



FINAL EVALUATION OF THE FEED ENHANCEMENT FOR ETHIOPIAN DEVELOPMENT PROJECT PHASE II (FEED II) (Final Report)



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ACRONYMS AND ABBREVIATIONS

AIBP	Agro-Industrial By-Products
CP	Crude Protein
DA	Development Agent
DM	Dry Matter
EC	Ethiopian Calendar
ETB	Ethiopian Birr
FAO	Food and Agriculture Organization
FCM	Formulated Concentrate Mixture
FEED	Feed Enhancement for Ethiopian Development Project
FGDs	Focus Group Discussions
FTC	Farmers Training Center
GO	Government
GM	Gross Margin
GTP	Growth and Transformation Plan
HH	Household
ILRI	International Livestock Research Institute
KGs	Kilograms
KII	Key Informant Interview
LMP	Livestock Master Plan
M&E	Monitoring and Evaluation
ME	Metabolisable Energy
NGO	Non-Governmental Organization
PCs	Primary Cooperatives
ROI	Return on Investment
SHF	Smallholder Farmers
SNNPR	Southern Nations, Nationalities, and Peoples' Region
SNNPR	Southern Nations, Nationalities and Peoples Region
ToT	Training of Trainers
USD	United States Dollar
USDA	United States Department of Agriculture
VDFACA	Veterinary Drug and Animal Feed Administration and Control Authority of Ethiopia.
%	Percent
&	And
\bar{x}	Mean/Average
Σ	Sum

Definitions and Exchange Rates:

Woreda is a district level administrative unit in Ethiopia.

Kebele is the lowest administrative unit in Ethiopia.

Ethiopian Birr (ETB) 28.5196 = US\$1 (Weighted Average Exchange Rate on April 5, 2019 as per National Bank of Ethiopia)

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Executive Summary

The Feed Enhancement for Ethiopian Development Project – Phase II (FEED II) was designed and implemented during the past five years. Funded by USDA, the project was initially designed to be implemented for three-years but later extended for additional two years. The ultimate goal of FEED II is to increase the incomes of Ethiopian smallholder livestock producers by improving access to, and use of consistent, affordable, high quality animal feed that can support greater livestock productivity and efficiency. To sustainably increase the incomes of Ethiopian smallholder farmers in project target areas, FEED II aims to increase the productivity of livestock and poultry by 15% by developing the animal feed sector and expand trade of agricultural products in the livestock and poultry sector by 15%. A terminal evaluation was conducted to determine the achievements of the project against its targets and objectives. The evaluation used mixed methods and surveyed 1,894 direct beneficiary households, 73 follower farmers, 12 union-based feed manufacturing enterprises and hundreds of other stakeholders.

The findings of the final evaluation showed that a significant proportion of target smallholder farmers adopted the different improved livestock and agricultural technologies and practices promoted by the project, which ranged from improved forage cultivation to feeding concentrates to applying feeding troughs. Development of animal feed sector and adoption of the different improved practices promoted by the project contributed to increased livestock productivity. Unit productivity of fattened animals measured by number of fattened animals per 100 households increased by 32% from baseline, exceeding the 15% target set for livestock productivity. Unit productivity of poultry increased by 12% following the project intervention. Average ownership of chickens increased to 9.98 chicken (both local and improved) at endline compared to 8.9 at baseline, a 12% growth from baseline. Milk productivity of beneficiary households also more than doubled. A significant proportion of households also moved away from local to improved breeds following the project intervention. The project also expanded trade of agricultural products in the livestock and poultry sector by 210%, exceeding its 15% target significantly.

1. BACKGROUND

1.1. Introduction

Ethiopia has the largest livestock population in Africa and the fifth largest in the world. The livestock subsector contributes nearly 20 percent of total GDP and foreign exchange earnings of the country, and some 35 to 40 percent of agricultural GDP (World Bank, 2017). Despite high livestock population and the contribution of livestock to the economy and small holders' livelihood, the production system is subsistence oriented, is not adequately market-oriented and livestock productivity remains very low (Negassa et al., 2011). The key challenges that continue to undermine the performance and potential of the livestock sub-sectors include reduced availability and access to communal grazing and natural pasture; insufficient access to forage, forage seeds and feed supply; poor animal health due to disease prevalence; low livestock genetic make-up; limited adoption of improved livestock practices and poor provision of livestock support services. In addition, the sector has a low commercial market off-take due to inadequate processing and marketing infrastructure.

It was against this background that the Feed Enhancement for Ethiopian Development Project – Phase II (FEED II) was designed and implemented during the past five years. The Ethiopian government in its Growth and Transformation Plan (GTP) has also identified the transformation of the livestock sector as a source of economic growth in the second GTP and beyond through intensification and commercialization of production. Funded by United States Department of Agriculture (USDA) Food for Progress Program, FEED II has been implemented by ACDI/VOCA since September 2013 in Amhara, Oromia, SNNP and Tigray regional states of Ethiopia. The project was initially designed to be implemented for three-years but later extended for additional two years.

The ultimate goal of FEED II is to increase the incomes of Ethiopian smallholder livestock producers by improving access to, and use of consistent, affordable, high quality animal feed that can support greater livestock productivity and efficiency. To sustainably increase the incomes of Ethiopian smallholder farmers in project target areas, FEED II aims to increase the productivity of livestock and poultry by 15% by developing the animal feed sector and expand trade of agricultural products in the livestock and poultry sector by 15%. These objectives are to be achieved through four Intermediate Results (IRs), which address availability, access, knowledge about and utilization of feed resources. FEED II project implementation covers four regions – Amhara, Tigray, Oromia and SNNPR – where over 80% of the country's livestock population resides. Within these regions, the project has worked in 39 woredas and over 186 kebeles. The project has been working with a total of 24 cooperative unions (12 from FEED I and 12 FEED II), which have been the key entry and scalability points through which the project is implemented.

As FEED II is now ending, ACDI/VOCA commissioned ICOS Consulting PLC to conduct a final evaluation of the project. The purpose of the final evaluation is to assess whether the project has achieved the expected results outlined in the results framework. The final evaluation assessed areas of project design, implementation, management, lessons learned and replicability. It also sought to provide lessons learned and recommendations for USDA, program participants and other key

stakeholders for future food assistance and capacity building programs. In general, the evaluation assessed: a) relevance, b) effectiveness, c) efficiency, d) impact, e) sustainability, and f) other areas of interest to USDA and stakeholders. In addition, the evaluation has identified what the project should continue, cease and change to improve outcomes to ensure sustainability in FEED III. More specifically, the final evaluation intends to:

- i. Collect household socio-economic data pertaining to livestock farmers in the project zone of influence;
- ii. Determine the endline values for contextual outcomes and impact level performance indicators as outlined in the project performance monitoring plan;
- iii. Identify gaps and weaknesses in feed manufacturing supply chains in each of the four project areas including feed regulatory framework;
- iv. Identify and document innovative feed and forage production systems that promote smallholder and market resilience;
- v. Identify feed and forage production capacity gaps, sector policy constraints and organizational weaknesses related to feed manufacturing and feed distribution supply chains;
- vi. Identify activities that can act as catalysts in developing sustainable forage production systems that can facilitate on-farm feeding practices;
- vii. Identify opportunities for collaborative learning and action along the feed value chain that can foster livestock production systems change;
- viii. Identify constraints in maximizing beneficial use of available feed resources among livestock and poultry smallholder farmers;
- ix. Assess the impact of the project on upstream and downstream economic activities of buyers/suppliers of sub-grantees; and
- x. Identify recommendations for FEED III based on findings.

This report presents the findings of the FEED II project final evaluation that was conducted from December 2018 through February 2019.

1.2. Evaluation Approach and Methodology

1.2.1. Design and Methodology

The final evaluation utilized the FEED II baseline study design and methodology so as to ensure consistency and comparability. Hence, like the baseline survey, the final evaluation used a non-experimental independent sample pre/post-test evaluation design. The study was also a cross-sectional survey and designed to provide region, livestock, household and cooperative level information related to project indicators. The final evaluation also employed mixed (quantitative and qualitative) approaches.

1.2.2. The Study Population

The major study populations for the final evaluation were direct beneficiary smallholder livestock producer farmers and feed manufacturing enterprises established under cooperative unions. In addition to smallholder farmers, follower farmers; primary cooperatives and private enterprises

engaged in dairy, poultry, fattening and forage production; commercial feed ingredient suppliers; feed equipment manufacturers; development agents, relevant experts of the federal, regional, zonal and woreda offices of agriculture and livestock development, and cooperative promotion offices and other implementing partners were also targeted by the evaluation.

1.2.3. Sampling

i. Sample Size

The sample size for the household survey was determined in such a way that it enables regional level representation. FEED II hypothesizes that income from livestock depends, in part, on use and non-use of improved new technologies introduced by the project. The project targeted to reach 40,481 direct and over 242,886 indirect beneficiaries (source: modified project document). It also aimed to ensure that 70% of targeted direct beneficiaries adopt improved agricultural technologies such as improved forage-growing systems, increased use of manufactured feed, improved feedlot, dairy and poultry production practices. Like the baseline survey, the sample size was determined considering a 5% margin of error and 95% confidence level, 1.3 design effect and 10 percent non-response rate and using Cochran's general formula (J.E. Bartlett et al., 2001).

$$n = ([Z^2 \times PQ / e^2] \times \text{design effect}) \times \text{NR}$$

Where n is the estimated sample size

Z= 1.96 from a standard distribution table at 95% confidence level

P= proportion of beneficiaries expected to adopt the new agricultural technologies (0.7)

Q= 1-P (those who will not adopt the new agricultural technologies) (0.3)

e = the level of error term which we are going to accept/tolerable (0.05 or 5%)

NR= Non-response rate

Feeding these values to the above formula resulted in a sample size of 462 smallholder farmers per region. In total, the final evaluation team planned to interview 1848 smallholder farmers in the four regions. The field team actually surveyed 1,894 smallholder farmers, exceeding the target sample size. The planned and actual sample size for the household survey is presented in Table 1 below.

Table 1: Planned and Actual Sample Size for Direct Beneficiary Households Survey

Region	Target Sample	Actual Sample
Amhara	462	480
Oromia	462	464
SNNP	462	483
Tigray	462	467
Total	1,848	1894

ii. Sampling Procedure

A multi-stage sampling was utilized to reach to sample beneficiary smallholder farmers for the survey. The sampling process started with selection of woredas. The woredas selected for the final evaluation were the ones that were covered by the baseline study, which considered geographical disparity as well as the types of cooperatives in each woreda in selection of the woredas for the survey. A total of 32 project woredas (eight woredas per region) were covered by the final evaluation. All but one baseline woreda were covered by the final evaluation. This project woreda, in Oromia region, had to be replaced by another woreda in the same region owing to security concerns. In terms of project woreda representation, out of the 39 project woredas, the final evaluation covered 32 (82%) of them.

In the second stage of sampling, kebeles were selected from each sample woreda to administer the household and local official surveys. Hence, a total of 64 kebeles from the 32 woredas were covered by the final evaluation.

Some of the kebeles that were covered by the baseline study were also included in the final evaluation. The selection of kebeles for the baseline survey gave major emphasis to high livestock potential kebeles. Kebeles that were not covered by the baseline were also surveyed for the final evaluation due to additional considerations. One of the considerations was the need to ensure representation of smallholder farmers by their year of entry into the project (from 2014 to 2017). The evaluation team had to include new kebeles for the survey so as to find adequate number of smallholder farmers that were reached by the project in 2017.

The third stage in the sampling process was the selection of smallholder farmers for the survey, which was undertaken using systematic sampling technique based on the list of beneficiary farmers maintained by the project and/or its local government counterparts. On average, about 29 beneficiary smallholder farmers participated per kebele in the endline survey.

In addition to households, the evaluation team interviewed cooperative unions supported by the project, nursery sites, livestock enterprises, buyers and providers of these sub-grantees and others. A total of 12 unions (8 FEED II and 4 FEED I Unions) were interviewed. The selection of the cooperative unions in each category (FEED I and II) was undertaken using purposive sampling technique. The key criterion for inclusion was representation of FEED I and II unions in the sample. Another criterion was the woreda or location in which the union was located. FEED II unions that reside in woredas selected for the smallholder farmer survey were selected for consultation. The selection of other sub-grantees such as dairy, poultry and fattening farms followed a two-stage process. The first stage was stratifying these sub-grantees based on their area of engagement (such as poultry, dairy, fattening, etc.) under each of the four regional states. Thereafter, sample sub-grantees were selected randomly. The overall field work performance in terms of the number of areas covered and people consulted is presented in Table 2.

1.2.4. Methods and Data Collection Instruments

The final evaluation study employed both quantitative and qualitative data collection techniques. Quantitative data was largely collected through a structured questionnaire. Qualitative data was gathered through key informant interviews, FGDs, and observations.

- i. **Questionnaire:** Different sets of semi-structured questionnaires were designed and administered to gather quantitative data from direct and indirect project beneficiaries. To ensure comparability and consistency, direct beneficiary smallholder farmers were surveyed by administering the structured questionnaire used during the baseline after making some adjustment on exposure variables. The questionnaire was originally developed in English and later translated into Amharic and Oromiffa languages for administration. The local language versions of the questionnaire were administered using tablets. Other short surveys were also administered on to a sample of follower farmers, as well as input suppliers and output buyers of sub-grantees of the project. A total of 73 follower farmers were surveyed (nearly one follower farmer per sample project kebele) with the aim to capture how they received the knowledge transfer, whether they adopted the promoted improved practices, and so on. These farmers were identified for interview by model farmers. One follower farmer per sample kebele was selected and interviewed by field supervisors. Short semi-structured questionnaires were also administered on input suppliers and output buyers of sub-grantees of the project. The questionnaires contained close and open-ended questions. These questionnaires were designed in English and were administered through translation.
- ii. **Focus Group Discussion (FGD):** A total of 32 focus group discussions involving 269 direct beneficiary smallholder farmers (193 male and 76 female) were conducted. The focus group discussions were facilitated by field coordinators guided by semi-structured questions. On average, about 8 people participated in the FGDs and attempts were also made to ensure gender representation in the groups. The participants were selected in consultation with development agents and local officials. See Table 2 for details.
- iii. **Key informant interviews:** In-depth interviews were conducted with 157 key informants from regional and woreda agriculture/livestock office, and development agents; managers of feed manufacturing units at Unions and Nursery sites; representatives of Ethiopia Meat and Dairy Industry Development Institute, Ethiopian Animal Feed Industry Association, and Veterinary Drug and Animal Feed Administration and Control Authority; feed mill equipment manufacturers. Different sets of semi-structured interview guides with predominantly open-ended questions were developed for each category of respondents. Informed oral consents were secured from data sources before the interviews were conducted. Some interviews involving key informants such as development agents and woreda agriculture offices were also recorded with the consent of participants.
- iv. **Observation:** Each field team conducted field visits to selected project activities/sites such as Forage Nursery Sites (7 of them were visited), feed manufacturing plants, livestock enterprises and smallholder farmers' backyard forage production activities in order to have a visual observation of some of the projects' activities so as to observe their existence and functioning.

- v. **Case stories:** The field team developed for 20 (15 male and 5 female) people through interview and observation with the aim to document significant success stories and impact of the project on direct and indirect beneficiaries. Cases were selected with local project counterparts such as development agents. Each case was profiled with the help of a checklist and guiding questions.

Table 2: Stakeholders Consulted for the Final Evaluation

Field Performance	Amhara	Oromia	SNNPR	Tigray	Total
Woredas covered	8	8	8	8	32
Kebeles visited	16	16	16	16	64
Direct beneficiary smallholder farmers surveyed	480	464	483	467	1894
FGDs conducted	8	8	8	8	32
FGD participants	62	69	65	73	269
Cooperative unions/Feed manufacturing enterprises consulted	4	2	3	3	12
Key informants consulted	49	37	45	26	157
Case stories developed	6	3	2	5	19
Follower farmers interviewed/ surveyed	17	15	21	20	73

1.2.5. Recruitment and Training of the Evaluation Team

Field researchers and enumerators were recruited considering their experience in similar agriculture research, communication skills and local language proficiency, familiarity with the study areas, ability to work as a member of a team, and having relevant technical skills and training in data collection. Field supervisors and enumerators were recruited from the respective regional states and brought in to Addis Ababa for training. The overall evaluation team including field team members were trained for two days in Addis Ababa before they were deployed to the field. The training was given in collaboration with ACDI/VOCA FEED II team. In total, three key consultants, eight regional coordinators and 31 field supervisors and enumerators, one computer programmer (43 in total) participated in the final evaluation study. Each regional team was composed of a regional field coordinator, assistant regional field coordinator, field supervisor and enumerators. All the data collectors had a minimum of bachelor's degree with some experience in similar surveys. The field team was provided with a data collection manual to read and refer to at times of difficulty during data collection in the field.

1.2.6. Data Collection/Field Work

Data collection began simultaneously across the four project regions. Each field team started their field work by obtaining letter of cooperation from relevant regional government bodies. The field team held daily review meetings to review their progress, data gathered using tablets and transfer the survey data to online server, revised their next day plan and capture lessons. Each field team also held call conference with the team leader to provide progress update and share lessons. Field

coordinators were tasked with qualitative data collection through focus group discussions, observation and in-depth interviews with different stakeholders.

1.2.7. Data Management and Analysis

Immediately after completion of data collection, a half-day field work review workshop was held to review the field proceedings, capture lessons and observations. The preparation of data for analysis also started immediately after the field work. Much of the quantitative data was gathered using tablets. Hence, data collection and entry happened concurrently. The use of tablets ensured more control over the data quality by automatic skip-pattern and validation of the response, minimizing data-entry errors. Some of the paper-based short surveys conducted with follower farmers, ingredient suppliers and output buyers were entered into SPSS. All survey data was then cleaned before analysis by running different tests involving all entries to spot missing values, outliers and errors in data collection. Qualitative data was translated and transcribed by field coordinators and supervisors that gathered them. The field researchers then typed in English into Microsoft word format for analysis.

Different statistics were computed depending on the data type and project indicators that ranged from simple descriptive to inferential statistics. Whenever necessary and possible, differences between or among survey groups were also tested for their significance at $p < 0.05$. Qualitative data analysis and interpretation was conducted by using qualitative content analysis methodology. The evaluation team also brought the baseline and endline survey data together to compute some statistics on certain project indicators and outcomes. Qualitative data analysis was used to validate or supplement quantitative findings and clarify responses from the quantitative survey.

1.2.8. Limitations and Challenges of the Evaluation Study

The survey team faced some challenges that had some impact on data quality. Difficulties faced by some beneficiary farmers to remember the support they received from the project might have understated some reported figures. The timing of evaluation was not good as there is large government official reshuffling owing to current political reforms in the country. The field team tried to deal with the challenge by tracking and consulting ex-officials or experts that worked with the project or know the project better. But it is likely that some of their views may not represent the intention or views of current government officials. The fact that the field work was conducted during harvest times in some areas also hampered data collection. There was an error in coding the survey questionnaire as related to local cows. As a result of the error, maximum and minimum milk production was captured on only 302 households that owned 500 cows. Many sub-grantees including feed manufacturing unions were not found to have separate financial records for their operations. They tend to include financial records of the project-supported business activities with their other operations.

2. RESULTS AND DISCUSSIONS

In this section of the report, the findings of the final evaluation are presented based on the standard evaluation criteria of effectiveness, relevance, sustainability and cross-cutting issues. The description of the results and discussion of the results henceforth will portray of the project's achievement as the expected results outlined in the results framework.

2.1. Effectiveness

Effectiveness is a measure of the extent to which an intervention's intended results (outputs or outcomes) have been achieved or the extent to which progress toward outputs or outcomes has been achieved. In this section, the findings are presented focusing on household socio-economic data pertaining to livestock farmers, and contextual outcomes and impact level performance measures by comparing final evaluation/endline survey results with that of baseline.

2.1.1. Demographic Characteristics of Respondents

The vast majority of beneficiary households (85%) that participated in the survey were men headed while the remaining 15% of households are women-headed. Close to two-third (65%) of the respondents are between 40 and 50 years old. Household heads aged below 30 years represented only 5% of the respondents. Close to a third of the household heads are over 50 years old. About 28% of respondents are illiterate while the majority (59%) of them can read and write or have primary education. Respondents with secondary and above level education represented only 13% of the total. Seventy-one per cent of the respondents are members of cooperatives and the vast majority of them (78%) belong to a multipurpose cooperative. Only 18% of households are members of livestock cooperatives. Households in Tigray and Oromia are more likely to be members of cooperatives than those in Amhara and SNNP. On average, a household has 6.5 members, which is closer to the baseline results of 6.2 but much larger than the national average of 4.6 (3.5 persons in urban areas and 4.9 persons in rural areas). Average household size did not differ significantly among regions. The demographic characteristics of respondents was more or less comparable with those that participated in the baseline study (See Annex 3).

