In Fogera, in particular, trypanosomes (*gendi*), internal parasites (liver fluke, lung worm, gastro-intestinal parasites) and external parasite (ticks and flies); anthrax, black leg and foot and mouth disease abound. This challenge becomes more important following the replacement of indigenous Fogera breed by other local neighboring *woreda* cattle type like Farta and Simada which are not adapted to the Fogera environment. The inefficient health service deliveries coupled with limited and expensive supply of rural drug suppliers could not cope with the growing demand for modern veterinary services. To minimize fly bite, cattle are kept in-house between 11 AM and 3 PM. ILRI and partners conducted a blood test and 16 out of the 230 animals (about 7%) in 4 villages in the infected areas had *T. vivax*. There were clear differences of infection rate between the sample villages. These results are similar as tests conducted by the regional animal health laboratory (in 2005) on 120 animal blood samples in the six most infected *kebeles*, i.e. 8.5% prevalence rate. This indicates that there is a need for innovative ways of combating the diseases and strengthening animal health services.
- The urban and peri-urban system producers, which sold milk individually, experienced difficulties especially during the fasting periods.

4 Value chain interventions

Dairy value chain development comprises extension, input supply (feed, bull services, and veterinary services) milk production, dairy processing and milk and milk products marketing. Under this section, all interventions in dairy commodity value chain will be discussed.

4.1 Extension interventions

Knowledge and skills for dairy commodity development were very limited. Therefore various extension activities were carried out to stimulate smallholder dairy development such as training, meetings, study tour, field days, and workshops.

Training

A number of trainings were conducted to raise awareness and build capacity of farmers, DAs and experts in key interventions areas in collaboration with actors from NGO and the private sector.

- Training on forage agronomic practices and identifications of various forage species to Fogera WOoARD staff was conducted by a forage specialist formerly working with ILRI.
- Papyrus Hotel collaborated with IPMS and provided practical training to two OoARD staff and two dairy technicians on packing and quality control of butter.
- Communal grazing land delineation training by using GPS was given.
- Training on improved dairying for 10 persons from two dairy cooperative was conducted in collaboration with local NGO called Jerusalem Children's Development Organization (JaCDO) at Bahir Dar. The trainees benefited from practical exposure to JaCDO dairy farm, which integrated processing activities. Cooperative staff/members and non-members were also trained on cooperative principles and improving dairy cooperative performances.

- Community members and extension staff were trained on proper use and management of fly traps and pour-on insecticides for trypanosomosis control. The training focused on appropriate ways of setting of traps, selection of trapping sites, maintenance of traps and on facilitating community collective action for enhanced use of the control program. The training included group exercises in which farmers explored suitable approaches to using traps in the selected areas and even beyond. One of the outcomes of such exercises was that participating communities noticed practical problems of maintaining traps in the field and suggested use of bamboo poles instead of metals prepared by the project.

Meetings

Project partners organized sensitization meetings on the eradication of Amikela and rehabilitation and management of the communal grazing lands. Participants in these meetings comprised representatives of the various *woreda* level government offices including the *woreda* administration and the *woreda* office of agriculture and rural development (OoARD). Following this, consecutive meetings with *kebele* representatives were facilitated in order to understand and appreciate the effects of Amikela and share ideas on what measures should be taken.

Finally, a one week Amikela clearance campaign was organized through community participation in six highly infested *kebeles*



Figure 2. Community participation in clearance of Amikela in infested *kebeles*.

Study tours

Study tours were organized outside the PLWs for capturing knowledge relevant to key constraints to market-oriented smallholder dairy development in Fogera.

- Farmers and development agents made a visit to Ghibe valley, where a community-based approach to trypanosomiasis control program was being pilot tested by ILRI with partners. During exchange visits, farmers exchanged views with host farmer and get more information on how the disease can be controlled and the role of the community in this process.
- Farmers, development agents and experts from Fogera WOOARD and *woreda* council visited Atsbi *woreda* in Tigray Region to learn about the *woreda*'s successful experience in enclosure and rehabilitation of communal grazing land. On their return to Fogera, the tour participants shared lessons learnt with various stakeholders. Finally, participatory action plan was prepared followed by consecutive discussions with community member at PAs level in order to scale out similar experiences.
- To facilitate the understanding of stakeholders regarding market-orientation and milk value chain, another tour was organized for *woreda* administrator, WALC chair, Andassa Research Center and representatives of dairy cooperatives in Ada'a. The team visited a private farm, Genesis Farm, and Ada'a Dairy Cooperative, which is the most advanced cooperative in the nation.

Field days

- Following various field days, consultative and participatory planning meetings were conducted for 23 *kebeles* in the *woreda* in order to share experience on improved communal grazing land management that was started in Kuhar Michael *kebele* Mangaloma site in 2007/08. In order to give more emphasis, these field days were facilitated by the *woreda* administrator and OoA heads. After planning meeting, participants shared information among the different stakeholders including the DAs, *kebele* administrators, and the communities.

- In 2009, community representatives from all PAs in the *woreda* participated in two model backyard forage development interventions in Aember PA where various forage species were planted and established and cut-and-carry systems practised. This backyard forage development was linked to dairy development. The owner of this backyard forage development has Holstein Friesian crossbreed and local cows.
- Rice straw urea treatment demonstration has been undertaken by one of the participants at Woreta Zuria PA to his social group ‘*yetela mahiber*’ to show the effect on milk production. Another formal field day was organized by the DAs for farmers in Aember PA in 2009.



Figure 3. Field days. Mangaloma site visit (left); general discussion facilitated by OoARD head and administrator (right).