2.1.2. Livestock Production and Productivity

2.1.2.1. Livestock Ownership and Composition

As presented in Table 3 below, about 92% of the respondents owned one or more mature cows during the 12 months preceding the endline survey. The proportion of target beneficiary households that owned crossbreed mature cows increased from 23% at baseline to 38% at endline. In contrast,

the percentage of households that owned local cows declined from 79% at baseline to 72% at endline. Analysis of survey data also shows that households owned more livestock in the 12 months preceding the endline survey than at the time of the baseline survey. On average, a household owned 1.68 and 0.75 local and crossbreed mature cows at endline, respectively, compared to 1.5 and 0.4 at baseline. The results show that direct beneficiary households owned a larger number of mature cows at endline than baseline. This was largely the case due to increased ownership of crossbreed cows during the intervention period. The average number of crossbreed cows owned by sample households at endline survey was almost twice as much as that of the baseline, and the difference was statistically significant. Compared to baseline, the average number of local cows owned by households at endline also increased significantly. However, the proportion of households that owned local cows declined by seven percentage points from baseline. The results suggest that direct beneficiary farmers are increasingly acquiring crossbreed cows to improve their livestock productivity. The training provided by the project on modern livestock management was instrumental in helping farmers apply better livestock management practices. 'I put what I learned from the project into practice and purchased two crossbreed cows,' one model farmer responded when asked about the benefits he obtained from the training provided by the project. Many farmers and key informants also indicated that farmers are shifting from local to crossbreed cattle. "Most farmers are trying to shift from local to crossbred dairy cattle,' a woreda agriculture office official also said. Indeed, analysis of qualitative data suggests that ownership of crossbreed cattle could have even been much larger if such animals were accessible and affordable to buy.

'Before the project intervention we count our cows not their products and efficiencies, and most of us had local cows that gives us an average of 2 liters of milk per day, but now those who have hybrid milk cows and practically implemented the training received from the project are getting better yield and they are obtaining an average of 8 to 20 liters of milk per day' a direct beneficiary farmer that participated in one of the FGDs said.

The proportion of households that owned local and crossbreed bulls/oxen also increased from 74% and 10%, respectively, at baseline, 77% and 17% at baseline. A household, on average, owned 1.86 local and 0.28 crossbreed bull/oxen at endline, compared to 1.65 local and 0.15 crossbreed ox at baseline. The differences were statistically significant. In terms of overall cattle ownership, households that owned local and crossbreed cattle¹ represented 89% and 47% of the endline survey respondents, compared to 93% and 27% at baseline. Beneficiary households on average owned 5.5 local (5 at baseline) and 1.84 crossbreed (0.94 at baseline) cattle at endline. The results show that ownership of crossbreed cattle doubled over the intervention period which was also statistically significant.

Table 3: Percentage and Average Livestock and Poultry Ownership by Animal Category at Baseline and Endline

Type of Animal	Type	Baseline	Endline
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¹ The cattle population is the sum of mature cows, mature bulls/oxen (> 2 years), heifers, male cattle (6 months to 2 years), and calves (any sex < 6 months).

		# and % of HHs who own the animal	Mean	Animal Count	# and % of HHs who own the animal	Mean	Animal Count
Mature Cow ²	Indigenous	79%	1.5a	2871	72%	1.68b	3181
	Crossbreed	23%	0.36a	694	38%	0.75b	1423
	Total	89%	1.86	3565	92%	2.41	4604
Mature Ox ³	Indigenous	74%	1.65a	3156	77%	1.86b	3526
	Crossbreed	10%	0.15a	292	17%	0.28b	539
	Total	78%	1.8a	3448	82%	2.12	4065
Cattle Total	Indigenous	93%	5.11a	9785	89%	5.55b	10506
	Crossbreed	27%	0.94	1802	47%	1.84b	3488
Sheep (local)		54%	3.36a	6438	52%	4.09b	7741
Goat (local)		17%	1.01a	1934	19%	2.15b	4079
Chicken	Indigenous	66%	5.75a	11007	41%	3b	5682
	Crossbreed	15%	3.08a	5888	62%	7.08b	13417
	Total	72%	8.83	16895	79%	9.98	19099

Note: Values in the same row and sub table not sharing the same subscript are significantly different at $p < .05$

Beneficiary households' ownership of other animals such as sheep, goats and chickens also increased during the project intervention period. As also shown in Table 3 above, a household on average owned 9.98 chicken (both local and improved) at endline compared to 8.9 at baseline, a 12% growth from baseline. The change was particularly significant in regards to ownership of improved chicken. The proportion of households that owned improved chicken increased from 15% at baseline to 62% at endline. On average, direct beneficiary households that participated in the endline survey owned 7.1 improved chicken compared to 3.1 at baseline. In contrast, ownership of local chicken declined from 5.8 chicken per household at baseline to 3 chicken at endline. These findings suggest that direct beneficiary farmers have been reducing their local chicken ownership in favor of improved breeds, which can be considered a significant development in the right direction to improve poultry productivity. Qualitative data gathered from direct beneficiary farmers and government counterparts attributed the shift to the project intervention. '...some farmers are shifting from keeping indigenous chicken to improved hybrids for egg production,' a woreda agriculture/livestock office expert said. The training provided by the project was said to have enabled farmers to gain knowledge about which animal breed are more productive and which aren't.

² Mature cow refers to female cattle that have at least one calf.

³ Mature bull/ox refers to male cattle that are greater than 2 years old

2.1.2.2. Milk Production and Productivity

The vast majority (79%) of households reported having dairy cows at some point in time during the year preceding the endline survey, which was also exactly the same as the baseline results. Over the past five years, as shown in Table 4 below, the proportion of sample beneficiary households that owned local dairy cows remained the same at endline as was the baseline (59%). In contrast, there was a ten-percentage point increase in the proportion of households that owned crossbred dairy cows (from 20% at baseline to 30% at endline). As also explained in the previous section of this report, these results suggest that beneficiary farmers have been increasingly buying improved cows so as to improve their milk production and productivity. Qualitative data analysis findings attributed the change to the project intervention.

Table 4: Percentage of Households that Own Dairy Cows by Region at Baseline and Endline

Types of Dairy Cows	Amhara		Oromia		SNNPR		Tigray		Total	
	Baseline 478	Endline 479	Baseline 480	End line 464	Baseline 477	Endline 480	Baseline 479	Endline 467	Baseline 1,914	Endline 1890
Local (indigenous) only	59	57.2a	55	38.6b	63.9	54.4a	58	43.5b	59	48.5
Crossbred only	8.6	9.2a	13.5	29.5b	17.6	22.5b,c	10.9	19.1c	12.6	20.0
Both types	4.8	19.6a	15.4	12.7b	6.5	4.0c	4.4	3.2c	7.8	9.9
Have no dairy cows	27.6	14.0a	16	19.2a	11.9	19.2a	26.7	34.3b	20.6	21.6

Note: Values in the same row and sub table not sharing the same subscript are significantly different at $p < .05$

About half (49%) of households owned only local/indigenous lactating cows, compared to 59% at baseline. In contrast, a fifth (20%) of endline survey respondent households (compared with 13% at baseline) owned only crossbred cows. One in ten households owned both indigenous and crossbred lactating cows. Average dairy cow ownership per household increased from 1.29 cows at baseline to 1.4 at endline, an increase of 8% (see Table 4 above).

In terms of milk production, as summarized in Table 5 below, the average maximum amount of milk produced (highest amount of milk produced per day) from 1,489 indigenous lactating cows in a typical day during the last year before the endline survey was 3485 liters (compared with 3,256.35 liters from 1,701 cows at baseline) while the average minimum (lowest level milk production) was 2017 liters (compared with 1,569.03 at baseline). This provides an average maximum and minimum milk production of 3.8 and 2.2 liters/day/cow, compared with 1.91 and 0.92 liters per day per cow at baseline, respectively. This suggests that milk productivity doubled over the past five years. The average maximum daily per cow milk production grew from 2.95 liters at baseline to 6.02 liters, a 100% increase from baseline. The average minimum daily milk production from a single cow also increased from 1.4 liters to 3.6 liters, a 154% increase from baseline.

Table 5: Average Maximum and Minimum Quantities of Milk Reported from Lactating Cows by Breed Type

Types of Lactating cows	Number of Lactating cows		Maximum total amount of milk collected from all lactating cows (liters/day)		Minimum total amount of milk collected from all lactating cows (liters/day)		Average maximum amount of milk collected (liters/cow/ day)		Average Minimum Amount of milk collected (liters/cow/ day)	
	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline
Indigenous/local	1,701	1489	3,256.4	3484.6 ⁴	1,569.0	2017.4	1.91	3.8	0.92	2.2
Crossbred	371	616	2,744.8	3936.5	1,410.5	2525	7.4	10.4	3.8	6.7
Both types	399	513	1,278	1495	524	807	3.2	8.0	1.31	4.3
Total	2,471a	2637b	7,279.7	8916.1	3,503.5	5349.4	2.95a	6.02b	1.42a	3.6b
% change from baseline to endline (from total)	7%		22%		53%		104%		154%	

Note: Values in the same row and subtable not sharing the same subscript are significantly different at p< .05

Most farmers who participated in FGDs agreed on the project's role in improving their livestock productivity. Participants stated that due to feeding better quality forages like elephant grass and oats/vetch mixed fodder and supplementing with manufactured dairy ration, the milk yield of especially crossbreed cows increased from 3 liters/day /cow to about 8 liters/day/cow, and in some high-grade cows, up to 15 liters/day/cow. This is also evident from the survey findings presented in Table 6 that showed large increase in use of concentrate mix over the past five years. The proportion of dairy cow owners that fed concentrate mix to their dairy cows increased from a mere 4% at baseline to 39% at endline. Qualitative data analysis results also suggest that the percentage of households that used concentrate mix could have been much higher than the reported figures if prices were affordable and products are widely available. For many households, the price of concentrate mix is high and considered less cost effective when used on local breeds. While there was sharp a increase in use of concentrate mix, the proportion of households that fed their dairy cows agro-industrial byproducts (wheat bran, oilseed cake, molasses, brewers grain, etc.); other high quality feeds (atela, grains); green forage, grass, hay, silage; and crop residue (teff straw, wheat straw, maize stover) has either remained the same or showed little changes during the period.

Table 6: Percentage of Dairy Cow Owners by Types of Feed Provided to Dairy Cows and Region at Baseline and Endline

Types of feed	Amhara (%)		Oromia (%)		SNNPR (%)		Tigray (%)		Total (%)	
	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline
Concentrate mix (factory formulated)	2.3	9.7a	3.7	46.4b	6.0	60.9c	4.3	39.1b	4.1	38.5
Agro-industrial byproducts	18.8	38.0a	36.0	26.4b	41.4	5.6c	22.5	29.0a,b	30.5	24.7
Other high quality feed (atela, grains)	93.4	86.0a	67.0	77.1b	47.6	18.7c	65.0	81.4a,b	67.2	65.1

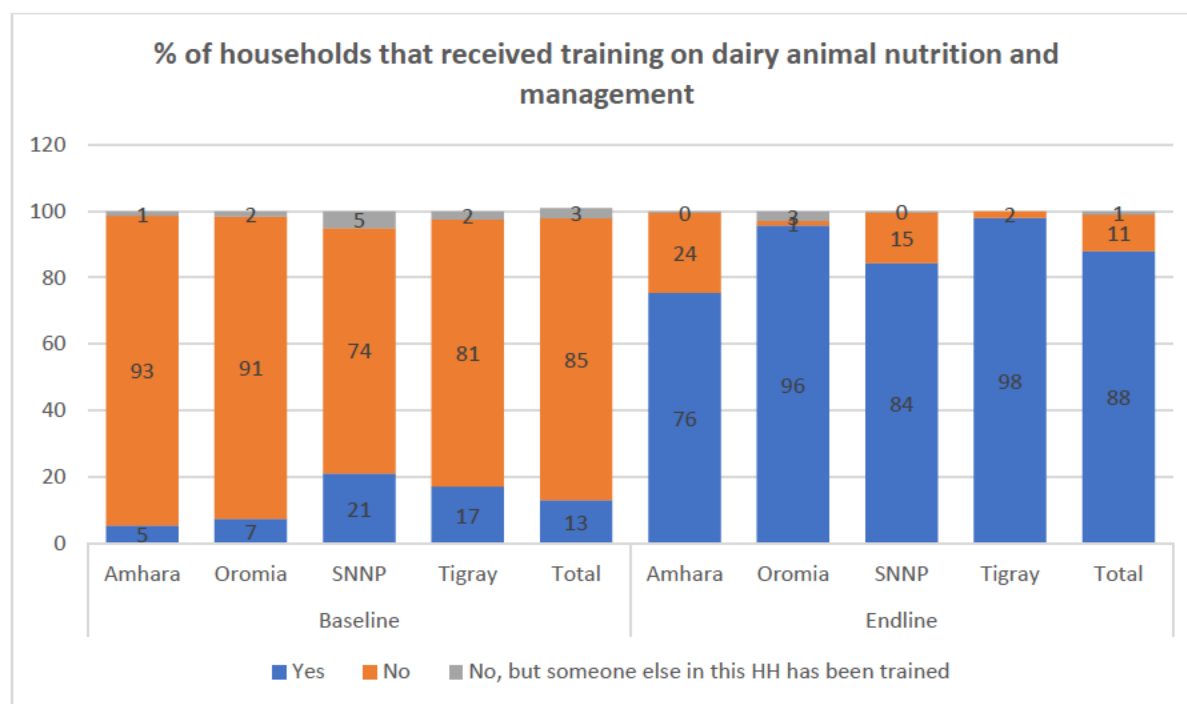
⁴ There was an error in coding the survey questionnaire as related to local cows. As a result of the error, maximum and minimum milk production was captured on only 302 households that owned 500 cows. The maximum and minimum milk production data for local cows should have been collected for 917 households instead of 302. There was no error on data gathered for crossbreed and both types of cows. The evaluation team computed the minimum and maximum figures by assigning the average milk production of the 302 households to the other households (917-302) from which this data was not captured by the tablet based survey

Green forage, grass, hay, silage	95.1	85.2a	75.2	86.9a	75.2	96.2b	92.0	98.4b	89.1	91.3
Crop residue	96.8	95.6a	96.0	95.2a	96.0	97.2a	94.8	98.0a	96.4	96.4

Note: Values in the same row and sub table not sharing the same subscript are significantly different at $p < .05$

The training provided by the project dairy animal nutrition and management was one of the key factors behind the positive developments. As depicted in Figure 1 below, the proportion of respondents who received training on dairy animal nutrition and management grew from 13% at baseline to 88% at endline, and the difference was statistically significant. However, it is important to note here that almost all respondents are said to have participated in the training. The difference might have been partly caused by farmers' inability to remember the training session in which they participated.

Figure 1: Percentage of households that received training on dairy animal nutrition and management



The evaluation team tried to examine if there was any relationship between amount of milk production and type of feeds used to dairy cows. As shown in Table 7 below, statistically significant differences were found in milk productivity between farmers that fed and did not feed concentrates, agro-industrial by-products, and other high-quality feeds. The maximum amount of milk collected from all dairy cows by households that fed these feeds to dairy cows during the reference period was significantly larger than those that did not. The use of concentrate feed was also found to play important roles in increasing the minimum as well as maximum amount of milk collected per day, and the project was credited for this. Apart from sensitizing farmers about the importance of concentrate feed, the project improved supply of and access to such feed products by establishing

union-based feed manufacturing enterprises and supporting backward and forward linkages. The head of a woreda livestock and fishery development in this regard said the following:

‘...The project trained farmers on modern animal feeding and other management, provided improved forage seeds and seedlings that used to be inaccessible, promoted and linked the manufactured feed supply and demand. The project initiated the manufactured feed supply and demand. Because of training and promotion, about 50% of beneficiary farmers buy manufactured feed for dairy and fattening. Farmers started focusing on better animal management as the awareness of farmers on modern animal management enhanced by the project through training, visit, field day and provide awards for best performing farmers.’

Indigenous dairy cows owned by households that feed concentrate feed produce milk for 7.5 months compared to 7 months for those that did not feed concentrates. In other words, the findings suggest that feeding concentrates make indigenous cows provide milk for longer period and the difference was statistically significant. But this was not the case for cross-breed cows (see Table 7).

Table 7: Milk Productivity and Type of Feed Fed to Dairy Cows

	Concentrates		Agro-industrial by-products		Other high quality feeds		Green forage, grass, hay, silage		Crop Residue	
	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
What was the maximum amount of milk you collected in one day from all of your cows during the past 12 months	5.01a	7.64b	5.76a	6.82b	5.52a	6.29b	4.85a	6.13a	6.12a	6.01a
What was the minimum amount of milk you collected in one day from all of your cows during the past 12 months	2.80a	4.91b	3.57a	3.75a	3.36a	3.74a	2.47a	3.72b	3.38a	3.62a
On average how many number of months did your indigenous dairy cows produce milk (i.e. the typical length of a single lactation)?	7.00a	7.48b	7.23a	6.86a	7.21a	7.12a	7.27a	7.13a	6.83a	7.16a
On average how many number of months did your crossbreed dairy cows produce milk (i.e. the typical length of a single lactation)?	9.31a	9.12a	8.96a	9.66b	9.37a	9.13a	10.33a	9.09b	9.33a	9.21a

Note: Values in the same row and sub table not sharing the same subscript are significantly different at $p < .05$

When we look at milk productivity against use of improved practices, as presented in Table 8, households that practiced drinking troughs to provide clean water for animals; feeding a total mixed ration; supplementation with urea molasses lick blocks; and factory produced formulated feed were more likely to collect more milk than those that did not use these improved practices. The impact on milk productivity is more pronounced among households that fed concentrates. The difference was statistically significant. Farmers as well as government officials indicated that the project enabled these changes by providing practical training; supplying initial improved forage seeds/seedlings as well as concentrate feeds; improving accessibility of concentrate mix; and supporting the provision of technical support. In this regard, one of the direct beneficiary farmers said the following:

‘The training providing by the project on livestock feeding and management was practical. After the training, starting materials were supplied in the form of foundation seed and planting material of forage crops; concentrate feeds of various kinds of formulations that they tested on their farm animals. We then realized the benefit of feeding better quality forage and -concentrate by the increased milk yield from three liters to more than eight liters. We built feed troughs exactly as

demonstrated during the training using locally available material and that proved to be handy in reducing wastage of feed material and avoidance of contamination with internal parasites. I also purchased a crossbreed heifer for ETB 14,000 and fed her with concentrate dairy ration; and the milk yield increased substantially from 8 lts to 15 lts/day.'

Table 8: Milk Productivity and Feeding Practices

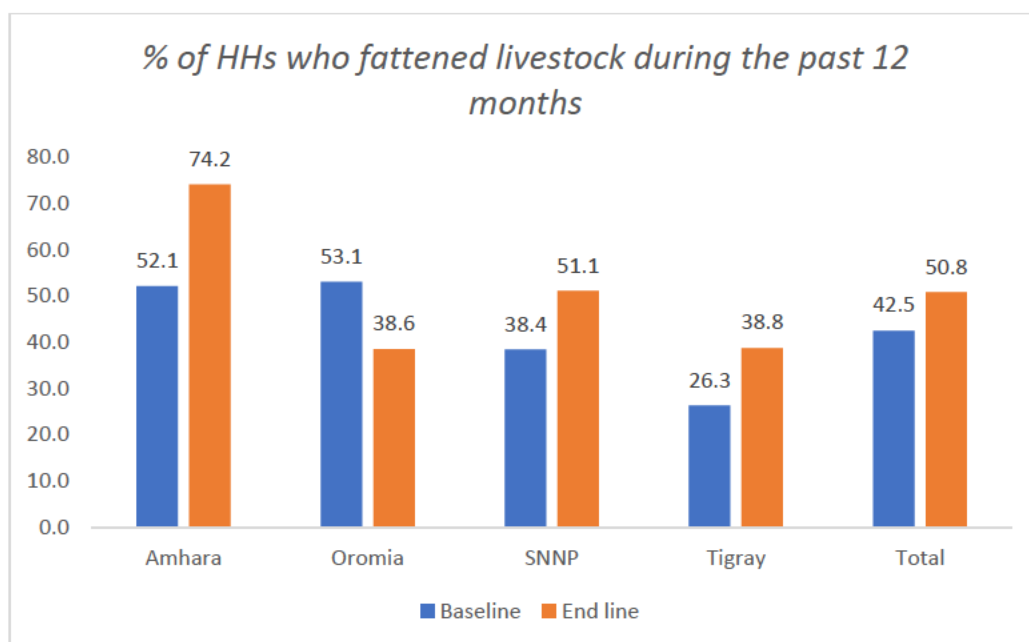
Have you ever used any of the following improved practices in the past four years?																
	Feeding troughs to feed animals		Drinking troughs to provide clean water for animals		Feeding a total mixed ration		Baling		Urea treatment of crop residues		Supplementation with urea molasses lick blocks		Silage making		Factory produced formulated feed	
	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Maximum amount of milk you collected in one day from all of your cows during the past 12 months	5.74a	6.21a	5.52a	6.63b	5.38a	8.74b	6.00a	6.11a	5.98a	6.22a	5.90a	7.52b	5.94a	6.99a	5.19a	8.04b
Minimum amount of milk you collected in one day from all of your cows during the past 12 months	3.29a	3.83b	3.18a	4.15b	3.15a	5.56b	3.57a	3.87a	3.58a	3.79a	3.54a	4.45a	3.54a	4.57b	2.99a	5.14b

Note: Values in the same row and sub table not sharing the same subscript are significantly different at $p < .05$

2.1.2.3. Livestock Fattening

During the intervention period, the proportion of households that have been involved in fattening activities also showed modest increments from baseline. As depicted in Figure 2 below, the percentage of households that engage in fattening of cattle, sheep and/or goats during the 12 months preceding the survey increased from 43% at baseline to 51% at endline. As was the case at baseline, however, endline survey respondents might have considered any “feeding” of animals that would ultimately be sold for meat qualified as “fattening.”

Figure 2: Percent of Households that Fattened Cattle, Sheep and/or Goats during the Past 12 Months at Baseline and Endline



Households involved in livestock fattening were asked about the type of feeds they feed their fattened ruminants. As shown in Table 9, 95% and 85% of the respondents used crop residues, and green forage, grass hay and/or silage, respectively, as major diets for livestock fattening across the study areas. The use of Formulated Concentrate Mixture (FCM) increased from 6% at baseline to 43% at endline. On the other hand, the proportion of respondents that fed ingredients of AIBP as supplements to their fattening livestock decreased from 42% at baseline to 35% at endline while little changed in use of other high-quality feeds, crop residue and others.

Table 9: Percentage of Respondents involved in Fattening by Types of Feed they Provided to Fattened Animals at Baseline and Endline

Feed Types	Amhara (%)		Oromia (%)		SNNPR (%)		Tigray (%)		Total (%)	
	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline
Concentrate mix	3.7	14.0a	8.5	49.7b	9.1	77.7c	2.7	45.9b	6.3	43
Agro-industry byproducts	19.8	52.2a	62.7	40.2a,c	50.3	7.3b	31.9	35.9c	42.1	35
Other high-quality feed	94.5	90.7a	68.7	78.8b	54.5	34.4c	70.9	86.7a,b	74	73
Green forage, grass, hay, silage	91.8	75.8a	75.6	86.0b	96.1	91.9b	80.8	91.7b	86	85
Crop residue	89.9	93.0a	94.5	93.3a	93.3	97.6a	96.8	96.1a	93.1	95

Note: Values in the same row and sub table not sharing the same subscript are significantly different at $p < .05$

The large increase in proportion of households that fed concentrate mix to their fattened animals could be partly explained by exposure to fattening management training provided by the project as well as increased access to such feed. Over 93% of households received training on fattening management at endline, compared to just less than 12% at baseline. The training helped farmers to

engage in fattening and improve their fattening practices. ‘Most of us didn’t even know about concentrate feed and improved animal feeding practices. ...hence the project can be considered a pioneer. There is improvement in livestock productivity due to the changes in our feeding practices, and the concentrate feed and other improved forages we have been feeding to our livestock,’ a farmer that participated in one of the FGDs said.

2.1.2.3.1. Cattle fattening

The project targeted to increase unit productivity of fattened cattle measured by number of cattle fattened/ year/100 HHs by 15%. At baseline, unit productivity of fattened cattle was 12.93 per year per 100 HHs. As illustrated in Table 10, across the project intervention areas and among those households that were involved in animal fattening, 92% of them (or 46% from total respondents) were involved in cattle fattening activities during the 12 months period preceding the endline survey compared to 68% (or 32% from total respondents) at baseline. The number of households that were involved in animal fattening as well as number of animals fattened have increased by 44% and 32%, respectively, from baseline. When computed from total number of survey participants, the average fattened cattle ownership increased from 0.68 cattle per household at baseline to 0.9 fattened cattle per household at endline, a 34% increase from baseline. Hence, when livestock productivity is measured by percentage increase in number fattened animals, it can be said that the number of fattened animals has increased by 34% from baseline. Unit productivity of fattened cattle measured by number of cattle fattened/ year/100 HHs also increased from 12.93 at baseline to 17.1 at endline, a 32% growth. Hence, the project has overachieved its target of increasing livestock productivity by 15%.

The proportion of households that engaged in cattle fattening at endline grew by close to 43% compared to the 613 HHs that were involved in cattle fattening at baseline. Government officials and farmers alike stated that farmers have been increasingly engaging in cattle fattening during the project intervention period that they believe was mainly due to the training provided by the project and increased awareness and access to improved animal feed. Recognizing the importance of engaging in fattening activities, many farmers are even fattening retired oxen to add value before sale which was not the case before the project intervention. In reply to the query as to whether there has been a change in livestock productivity due to the project support, a woreda agriculture office head replied: ‘We have observed good result in cattle fattening whereby farmers are feeding improved forage in combination with local beer byproduct, cereal straw and manufactured fattening concentrate feed obtained from the Union’s feed plant in the woreda.’ Another woreda government official also said the following which seems to be shared by farmers and other stakeholders:

‘... a significant number of farmers are working on fattening of bulls or oxen (4-20 heads) and sheep (12-15 heads). Time of fattening shortened to 3-4 months (earlier up to 1 year) and farmers started seasonal fattening by linking their activities to main holidays. Farmers have acquired important knowledge on manufactured formulated feed and started using for dairy and fattening. Generally, about 50% of beneficiary farmers have benefited either from dairy or fattening.’

Table 10: Percentage of Households by Region and Number of Cattle Fattened at Baseline and Endline

Number of Cattle Fattened	Total		% change from baseline
	Baseline	Endline	
Number of HHs that fattened cattle	613	874	43%
Percentage of HHs that fattened cattle (from total respondents)	32	46	14%
Total cattle fattened	1,293	1709	32%
Number of fattened cattle per year per 100 HHs	12.93	17.1	32%
Mean number of cattle fattened (from total survey respondents)	0.68	0.9	34%
Length (No. of days) of fattening per cycle	116.6	103	12%

Note: Values in the same row and sub table not sharing the same subscript are significantly different at $p < .05$

As also shown in Table 10 above, the length of each cattle fattening period/cycle was reduced from 117 days at baseline to 103 days at endline. Analysis of qualitative data also confirms the same. Many farmers and government officials indicated that the fattening period has declined to 3 to 4 months. Direct beneficiary farmers and government officials associated the reduction in fattening period to increased use of improved animal feed and feeding practices. The intervention was found to be a key contributor to these positive developments by helping farmers learn improved livestock management and feeding practices, promoting improved forage and manufactured feed, making manufactured feed and improved forage seed/seedlings accessible to farmers. ‘... the feed we use to fatten livestock helps the oxen to gain weight in relatively shorter period of time,’ a farmer that participated in one of the FGDs said. Similarly, a head of a woreda agriculture office said the following to explain how and why the reduction in fattening period happened.

‘Farmers started focusing on better livestock production as their awareness of farmers on modern animal management enhanced through training, visit, field day and awards for best performing farmers. The project distributed improved forage such as oats, vetch, elephant grass, desho and alfalfa at kebele level. Apart from supporting establishment of feed manufacturing enterprises, the project supported primary cooperatives supply manufactured feed from feed enterprise. The distribution of manufactured feed through dairy cooperatives increases accessibility of feed. Farmers have also got better access to balanced feed to increase productivity of their animals. As a consequence, the productivity of livestock is improving. Milk yield increase by about 2 to 4 kg in crossbred cows, fattening period reduced from 7 to 3 - 4 months.’

2.1.2.3.2. Sheep and Goat Fattening

The proportion of households that fattened sheep declined slightly from 20% at baseline to 17% at endline. The number of sheep fattened also declined from 2,126 at baseline to 1,547 at endline (Table 11). Although the proportion of farmers engaged in sheep fattening declined slightly, the project helped farmers to engage in sheep fattening activities. A woreda agriculture office expert in this regard said the following:

‘The project encouraged sheep fatteners in the woreda whereby some farmers using manufactured fattening ration for sheep achieved good result that the sale of fattened sheep dramatically raised their household income; one of the fatteners has even accumulated enough capital to purchase a Bajaj taxi.’

Table 11: Percentage of Households by Region and Number of Sheep Fattened at Baseline and Endline

Number of Sheep Fattened	Region								Total	
	Amhara		Oromia		SNNPR		Tigray		Baseline	Endline
	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline		
No sheep fattened (%)	71.3	59a	73.5	89b	85.5	93c	88.7	92b,c	79.8	83%
1-4 sheep fattened (%)	22.8	18.75a	13.5	1.94b	13.4	4.76b	4.4	0.00	13.5	6.44
5-9 sheep fattened (%)	3.1	16.88a	5	4.74a	0.8	1.86	3.8	2.57a	3.2	6.55
10-49 sheep fattened (%)	2.7	5.63a,c,d	7.9	4.09a,b	0.2	0.62c	2.9	4.28b,d	3.4	3.64
50 and + sheep fattened (%)	-	0.21a	-	0.00	-	0.00	0.2	1.07a	0.1	0.32
No. HHs that fattened sheep	137	199a	127	50b	69	35c	54	37b,c	387	321
Total sheep fattened	534	738	966	299	174	69	452	441	2,126	1547

Note: Values in the same row and sub table not sharing the same subscript are significantly different at $p < .05$

As was the case at baseline, goat fattening was found not to be a common practice in the project intervention areas as only 3% of respondents reported to have fattened goats. At baseline, only 3.8% of respondents were involved in goat fattening.

2.1.3. Poultry Management and Productivity

2.1.3.1. Poultry size and breed kept by households

Direct beneficiary smallholder farmers that participated in the survey were also asked to provide information about their chicken ownership. As Table 12 below presents, about 35% of households owned egg laying local hens, which was a significant drop from baseline of 63%. On average a household owned 1.8 local egg laying hens at the time of the endline survey, compared to 3.53 at baseline. The decline in local chicken ownership was due to the fact that households were increasingly buying improved chicken.

Table 12: Households Ownership of Local and Improved Chickens during the 12 Months Preceding the Survey by Types and Region at Baseline and Endline

Chicken Types	Amhara		Oromia		SNNPR		Tigray		Total	
	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline
Total egg laying local hens	1,018	1,049	1,392	488	781	277	1,049	546	4,240	2,360
Mean egg laying local hens per egg laying local hen owner HH	3.32	2.78a	4.24	1.53b	2.84	1.01c	3.59	1.58b	3.53	1.80

Number & % of HHs with egg laying local hens	307 (64%)	277 (58%)	328 (68%)	139 (30%)	275 (58%)	96 (20%)	292 (61%)	146 (31%)	1,202 (63%)	658 (35%)
Total HHs (n)	478	480	480	464	477	483	479	467	1,914	1,894

Note: Values in the same row and sub table not sharing the same subscript are significantly different at $p < .05$

In contrast, ownership of improved egg laying chickens increased significantly among endline survey participant households compared to baseline. As shown in Table 13, about 53% of households owned improved chickens at the time of the endline survey, compared to 22% at baseline. The average number of egg laying improved chickens owned by a household increased from less than 1 at baseline to over 4 at endline. This change was also confirmed by government officials and farmers that participated in qualitative interviews. “Some farmers are shifting from keeping indigenous chickens to improved hybrids for egg production. About 30 - 40% of beneficiary farmers have started keeping improved chicken. Some farmers have also engaged in day old chicken rearing and egg production from improved chickens,” a woreda government official said.

Table 13: Total and Average Number of Improved Chickens by Region at Baseline and Endline

Chicken Types	Amhara		Oromia		SNNPR		Tigray		Total	
	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline
Total egg laying improved hens	284	1128	331	1332	364	848	502	2042	1481	5350
Mean egg laying improved hens per household that own such chicken breed	0.6	2.99a	0.7	4.19b	0.8	3.11a	1	5.90c	0.8	4.07
Total number & % of HHs with egg laying improved hens	92 (19.2%)	246 (65.3%)	92 (19%)	247 (53%)	85 (18%)	217 (45%)	149 (31%)	299 (64%)	418 (22%)	1009 (53%)
Total HHs (n)	478	480	480	464	477	483	479	467	1,914	1,894

Note: Values in the same row and sub table not sharing the same subscript are significantly different at $p < .05$

Ownership of improved pullets and male chickens aged over three months was also observed compared to baseline. On average, a household owns 0.74 female and 1.15 male improved chickens aged over 3 months years/year/HH, compared with 0.4 at baseline. Ownership of male chickens varied significantly among the regions.

A local hen on average laid 124 eggs per year, an over 92% increase in egg production compared to baseline. Annual egg production from improved chickens was over twice as much as that of local chickens. On average, an improved chicken laid about 265 eggs per year, which was also an over 41% increase from baseline average of 187 eggs per year. The average egg laid by local and improved chickens seem to be very large (see Table 14 below). The national average for number eggs produced per year by local and improved hens was around 50 and 150 (World Bank, 2017). But this national average might be a bit old and might not be the current reality. In addition, the large increase in egg productivity was mainly associated with the use of manufactured poultry feed and improved poultry

management practices, according to government officials and many farmers that participated in FGDs.

Apart from shifting to keeping improved chicken, farmers are using improved poultry feed and applying the improved poultry management practices, which are said to increase the egg productivity of local and improved chickens. The following is what one farmer that participated in one of the FGDs said “...we currently own more improved chickens than before. These chickens lay about 27-30 eggs per month.” This suggests that the annual amount of egg production stated above actually makes sense.

Table 14: Total and Average Egg Production by Breed Type and Region at Baseline and Endline

Egg producing hens	Amhara		Oromia		SNNPR		Tig-ray		Total	
	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline
Total egg laying local hens	1,018	1049	1,392	488	781	277	1,049	546	4,240	2360
Mean egg production per year/local hen	66.2	131a	66.1	117b	62.5	115b	62.5	121a,b	64.4	124
Total egg laying improved hens	284	1128	331	1332	364	848	502	2042	1,481	5350
Mean egg production per year/improved hen	183.02	299a	182.6	220b	193.9	280c	189.7	2612d	187.3	265

Note: Values in the same row and sub table not sharing the same subscript are significantly different at $p < .05$

2.1.3.2. Poultry management

The findings of the endline survey suggests improvement in improved poultry management practices. As shown in Table 15, the proportion of households that did not use housing or used unconfined shelter for poultry declined from 26% and 49% at baseline, respectively, to 12% and 13% at endline. In contrast, households that use confinement and shelter showed large increment. The percentage of households that use confinement and shelter at night or year-round increased from 23% and 2% at baseline to 56% and 19% at endline, respectively. The majority of households still use shelter and confinement at night. Less than a fifth of the households use confinement and shelter year-round and respondents from Oromia and SNNP are more likely to use these improved practices than others. It is also important to note that poultry housing system of households differed among some of the regions. Households in SNNPR are less likely not to have housing for their poultry than the rest of the regions, despite this fact, the practice of no housing in the same region has shown a decline at endline.

Table 15: Percentage of Chicken Holder Households by the Type of Housing System and Region at Baseline and Endline

Types of poultry housing system	Amhara		Oromia		SNNPR		Tigray		Total	
	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline

No housing	32.0	18.5a	35.3	12.1a	27	13.1a	11.7	4.5b	26.4	12.1
Shelter but unconfined	58.4	7.1a	47.9	13.6b	40.6	7.2 a,b	46.6	21.7c	48.5	12.6
Shelter and confined at night	10.1	59.2a	15.1	45.7b	32.2	56.7a	36.9	62.6a	23.4	56.3
Confinement and shelter year-round	-	15.2 a,c	1.6	28.6b	0.3	23 a,b	4.7	11.2c	1.7	19.1

Note: Values in the same row and sub table not sharing the same subscript are significantly different at $p < .05$

Positive changes were also observed in type of poultry feed used by households over the past few years. As shown in Table 16, scavenging home grain supplements has remained the dominant poultry feeding system (81%), which was also the case at baseline. But noticeable changes were observed in proportion of households that practice scavenging with concentrated feed supplements, full feeding with home grown grains as well as full feeding with manufactured feed, which were almost negligible at baseline. Scavenging with concentrated feed supplements is now a poultry feeding system among 35% of households at endline, compared to 5% at baseline. The proportion of households that practiced full feeding with home grown grains or with manufactured feed also increased from 3% and 0.2% at baseline to 33% and 15% at endline, respectively. However, it is unclear why scavenging showed increment while at the same time an increased number of households adopted improved practices.

Table 16: Percentage of Chicken Holder Households by Types of Poultry Feeding Systems and Region at Baseline and Endline

Poultry Feeding system	Amhara		Oromia		SNNPR		Tigray		Total	
	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline
Scavenging	7.3	27.6a	8.0	64.7b	6.0	49.5c	5.8	12.0d	6.8	37.1
Scavenging with home grain supplements	91.9	72.9a	88.5	84.7b	82.7	68.7a	76.7	95.5c	85	80.9
Scavenging with concentrated feed supplements	0.8	38.0 a,b	3.0	31.5 a,c	9.9	45.0b	7.8	28.6c	5.3	35.3
Full feeding with home grown grains	-	39.2a	-	34.7a	1.5	39.2a	9.4	19.3b	2.8	32.8
Full feeding with manufactured feed	-	21.0a	0.5	19.1a	-	19.9a	0.3	2.1b	0.2	15.3

Note: Values in the same row and sub table not sharing the same subscript are significantly different at $p < .05$

Improvements in poultry management practices can be partly attributed to the training provided to beneficiary households. The percentage of households that participated in poultry nutrition and feeding training grew from less than 10% at baseline to 77% at endline. Households in Oromia and SNNP were more likely to participate in such training than those in Amhara and Tigray regions. It is also important to note that the proportion of respondents that received training on poultry nutrition and feeding differed from those that received training on improved fattening management (93%) which were provided at the same time. The difference might be partly due to difficulties faced by some respondents to remember training sessions they attended.

The evaluation team also tried to examine any relations that may exist between amount of egg production and poultry feeding practices. As shown in Table 17, the average egg production laid per local hen was higher among those households that practice scavenging alone or with home grain or commercial feed supplements, and full feeding with manufactured feed, compared with those that did not practice these methods. Average egg production laid per improved hen was higher among households that practiced scavenging with commercial feed supplements, full feeding with home grown grains, and full feeding with manufactured feed, compared with those that did not practice these methods. It is also interesting to observe that average egg production laid per improved hen would suffer when households feed their chickens by scavenging alone or with home grown supplements. In other words, improved hens were not responsive and productive when they are fed with these methods.

Table 17: Average Egg Production during the Past 12 Months Preceding the Survey, and Poultry Feeding Practices by Region

	Did you feed your chickens									
	by scavenging?		by scavenging with supplements (home grains)?		by scavenging with supplements (Commercial feed)?		with full feeding with home grown grains?		with full feeding with manufactured feed?	
	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Average egg production (number of eggs) laid per local hen Per Clutch during the past 12 months	13.91a	13.63a	14.69a	13.59b	13.61a	14.25b	13.56a	14.33b	13.57a	15.15b
Average egg production (number of eggs) laid per local hen during the past 12 months	110.77a	126.92b	100.11a	120.56b	118.52a	112.04b	121.54a	105.86b	119.91a	97.41b
Average egg production (number of eggs) laid per improved hen during the past 12 months	267.23a	239.64b	267.59a	254.63b	254.70a	261.67a	248.06a	273.33b	252.45a	279.55b

Note: Values in the same row and sub table not sharing the same subscript are significantly different at $p < .05$

2.1.4. Sustainable Forage Production Systems

Sustainable forage production was one of the strategies of the project to achieve its objectives and goals. In this section, the findings of the evaluation as related to forage production are presented in this section.

2.1.4.1. Improved forage production and cultivation at farmer level

There were different initiatives that were implemented by the project to develop sustainable forage production system. Among these included the provision of training, seeds/seedlings and technical support for model farmers to grow improved forage in their backyard. Almost all households that participated in the endline survey received training on improved forage production during the past five years. The proportion of households that received such training increased from less than 10% at baseline to over 96% at endline. Households were reached through government extension agents, forage experts who received TOTs and FEED II field staff. The training was conducted with theoretical/classroom sessions, practical demonstration and site observations in the field. During the site visits, best forage development activities from the established nursery sites, farmers' training

centers, individual farmers and investors were viewed, and trainees shared experiences and lessons learned.

Baseline and endline percentages of households that cultivated improved forage along with the size of land allocated to that activity is presented in Table 18. Over 71% of households cultivated improved forage during the 12 months preceding the survey at endline, which was a more than double increase compared with the 30% at baseline. The surveyed direct beneficiary households stated that provision of seeds and seedlings along with training increased their adoption of improved forage cultivation practices. The findings also suggest that some of the households that received the training have not cultivated improved forage (96% of HHs received training but 71% of HHs cultivated improved forage). This could be partly associated with lack of land, shortage of water, and small amount of improved forage seed received from the project. On average, a household planted improved forage on 303m² plot of land during the 12 months preceding the survey (or 40.9 hectares among all those surveyed who cultivated forage during the period), which was a three-fold increment from baseline of 101m². Considering the 37,261 smallholder farmers that were trained by the project to establish and maintain sustainable forage plots, the findings could mean that the 1,129 hectares were planted to improved forage over the past five years. Many farmers also plan to increase their improved forage production in the future hoping that seed/seedlings would be available.