Consultative stakeholder workshops

Stakeholder workshops were also organized to share experiences and to reflect on the status of the dairy sub-sector in the *woreda* and the Amhara region as a whole.

- Stakeholder consultative workshop involving representatives from nine PA executive committees and influential community leaders was organized and facilitated in collaboration with the Fogera WOoARD, Administration (chairperson), Justice and Security Offices in the early 2009 (Figure 4). Management of communal grazing land became one of the top agenda for the *woreda* administration because access to and controlling grazing land becomes sources of conflict within and intra-community.



Figure 4. Stakeholders' consultative workshop chaired by the WALC chairperson (left); and community discussion at PA level (right).

- Workshop organized by IPMS on 'Opportunities and constraints of dairy development in Ethiopia and Ada'a dairy cooperative experience' and attended by heads of regional bureaus and representatives from dairy cooperatives in Bahir Dar Zuria.
- Workshop conducted in Woreta with staff from Fogera WOOARD and Dehansit dairy cooperative executive committee members.
- After the study tour to Ghibe and presentation of preliminary results of trypanosomosis prevalence survey, a series of community meetings were held to discuss issues related to ownership and management of the selected interventions and about good practice in use of trypanocidal drugs.

Knowledge generation

The project also facilitated various studies based on the identified main constraints on livestock development in Fogera *woreda*. These included: three MSc studies: 1) Cattle milk and meat production: Constraints and opportunities for development (Belete 2006); 2) Effects of nitrogen fertilizer and harvesting stage on yield and quality of natural pasture (Ashagre 2008); and 3) Analysing on-farm evaluation of urea treated rice straw and rice bran supplementation on feed intake and milk yield (Teshome 2009). Besides, one DVM study was supported on major animal health problems of market-oriented livestock development (Kassahun 2007).

See details of capacity development for the number of trainings, field days conducted, workshops, consultative meetings, and study tours facilitated from 2007–2009 through the support of the project in Annex 1.

4.2 Production interventions

Fodder/feed

Key interventions for feed improvement included introduction of on-farm production of appropriate forage species, urea treatment of crop residues and rehabilitation and improved management of communal grazing areas.

- Various forage species planting were supplied/introduced by Andassa Livestock Research Centre every year from July to September from (2006–2011). The type of forage planted included Sudan grass, Napier, Rhodes grass, *Desmodium*, *Setaria*, and *Panicum* species. Every year, around 100,000–150,000 cuts/splits were distributed. These species are planted around farm boundaries, backyard, gully (stabilizations) and over sowing in the natural pasture.
- Delineations of major communal grazing land have taken place in collaboration with the *woreda* land use and administration desk under OoA, *woreda* security office under the *woreda* administration and the Fogera *woreda* administration office. First, *kebeles* were identified jointly based on various parameters, GPS equipment acquired and on job skill training was provided from IPMS head office to experts assigned to undertake the delineation activities including the project staff; using the *kebele* elders in each delineated grazing land sites, based on 1989 EC land redistribution during the Ethiopian transitional period delineation was conducted in representative areas.



Figure 5. Community members delineating grazing areas.

- Community-based Amikela clearance and communal grazing land enclosures, including development of land use rules and regulations, were established. Table 1 gives an overview of the community labour requirements for Amikela clearance.
- Project promoted use of the harvest from these communal areas through demonstration of supplementary feeding with two ‘*ekef*’ hay which is equivalent to 1.85 kg hay/day on top of other grazing.

Table 1. One week Amikela clearance interventions in six highly infested PAs in 2007

| Peasant association name | Number of person days | | Area coverage in (ha) |
|--------------------------|-----------------------|--------|-----------------------|
| | Male | Female | |
| 1. Shaga | 1200 | 350 | 75.00 |
| 2. Wagetera | 436 | 98 | 67.00 |
| 3. Aboakokit | 996 | 683 | 38.75 |
| 4. Kedest Hanna | 923 | 143 | 42.75 |
| 5. Nabega | 392 | 240 | 21.00 |
| 6. Shina | 1742 | 95 | 23.75 |
| Total | 5689 | 1609 | 268.25 |

- As rice production intensified, rice straw/bran has become a major feed source. To improve palatability and uptake, urea treatment of rice straw was demonstrated on 59 farms in 13 PAs and each farmer was supported with 2 kg of urea and 7 meter plastic sheet. Later on, one silo-box with the capacity of 1 m³ for above ground urea treatment was used by model farmers as a demonstration to minimize labour cost.
- An MSc student also studied the impact of urea treated straw and supplementary feeding of rice bran and other concentrates. The following treatments were used:
 1. Grazing + untreated rice straw *ad lib*
 2. Grazing + treated rice straw *ad lib*
 3. Grazing + treated rice straw *ad lib* + rice bran
 4. Grazing + treated rice straw *ad lib* + formulated concentrate mix.

Twenty Fogera cows were used for the feeding trial and blocked on weight and milk yield bases. Initial mean body weight of the cows was 259.75 ± 33.8 and milk yield was 1.23 ± 0.26 . The dairy cows were assigned and fed with four feed treatment groups for a period of 45 days to collect feeding response data and with an adaptation period of 15 days. The last treatment required treating the rice straw with urea and fermenting it for 21 days in an air tight condition. Then, the urea treated rice straw was aerated for a minimum of 12 hours prior to feeding to facilitate the escape of free ammonia.

Genetic improvement dairy animals

Both Fogera and Holstein Friesian bulls were introduced for breed improvement. Besides increasing milk yield, Fogera breed was intended to revive the genetic resources of the local Fogera cattle and the Holstein Friesian was opted for improving milk yields. These bulls were brought to the *woreda* in August 2007. As some of the bulls were young, they did not start service until 2008.