Table 18: Percentage of Households that Cultivated Improved Forage 12 Months Preceding the Survey by Region at Baseline and Endline

Have you Cultivated Forage During the past 12 Months?	Amhara		Oromia		SNNPR		Tigray		Total	
	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline
Yes	37.2	76.7a	26.2	61.4b	38.6	91.3c	17.5	54.6b	29.9	71.2
No	62.8	23.3a	73.8	38.6b	61.4	8.7c	82.5	45.4b	70.1	28.8
Total (n)	478	480	480	464	477	483	479	467	1,914	1894
Average land size planted to improved forage (computed from total sample HHs_	142m ²	630m ²	124 m ²	59m ²	80m ²	236m ²	59 m ²	280m ²	101m ²	303m ²

Note: Values in the same row and subtable not sharing the same subscript are significantly different at p< .05

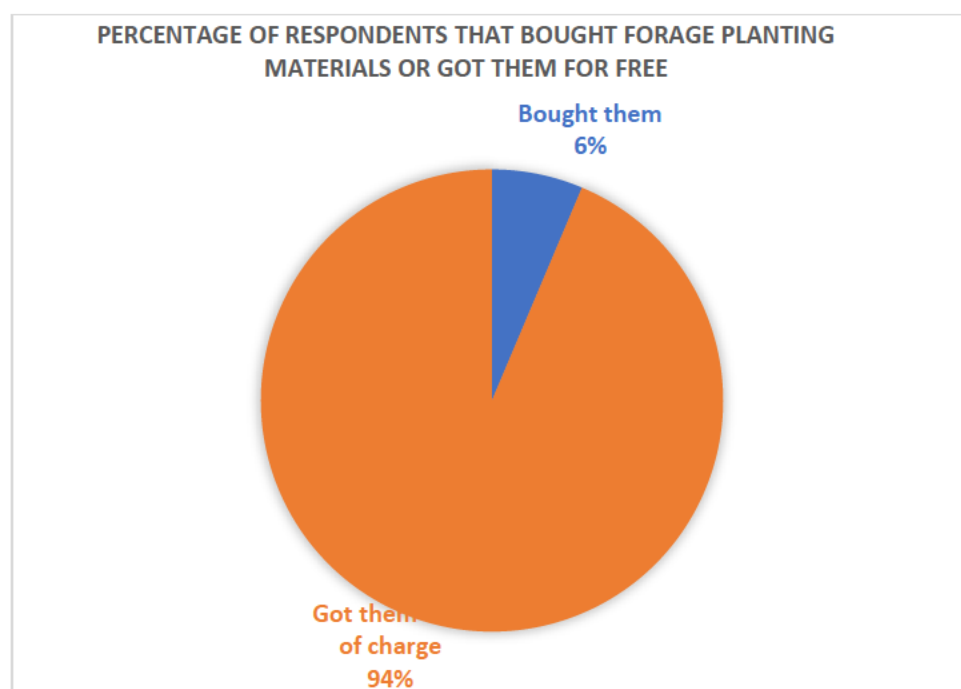
Statistically significant variations were found among regions in plot of land they planted to improved forage, as shown in Table 18 above. Plot of land planted to improved forage is highest in Amhara and lowest in Oromia. Indeed, the amount of land planted to improved forage declined in Oromia compared to baseline. It is unclear why this decline occurred given the fact that many farmers were made aware of the improved forage varieties by the project intervention and started cultivating these forage plants after that. The fact that some of the nursery sites have not been operational for the last two years following withdrawal of the project support might have hampered availability of forage seeds and seedlings, and ultimately cultivation of improved forage in the region. Shortage of water/drought also affected some of the project intervention areas such as Kuyu woreda. A farmer that participated in FGD in this regard said ‘We have cultivated and adopted oats and vetch improved forage. However, due to land cracking during the dry season some improved forage such as tree

lucerne, elephant grass, desho couldn't sustain in the area.' The amount and timing of seed distributed to farmers, lack of land for forage production, and shortage of water were also mentioned as bottlenecks to improved forage cultivation. A farmer that dwells in one of the affected woredas in Oromia said the following:

'...We have learned about improved forage but the amount of seed was too small to expand. We also lack land for forage production. Furthermore, shortage of water and free grazing during dry season destroyed the cultivated improved forage. The delay of seed distribution has also affected the adaptation of cultivated forage.'

The project was very successful in creating awareness among farmers and government experts about the different kinds of improved forages. Farmers are also increasingly allocating land for improved forage plantation. The demand for improved forage seed and seedlings has also increased significantly. Some have managed to produce their own seeds and even sell to other farmers or to the market. However, many beneficiaries complained about the unavailability or shortage of seed or seedlings. Forage nursery sites established by the project bridged some of these gaps by distributing seeds and cuttings free of charge. Initial seeds and seedling were supported by FEED II project and the nursery sites were producing the seeds and seedling for replacement and dispatch. But their capacity has remained limited and some are not functional. Some farmers tried to buy seed from the market but were not able to do so due to their high price and fear that the seeds might not be genuine seeds. As also depicted in Figure 3 below, only 6% of direct beneficiary households bought improved forage seeds, seedlings, cuttings or splits.

Figure 3: Percentage of respondents that bought forage planting materials (seeds, seedlings, cuttings, splits, etc) or got them for free



Other challenges that hampered the cultivation of improved forage relates to adaptation of some forage varieties such as alfaalfa and desho. 'The major challenges of improved forage production were shortage and delay of distribution of seed and seedlings. Some of the forage varieties such as alfalfa and desho couldn't adapt to the area,' a woreda livestock office official said. In other areas, there was also adaptation problem of some forage varieties such as desmodium, Rhodes, Desho and elephant grass, which hampered even a more improved forage development and extension than what was observed during the final evaluation.

Households that cultivated improved forage 12 months preceding the survey were asked about their use of improved forage planting materials. As shown in Table 19 below, the proportion of households that used improved forage planting materials (seeds, seedlings, cuttings, splits, etc.) more than doubled over the past 5 years. Among all surveyed households 52% of them used improved forage planting materials, compared to 24% at baseline. Region-wise, respondents from SNNPR were less likely to use improved forage planting materials than the rest three. The sources for these improved forage planting materials were government (35% at endline vs 17.6% at baseline), other farmers (1% at endline compared with 8% at baseline), purchases from private venders (2%), and NGOs (19% at endline versus 2% at baseline). This suggests that the proportion of households that received improved forage planting materials from government and NGOs increased significantly over the past five years. Although pure attribution is difficult given the non-experimental nature of study design, qualitative data analysis results suggest that the project (identified in the name of government or itself) was the major supplier of improved planting materials.

Table 19: Percentage of Households that Cultivated Improved Forage 12 Months Preceding the Survey by Region at Baseline and Endline

	Amhara		Oromia		SNNPR		Tigray		Total	
	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline
DID YOU USE IMPROVED FORAGE PLANTING MATERIALS (SEEDS, SEEDLINGS, CUTTINGS, SPLITS, ETC.) OVER THE PAST 5 YEARS?										
Yes	32.8	58.1a	20	49.8a	31.7	57.1b	12.3	42.4a	24.2	52.0
No	4.4	18.5a	6.2	11.6a	6.9	34.2b	5.2	12.2a	5.7	19.3
No forage cultivation done⁵	62.8	23.3	73.8	38.6	61.4	8.7	82.5	45.4	70.1	28.8
Total (n)	478	480	480	464	477	483	479	467	1914	1894
WHAT WERE THE SOURCES OF IMPROVED MATERIALS?										
Government	17.8	50a	14.6	5.2b	26	41.6c	12.1	40.3d	17.6	34.5
NGO	1.3	6.0a	0.6	45.9b	5	15.3c	1.9	7.3a,c	2.2	18.5
Purchased from private vender	0.6	2.5a	7.9	0.9a	2.9	1.2a	0.2	2.4a	2.9	1.7
Farmer exchange	16.3	2.1a	5.8	0.9a	10.9	0.6a	0.4	0.2a	8.4	1.0

Note: Values in the same row and sub table not sharing the same subscript are significantly different at $p < .05$

⁵ No forage cultivation done" refers to missing values as the question was asked to households that said they have not cultivated improved forage. In other words, the 'no forage cultivation row is indicated in the table to show that the percentages are computed from the total number of surveyed households rather than from the valid total as was also the case in the baseline study.

2.1.4.2. Establishment of Forage Development/Nursery Sites

FEED II in collaboration with government, and cooperative unions established union-based forage nursery sites. The government provided land for nursery site development and provided supportive supervision and other support to the nursery sites. In some regions such as Amhara, the government has also started allocating budget to pay salary of nursery site staff and operate the site after the project stopped its funding.



Ligaba Nursery Site (Amhara Region)

FEED II assisted the establishment/development of 14 union-based nursery sites and some private forage enterprises by providing training, and technical assistance as well as provision of parent seed and seedlings. Moreover, the project supplied financial and in-kind supports for constructing fences and store. It also provided tools, irrigation pump, accessories and others necessary for cultivation. It is also the project that paid the salaries or provided top-ups for the site staff. Furthermore, the project capacitated union staff and government extension agents on nursery management. It also organized domestic learning exchange visits for forage production stakeholders. The project has also developed good

nursery management capacity. Apart from union-based nurseries, FEED II also supported the establishment of community youth group-based forage enterprises in some areas.

Many of the nursery sites established through the support of the project have now become sources of seeds and seedling. Although functionality of nurseries seems to vary from one region to another, those that are operational have been producing seed/seedlings to support forage production by smallholder farmers. There also seems to be a joint ownership of nurseries by woreda agriculture/livestock office and unions. But it is usually the woreda governments that are playing important roles in the operation of the nurseries.

The woreda governments are running the nursery sites which is vital for their sustainability. After the project withdrew its support about two years ago (according to key informants), some regional governments started allocating budget to run the nurseries. While most nurseries often provide seed/seedlings free of charge, some have started generating income which are also important in reducing financial burden of government and sustaining their operation. But they are more like exceptions. One of such nursery sites is found in SNNPR which provides some seed/seedlings free of charge while charging for others. In the last 12 months that ended on July 7, 2018, the nursery site managed to produce 600,000 splits of Desho grass, 258,315 cuttings of Elephant Grass, 250,000 splits of Guatemala grass, and 400,000 pieces of Phalaris grass. While the site provided the Desho and Phalaris grasses that it produced during the period free of charge to farmers, it generated around ETB 210,000 from sale of Elephant Grass and Guatemala grass that it produced at reasonable price. The income generated from sale of seed/seedlings was shared among the woreda agriculture office, union and farmer training center (FTC), which all are said to have used to support the nursery site. For example, the woreda agriculture office used its share to purchase inputs for the nursery site.



Nadugne Agam Forage Development Site (SNNPR)

Nursery sites have been playing vital roles in ensuring continued availability of improved forage seed/seedlings to farmers. They were also creating awareness among farmers in surrounding areas about the importance of improved forage. A nursery site manager in this regard said the following:

'The seeds and seedlings distributed to farmers were free of payment. The distribution was conducted at kebele level though development agents and the project supported the transportation facilities and other costs. When the nursery site was operational, we distributed about 50,000 seedlings of Sesbania, 40,000 seedlings of tree lucerne, 16,000 seedlings of fodder beet from the nursery site to two woredas, including ours. In addition, the project distributed significant amount of oats, vetch, desho and elephant grass to farmers.'

The project has been very successful in creating demand for improved forage. There is high demand of seeds and seedlings/ cuttings from farmers and the demand is increasing over the years. However,



Sodo Buee Nursery Site (SNNPR)

this demand is not being met by the nursery sites due to their limited capacity. Nursery sites in some areas such as in Tigray and Oromia are not also currently functional. While lack of budget allocation by government when the project ceased its support was the major reason identified for non-functionality of nursery sites in Oromia. They are still dependent on external support as they don't generate income of their own or government does not allocate budget to run them. Woreda governments have also a budget too small to provide continuous monitoring and supervision of the nursery site. As a result of shortage or lack of budget, nurseries are also being challenged by lack of transportation services for collecting and delivering seeds/seedlings for farmers. Some also lack a focal person

for monitoring day to day activities of the nursery site. The involvement of unions was also found inadequate. As a result, their support to the nursery site has not been that strong which was associated with the fact that the nurseries are not generating income for the unions. Indeed, nursery sites lack clear ownership. There is weak relation between union and woreda agriculture/livestock and fishery development offices. A forage expert in one of the woreda Livestock and Fishery Development offices in this regard said the following:

'The project supported our office to establish of nursery site financially and technically. It also provided initial seed and support the distribution. FEED II covered the cost of daily labor, provided training for expert, purchased small generator to pump water, purchased small farm equipment, helped seed and seedling distribution and arranged experience sharing visit and train farmers. We have developed interest at farmers level on importance and contribution of improved forage and bring change on livestock productivity. In addition, we have developed capacity on nursery site management. The seeds and seedlings produced by the site were distributed for farmers free of payment. The distribution was conducted at kebele level though development agents and the project supported the transportation facilities and other cost of transportation. The only source of fund for this nursery site was FEED II project. There is high demand of seeds and seedling/ cuttings from farmers and the demand is



Azedebo Forage Development Site (SNNPR)

increasing over the years. The nursery site is not operational in the last two years due to absence of budget allocated by the project and government.'

In sum, the project was instrumental in creating awareness about improved forage among government experts and farmers. Farmers started allocating land for forage development and focusing on better livestock production as the awareness of farmers on modern animal management is enhanced through training, farm visits, field days and awards for best performing farmers. As a result, the productivity of livestock is improving (see relevant sections of this report for more details). Some of the respondents were also able to sell forage seed to generate additional income. The direct beneficiary households involved in FGD also indicated that the intervention helped in reducing mortality of calves. This qualitative result obtained from FGD is obviously not only a function of the improved forage. It is a result of a combination various intervention such as improved feeding practices like using formulated concentrate mixture. The interviewees in one of the project intervention woredas of Amhara region also said that the training and demonstration of improved forage crop production and utilization has brought about attitudinal changes among farmers in favor of cultivated forages rather than the free grazing system as indicated by substitution of maize with improved forage crop cultivation like Rhodes grass and oats-vetch mixture by some farmers who own mature crossbred dairy cows and relatively have better market access for dairy products. Rhodes grass cultivation in some areas of Amhara region is likely to continue. According to the head of the livestock and fishery office in one of the woredas of Oromia regions, around 50% percent of beneficiary farmers cultivated and used improved forage varieties such as oats, desho and elephant grasses.

2.1.4.3. Impact of project forage production activities on forage milk production

Many households that participated in focus group discussions appreciated the introduction of the new improved forage varieties that they have never been aware of. Farmers are happy with the project as it introduced them to additional animal food sources. 'The contribution of nursery site is high to expand improved forage and reduce dependency on crop residue,' Woreda Agriculture Office Head said. Another government official also said the following:

'There are two major positive results from FEED II project. The first is improved forage. For the first time in decades of livestock extension history, unknown forage species have been introduced by VOCA projects and multiplied at a nursery site for subsequent distribution to farmers. Again, it was VOCA that established the forage nursery on a 1.5 ha of fenced irrigable land and the operation costs was being financed by the FEED II project until last June. At least ten perennial forage species have been multiplied at the nursery. By means of this activity the project availed to farmers' alternative species of forages that suit different production systems and land holdings of the smallholder farmers.'

Direct beneficiary households that participated in FGDs also indicated that feeding improved forage to their dairy cows and other livestock increased their productivity. A case story presented below also illustrates this assertion. Government officials also had a similar opinion.

'...now improved forage production has gained acceptance in the woreda. Farmers especially those having cross-bred cows have realized that feeding of improved forage increases milk yield. These

activities in turn encouraged improved forage crop production ...feeding animals on a locally made feed trough which also has facilitated on-farm feeding and a retreat from free grazing tradition’ a government official said.

Survey findings also showed that households that used improved forage were able to increase the average number of months indigenous and crossbreed dairy cows produce milk to 7.45 and 9.6 months, respectively, compared to 6.6 and 8.37 at baseline. The change was also statistically significant. However, statistically significant differences were not found in minimum and maximum milk productivity between households that used and did not use improved forage planting materials over the past five years (see Table 20).

Table 20: Use of improved forage and milk productivity

	Did you use improved forage planting materials (seeds, seedlings, cuttings, splits, etc) over the past 5 years?	
	No	Yes
Maximum amount of milk collected in one day from all of cows during the past 12 months	5.76a	6.02a
Minimum amount of milk collected in one day from all of cows during the past 12 months	3.57a	3.49a
Average number of months indigenous dairy cows produce milk (i.e. the typical length of a single lactation)	6.60a	7.45b
Average number of months did crossbreed dairy cows produce milk (i.e. the typical length of a single lactation)	8.37a	9.60b

The survey findings also showed that a small number of farmers benefited from sale of seed and seedlings. About 1% and 8% of respondents sold seed and seedlings, respectively, during the 12 months preceding the endline survey.

Aynalem, who is married with five children, lives in Denbecha Woreda in Amhara region. She received training from the project on production of improved forage, livestock nutrition management, improved feeding system, and improved poultry/dairy production. She implemented improved livestock feeding and management practices like dairy production from a cross-bred cow; egg production from improved chicken breeds; and production of improved forage (Rhodes).

Apart from training, she also received farm supplies, including forage seed free of charge (even though it was not enough), including Rhodes grass that she planted at the backyard on about 800 square meter plot. She also received concentrate feed from the project. She mentioned that before initiation of the projects, she never heard of such improved forage crops. After planting improved forage, she has been harvesting these forages and feeding tethered stock on feeder trough built from local wood materials. Feeding cattle using such home-made feeder troughs helped her minimize feed wastage and protect animals from parasites.

When asked about the benefits her family obtained from the project support, Aynalem said that the project helped her gain an understanding of improved animal feed and dairy/poultry production; increase forage from a piece of land (three times a year) by planting Rhodes; and increase her income by selling Rhodes seed (1500 ETB) and poultry products. Her Rhodes grass can feed her cattle from a small piece of land and she got money from sale of its seed. She also owns two crossbreed cows.

According to Aynalem, her household livelihood has changed from a subsistence mixed farming to a moderately technology-oriented way of farming and improved livestock production through improved feeding and improved forage production. However, although she was able to increase her milk and egg production, Aynalem has not been able to earn deserving income due to lack of access to markets. While she is very satisfied with what she gained from the Project support, she did not conceal her dissatisfaction with availability and accessibility of manufactured feed.

Plate -1: Aynalem at her Rhodes farm



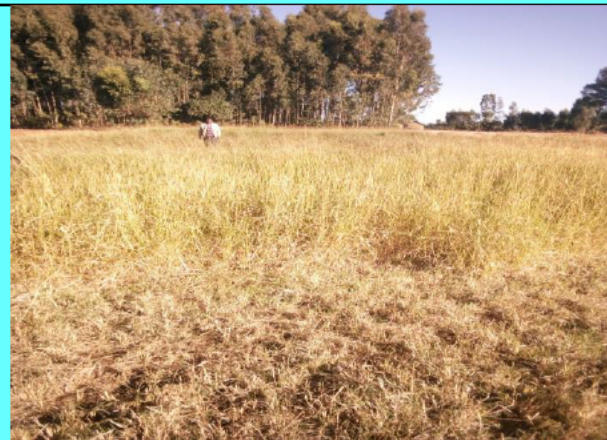
Plate 2: DA, Aynalem & her husband (from left to right) at her Rhodes farm



Plate -3: improved calfs eating Rhodes



Plate 4: Utilization of Rhodes



2.1.5. On-Farm Feeding Practices and Adoption of Other Improved Practices

Promotion of on-farm feeding practices was one of the strategies employed by the project to improve livestock productivity. In this section, the findings of the final evaluation as related to on-farm feeding practices are presented in comparison with the baseline results.

2.1.5.1. Farm management and improved livestock feeding and nutrition practices

As shown in Table 21, the percentage of endline survey participating households that practice cut and carry, supplementation of crop residues with green fodder, and formulated feed showed noticeable increment compared to baseline. In contrast, a decline was observed in proportion of households that use troughs to provide clean water for animals, practice rotational grazing, and hay making. The reduction in use of rotational grazing system and hay making practices by the households might be associated with the increased in cut carry system practiced by the respondents from 76% at baseline to 89% at endline. It is unclear why the percentage of households that provide free choice access to clean water dropped from 63% at baseline to 21% at endline.

Table 21: Percentage of Households that Adopted Improved Practices at Baseline and Endline

Improved Practices	Amhara		Oromia		SNNPR		Tigray		Total	
	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline
Cut and carry	84	93a	70	84b	82	92a,c	66	88b,c	76	89
Feeding troughs to feed animals	53	40a	58	49	38	53a	74	84b	56	59
Using troughs to provide clean water for animals	43	35a	44	42a	51	39a	60	63b	49	45
Rotational grazing	28	19a	37	33b	48	32b	10	29b	31	28
Record keeping of any kind	6	21a	3	10b	6	12b	6	25a	5	17
Feed a total mixed ration	7	16a	21	28b	18	10a	19	24b	16	19
Forage chopping	36	42a	45	40a	66	68b	41	66b	47	54
Baling	4	14a,c	1	6b	40	14a	9	20c	13	14
Supplementation of crop residues with green fodder	23	62a	19	76b	53	58a	43	65a	34	65
Urea treatment of crop residues	3	15a,c	2	10a	13	21b	6	16b,c	6	15
Supplementation with urea molasses lick blocks	2	4a	2	7.1a	4	4.8a	4	16.5b	3	8
Hay making	79	84a	70	48b	67	45b	73	73c	72	63
Silage making	1	3a,b	2	7a	8	1b	2	20c	3	7
Feeding factory formulated feed	4	6a	4	49b	11	27c	5	35d	6	29

Note: Values in the same row and sub table not sharing the same subscript are significantly different at $p < .05$

The proportion of respondents along with the number of improved practices they adopted is depicted in Figure 4 below. About 10% of the respondents adopted 1 to 2 practices. The majority (71%) of respondents adopted from 3 to 6 practices. Close to a fifth of respondents adopted over 6 improved practices.

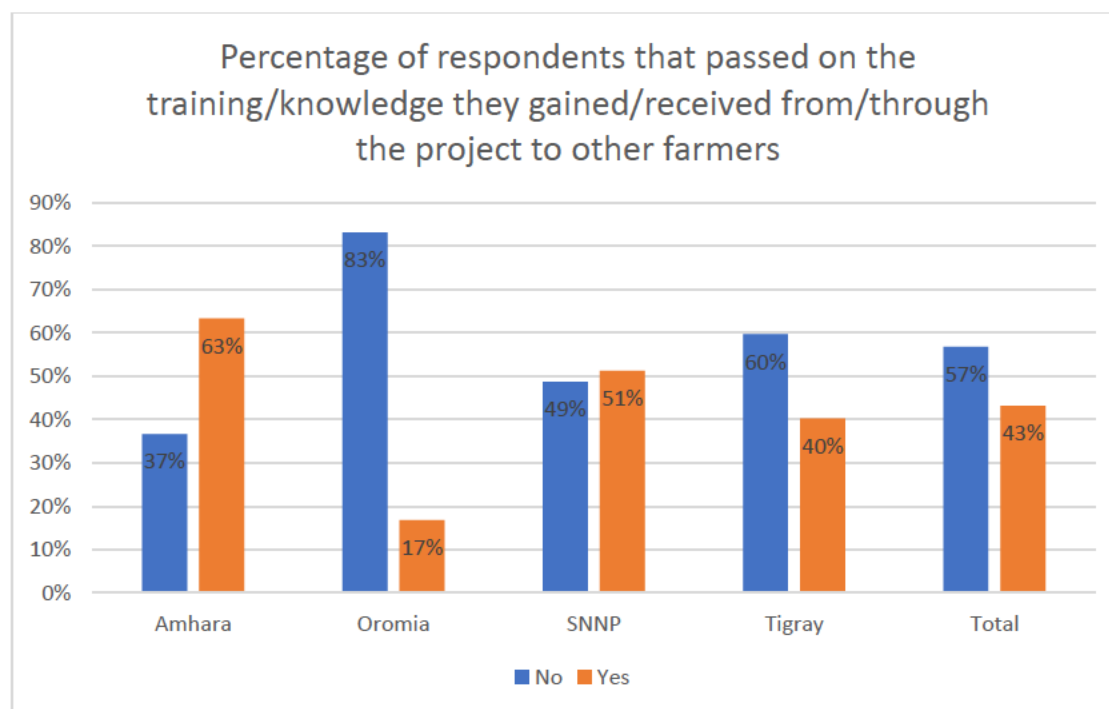
Figure 4: Number of Improved Practices and Percentage of Households that Adopted the Practices at Endline



2.1.5.2. Knowledge transfer /adoption of improved practices/technologies

The final evaluation included some questions to measure the extent to which model farmers and direct beneficiary farmers transferred their training/knowledge. Both direct beneficiary and follower farmers were asked about knowledge sharing. As depicted in Figure 5 below, about 43% of direct beneficiary households transferred their knowledge to other farmers. Knowledge sharing was highest in Amhara region and lowest in Oromia region.

Figure 5: Percentage of households that did/did not transfer knowledge they gained through the project

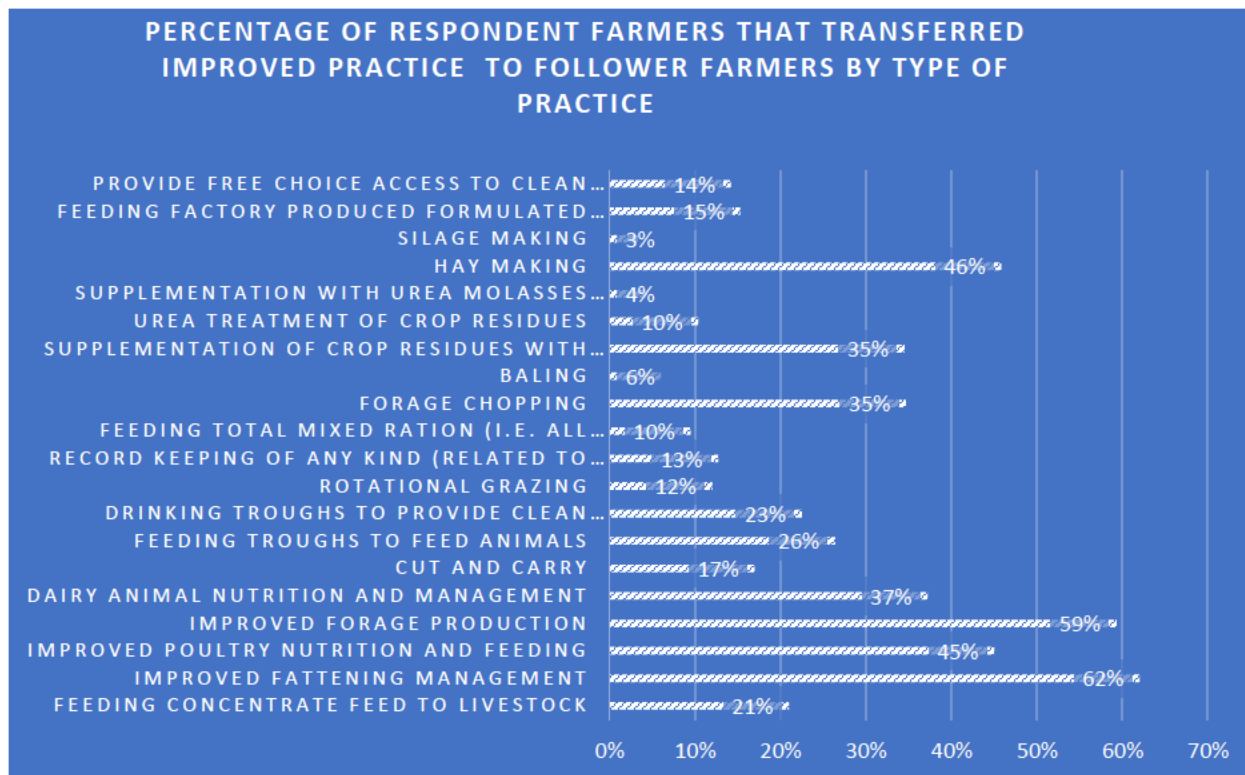


Households that transferred knowledge to other farmers were also asked about the number of farmers to whom they transferred the knowledge. The findings showed that households transferred

their knowledge to close to 6.44⁶ (median of 5) other farmers. The most widely knowledge and practices transferred by model farmers to followers were fattening management (62%), improved forage production (59%), improved poultry nutrition and feeding (45%) and hay making (46%). About 37% of the model farmers also transferred their knowledge on dairy animal nutrition and management to other farmers. Baling, supplementation with urea molasses lick blocks and silage making were the least transferred and adopted practices among follower farmers (see Figure 6 below).

Figure 6: Percentage of households by type of knowledge/practices transferred and adoption of these practices

Some model farmers were able to share their knowledge to hundreds of farmers that came from different areas. Model farmers also said that an average of 4 follower farmers (median of 2) adopted the improved practices transferred to them.



About 59% of model farmers indicated that their follower farmers adopted improved fattening management, followed by those that adopted improved forage production (54%). Over 43% also stated that the knowledge on poultry nutrition and feeding, and hay making that they transferred were adopted by other farmers. About a quarter of model farmers indicated that their followers adopted one to two improved practices. Close to 40% of follower farmers are said to have adopted three to four practices. About a third of follower farmers adopted 5 to 9 practices. In sum, the findings suggest that the vast majority of follower farmers adopted two or more improved practices.

⁶ Some farmers that transferred their knowledge to over 50 other farmers were excluded from the determination of the mean they are exceptional and not reflective of most farmers, thereby distorting interpretation of the data if not removed.

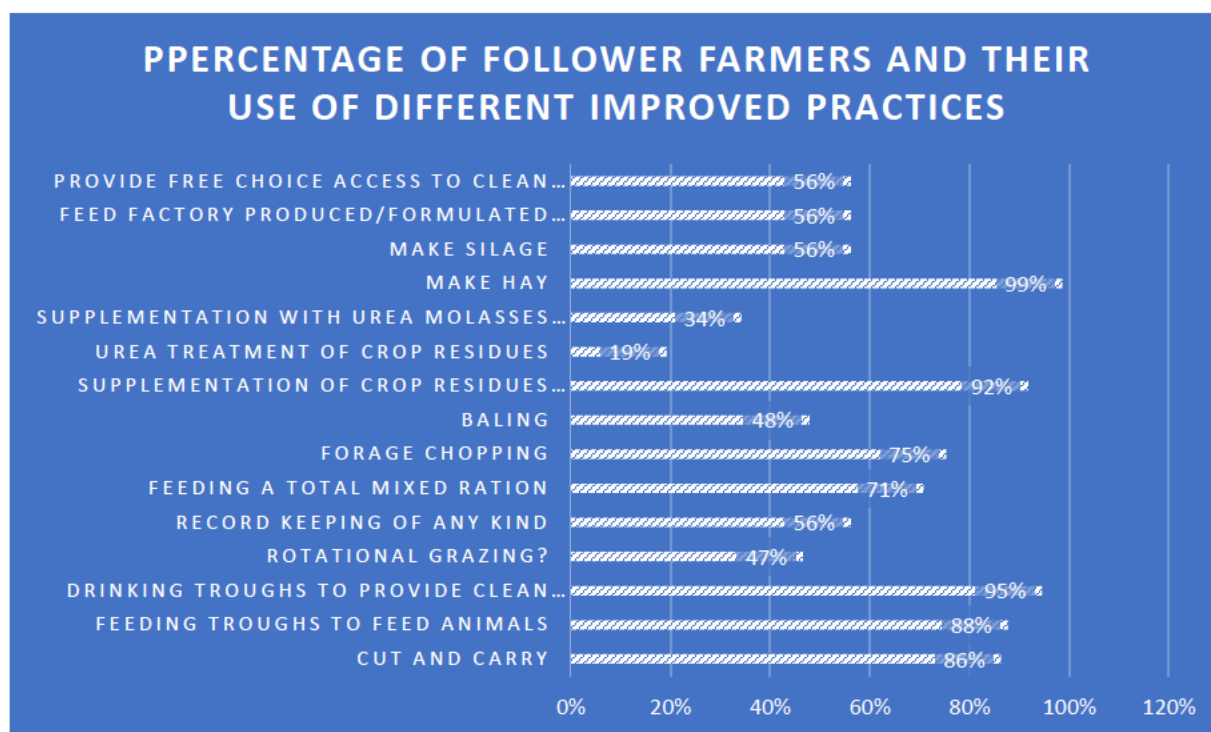
The evaluation team also consulted around 73 follower farmers. All of them indicated that they received some knowledge transfer on improved practices from model farmers. As shown in Table 22 below, 89% of the follower farmers received transfer of knowledge on dairy animal nutrition and management during the past four years. Over half of follower farmers received transfer of knowledge on improved forage production, fattening management, and poultry nutrition and feeding. The findings could provide some confirmation that model farmers are actually transferring their knowledge to follower farmers.

Table 22: Percentage of follower farmers that received transfer of knowledge from model farmers over the past four years

		Amhara	Oromia	SNNPR	Tigray	Total	
		N	N	N	N	N	%
Have you received any transfer of knowledge on dairy animal nutrition and management?	Yes	13	14	20	18	65	89%
	No	4	1	1	2	8	11%
Have you received any transfer of knowledge on improved fattening management?	Yes	11	9	11	6	37	51%
	No	6	6	10	14	36	49%
Have you received any transfer of knowledge on improved poultry nutrition and feeding?	Yes	17	2	14	5	38	52%
	No	0	13	7	15	35	48%
Have you received any transfer of knowledge on improved forage production?	Yes	17	4	11	8	40	55%
	No	0	11	10	12	33	45%

As also depicted in Figure 7 below, most follower farmers said that they use at least five improved practices, including hay making, supplementation of crop residue with green fodder, feeding and drinking troughs, and cut and carry method.

Figure 7: Percentage of follower farmers and their use of different improved practices



2.1.5.3. Knowledge on animal nutrition

Minerals supplements are very critical for growing and lactating ruminants and poultry. For instance, limestone is known as calcium source which is an important mineral for lactating dairy cows and laying hens specially to reduce milk fever and soft eggshells respectively. In this regard, farmers were asked to identify which feeds/minerals could reduce the occurrence of milk fever in dairy cows (hypocalcemia; cow goes down soon after calving) and the occurrence of soft egg shells. Over 43% of them indicated that they don't know which feeds can reduce milk fever in dairy cows and the occurrence of soft egg shells in poultry, compared to 64% at baseline.

Close to 31% said that salt reduces the occurrence of milk fever and soft egg shells, while this was the case for 14% of households at baseline. The proportion of households who knows that limestone can reduce the occurrence of milk fever or soft eggshells increased from 4.7% at baseline to 21.1%. In sum, relatively larger proportion of households that participated in the endline survey know the different types of feeds that reduce milk fever and soft eggshells compared to baseline. Although there were some changes, households in Oromia and Amhara are more likely to lack knowledge about the type of feed that reduces the incidence of milk fever and soft egg shells than those in Tigray and SNNP. This was also mainly the case at baseline.

The proportion of households that were not able to compare the impact of feeding one kg of noug cake on milk production with different kgs of cottonseed cake declined from 79% at baseline to 55% at endline. This suggests that target households have acquired some knowledge about the nutritional content or values of noug cake and cottonseed cake over the past five years.

Plant growth stage at harvest is one of the most important factors that affect the quality of forages. Usually forages harvested at early growth stage have better nutritive value for livestock and can give

more milk production than the forage harvested at later stage of growth. In this regard, households were asked about their knowledge on using these kinds of feeds and their impact on milk yield. The proportion of households that said that grass cut 30 days after the last cutting of the same plot can support more daily milk production when fed to a crossbred dairy cows as grass cut 60 days after the last cutting increased from 30.1 to 43.6%. On the other hand, on average the proportion of respondents who did not have any knowledge on the effect of grass growth stage at harvest on daily milk production of crossbred dairy cows reduced from 41.6% at baseline to 7.6% at endline, though they don't seem to have the right understanding.

Both energy and protein sources are essential for improving dairy milk productivity. Generally, grasses like Elephant and Rhodes are sources of energy while vetch is a protein source. A dairy cow fed in combination of elephant grass with vetch forage can produce more milk per day than when fed elephant grass alone. The proportion of households with such understanding showed modest increment compared to the baseline. Households who did not have any knowledge on feeding Rhodes grass or vetch or teff straw in combination with elephant grass also declined from 62.5% at baseline to 31.6% at endline.

2.1.5.4. Business knowledge

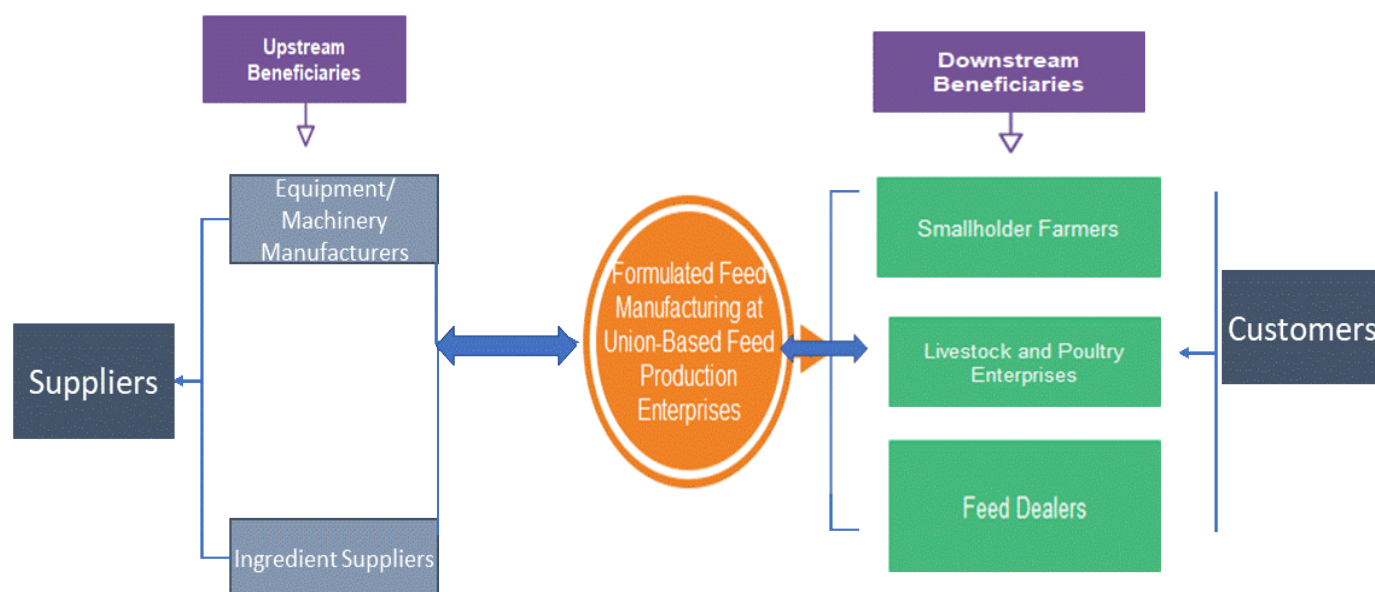
Business knowledge is important for farmers to make viable investment decisions and engage in sustainable livelihood activities. For an enterprise choice, for example, farmers should compare market price minus input cost for each of the different enterprises they might consider investing and choose the largest of all. If they have the choice of investing their money in raising broiler chickens or fattening sheep for income, about 45% of households would decide by comparing market price minus input cost for each and choose the larger of the two, compared to 18% at baseline. This shows that farmers have gained some business knowledge that they need in making investment choices. The proportion of respondents that would not know how to decide declined from 32.9% at baseline to 4.2% at endline.

Target households were provided training on record keeping. Over 17% of households indicated that they adopted record keeping lessons learned through the project. Households were also asked about the kind of information that they need to collect to know their profit/loss if they plant a piece of their farm land to forage. The percentage of households that know some of the answers increased compared to baseline. For example, the percentage of households that said that they need to collect information about amount of money spent on input and labor to raise the forage and marketing expense and price received per bale of forage sold increased from 14% and 10% at baseline to 40% and 16% at endline, respectively. Households that don't know what information to collect also declined from 51% to 18%. However, it important to note that the proportion of households that know the full answer to the question declined from 10% at baseline to 2% at endline. This suggests that though business knowledge of households showed some improvement, they still have partial understanding.

2.1.6. Manufactured Feed Development

In this section of the report, the project achievements and contributions toward the supply of and demand for formulated feed is presented. As depicted in Figure 8 below, the project strengthened the whole formulated feed value chain. On the input supply side, the project supported local feed mill manufacturers and ingredient suppliers and linked them with the union-based feed manufacturing enterprises. At the center, the project made significant investment to establish union-based feed manufacturing enterprises. On the demand side, the project created awareness and demand for formulated feed among livestock and poultry enterprises, smallholder farmers and dealers. In addition, the project created linkages between the feed manufacturing enterprises and buyers of the feed products. FEED II also strengthened regulatory capacity in the animal feed sector.

Figure 8: Formulated Feed Value Chain



In this section, the contribution of the project in each of the three components of the formulated feed value chain is discussed in some detail.

2.1.6.1. FEED II Contribution to Development of Feed Input/Ingredient Supply Chain and System Strengthening

FEED II project has been strengthening the feed ingredient supply chain by providing cash grants and technical support to feed input/ingredient trading/producing enterprises. Project monitoring reports showed that FEED II disbursed USD 716,559a in the form of in-kind and cash grants to feed ingredient supply chain actors. The key actors in the feed ingredient supply chain supported by the project included feed ingredient producers and traders, feed processing and handling equipment

manufacturers, and animal feed associations and regulators. The project activities and contributions as related to each of these key actors is presented below.

Feed Ingredient Suppliers

Project progress reports showed that thirty feed ingredient supply enterprises and other input and service providers were supported with technical assistance. The project also provided cash grants to feed ingredient supply chain actors to foster supply. Market linkages were also established between private sector feed ingredient suppliers and feed manufacturing enterprises established under unions with the project support. Feed ingredient supplying enterprises that were consulted for the final evaluation also recognize the role played by FEED to foster linkages to suppliers in collaboration with relevant institutions. All the 22 feed ingredient suppliers consulted by the evaluation team confirmed that market linkages have been established mainly with concentrate feed manufacturers that are said to be their major customers. All but one of them said that there is adequate demand for their feed/forage ingredients.

Feed manufacturing enterprises on their part also acknowledged the contribution of the project in facilitating linkages with their ingredient suppliers while also mentioning the fact that most of them buy the ingredients through a bid process for purchases with a value above a certain amount. Union-based feed manufacturing enterprises largely procure feed ingredients from the open market. The main sources of ingredient supply are other unions, primary cooperatives and other private suppliers (flour and oil mills, premix suppliers largely located in Addis, etc.).