Animal health management

To tackle the diagnosed trypanosomosis problem, a community-based trypanosomosis control program was initiated (see subsection 4.3)

4.3 Input supply and service delivery interventions

Bull station service and dairy cooperatives support

The project also introduced private bull service stations to improve genetic potential of local dairy cows through natural mating. It also opened four Fogera bull stations in the rural system. Bulls were brought by the farmers from Andassa Livestock Research Center (purchased at a subsidized price of [Ethiopian birr [ETB]¹ 3/kg live weight). Besides improving milk/butter production, these bulls were also introduced to restore the genetic makeup of the Fogera breed. Two businessmen in Woreta town where improved milk production for the market is the main aim purchased Holstein Friesian bulls. Before using the bull for natural mating, brucellosis test at field level was conducted for 632 cows in about 3.5 km radius where these bulls were placed. From the total blood sample, only two of them were positive. Owners of cow as well as bull station owners were informed about these results. Fogera bulls provided services free of charge, while Holstein Friesian bull gave services on payment basis (ETB 30/service).

The Fogera OoA has been providing Artificial Insemination (AI). Though AI is more reliable and safer than using natural mating in order to avoid sexually contagious disease, the service was constrained by lack of inputs, poor synchronization etc. Some cow owners also complain that using AI mostly ends up with male calves which are less preferable than female.

Trypanosomosis control

Following the study tour and meetings, project partners established a community-based trypanosomosis control program in a few selected areas with the help of trap nets (240), pour on and trypanocidal drugs.

The Fogera WOoARD veterinary department, private entrepreneurs, PAs administration and regional veterinary clinic and NGOs (CARE) took part in supplying various prophylactic and curative measures.

1. USD 1 is about ETB 17.80 in July 2012.

Multiplication forage planting materials

The ‘demonstration’ forage planting materials, supplied by Andassa Research Center, have been multiplied by farmers to supply neighbours in the communities.

4.4 Processing and marketing

To tackle the milk demand problem diagnosed during the PRA, project partners assisted in the development of two small dairy cooperatives, which were in turn assisted with processing and market promotion.

Dairy cooperative establishment

The OoARD, in collaboration with ILDP, UNLDP and OoARD and IPMS, established two dairy cooperatives at Woreta (Dehansit) and Aember town (Yabibal). Besides technical, managerial and financial support, the project also assisted in providing some spare parts to fix churner breakage, and capacitating the staff through training and study tours with similar institutions. Dehansit dairy cooperative was also assisted in securing land for construction and another site on the main road side for placing container to enhance marketing.

Processing/marketing interventions

Whole milk processing to skim milk, butter, yoghurt and cheese has been practised by the two dairy cooperatives to diversify marketing and tackle the low demand for fluid milk in the fasting period. To stimulate the use of skimmed milk, promotion of skimmed milk through free supply cafes and restaurants in Woreta town was used at the beginning of dairy cooperatives processing. Besides, market linkage was created between the dairy cooperative and Papyrus Hotel at Bahir Dar for table butter marketing opportunities.

OoARD/IPMS staff collected market prices information from Bureau of Trade and Industry, analysed it and informed the cooperatives for negotiation. Market linkage was also created between the dairy cooperatives and Papyrus Hotel in Bahir Dar for butter marketing.

5 Results and discussion

5.1 Production interventions

Fodder–Amikela clearance, grazing area enclosure

Area coverage and production

Following Amikela clearance in six highly infested communal grazing lands through community participations in 2007 for the first time, a total of 269 ha was managed to be cleared (Table 2). This further increased to 512 ha in 2010 through extension activities including field days, meeting and workshops.

Table 2. Area cleared from Amikela, area enclosure and number of HH owned the enclosure in Fogera *woreda* from 2007 to 2009

| Years | Amikela clearance | | Area enclosure | | No. of HH owned enclosure | |
|-------|-------------------|-----|----------------|-----|---------------------------|-----|
| | Area in (ha) | PAs | Area in (ha) | PAs | M | F |
| 2007 | 268.25 | 6 | 0 | 0 | 0 | 0 |
| 2008 | 287.75 | 9 | 13 | 2 | 280 | 41 |
| 2009 | 423.75 | 14 | 105.6 | 8 | 1134 | 136 |
| 2010 | 512 | 14 | 128.5 | 9 | 1234 | 156 |

Project partners also introduced for the first time in 2008 communal grazing land improvement in Amikela cleared area especially in Kuhar Michael and Shina PAs in a total of 13 ha. Following these two PAs success stories, area enclosures were scaled out to 9 PAs and the area coverage reached 128.5 ha in 2010 (Table 2).



Figure 6. Community members busy with Amikela infested area clearance.

Biomass of the pasture yield in these enclosure sites was determined by collecting samples using 1 m² quadrants. Each sample was subdivided into grasses/hay, legumes and weeds. Fresh weight was recorded immediately after harvest whereas hay dry weight was taken by letting the grass dry for one week in direct sunlight. Samples were taken randomly in nine sites in Mangaloma, another nine samples taken in Keser site having 10 ha in Aba Kiros PAs as stated above.