Data gathered from government officials also showed growing investment in agro-processing sector that could improve the supply of feed ingredients. The growing trend was largely associated with the implementation of the FEED project. Some unions are also investing in flour mills to produce some of the inputs needed by their feed manufacturing enterprises. A regional agriculture bureau official in this regard said the following:

‘Investment in food processing agro-industries such as flour mills has increased availability of raw materials for compound feed manufacturing factories. For instance, Gozamin Farmers Union has integrated flour mills with feed manufacturing factory such that by products like wheat bran and middling are directly made available for the feed factory, a kind of backward integration. Therefore, as availability of feed ingredients improves, price setting can be revised to a level that farmers can afford to buy and use.’

However, inadequate and/or timely supply feed ingredient is still a challenge to many feed manufacturing enterprises, which sometimes causes disruptions in operations resulting in occasional failure to meeting demand at sales points. Seasonal variabilities in the amount, quality and price of ingredients are also prevalent. Availability of sufficient resources (cash and storage facilities) for bulk purchase at times of harvest when prices are lowest is also a common problem shared by many plants. Some unions have mitigated the challenge by investing in ingredient producing enterprises, such as those with flour mills. Others are also in the process of establishing flour factories to ensure continued supply of inputs. ‘The supply problem is very critical, it even made us

temporarily stop production. To resolve this problem, we are about to establish a flour factory and we believe that this will improve our production as it will give us sustainable input supply,’ a manager of one of the project-supported feed manufacturing enterprise said.

Union procurement policies are also restrictive and lengthy limiting capacity to respond to immediate input needs or opportunities of limited-time price reductions and when supplies are limited. Suppliers in many instances are not willing to participate in auctions/bid required by the purchasing regulation of unions that oblige them to bid out any items worth more than a certain amount and the lengthy purchase and payment procedures. Unions are also being challenged to find suppliers that can issue receipts/invoices for payments they make to buy inputs. But suppliers prefer to sell their product to other private retailers who usually don’t request receipt for the money they paid or with less stringent procedures. ‘There is input supply problem. The rules and regulation of union influence the purchase of input. There is no sufficient amount of input in the market to purchase through bid and we have shortage of purchaser to conduct continuous purchase,’ a feed manufacturing enterprise manager said. Weak coordination between the union board and feed enterprise manager was also a factor in delaying acquisition of inputs.

‘One of the main challenges that hinders the activity of feed enterprise is low input supply. This is mainly related to financial rules and regulation. The Performa based purchase system limits the amount of money to 50,000 ETB to purchase input and this causes low supply, repeated requisition and travel. The trader may refuse to provide Performa and sometimes change of price may disqualify the purchase order. (2) There is poor coordination between manager and boards which cause delay for approval as some of the traders give 2-3 day time limit for prices of input. (3) Sometimes there is shortage of truck to transport inputs as the vehicle serves both for the feed enterprise and union.’

Continued price increases, high dependence on a few suppliers for some ingredients limit the unions’ capacity to negotiate for better prices and quality. There is a relatively wider supply base for ingredients like grains that can, in some cases, be procured from member cooperatives sometimes with special concessions. Strengthening the capacity of primary cooperatives to produce ingredients that target the feed plants should be encouraged. Key challenges in relation to imported ingredients and equipment include limitations in access to hard currency, tax burden including VAT that ultimately reflect on the prices of such ingredients at the plant level.

Contractual agreements for ingredient supplies are also very limited to some unions and few inputs. Primary cooperatives that work under the Merkebe union, for example, have a contractual agreement with the feed plant to supply inputs. But the relation with other suppliers is said to be demand driven. FEED has worked to support forward contracting, but contextual factors such as continued price increases have limited the union’s success in contracting. A feed manufacturing enterprise manager in this regard said ‘The relation between suppliers and feed manufacturing is not bound with contract. We don’t have any specific contractual agreement with the factory to supply inputs.’

Feed Mill Equipment Manufacturers

FEED II project also supported five manufacturers with technical and financial assistance to design and manufacture feed manufacturing equipment to ultimately ease the supply of machinery even beyond the union feed plants. Supporting these local equipment manufacturers was considered

appropriate to build local capacity to manufacture, maintain and repair feed manufacturing equipment. The project worked closely with the grantees and the phased and performance-based grant release approach was seen as effective by the grantees. The approach and support provided by the project enabled grantees to manufacture prototype equipment as per requested specifications. In addition to building their capacity on manufacturing of feed mill (some received this support in FEED I), the project also helped the manufacturers to get customers for the products by linking them with the feed manufacturing enterprises and creating demand for formulated feed which in turn increased demand for feed mill. One of the equipment manufacturers in this regard said the following:

'I have been involved with ACDI-VOCA starting from FEED I. I received capacity development support in FEED I. We have also got financial support and business opportunity for us to create new one and make modification on the existing feed mill. Our major customers are farmer unions at different regions, government agriculture research institutes, universities and sometimes individuals. I usually get orders through referral and ACDI-VOCA. ...The demand for our feed mill product is growing, since the farmers are aware of the benefit of manufactured feed. We have now good capacity for producing feed mill and we are updating ourselves with the help of internet and the FEED project.'

Feed mill manufacturers learned new ways of production through project support. One of the grantees also said that his firm would not have thought of producing feed milling equipment if it wasn't for the FEED project. Apart from technical support, the project linked the feed mill manufacturers with unions. While acknowledging increased demand for feed milling equipment over the past few years, the manufacturers were not able to utilize their production capacity well. 'The knowledge transfer is good. But FEED II project's support on market linkage was limited compared to its ability to create such linkages. It was only two feed equipment that my company has managed to sell ACDI/VOCA per year in comparison to our 60 to 70 equipment production capacity,' an owner of one of the feed equipment manufacturers said. Data gathered from one of the equipment producers showed increased client base over the years. Apart from selling to FEED project supported unions, the feed milling equipment manufacturer has been selling to meat and dairy institute, universities, TVT colleges, capital goods supplier, agricultural research institutes, Ethiopian feed industry, Ethiopian poultry association, Chamber of Commerce, and other investors and individuals. Although attribution is difficult, revenue and profit of one of the equipment manufacturers increased from Birr 899,553 and 151,061 in 2015 to 7,184,047 and 599,092 in 2018, respectively. According to the feed equipment manufacturers, their production and income could have been much better if importation of necessary metals and access to finance to sell the equipment on credit was possible.

Capacity Building and System Strengthening

As part of its input supply strengthening initiative, the project trained mechanics to repair feed manufacturing equipment. This was considered important by feed enterprises and other stakeholders to ensure continued operation of feed producing machineries.

FEED II also provided technical and financial assistance to the Ethiopian Animal Feed Industry Association. The technical assistance involved international and local experience sharing visits, and training on feed formulation, feed manufacturing process, basics of animal nutrition and others. It also received grants for different activities that included publication of bulletins and consultation with stakeholders. The association's capacity has also been studied and enhanced through the project support, which enabled it to engage in feed policy issues, conduct studies on Ethiopian tax system on animal feed, and produce operation manuals on animal feed manufacturing processes. The 25 feed manufacturing enterprises established by the FEED project are also members of the association. The

project also supported the Ethiopian Meat and Dairy Technology Institute to collect, analyze and distribute transaction data from feed and livestock industries.

FEED II has also strengthened feed quality control and standards enforcement mechanisms by providing training and supporting staff of the Veterinary Drug and Animal Feed Administration and Control Authority to participate in the international experience sharing visits and conferences. The authority worked closely with the project as a partner. Officials consulted for the final evaluation also indicated that the project support helped them develop necessary skills and knowledge that they needed to formulate relevant directives that govern the animal feed sector. The project support also came at the right time as the authority was a recent establishment that needed all rounded support to develop capacity needed to control and regulate quality and safety of feed manufactured by this union. Some encouraging improvements were also observed during the project period. Quality has improved. National feed standards covering an array of different feeds and various regulations guiding feed quality and safety inspection are now in place to serve as the basis of the regulatory framework to help ensure feed quality and safety. The feed regulatory body has started to inspect the feed at production, storage and distribution stages to help uphold quality and safety (Alemu and Seyoum, 2019).

2.1.6.2. FEED II Project's Contribution to Production/Supply of Manufactured Feed

i. Trends in production of manufactured feed

The Ethiopian government has identified the transformation of the livestock sector as a source of economic growth in both the first and second Growth and transformation Plans (GTP I and II; 2010-2015 and 2016-2020, respectively) through intensification and commercialization of production. The growth of the animal feed sector, specifically commercial feed production, will be key to bring about this transformation.

Survey of the commercial feed sub-sector conducted during the period August 2016 to March 2017 (Seyoum, 2017; commissioned by FEED II), reported that the distribution of feed processing plants in the country is skewed with most (68%) of the private feed processing plants located in Oromia and Addis Ababa where there is good business/demand for formulated feed. The Amhara and SNNP regions each account for 13% while Tigray accounted for 6% (Seyoum, 2017; FAO 2018). The cooperative union-based feed manufacturing plants are more evenly distributed across SNNP, Oromia, Amhara, and Tigray in locations deeper in the countryside for broader access to farmers and some are, as a result, located in places private feed processing plants may not want to operate.

Production of compound feed in Ethiopia has almost doubled during the last five years as a result of the relatively fast growth in the number of feed mills and an increase in the level of production by existing ones. The level of technology use has also shown advances. Nevertheless, the quantity being produced currently does not match the country's huge livestock population.

The types of feeds produced in the country have become more diverse. New additions are, for example, pig feeds, aquaculture feeds, etc. The rations are also becoming more diverse in terms of the form. Feed was produced in the form of mash earlier but other forms like pellets, crumbs etc. are now available. The production of complete feed was the norm. Recently, concentrates of different

formulations for mixing with grains to come up with complete feed are coming. New trends in the distribution mechanism are also emerging. Delivery at farm gate, packaging of different sizes to meet customer requirements, etc. are emerging. Laboratory service (public and private) is becoming more readily available.

ii. Production of formulated feed by FEED II supported feed manufacturing enterprises



FEED II project contributed to the changes described above in many ways. One of these ways included establishment of feed manufacturing enterprises. FEED II project supported the establishment of 12 union-based feed manufacturing enterprises and provided technical assistance to these newly established enterprises and those that were formed under FEED I project in business plan development and marketing,

and accounting and reporting. Project progress reports showed that FEED II disbursed USD 2,164,378 in-kind and cash grants to unions to establish feed manufacturing enterprises. It also provided training to union staff to establish and operate feed manufacturing enterprises. Training of staff on feed mill management and feed manufacturing, simple repairs, and upkeep of mill facilities helped to reduce down times of the factories. FEED II also facilitated domestic and international learning visits to hundreds of feed manufacturing stakeholders. The project also awarded grants to the 12 feed manufacturing enterprises established under FEED I to expand their businesses. Training on Peachtree accounting was also offered to facilitate financial management.

FEED's choice of establishing feed plants for supplying concentrate feed as an intervention was considered to be appropriate and innovative by stakeholders from the regional level down to the beneficiaries surveyed from the perspective of 1) the key role concentrate feed supply plays in market orientation/intensification of smallholder livestock production, and 2) the increasingly prevalent shortage of land for extensive management of livestock and protection of the natural resource. This is also the direction of livestock development in the national livestock masterplan.

Overall, all but one plant assessed for the final evaluation were operating well (were functional) despite differences in the level of performance as a result of challenges specific to their circumstances. Production and gross sales/revenue and profitability of the union feed plants have been increasing steadily since their establishment commensurate with the increase in awareness of the benefits by smallholder farmers. Twenty-five union-based feed manufacturing enterprises produced and sold 11,286.73 metric tons of concentrate feed from April-September 2018. Of the total, 51.63%, 32.12%, and 13.96% were dairy, fattening and poultry concentrates, respectively. (FEED II Year V Semi-Annual report).



All union-based feed plants surveyed asserted to have an active business plan, mission statement, annual action plan, prepare annual budgets, produce financial statements and have a clear and transparent governance system. The evaluation team consulted 12 feed manufacturing enterprises that have been supported by the FEED II project (but three of them were established under FEED I).

Average daily production capacity of these enterprises was around 105 quintals in the period July 2016 to June 2017 and July 2017 to June 2018. But their actual production rate collectively, was 46 quintals, which represented around 44% capacity utilization based on an eight hour per day, five days a week basis.

Capacity utilization among FEED II supported plants increased significantly from 36 quintals per day in 2017 to 56 quintals per day in 2018. The average annual production of the plants increased from 4,440 quintals in 2017 to 6,625 in 2018. This represents an increment of 67%. Each plant on average produced and sold around 5,500 quintals per year for the two years. A lower (34.9%) increment in production and a 39.27% increment in sales was reported by the project for a 6-month period (April 2018-September 2018) relative to an earlier 6-month period of Oct 2017 – March 2018 (FEED II Year V Semi-Annual report).



Despite the 44% of capacity utilization, the annual increment of 67% indicates a significant increment through time. This shows further increments would be expected given expected change in awareness of the benefits of compound feed, expansion of distribution channels, and improvements in storage and transport. Ingredient supply and power interruptions are also mentioned by some plants as limitations in this regard. Internal

management problems/gaps that hinder the plants' from producing at full capacity like the presence of an adequate number of skilled personnel, the stringent purchasing procedures, and weak leadership and management are also mentioned.

The union-based feed plants that are slightly lower in number (29 including 25 established by FEED) represented about 16% relative to the privately-owned plants (32) that contributed 84% of annual compound feed production (Seyoum et al. 2017; FAO, 2018). This seemingly small contribution in view of the small difference in the number of plants is due to the larger average capacity of the private plants (especially the very big capacity of one private plant inflating the average) and the larger sales due to their locations near places of higher demand warranting larger production levels. The potential, i.e. the production and returns on investment are, however, substantial for the union plants that are currently serving the rural markets. These plants also go beyond the profit objective to impact livelihoods, food security, and nutrition among their members, the rural households. Prices charged by union-based feed enterprises is a bit lower than other competitors. Unions also put in place mechanisms to ensure that the prices charged by their distributors are not high. 'The feed manufacturing enterprise supplies feed with more moderate price than traders,' a woreda agriculture office head said.

The contribution of the project-supported feed enterprises is well recognized by stakeholders consulted for the final evaluation. 'By organizing, empowering and providing grants to the unions and establishing feed manufacturing units in the unions the project has increased the production, process and supply of livestock and poultry feed,' a regional agriculture bureau official said. Concentrate feed manufacturing factories installed by the project are contributing to the supply of

different rations for specialized animal farms such as poultry, fattening and dairy. The demand for these products has also increased because animals that are fed with such better quality feeds have become more productive thus motivating farmers to buy more.

There is also agreement that the union-based feed plants are playing a catalytic role in the expansion of concentrate feed manufacturing in the country. 'Motivated by high demand for manufactured feed, private entrepreneurs are being involved in feed manufacturing business,' a regional agriculture bureau official said. Many union-based plants seem to have recognized the significant opportunity for growth, given the growing awareness resulting in substantial potential demand in their distribution areas, untapped sales channels to meet existing demand among member PCs and beyond. Consequently, some have taken or are planning to take additional measures in further improving their production and sales capacities like investing in additional equipment and input procurement and distribution networks, dedicating vehicles for input supply and formulated feed delivery by some.

Despite the encouraging efforts, faster growth at the various stages of production and distribution seems to be constrained by 1) limited marketing and point-of-sale education capacity, 2) access to credit which constrains investments in storage, procurement, transportation, and sales/marketing, and 3) weak business/financial and operational management capacity.

iii. Return on Investment and Gross Margin of Feed Manufacturing Enterprises

Apart from meeting social goals, union-based feed manufacturing enterprises established with the project support also have financial objectives. They would like to make a profit from the enterprises, which is also vital for the sustainability of the initiatives. The evaluation team also tried to look at the profitability of the feed enterprises by determining their return on investment (RoI)⁷ and gross margin (GM)⁸. ROI measures the gain or loss generated on an investment relative to the amount of money invested, while gross margin represents the amount of sales revenue that an organization retains after incurring the direct costs associated with producing the goods and services it sells.

The determination of RoI and GM was, however, challenged by the fact that many unions did not produce separate financial statements for their feed manufacturing operation. They produced consolidated financial statements covering all their business activities including feed manufacturing. Hence, collection of data pertaining to revenue, costs and expenses of feed manufacturing enterprises was not possible as doing so would require processing their transactions that went beyond the scope of the evaluation. It was even much harder to get reliable financial information from livestock/poultry/forage enterprises that were supported by the project. As a result, the evaluation team utilized financial data gathered by the project from each of the 12 FEED II supported unions and livestock/poultry enterprises supported by the project. This data was largely gathered on monthly basis that was also validated through phone calls, and physical visits. The financial data maintained by the project staff about grantees was also verified by data gathered by the evaluation team from a sample of the grantees. The evaluation team, for example, gathered information about

⁷ RoI is determined by dividing return by total investment and then multiplying the result by 100

⁸ Gross margin is the difference between sales revenue minus its cost of goods sold (COGS). Gross margin is often calculated in percentage terms by dividing the gross margin number by net sales revenue.

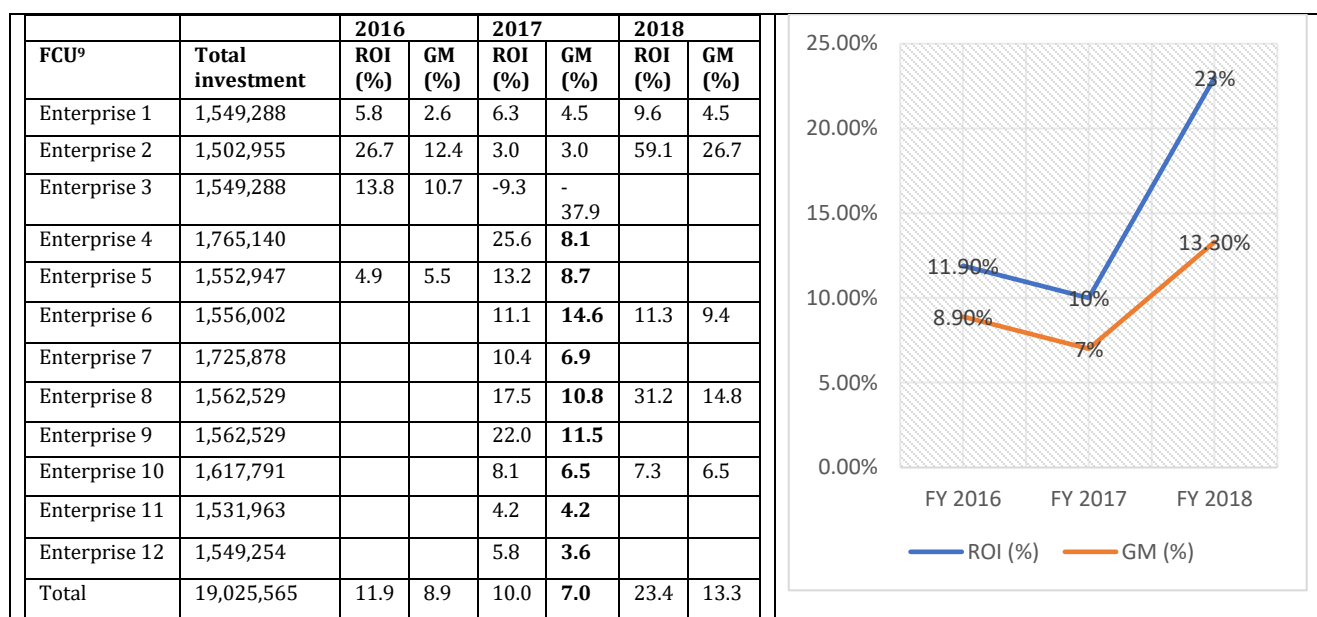
annual feed production and sales in units, average selling prices per quintal of feed, and other relevant information. This information was then used to validate the financial records maintained by ACDI/VOCA about the feed manufacturing operations of the 12 unions. The verification process showed that the financial information maintained by ACDI/VOCA was very close to the data gathered by the evaluation team. In light of this, the return on investment and gross margin figures were determined based on the financial information provided by the project staff.

As far as feed manufacturing enterprises are concerned, as shown in Table 23 (see Annex 7 for more details), the FEED II project invested Birr 15,605,565.45 to buy equipment and support construction of shed, which represented 82% of the total investment of Birr 19,025,565.45 for establishing the 12 feed manufacturing enterprises. The remaining was contributed by the unions. Out of 12 feed enterprises, four of them started production in 2016 and managed to earn income of Birr 8,259,167.25 in 2016 while incurring Birr 7,524,408.86 resulting in a total return of Birr 734,758.39. Considering a total investment of Birr 6,154,478.30 in the four enterprises, their RoI and gross margin in 2016 was 12% and 9% respectively. This can be considered an encouraging start given the fact that they utilized less than 54% of their production capacity. Indeed, most businesses often struggle to survive let alone to make a profit during the first few years of operation due to inexperience, lack of established client base, weak financial capacity, and so on. The feed enterprises managed to earn some profit in their first year of operation due to several factors. The integrated engagement of the FEED II project was one of those factors. Apart for supporting the establishment of the enterprises, the project linked them to ingredient suppliers and buyers of their products. It also worked significantly to create awareness among smallholder farmers about formulated feed. As a result, demand for manufactured feed has been growing. Drought that occurred in 2016 was the other notable factor that contributed to increased demand for manufactured feed which led to profitability of feed enterprises in the first year of operation.