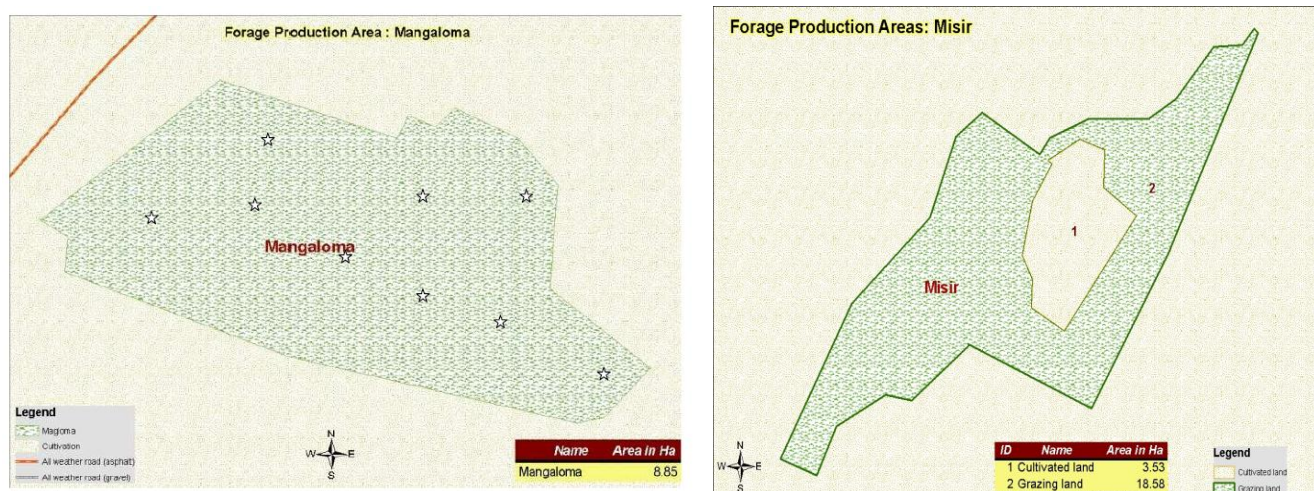


Figure 7. Mangaloma in Kuhar Michael kebele (right), and Misirmidir in Shina kebele (left) GPS grazing land delineation map.



Figure 8. Area enclosure and first harvest from left to right.

Total dry matter production obtained from a hectare varied between 7 and 11 t/ha. Composition of the vegetation differed between sites. Yekok sar (*Atraxon prionodies*), Tucha (*Pennistum glourum*), Serdo (*Cynodon dactylon*), Molale (*Phalaris arundinacea*) and Kuakuya (*Cassia mimosoides*) are the dominant grass species. Table 3 indicates that the total harvested biomass is highest in Mangaloma since this is located in the flood areas and harvested twice per season. The lower biomass yield in Keser was in part explained by the predominance of less productive grass species such as Cyprus and Yebere sar.

Table 3. Biomass production from area enclosures

| Sample sites | Sample size/No. | Fresh total average sample | Weight in gm/m ² | | | | | | Total dry matter yield ton/ha | |
|------------------|-----------------|----------------------------|-----------------------------|------------|------------|------------|----------|------------|-------------------------------|-----------------------|
| | | | Grass wt. | | Legume wt. | | Weed wt. | | Grass + legume | Grass + legume + weed |
| | | | Fresh | Dry matter | Fresh | Dry matter | Fresh | Dry matter | | |
| Mangaloma | 9 | 3911 | 3478 | 922 | 480 | 126 | 500 | 90 | 10 | 11 |
| Tihua | 1 | 3000 | 2500 | 700 | 500 | 100 | - | - | 8 | 8 |
| Keser (Aba Kiro) | 9 | 2356 | 2194 | 599 | 200 | 100 | 250 | 113 | 7 | 8 |
| Average | | 3089 | 2724 | 740 | 393 | 109 | 250 | 68 | 8 | 9 |

NB: wt. = weight, gm = gram.

Source: Date collected for this study

The percentage legumes varied from 6.82 to 16.67% of dry matter, with highest proportion of legumes in the Tihua site, which is privately owned and managed. The low percentage of legumes in Mangaloma was in part due to the fact that the samples had been taken after the legumes had already wilted in the field. Percentage weeds in Keser were much higher than in Mangaloma, i.e. 13.95% vs. 4.26%. Such differences are in part explained by differences in community efforts in Amikela

clearance before enclosure; moreover, the enclosure procedure in Keser took a longer time to finalize after the rain started. No weeds were found in the privately managed Tihua site.

Arrangements for managing and using the communal grazing areas were based on by-laws developed by the communities and the *kebele* administration with the help of the project staff and OoARD. Community guards were employed to enforce the enclosures and these were paid for with grass/hay harvested from the enclosures for the services they render. Trespassers were fined i.e. ETB 10/animal for first time offenders and ETB 20 for frequent offenders. (The fine payment was collected by the *kebele* administrative executive committee with legal receipts). In Kuhar Michael, a total of 8.85 ha of enclosed grazing area were used by 9 groups of about 20 members each. The whole area was subdivided in plots of 10 metre width of varying lengths. Allocation of these plots to each of the groups was done through a lottery system. The groups harvested their allocated plots jointly and divided the harvested biomass amongst the individual group members. The harvested biomass was collected in heaps (*nedo*), which were assigned to individual group members through lottery.



Figure 9. First cut, sharing of the grazing land among the communities using lottery system and second harvest (left to right, respectively).

Backyard fodder

Forage planting material was provided to 125 dairy cow owners for forage production in the backyard and farm boundary to feed their dairy cows. Some of the forage species are: Sudan grass, Desmodium, Rhodes Grass, Sesbania, Panicum, Setaria Pigeon pea and Fodder beat. Some dairy cow owners in Alemba and Woreta Zuria PAs have managed to plant up to 0.4 ha of land in their backyard that have managed cut-and-carry system and feed their dairy cows and increase their milk yield.