In 2017, all 12 new (FEED II) feed manufacturing enterprises were operational. They generated revenue of over Birr 27 million and managed to get 10% RoI and gross margin of 7%. This financial performance can also be considered very encouraging given that most of the feed enterprises started operation during 2017. Capacity utilization among a sample of enterprises visited by the evaluation team was below 40% during the period. Financial data was only available for five enterprises in 2018 that generated revenue of over 13.6 million, obtained RoI and gross margin of 23.4% and 13.3%, respectively. If data on all the enterprises was available and assuming similar growth pattern, one would expect RoI and gross margin higher than the previous years.

The RoI is expected to grow significantly in the coming years given the growing demand for formulated feed in the country, increased capacity utilization and economies of scale that comes along with larger production, and other factors. Indeed, some of the unions are expanding their manufacturing capacity which will also increase their return. Hence, the payback period is expected to be much shorter. Even at 12% RoI in the initial year of operation, the project can pay back the total investment in around 8 years. In sum, feed manufacturing investment was a viable initiative that generates profits for unions while also increasing supply and access to such feeds to the community.

Table 23: Return on Investment in Feed Manufacturing Enterprises	Figure 9: RoI and Gross Margin Growth Trends in Feed Manufacturing Enterprises
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Source: ACDI/VOC FEED II Project

2.1.6.3. FEED II Project's Contribution to Increased Access, Demand and Use of Formulated Feed, and Impact on Users/Buyers

i. Impact of FEED II on improving farmers' access to formulated feed

The emergence of the new union-based feed plants established with the support of the FEED project in recent years has made feed more accessible to smallholder farmers far from the service areas of private feed plants. 'The project has brought a significant impact especially on the livelihood of some model farmers, since it helped them to obtain manufactured feed at their vicinities. The availability of the manufactured feed has improved the productivity of livestock and this in turn has changed the livelihood of some beneficiary farmers,' a regional agriculture official said.

Hence, apart from supporting the production of concentrate feed at farmer owned unions, the project increased access to formulated feed to rural communities by strengthening or creating supply networks. Project supported union-based feed manufacturing enterprises often sell their produce to agro-dealers, primary cooperatives, individual farmers, and livestock (dairy, fattening and poultry) enterprises.

Most respondents said that the supply of formulated feed in their kebele is increasing. As shown in Table 24 below, close to 44% of households have access to manufactured feed within a 16 Km radius to a source of factory formulated feeds compared to only 18 percent at baseline. Only less than 13% of respondents do not know where the factory or formulated and mixed feed distribution center is, compared with 54% at baseline. This is a substantial improvement. There are now 253 feed sales

⁹ The evaluation team chose to not to identify enterprises by name as the financial data are confidential.

outlets (including the 25 feed enterprise unions' factory outlets) with almost 2,918,914 agriculture-dependent households within a 16km radius of a sales point.

Table 24: Percentage of Households by Distances to the Nearest Animal Feed Distribution Center and Region at Baseline and Endline

Distance to the nearest factory formulated and mixed distribution center	Amhara		Oromia		SNNPR		Tigray		Total	
	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline
<16 km	15.7	10.8a	20.9	69.6b	27.2	52.8c	9.6	41.5d	18.2	43.5
17-30 km	6.7	10.6a	1.4	6.3a	7.8	7.0a	7.1	32.1b	5.8	13.9
31km & more	6.7	44.2a	1.9	5.8b,c	3.9	4.3b	6.7	10.5c	4.9	16.3

Note: Values in the same row and subtable not sharing the same subscript are significantly different at $p < .05$

FEED helped the union-based plants to promote the formulated feed to potential customers. The project also supported unions to build shops for distribution of manufactured feed. Many respondents have indicated that it is through the support/effort of FEED that many smallholder farmers have accessed formulated feed. Almost all the areas currently supplied by the union-based plants were either not aware of the use of formulated feed and/or did not have access as formulated feed from the private enterprises did not reach them. The supply from the union plants is the sole source for many areas.

Encouraged by the increased demand, regional governments are also taking measures to scale up formulated feed production by establishing additional plants, which could in turn increase availability and accessibility of manufactured feed to farmers and livestock and poultry enterprises. Here is what a regional agriculture bureau official said.

'Following the project intervention and establishment of the six feed manufacturing units, farmers are becoming more aware of the concentrated feed, as a result the increase in the demand for the manufactured feed motivated other unions to see the opportunity of installing additional plants. The regional cooperative office has provided loan for the procurement and installation of five additional units. This shows our commitment to scale up the project. Currently, we are accepting additional requests from other unions for installation of processing plants, though we have deferred the process till we are able to create the needed demand for the manufactured feed, as the shortage of demand may make the unions to be discouraged by the business.'

ii. Impact of increased availability and accessibility of manufactured feed on downstream economic activity (e.g. by farmers, poultry raisers, milk processors and retailers)

Impact on Livestock/Poultry Productivity of Farmers

Increased availability and accessibility of concentrate feed contributed to increased livestock productivity of farmers. Many farmers that participated in FGDs said that the change in the farmer's

feeding practices, and use of concentrated feed and other improved forages have brought significant improvement on the productivity their livestock. The survey findings also proved the same. As shown in Table 25 below, the maximum and minimum amount of milk collected per day per cow by households that fed concentrates to their dairy cow was 2.63 and 2.1 liters higher than those that did not feed this mixed feed. Compared to households that did not feed concentrates, households that fed concentrates to their dairy cow was able to increase their maximum and minimum daily milk production from all dairy cows per day by 52% and 75%, respectively, and the difference was statistically significant. Average number of months indigenous dairy cows produce milk was also 7% higher for those that fed concentrates to their dairy cows, while no statistically significant difference was found on cross-breed cows. Households that fed concentrates to dairy cows sold milk that was 33% higher than those that did not feed such feeds. Similarly, income earned from sale of livestock and livestock products was 19% higher for households that fed concentrates than those that did not. The amount of milk and butter sold and income generated from sale of these products was also significantly higher for households that fed concentrates than those that did not. In light of this, it can be concluded that the supply and accessibility of concentrate feed enabled by the FEED II project has contributed to increased smallholder farmers' dairy productivity and income.

Table 25: Impact of feeding/not feeding concentrates on dairy cow productivity

	Have you ever fed concentrates to your dairy cow?				
	No		Yes		% difference
	Mean	%	Mean	%	
Maximum amount of milk collected in one day from all of cows during the past 12 months (liters/day)	5.01a	62%	7.64b	38%	52%
Minimum amount of milk collected in one day from all of cows during the past 12 months (liters/day)	2.80a	62%	4.91b	38%	75%
Average number of months indigenous dairy cows produce milk (i.e. the typical length of a single lactation)	7.00a	70%	7.48b	30%	7%
Average number of months crossbreed dairy cows produce milk (i.e. the typical length of a single lactation)	9.31a	48%	9.12a	52%	-2%
Number of liters of milk sold per month (liters/month) during the last 12 months	174a	38%	231a	62%	33%
Total amount of income earned from sale of livestock/products	24,348a	63%	28,946b	38%	19%
Total annual sales collected from butter sale (birr)	1996a	61%	3310b	39%	66%
Amount(killogram) of butter sold in a year.	11.7a	62%	16.1b	38%	38%
Amount (Liters) of milk sold in a year.	210a	62%	737b	38%	252%
Total annual sales collected from milk sale (birr)	2731a	62%	11288b	38%	313%

Note: Values in the same row and subtable not sharing the same subscript are significantly different at $p < .05$

It is also interesting to observe that smallholder farmers that reside close (less than 16 kms) to the nearest distribution point for formulated feed collected more milk than those that are live in areas that are far away. Average number of months indigenous and cross-breed dairy cows produce milk was also higher for respondents that live in less than 16 kms from the nearest distribution point for factory formulated. This might be because households that live close to distribution sites have the

incentive to buy and use concentrates. This is also evident from the fact that the majority of households that bought manufactured feed were those that live in less than 16 kms away from the distribution point (see Table 26).

Table 26: Distance from nearest distribution point for factory formulated and milk productivity

		Distance from nearest distribution point for factory formulated and mixed feed			
		<16 km	16-30 km	30 km or more	No distribution point in the area
Maximum amount of milk collected in one day from all of cows during the past 12 months		7.23a	5.14b	5.39b	4.71b
Minimum amount of milk collected in one day from all of cows during the past 12 months		4.52a	3.05b	2.92b	2.70b
Average number of months indigenous dairy cows produce milk (i.e. the typical length of a single lactation)		7.36a	6.36b	7.19a,b	7.32a
Average number of months crossbred dairy cows produce milk (i.e. the typical length of a single lactation)		9.36a	8.75a,b	9.72a	8.86a,b
Do you feed your livestock concentrates (factory formulated and mixed feed)?	No	317a	110b	221c	134b
	Yes	336a	64b	53c	68b

Note: Values in the same row and subtable not sharing the same subscript are significantly different at $p < .05$

Qualitative data analysis results also support quantitative findings. Increased supply and accessibility of concentrate feed encouraged many farmers to engage in livestock fattening and achieve better results. Compared to prices charged by local traders, the price of concentrate feed supplied by project supported feed manufacturing enterprises was also considered a moderate one. Here is how a government official described the impact:

‘The feed manufacturing enterprise supplies feed with more moderate price than traders. The distribution of manufactured feed through dealers increases availability of feeds to farmers as the feed enterprise is established far from our district (50km). It creates job opportunities for dealers and feed enterprise. The union, flour factory and feed enterprise benefitted through input and output supply. Farmers have also got better access to balanced feed to increase productivity of their animals.’

The distribution of manufactured feed through dealers and cooperatives increased accessibility of feed, which in turn encouraged use of such feed to improve productivity of livestock and poultry. ‘Oxen fattening and improved chicken breed rearing based on manufactured feed have raised household income of farmers,’ a government official said. These activities in turn encouraged improved forage crop production and use of concentrate feed; feeding animals on a locally made feed troughs which also has facilitated on-farm feeding and a retreat from free grazing tradition. The project has brought a significant impact especially on the livelihood of some model farmers, since it helped them obtain manufactured feed in their vicinities. The availability of the manufactured feed

has improved the productivity of livestock and this in turn has changed the livelihood of many beneficiary model farmers,' a woreda agriculture office head said. Availability of concentrate feed might also have also promoted self-employment among unemployed youth. Some unemployed youth were said to be encouraged to engage in animal fattening, dairy and poultry activities after they observed the significant productivity gains achieved by other neighboring farmers with the use of concentrate feed. In connection with this, a government official said the following:

'The project has brought a significant impact on farmers, livestock enterprises and input suppliers, especially smallholder farmers and enterprises that are engaged in livestock, dairy and poultry farming, as the availability of the feed has created additional opportunity to the farmers and jobless youngsters to consider the urban agriculture as business and means of self-employment.'

Farmers are said to buy manufactured feed mainly for fattening of sheep and cattle. This was mainly because the use of concentrate feed reduced fattening cycle time for farmers. Many farmers that participated in FGDs agreed that the fattening period was reduced to 3 to 4 months, which according to them used to take up to seven months before use of concentrate feed and other improved practices.

It is, however, important to note that the increase productivity was a function of a number of factors including those that relate to the project intervention. The training providing by the project on animal nutrition and feeding practices, ownership of cross-breed cows, and others were largely credited for a substantial increase in livestock and poultry productivity. 'The improvement in livestock productivity is due to the change in their feeding practices, and the concentrated feed and other improved forages they used to feed their livestock. Besides, they have the hybrid cows and hens that have better productivity than the local ones,' a woreda agriculture official said.

As much as farmers are motivated to use concentrate feed, they are also being challenged by the price of the feed. Most farmers and other stakeholders consulted for the evaluation agree that the price of concentrate feed is a bit high for farmers to buy. It was also considered less cost effective when such feed is used on local breeds. The case story below could illustrate the impact of the project intervention on a direct beneficiary farmer.

Alemitu (pseudo name), married with nine children of different age group above school age; all did attend school; the eldest is now a diploma holder teacher in junior high school. Household income of Alemitu before 5 years was from sale of food crops like finger millet, maize and wheat. Now after adopting improved animal production technologies largely introduced by ACDI/VOCA, the household income was from cattle fattening, sale of poultry products (egg and cockerels), and sale of milk from a cross-bred cow. There is a clear indication that the livelihood of Alemitu has improved over the last five years. She is a relatively well to do farmer as can be judged by the iron sheet-roofed house, half the living room filled with a pile of sacs containing recently harvested grain.

According to Alemitu contribution of ACDI/VOCA to improved livestock production included trainings on improved feeding and management of livestock and poultry; construction of feeding trough using local construction material; improved housing and sanitary handling of animals; planting improved forage crops and feeding techniques. She acknowledged the continual training and advisory role of the development agents (DAs) that led to successes in her activities.

Out of the above practices that Alemitu received training, she implemented improved livestock feeding and management practices like dairy production from a cross-bred cow; fattening of local oxen using concentrate ration; egg production from improved chicken breeds.

According to Alemitu, Feed II project of ACDI/VOCA has been providing farm supplies, including, forage seed of improved forage crops free of charge, including Rhodes grass that she planted at the backyard on about 20 square meter plot; sesbania and elephant grass planted along the fence of her compound. She mentioned that before initiation of the ACDI/VOCA projects in the past five years, she has not heard of such improved forage crops. Based on what she learned from the project training she has been harvesting these forages and feeding tethered stock on feeder trough built of local wood materials. Feeding cattle using such home-made feeder troughs helped her to minimize feed wastage and protect animals from parasites.

Alemitu said that she received initially free of charge compound (concentrate) feed of various specialized composition for chickens, milk cows and for fattening cattle produced by ACDI/VOCA-installed feed manufacturing factory. As an incentive for her active participation in improved livestock management practice, she received a gift of one quintal dairy concentrate feed. Having realized the benefit, she purchased concentrate feeds manufactured by the union's feed factory until recently when the price became beyond her financial capacity and quit purchasing compound feed. Instead, she started feeding animals with home-made rations composed of raw materials most of which are home-produced and some purchased from dealers.

As regards to benefits gotten from FEED II project, Alemitu has successfully put into practice ACDI/VOCA's training on improved feeding and management practice. As a result, her household income has significantly increased. Her cross-bred cow is now on her second calf, and the milk produced, about 4 liters per cow per day, is rented to school teachers. Similarly, the egg produced from improved chicken breed is sold to school teachers and to market in a nearby town. The income from sale of these products has been used to cover living expenses, clothing and school expenses for children, etc. From her stories and observations in and out of her house, Alemitu is well satisfied with what she gained from the Project's development activities, knowledge and material support. However, she did not conceal her dissatisfaction as regards to the price of manufactured feed which nowadays could not afford to buy and so quitted using the same from the union's product.

Regarding her future plan, Alemitu said that she has saved and allocated birr 3,000 to purchase egg type chicken pullets through a local dealer. She as well is sure to continue fattening oxen and dairy production although the high price of manufactured feed has become prohibitive.

Regarding challenges to sustenance of using improved livestock production systems, Alemitu mentioned that the price of the manufactured animal feed has become unbearable that many farmers avoided buying the manufactured ration and instead began buying raw materials like wheat bran (frushka) and oilseed cake (fagulo) individually to produce home-based rations prepared in a traditional way. Surely, the price set by the union is so expensive to the extent that it is likely to affect the sustainability of using introduced technologies. Other problems include lack of capital to build improved cattle shed, poor transport, lack of electric power supply and absence of market linkage for livestock products.

By way of recommendation, Alemitu said that the union has to consider the current price of raw materials in setting the price of their manufactured feed. She also recommended that the union improve packaging of the products which has become substandard- use of poor quality sacs that are often torn, and the quantity lacks uniformity probably due to using faulty balance.

Regarding knowledge transfer, Alemitu has been appointed as the chairperson of women cooperatives in the sub-kebele. She has been advising the cooperative members on improved poultry production, fattening and dairy. She estimates forty women have taken up her advice and taken up their preferred activities. There is positive challenge among members in being involved in improved chicken breeds rearing. It is common to see at least 5 to 10 chickens in every household in the sub-kebele. According to Alemitu, the outstanding challenge in the acceptance and sustained use of improved practices is high price and lack of supply chains for manufactured feed, lack of market linkage for animal products.



Plate 1. Crop harvested and conserved at home

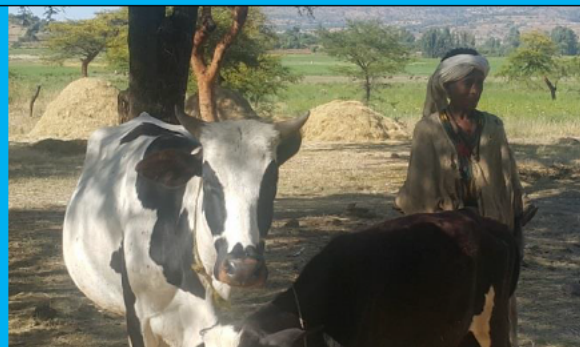


Plate 2. Cross-bred cow of Alemitu



Plate 3. Feeder trough used by Alemitu

Impact on livestock and poultry enterprises

The project targeted to support the establishment of 30 feedlot, poultry and dairy enterprises. Progress reports showed that the project only managed to establish 15 dairy, fattening and poultry related enterprises. About half of these enterprises are private while the rest are cooperatives. Most of them are dairy enterprises. Different kinds of support were provided for these enterprises including in kind and/or fixed obligation grant with leverage requirement, training on business management and improved nutrition and feeding practices along with technical support and others. Value of in-kind and cash grants budgeted for disbursement for 30 feedlot, poultry and dairy

enterprises was USD 675,000. The project actually disbursed USD 544,075 for 15 such enterprises, according to project progress reports.

The evaluation team consulted 8 livestock and poultry enterprises and gathered some primary and secondary data to gain insight about their financial status, impact of the project on their operation, and so on. While some qualitative and quantitative data was gathered, the evaluation team found it difficult to get financial reports of many of the enterprises. This was largely because many of them did not process their financial transactions and produce financial statements. In light of this, the evaluation team had to base its financial analysis on data that has been collected by ACDI/VOCA on monthly basis from 12 enterprise in 2016, 2017 and 2018. Before putting the data into use, however, the evaluation team verified many of the figures maintained by ACDI/VOCA by comparing financial and non-financial data gathered by the evaluation team from the enterprises.

As shown in Table 27 below, the project and enterprise owners invested Birr 11,377,035 over the past three years. The RoI of the 12 enterprises averaged 26% which can be considered very attractive by any standard. This means that for every Birr 100 invested, the livestock enterprises earn Birr 26 as profit. However, it is important to note that the two fattening firms incurred a loss in the past three years, which might be due to the nature of their business. In other words, fattening firms incur a lot of costs and start generating revenue with the fattened animals are sold which could take some time. Among the three categories of enterprises, poultry farms earned the highest RoI followed by dairy firms. When we look at the operation of individual enterprises in each category (See Annex 8), it becomes clear that much of the income was actually generated by few private enterprises, while some others have either earned low income or experienced losses. Low or negative profit is understandable particularly for newly established enterprises until they manage to produce and sell in larger quantity that offsets their large initial costs. Their return is expected to grow in the future. In conclusion, the results suggest that the enterprises that the FEED II project supported are financially viable.

Table 27: Return on investment (RoI) of livestock and poultry enterprises supported by the project

Year	Item	Dairy Total (7 enterprises)	Poultry Total (3 enterprises)	Fattening Total (2 enterprises)	Grand Total
2016	Investment	3,605,998	2,555,010	472,746	6,633,754
	CASH IN (Revenue)	2,538,396	1,023,945	339,000	3,901,341
	CASHOUT (expense)	2,486,375	695,919	290,340	3,472,634
	NET CASH	52,021	328,026	48,660	428,707
	ROI	1.4%	13%	10%	6%
2017	New investment	2,922,734	-	1,490,000	4,412,734
	T-Investment	6,528,732	2,555,010	1,962,746	11,046,489
	CASH IN (Revenue)	6,071,586	1,846,298	840,240	8,758,124
	CASHOUT (expense)	4,606,104	1,185,494	1,292,972	7,084,570
	NET CASH	1,465,482	660,803	(452,732)	1,673,553

	ROI	22%	26%	-23%	15%
2018	New investment	117,880		-	117,880
	T-Investment	2,584,321		1,490,000	4,074,321
	CASH IN (Revenue)	1,846,953		284,000	2,130,953
	CASHOUT (expense)	981,538		343,487	1,325,024
	NET CASH	865,416		(59,487)	805,929
	ROI	33%		-4%	20%
Sum	Total Investment	6,859,279	2,555,010	1,962,746	11,377,035
	CASH IN (Revenue)	10,456,935	2,870,242	1,463,240	14,790,418
	CASHOUT (expense)	8,074,017	1,881,413	1,926,798	11,882,228
	NET CASH	2,382,918	988,829	(463,558)	2,908,189
	ROI	35%	39%	-24%	26%

Data source: ACDI/VOCA, 2019.