Crop residues/treatment

Rice straw production

The rice production in Fogera increased tremendously from 6871 ha in 2005 to 15,547 ha in (2011). Based on the estimated yield/ha i.e. rice straw production/ha was about 9.44 t and rice bran together with chaff² was 1.7 t/ha. The amount of rice straw and rice bran and chaff resulting from this rice production area was estimated to be 144,967 t rice straw and 26,119 t rice bran and chaff (Tilahun et al. 2012).

While farmers appreciated urea treatment of rice straw, the technology did not scale out widely, reportedly due to lack of urea during the dry season.

Milk yield and income

The student thesis research results on the use of (urea treated) rice straw, rice bran saw a doubling of daily milk yields (Teshome 2009).

Table 4. On-farm milk yields from different feeding trials

| Treatment | Daily milk yield (litres) | Increase over control |
|---|---------------------------|-----------------------|
| Grazing + untreated rice straw <i>ad lib</i> | 1.2 | - |
| Grazing + treated rice straw <i>ad lib</i> | 2.36 | 1.16 |
| Grazing + treated rice straw <i>ad lib</i> + rice bran | 2.48 | 1.28 |
| Grazing + treated rice straw <i>ad lib</i> + formulated concentrate mix | 2.63 | 1.43 |

Source: Teshome (2009).

2. Chaff/husk is dry, scaly protective casings of the seeds of rice grain.

The urea treatment demonstrations, which took place in 2 PAs (56 farms), were later on scaled out to 13 PAs. No formal data on milk yield increases were collected but farmers reported similar increases as reported in the student thesis. According to farmers perceptions, they have appreciated the treatment of rice straw with urea, since it improved palatability, softened the straw and showed better response in milk yield and body weight of their cows during peak feed shortage season (Teshome 2009).

Supplementation of free grazing Holstein Friesian crossbreed cows with 2 ‘*ekef*’ (1.85 kg/day) hay per day reportedly increased daily milk production by 50% (own observation).

The household survey conducted by the project in 2007/08 compared various dairy performance indicators between adopters and non-adopters. A producer is classified as an adopter, once he/she has benefitted from one or more of the IPMS value chain interventions. The total number of households interviewed was 112 out of which 82 farmers (73%) were involved in dairy production. To further analyse the data, a distinction was made between sample farmers in rural PAs (9 PAs, 73 farmers) and sample PAs in peri-urban areas (1 PA, 9 farmers). Data on sample farmer participation in fluid milk/butter production and sale are presented in Table 5.

Table 5. Sample farmer participation in fluid milk/butter production and sale

| Farmer | Peri-urban | | | Rural | | |
|----------------------------|------------|-------------|-------|---------|-------------|-------|
| | Adopter | Non-adopter | Total | Adopter | Non-adopter | Total |
| Fluid milk producers (no.) | 6 | 3 | 9 | 36 | 37 | 73 |
| Fluid milk sellers % | 83 | 0 | 56 | 0 | 0 | 0 |
| Butter producers % | 67 | 100 | 78 | 81 | 84 | 82 |
| Butter sellers % | 67 | 100 | 78 | 36 | 30 | 33 |

Source: IPMS Household survey 2009.

The analysis of the sample farmers' data confirms that fluid milk sale is only important in the peri-urban system. Butter production is important in the peri-urban and rural system.

- About 56% of peri-urban sample farmers sell fluid milk while 78% produce butter all of whom also sell butter.
- Percentage of adopter dairy sample farmers who sell fluid milk in the peri-urban areas is 83%, while none of the non-adopter sample farmers sells any milk.
- None of the rural sample farmers sell fluid milk while 82% of them produce butter of which only 33% sell butter.
- In the rural areas, 81% of adopters produce butter and 36% sell butter. Among the non-adopters, 84% produce butter and 30% sell the butter.

Average production and sales of fluid milk and butter for the different sample categories are presented in Table 6. It is noted that data quality on total fluid milk production was insufficient and hence not reported.

Table 6. Average production, amount of fluid milk and butter produced and sold per household

| Product | Urban | | | Rural | | |
|-----------------------------------|----------------------|--------------------------|-------------------|----------------------|---------------------------|---------------------|
| | Adopter (No. = 6) | Non-adopter (No. = 3) | Total (No = 9) | Adopter (No.= 36) | Non-adopter (No. = 37) | Total (No. = 73) |
| Fluid milk production (lt) | NA | NA | NA | NA | NA | NA |
| Fluid milk sold (lt) | 1453 | 0 | 969 | 0 | 0 | 0 |
| Butter production (kg) | 51 | 50 | 51 | 37 | 29 | 33 |
| Butter sold (kg) | 42 | 28 | 37 | 16 | 8 | 12 |

Source: Household survey 2009.

The analysis of the data indicates that adopters/beneficiaries of interventions in the peri-urban area mainly benefit through sale of fluid milk. However, there was no difference in butter production between adopters and non-adopters in the peri-urban areas, i.e. 51 vs. 50 kg. It is interesting to note however that the average amount of butter sold/farmer is higher for adopter as compared to non-adopter farmer, indicating increased market participation by adopter farmers.

In the rural system, adopter farmers benefit from the interventions through increased production and doubling of the sales of butter. The latter is the result of increased market participation by adopter farmers as well as increased amount of butter produced. It is noted that these benefits will go to female members of the household, since they process and sell the butter. It is also noted that the potential number of farmers benefiting from value chain interventions in rural areas (butter system) is a multitude of the farmers in the (peri) urban system.

5.2 Improvements in access to services and markets

Bull service

The Fogera bull service produced 50 calves (20 female) over a 3 year period (see Table 7).

Table 7. Performance of Fogera bulls in Fogera *woreda* 2008 and 2010

| Name of the bull owners | Types of breed | No. of services | No. of cows conceived | No. of calves delivered | | |
|-------------------------|----------------|-----------------|-----------------------|-------------------------|--------|-------|
| | | | | Male | Female | Total |
| Abate Bere | Fogera local | 22 | 22 | 12 | 9 | 21 |
| Bereded Jegene | Fogera local | 16 | 15 | 8 | 6 | 14 |
| Aberaraw Jegene | Fogera local | 12 | 12 | 5 | 3 | 8 |
| Mulugeta Birhanu | Fogera local | 21 | 18 | 5 | 2 | 7 |
| Total | | | | 30 | 20 | 50 |

Source: Data collected for this study.

Two Holstein Frisian bulls were purchased by two cattle traders in Woreta town. One bull was sold before providing mating service while the other mated successfully with 104 cows during the period 2008–2010. In general, farmers preferred the Holstein Frisian bulls over the Fogera breed despite the fact that Fogera bull mating was free of charge while ETB 30 was charged for a successful Holstein Frisian mating.

Community-based trypanosomosis control

Following the initial initiative, CARE–Ethiopia in South Gondar Zone supported the community-based trypanosomosis program by making a revolving fund available for various drug purchases. At this moment, besides the government capital budget support, ETB 95,000 allocated from CARE has been revolving and made available for purchasing various chemicals and medicines. This program has been well known and given due attention by Bahir Dar Animal Health Laboratory to replicate for other types of disease controlling program.

After six years another blood test survey was conducted for a study conducted by Bahr Dar University to check on trypanosomosis prevalence. Of the 600 blood samples taken from 5 PAs (120 samples for each PA), only 2 animal were found positive which is around 0.33%.

Cooperative marketing/processing

Processing and sales of milk and other dairy products are summarized for Dehansit cooperative over the period 2006 to 2010 (see Figure 10). Purchase of milk peaks in April/May and September and processing into butter is most prominent during the Orthodox Christian fasting period where milk consumption during this time is very low.

Although both cooperatives purchased and processed milk during this period, impact is still limited since members can only deliver milk on a quota basis while non-members cannot deliver any milk especially during Orthodox Christian fasting period. As shown in the next graph, cooperative activity declined after an initial period of growth. Also sales of skimmed milk ceased over time. Lack of motivation of dairy cooperatives committee members, lack of awareness about cooperative principles, and adulteration of milk with water by some milk suppliers, eroded the credibility and sustainability of the new dairy cooperatives.

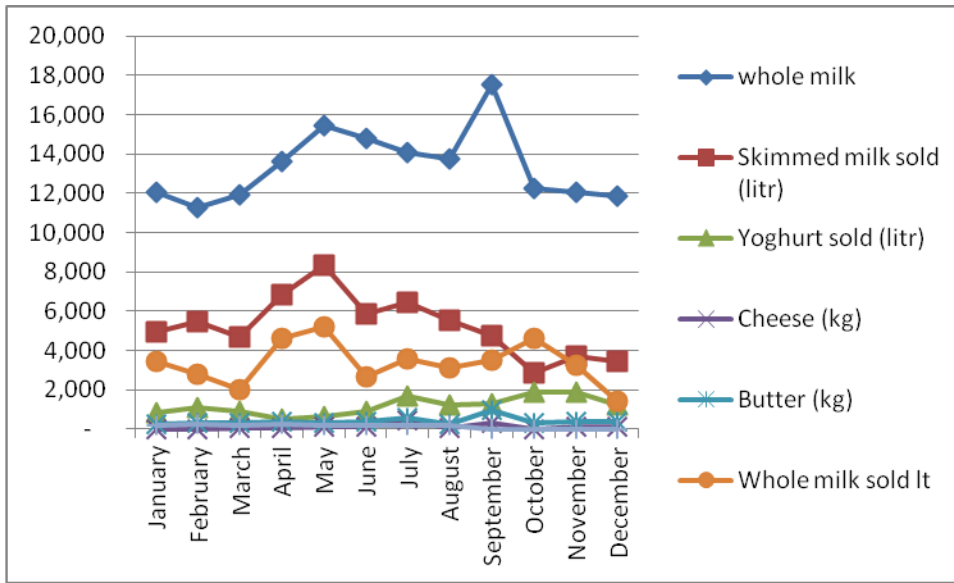


Figure 10. Dehansit dairy cooperative seasonal milk supply from 2005–2010.

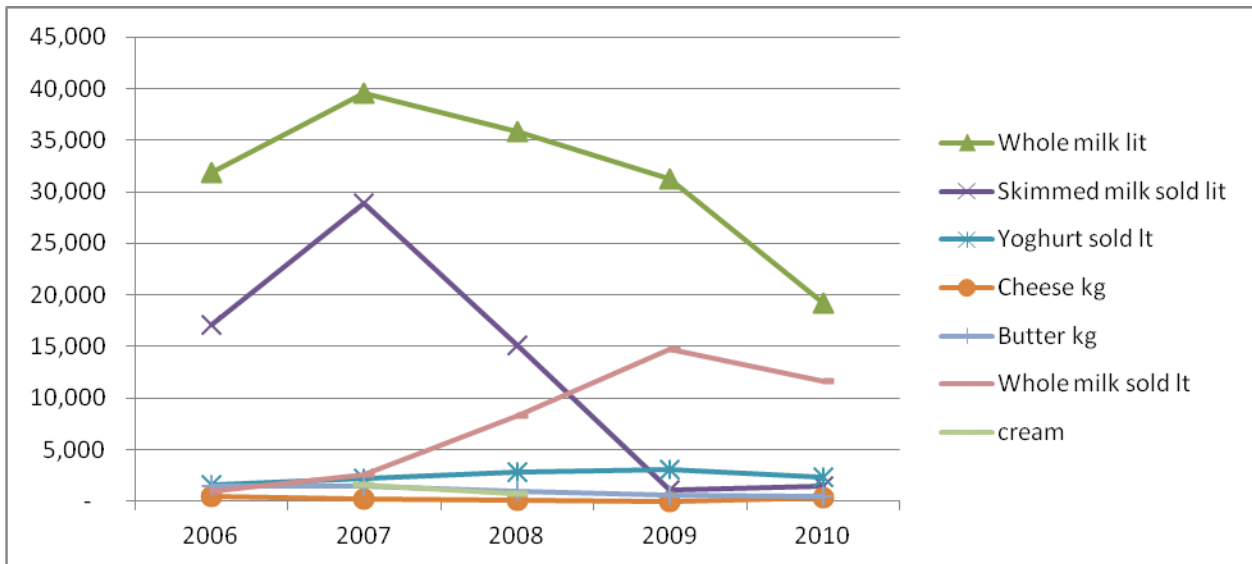


Figure 11. Dehansit dairy cooperative volume of milk supply and processing trends from 2006–2010.

The initial linkages created between the Dehansit cooperative and a hotel in Bahr Dar phased out due to lack of price incentive for the sale of butter.

5.3 Other indirect effects

Gender

As shown in the previous section, interventions in the rural areas resulted in a significant increase in income from the sale of butter. Home processing and sale of butter is the responsibility of women and hence women farmers have benefitted from these interventions.

The introduction of milk processing to butter, cheese, and yoghurt using improved technology is the first experience in the *woreda* which reduces time, energy and improves the efficiency of butter yield as compared to the traditional churners. These processing activities in both dairy cooperatives are carried out by women.

Environment

Clearance of Amikela coupled with livestock exclusion and cut-and-carry system helped to improve the total production but also the biodiversity of the grazing areas, in particular the amount of legumes (see Annex 2). Livestock exclusion also helps to prevent soil erosion whose cumulative effect on all grazing areas will contribute to less sedimentation of Lake Tana. Furthermore, the improved forage diversity/flowering resulted in more bee forage. According to forage specialists, four main trifolium species which are highly beneficial as source of bee forage have been identified.



Figure 12. Area enclosure enhances biodiversity and supports beekeeping development and field day.

5.4 Organizational and institutional arrangement

A number of actors have been involved at different stage in the dairy commodity value chain intervention (Table 8). Key actors include: cooperative and animal health teams under WOOARD, both private and public veterinary service providers, development agents, national dairy development, Land O'Lakes and *kebele* administration. Since 2005, after IPMS has started operational in the *woreda*, the interaction and linkage among these actors improved and the number of stakeholders increased.

Management of communal grazing land becomes one of the top agenda for the *woreda* administration and becomes sources of intra community conflict. Various governmental offices like Land Administration under WOOARD, the *woreda* administrations and security, *kebele* administration executive committee and community elders have been involved to resolve the dispute within and between the communities.

In 2009, a one-day communal grazing land consultative stakeholders' workshop was organized by involving various stakeholders. According to the *woreda* justice office representative, which was one of the stakeholders among others, more than 50% of the court case is related to communal grazing land conflict.

Following the consultative workshop and sharing of information among various stakeholders during the workshop, mapping was made of some of the largest communal grazing land using GPS, in collaboration with IPMS, Land Administration and *woreda* justice.

Land O'Lakes, Andassa Livestock Research Center, Fourth Livestock Project, NLDP, and ILDP have been involved in livestock and forage development interventions.

Moreover, IPMS facilitated the establishment of *Woreda* Advisory Learning Committee (WALC) that co-ordinates actors and leads innovation processes for sustainability. The establishment of WALC helped to improve the interaction and linkage among actors to a considerable level. Table 8 depicts lists of actors and types of involvement in dairy commodity value chain.

Table 8. Roles of key actors

| No. | Actors | Category | Role |
|-----|--|----------|---|
| 1 | Cooperative (WOoARD) | Public | Establishment, auditing services, providing technical backstop to dairy coops |
| 2 | Animal Health (WOoARD) | Public | Providing veterinary and improved animal husbandry service, artificial insemination, introduction of forage plating materials |
| 3 | Vet drug vendors | Private | Supplying de-worming tablets, minor treatment |
| 4 | Land O'Lakes | Public | Training in Bahir Dar; paid the rent for the building during the first 6 months |
| 5 | Members and non-members of milk supplier | Private | Supplying milk and receiving dairy product |
| 6 | Hotels (Addis, Bahir Dar and Woreta) | Public | Buy butter and skimmed milk on credit base |
| 7 | Municipality | | Providing place for new building |
| 8 | <i>Kebele</i> Administration | Public | Mobilizing community for Amikela (weed) clearance program |
| 9 | Farmers | Private | Owning dairy cattle and taking care of cows |
| 10 | IPMS | Project | Introducing new technologies; like forage planting materials, facilitating Amikela clearance through community participation practices, skills, facilitating linkage of different actors, promoting value chain commodity development approach facilitating study tours, input support for dairy cooperatives and financial support |
| 11 | <i>Woreda</i> Administration Office | Public | Mentoring the <i>kebele</i> administration to give support for community participation in Amikela clearance |
| 12 | <i>Woreda</i> police office | Public | Settling dispute among the community |
| 13 | Community elder | Public | Settling dispute within the community |

6 Lessons/challenges

The commodity value chain approach initiated the development of some key interventions, which do show promise for the future but also need further attention since development is a continuous process.

- Participatory market-oriented extension using different knowledge management/capacity development approaches were successfully applied and had a positive effect on introduction and scaling out of intervention and linking various value chain actors and service providers
- As a result of the project's interventions in the rice value chain, the amount of rice crop residues (straw and bran) in the district increased dramatically. Use of these residues for dairy and meat development should be further studied and promoted
- Grazing land interventions were quite successful; lessons learned on communal use by different communities should be examined since different options may be used depending on existing rights under free grazing. Fine tuning user rights may reduce conflicts
- Use of the improvement in grazing area vegetation for apiculture should be promoted
- Women in the rural production system have especially benefitted from the various interventions since it increased milk production for butter production—an enterprise which is managed and controlled by women
- While bull stations made a significant impact on the number of improved dairy cows in the district, total number of improved dairy animals is still low. Mass insemination approaches using hormones and sex determinants (sexed semen, sex fixer) are presently being tested by ARARI, BOA and IPMS. If successful, these interventions should be considered to improve the breeds in the District,
- Processing and marketing of milk in the peri-urban system through cooperative formation experienced considerable managerial difficulties. Members did however benefit through better access to markets and knowledge. When milk volume increases, linkage with the larger Bahr Dar milkshed should be developed and emphasis should be put on milk collection,

- The invasion of communal grazing land with Amikela, shrinkage of grazing land and difficulties on the introduction of cut-and-carry system has been the main challenges which need various stakeholders' involvement and long-term commitment.

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Annexes

Annex 1. Summary of training field days, meetings and workshop conducted (2007–2009)

| Type of events | Start date | End date | Title | Gov. employee | | Farmers | | Private | | Total |
|----------------|------------|-----------|--|---------------|---|---------|---|---------|----|-------|
| | | | | M | F | M | F | M | F | |
| Workshop | 29-Apr-07 | 29-Apr-07 | Dairy commodity development and its constraint | 7 | 2 | 25 | 6 | 3 | | 43 |
| Meeting | 22-Dec-07 | 22-Dec-07 | Awareness raising consultative meeting on trypanosomosis control | 5 | 3 | 15 | 4 | | | 27 |
| Field days | 6-Mar-08 | 6-Mar-08 | Filed day on rice urea treatment to improve dairy production and fattening commodities interventions | 3 | 0 | 38 | 5 | | | 46 |
| Study tour | 8-Mar-08 | 16-Mar-08 | Farmers, experts, study tour and experience sharing on closure site management, improved onion storage, zero grazing | 5 | 2 | | | | 16 | 23 |
| Study tour | 22-Mar-08 | 28-Mar-08 | WALC/RALC members study tour for dairy development at Ada'a dairy cooperatives activities and Genesis farm | 7 | | | | | | 7 |

| Type of events | Start date | End date | Title | Gov. employee | | Farmers | | Private | | Total |
|----------------|------------|-----------|--|---------------|---|---------|---|---------|---|-------|
| | | | | M | F | M | F | M | F | |
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| Field days | 6-Mar-08 | 6-Mar-08 | Field day on rice urea treatment to improve dairy production and fattening commodities interventions | 3 | 0 | 38 | 5 | | | 46 |
| Field day | 9-Oct-08 | 9-Oct-08 | Communal grazing site performance monitoring | 4 | 1 | 80 | | 3 | | 88 |
| Training | 7-May-09 | 7-May-09 | Communal grazing land delineation using GPS | 1 | | | | 2 | | 3 |
| Training | 8-May-09 | 9-May-09 | Forage development training | 23 | 3 | | | | | 26 |
| Workshop | 15-May-09 | 15-May-09 | Communal grazing land management stakeholders workshop | 36 | | 36 | | | | 72 |
| Meeting | 18-May-09 | 18-May-09 | Communal grazing land management stakeholders with <i>woreda</i> administration and experts | 5 | | | | | | 5 |

| Type of events | Start date | End date | Title | Gov. employee | | Farmers | | Private | | Total |
|----------------|------------|-----------|--|---------------|---|---------|---|---------|---|-------|
| | | | | M | F | M | F | M | F | |
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| Field day | 9-Oct-08 | 9-Oct-08 | Communal grazing site performance monitoring | 4 | 1 | 80 | | 3 | | 88 |
| Meeting | 9-Oct-08 | 9-Oct-08 | Shina <i>kebele</i> forage development | 4 | | 35 | 6 | | | 45 |

Annex 2. List of main forage species and their composition in Mangaloma area enclosure, 2009.

| No. | Species name | Local name | Composition in % |
|-----|-------------------------|---------------|------------------|
| 1 | <i>Pennisetum</i> | Tucha | 27 |
| 2 | <i>Trifolium spp</i> | Wajima/Magete | 11 |
| 3 | <i>Gungurda</i> | Gungurda | 10 |
| 4 | <i>Cynodon dactylon</i> | Serdo | 13 |
| 5 | <i>Guinea grass</i> | Panicum | 13 |
| 6 | <i>Cyprus spp</i> | Gicha | 8 |
| 7 | <i>Yekok sar</i> | Yekok sar | 9 |
| 8 | <i>Andropogon spp.</i> | Gaja | 2 |
| 9 | <i>Hygrophilla spp</i> | Amikela | 2 |
| 10 | Yewf teff | Yewf teff | 2 |
| 11 | Others | | 3 |

Sources: Andassa Livestock Research Center and IPMS PLW progress report.



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