All livestock and poultry enterprises consulted by the evaluation team use concentrate feed for their livestock/poultry. The union-based feed plants established by the project were also identified as key sources of concentrate feed. With use of concentrate feed, the enterprises improved their productivity and income. 'Concentrate feed manufacturing factories installed by the project are contributing to the supply of different rations for specialized animal farms such as poultry, fattening and dairy. On the other hand, the demand for these products has increased because animals that are fed with such better quality feeds have become more productive,' a government official said.

Feeding fattened animals concentrate feed was considered very effective in reducing the fattening cycle time. The feed development initiative of the project is also said to be catalyzing the expansion of livestock and poultry enterprises. A regional agriculture bureau official in this regard said the following.

'Another commendable activity of the Project is the installation of a compound feed manufacturing machine which is an innovative undertaking, now playing a catalytic role in the expansion of modern poultry, fattening and dairy enterprises. By using fattening rations obtained from Farmers Union-based feed manufacturers, it has become possible to fatten cattle in less than three months.'

Use of concentrate feed has also increased livestock and poultry productivity. One of the dairy enterprises supported by the project, for example, has been using concentrate feed for dairy cows since 2013. The enterprise source the feed from nearby union-based feed manufacturing enterprise and other private ones. According to the owner of the enterprise, the supply of manufactured feed is growing. With the use of concentrate feed, the enterprise was able to increase average milk yield per day per crossbreed cow to 16 liters from 12 liters in the past. The enterprise produces cheese, butter, yogurt and milk and sells them to farmers and urban dwellers. It buys milk from farmers. When asked about the gaps and weaknesses in feed manufacturing supply chains, the enterprise owner identified

high price and poor quality of manufactured feed. The respondent referred to manufactured feed in general. The findings showed that union produced feed is of better quality and price compared to other suppliers though it is still considered high from buyers point of view. Many other livestock and poultry enterprises also shared similar opinions. A case story below illustrates the impact of the intervention on the operation of a poultry enterprise supported by the project



Bagerish ¹⁰Poultry Enterprise was one of the private firms that received support from the project. The main products of the enterprise are pullets (young and below one-year old female chicken that has not started laying egg), broiler chicken for meat, and 45 days chicken. Its major customers are government agriculture office to distribute for farmers; and unemployed youth to start poultry enterprise. In the past five years, the enterprise's revenue grew from ETB 228,036 in 2014 to ETB

1,091,700 in 2018. But it started earning a profit since 2018 which is expected to grow in the coming years with increased production and sales.

The Poultry Farm had 6,120 one-week old chickens at the time of the visit. The enterprise has been buying concentrate feed since 2014 after receiving advice from development agents. According to the enterprise owner, the supply of manufactured feed has been increasing in the woreda/kebele. Significant improvements have been made in poultry productivity after the enterprise received assistance from the FEED II project. According to the owner of the enterprise, average egg laid per chicken per month increased from 18-20 eggs to 30 eggs. Average egg laid per chicken throughout its life was also said to increase from 480 to 720.



Impact on Dealers

Concentrate feed dealers are often primary cooperatives that are members of unions that manufacture concentrate feed. These primary cooperatives are ideal for making concentrate feed accessible to farmers. They also offer the feeds at lower prices than traders. Some of the cooperatives that sell manufactured feed indicated that their engagement in sale of such feed has increased their income and diversified their income sources. But they were not able to give figures showing amount of income earned as they tend to mix the finance relating to concentrate feed with other commodities they trade. Most importantly, they are happy with their engagement in concentrate feed dealership as doing so allows them to make such feed accessible to their members. Hence, apart from getting an additional source of income, their involvement in sale of manufactured feed is contributing to their overall purpose of improving the productivity and lives of their members. 'Dealers of feed manufacturing enterprises supply feed to farmers and others with more moderate price than traders. Apart from reducing prices, the distribution of manufactured feed through dealers increased

¹⁰ Evaluation team chose to use pseudo names instead of real ones to protect privacy and confidentiality.

availability of feeds to farmers. It also created job opportunities for dealers,' a government official said.

Dealers and particularly cooperatives, however, seem to believe that awareness about the concentrate feed is yet low. As a result, demand for such feed is not as much as they expected. Apart from awareness, however, the high price of concentrate feed and inadequate ownership of improved breeds for which farmers often prefer to use manufactured feed were identified as constraints to low demand for such feed.

Like cooperatives, private agro-dealers that are involved in retailing concentrate feed are also happy with the results they obtained. The dealers indicated that their involvement in sale of manufactured feed increased their income. They mostly sell the feed to farmers by working closely with development agents. The case story presented below illustrates the impact of increased concentrate feed supply on an agro-dealer.

An agro-dealer in one of the project woredas started retailing concentrate feed manufactured by union-based plants in early 2017. It sells rations for fattening, poultry and dairy that it often procures from Bokoji Union Feed Manufacturing plant. But before 2017, it used to buy the feed from private firms. On average, the dealer sells 192 quintals of concentrate feed per month.

The dealer believes that there is no adequate supply of concentrate feed. The major customers of its concentrates are farmers, other agro-traders, livestock fattening enterprises, poultry farms/ enterprises and dairy farms. According to the owner, the agro-dealer sells about 70% of its concentrates to farmers, who are often reached by working with government and development agent as well as cooperatives. The dealer also said that potential demand for concentrate feed is large. The average number of quintals of concentrate feed that the dealer sells per month along with the price is as follows.

The dealer observed positive changes in income after retailing concentrate feed. According to the owner, average monthly income increased from Birr 60,000 to Birr 153,600 after he started retailing concentrates. Profit also grew from Bir 2700 per month to 10,500 per month. The dealer shared that his customers are happy with the quality and results they achieved with the concentrate feed. As a result, their number is growing from time to time. Attracted by the return, the dealer is planning to construct his own manufacturing feed enterprise and expand his shops to make them accessible to buyers.

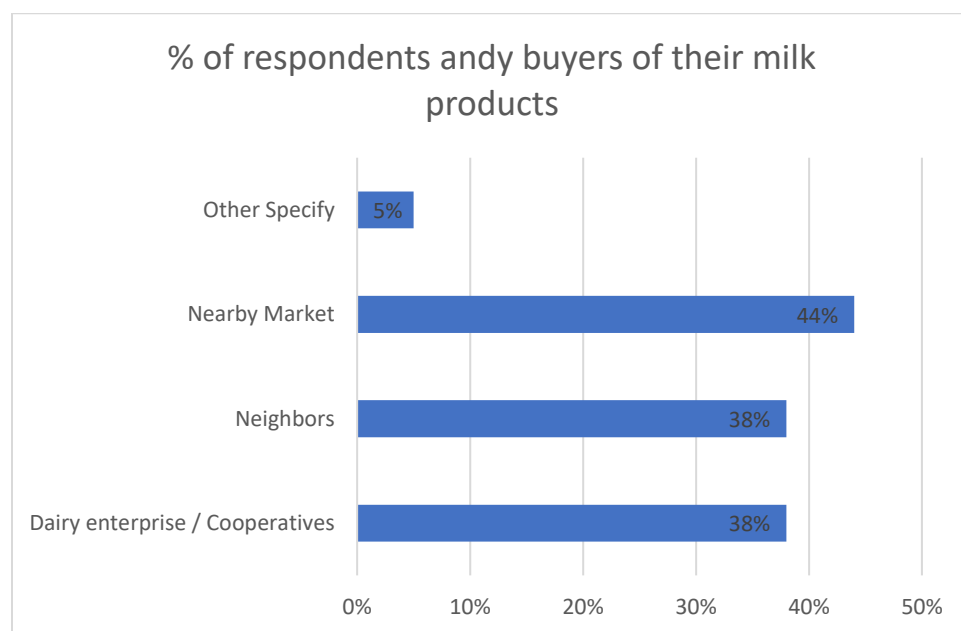
When asked about the challenges the dealer often faces in retailing concentrate feed, the owner identified lack of adequate and reliable supply of the feed from unions as well as problems of transportation.

iii. Impact of project-supported livestock and poultry enterprises on downstream economic activity of traders and consumers

Smallholder farmers are among the suppliers of inputs such as milk to livestock enterprises. The support provided by the project to cooperatives to engage in dairy processing activities played an important role in creating some market access to farmers to sell milk and milk products. In this

regard, one direct beneficiary farmer that participated in one of the FGDs said ‘The project established a dairy cooperative and supported the construction of a dairy shop. Thus, we have good access to buy manufactured feed and sell milk.’ Government bodies also had a similar opinion. Apart from creating demand for concentrate feed manufactured by unions, the establishment of livestock and poultry enterprises was said to be a smart approach to improve market access to farmers sell their produce to and buy products from the enterprises. However, access to markets has remained one of the major challenges of smallholder farmers. As shown in Figure 10, only 38% of respondents sold their milk to dairy enterprises/cooperatives. About 44% of them are still travelling to the local market to sell their milk. Some 38% of the respondents are also selling their milk to neighbors.

Figure 10: Buyers of milk produced by smallholder farmers



The qualitative data analysis results also support quantitative findings. While appreciating the changes that have been happening in their production and productivity, beneficiary smallholder farmers that participated in FGDs expressed their frustration about the lack of access to market to sell their increased livestock production.

‘We are benefiting from sale of eggs in a better way. We are producing high amount of milk although there is not that much demand for it. We convert the milk into butter, which sells at a price of birr 150 per kilogram. It is a very good income. We also buy day-old chickens for Birr 70 and earn a profit from selling them at Birr 250. All of those benefits are very high when compared with the situation five years ago. However, access to markets has remained a critical problem particularly during the fasting seasons. During this season, the price of our products gets lower and we can’t hold our products for longer period of time as they are perishable’ a beneficiary farmer that participated in one of the FGDs said.

Market access is particularly a major problem for farmers that are involved in fattening activities. Unlike dairy and poultry products, it is not easy to find buyers for fattened livestock given their high value. As a result, farmers are often forced to go to central or larger market to sell their fattened livestock which are sometimes located hundreds of kilometers away from their residence. A development agent in this regard said the following:

'It is very good in providing fodder crop. Although the problem is the farmers sell them in the market they found after fattening the cattle. For example, they take them straight (directly) to Mekele city [capital city of Tigray region] or to Abiy Gidy city to sell them. There is no one that buys them going to their houses. Besides, fattened animals are only demanded when it is holiday time.'

Poultry enterprises that have been supported by the project also created some market access for beneficiary households to buy poultry products. As shown in Table 28 below, about 45% of direct beneficiary households bought poultry and poultry products from nearby a poultry enterprise. A significant majority (71%) of respondents said that poultry products have become available in their areas in the past five years. About half of the respondents also said that poultry products have become more affordable than before in their areas or access to buy improved chickens/hens has increased over the past five years. Increased egg production, increased income and increased production of chickens were identified as major changes in livelihood over the past five years by 72%, 58% and 52% of households, respectively.

Table 28: Beneficiary households' access to poultry market

Questions	Response Categories	N	%
Have you bought poultry products in the past five years?	No	549	29%
	Yes	1345	71%
Where did you buy the poultry products from during the past five years?	Nearby Poultry Farm/Cooperative	604	45%
	Nearby Market	985	73%
	Others (specify)	19	1%
What has changed in poultry product availability and affordability in the past five years?	Poultry products have become available in my area	1353	71%
	Poultry products have become more affordable than before in our area	897	47%
	Access to buy improved chickens/hens has increased	1005	53%
	Others (specify)	120	6%
What has changed in your household's lives in the past five years?	Increased egg production	1370	72%
	Increased number/production of chickens	993	52%
	Increased income	1092	58%
	Others (specify)	225	12%

The project also had an indirect impact on traders that buy products from enterprises it supported. Consultations made with restaurants and retail shops that buy products of enterprises showed that the enterprises created opportunities for them to buy dairy and poultry products in nearby areas. Some traders also found the prices charged by project-supported enterprises a bit lower than others.

The quality of dairy or poultry products supplied by the enterprises was also considered good compared to other suppliers. The case of a coffee shop that buys from Mestewal dairy enterprise may illustrate the benefits and impact very well. Chaltu (pseudo name) Coffee shop buys milk from Mestewal dairy enterprise over the past six months. When asked about the benefits she gained from buying dairy products from the dairy enterprise, Chaltu identified access to buy dairy products, buying dairy products at cheaper/lower prices, improved household nutrition and health, and improved quality of dairy product.

2.1.6.4. Challenges in production, distribution, and use of formulated feed

The production and marketing of formulated feed is being challenged by different factors. Some of these are national level challenges that are beyond the control of feed producers. The overall challenges at country level include: 1) escalating prices of feed ingredients driving up compound feed production costs; 2) unsupportive multiple taxations; 3) periodic feed ingredient shortages; 4) feed ingredient safety and quality, 5) unreliable demand for compound feed, 6) lack of research and extension support for the commercial feed sub-sector, 7) lack of feed analytical services at commercial scale 8) unreliable power supply; 9) shortage of qualified and dependable labor; 10) shortage of hard currency for companies engaged in importing specialty feed ingredients (e.g. pre-mixes); and 11) organizational capacity of the Ethiopian Animal Feed Industry Association to serve the needs of its members and the sector at large. In addition, awareness about formulated feed has remained inadequate and mostly project intervention areas specific. Areas other than those not covered by project have still limited awareness about the value of using formulated feed. Moreover, farmers using the formulated feed sometimes do not get the intended benefit due to poor targeting of the most responsive animals like selective feeding of crossbred cows, feeding the appropriate levels to get the desired responses, minimization of wastages, etc.

In addition to the overall country-level challenges that affect both private and union feed plants, the following are additional challenges at the union factories:

- i. **Input supply:** These include (1) inflexible financial rules and regulation (Proforma based purchase system); (2) poor coordination between managers and boards which cause a delay for approval as some of the input suppliers give 2 to 3 days' time limit for prices; (3) shortage of transport for inputs. Some inputs especially premixes for poultry rations, having to be procured from Addis Ababa. 4) Input price fluctuations 5) storage and financial constraints limit the purchase of inputs at times of harvest when prices are low.
- ii. **Machinery maintenance and upkeep:** Some unions indicated occasional breaks in operations due to machine breakdowns, but said they typically resolve these within a few days (e.g. trained staff repair), or enact work arounds (e.g., replace automation with manual processes). The occasional problem of availability of spare parts is also reported.
- iii. **Power supply:** Power interruption has an adverse effect on feed manufacturing. Some unions have reported production interruptions of 2-4 days a week due to power supply. Installation of standby generators is proposed to avoid production interruptions.

- iv. **Other challenges:** Some unions are managing many different enterprises and there is some lack of giving adequate attention to the feed enterprise. Shortage of skilled workforce in feed production and management as a result of high staff turnover has been mentioned by some unions.

There are also challenges in the distribution and sale of formulated feed of the union plants. The main distribution channels of union feed plants are through PCs, agro-dealers and direct sales to farmers. The general challenges related to distribution include:

- *Marketing plan:* none seemed to have a clear or comprehensive marketing plan.
 - *Limited access points:* The distribution networks have limited access points/retail shops that are not accessible enough to many users in outlying areas resulting in additional transport costs.
 - *Inadequate storage facilities:* Storage facilities for safe storage of ample quantities at many distribution sites to meet demand is a problem. This forced distributors to acquire small quantities more frequently creating gaps in supply and additional costs of transport. The available storage space in many cases is committed to other established products handled rendering the feed to possible contamination;
 - *Transport:* Most distributors lack their own means of transport and generally depend on rented vehicles causing delays and high prices.
 - *Archaic payment system at some factory outlets:* Long and bureaucratic payment system like the Gozamen union where buyers can't pay in cash to the factory and access the concentrate feed. Instead, buyers must deposit the payments in the bank (either the Commercial Bank or Abay Bank) and come up with the slip to access the concentrate feed. This discourages customers. Arranging a one-stop payment system is critical under such situations.
 - *Formulated feed supply/demand:* some PCs and agro-dealers that are in the network complain about inadequate feed supply from feed mills. Some 25% of retailers indicated shortage of supply from feed plants as a problem. Lack of adequate demand was mentioned as a problem by 50% of retailers surveyed. Most (63%) attribute the poor demand to lack of awareness among feed buyers/farmers. A lot needs to be done in raising awareness on the necessity and benefit of feeding concentrated feed including feeding to the most responsive animals to realize the benefits more visibly.
- Weak organizational capacity of PCs:* Many unions use PCs as distribution channels. PCs are not well organized to effectively distribute to farmers. Most PCs do not have dedicated store staff or salespersons and may not keep regular sales hours. Point-of-sale education is very limited, though some PCs and agro-dealers have received training. PCs are bound by restrictive policies relative to agro-dealers like bureaucratic decision-making, organizational structures and leadership teams that are less responsive to market changes and opportunities quickly.
- *Unaffordability of price:* Average price of manufactured feed at union-based feed manufacturing enterprises indicates that the most expensive formulated feeds across regions are poultry feeds (average of 1049 ETB/quintal) while fattening feed was the least expensive (699 ETB); formulated feed across feed types was on average most expensive in the Tigray region and least expensive in the SNNP. Fish feed was produced in the SNNP region only and had the lowest price of all formulated feeds. The variability across regions largely has to do

with ingredient prices. But most farmers that participated in the FGDs and government officials alike complained about the price of concentrate feed. They believe that the price is too high for many farmers to buy and use it. Cost reduction measures along the value chain need to be explored to further reduce prices.

2.1.7. Income from Livestock and Livestock Products

One of the key objectives of the project was to increase target smallholder farmers income from livestock and poultry. The target was to increase income from livestock and poultry by 15%. In this section, the findings of the final evaluation on income earned by smallholder farmers from livestock and poultry sales are presented.

2.1.7.1. Income from Sale of Fattened Oxen/Bulls



Close to 43% of the respondents sold fattened oxen and/or bulls during the 12 months before the endline survey, an increase from 28% at baseline. The biggest increase in number of households that fattened and sold oxen was observed in Amhara region, while a slight decline was seen in Oromia. Households that participated in the endline survey sold 1,450 fattened oxen and earned close to Birr 21 million. While the number of oxen sold at endline was 35% higher than the baseline, the value earned increased by over 150%, which might be due to improved body weight gained by the oxen as a result of improved feeds. On average, a household earned Birr 11,053 from sale of one fattened oxen, compared to Birr 4,366 at baseline, a 153% increase from baseline. Households in Amhara region earned the highest income from sale of fattened oxen than other regions. Income

from sale of fattened oxen was lowest in SNNPR (see Table 29 below).

Table 29: Distribution of Households by Number of Fattened Oxen/Bulls Sold and the Value of those Sales and Region at Baseline and Endline

Number of fattened bulls/oxen Sold	Amhara		Oromia		SNNPR		Tigray		Total	
	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline
None	66	35a	65	70.3b	72	55c	84	69b	72	57
1-2 head	30	59a	30	27.2b	25	42c	9	21b	23	38
3-4 head	3	4a,b	5	2a	3	2a,b	4	5b	3	3
5-9 head	1	2a,b	0.2	.4a	-	.2a	2	4b	1	2
10+ head	0.2	.4a	-	.2a	-	.4a	2	2a	0.4	0.6
Total HHs (n)	478	480	480	464	477	483	479	467	1,914	1894
Number of fattened oxen sold	255	471	261	216	198	312	362	451	1,076	1,450
Total birr collected from sale of fattened oxen	1,538,320	6,985,459	2,373,756	4,882,900	1,344,459	3,859,924	3,100,200	5,206,010	8,356,726	20,934,293
Average proceeds per household from sale of fattened oxen (birr)	3,218	14,553a	4,945.30	10,524 a,b	2,818.60	7,992b	6,472	11,148 a,b	4,366	11,053

Note: Values in the same row and sub table not sharing the same subscript are significantly different at $p < .05$

As few as 7% of households fattened and sold cow over the past year. As shown in Table 30 below, households earned close to 2 million Birr from sale of 195 fattened cows. While the number of fattened cows grew by 57% from baseline, income increased from sale of these cows increased by 112%. Average income earned from sale of a fattened cow also grew from 492 Birr to 1,055 Birr.

Table 30: Distribution of Households by Number of Fattened and Sold Cows and the Corresponding Sales and Region at Baseline and Endline

Number of cows sold	Amhara		Oromia		SNNPR		Tigray		Total	
	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline
No fattened cow sold	90	89a	93	95b	94	92a,b	97	95b	94	93
1-2 fattened cows sold	9	10a	6	5b,c	6	8a,b	2	4c	6	7
3+ fattened cows sold	1	.6a	1	.2a	0	.4a	1	1a	1	1
Total HHs (n)	478	480	480	464	477	483	479	467	1,914	1,894
Number of fattened cows sold	63	69	46	30	43	49	26	47	124	195
Total sales collected (birr)	281,198	792,348	230,970	377,800	246,500	444,000	182,200	383,000	940,868	1,997,148
Average earnings per HH from selling fattened cows (birr)	588	1,650.7a	481	814.2a	517	919.3a	380	820.1a	492	1,055

Note: Values in the same row and subtable not sharing the same subscript are significantly different at $p < .05$

The proportion of households that fattened and sold sheep did not change much over the past five years. Indeed, it declined slightly. Only 16% households fattened and sold sheep, compared with 18% at baseline. These households earned Birr 3.3 million from the sale of 1,272 sheep over the past year, compared with 2.1 million from sale of 1,882 sheep at baseline. Hence, although the number of fattened sheep sold declined slightly, the income earned from the sale of sheep increased by over Birr 1.2 million. This might be due to inflation and use of improved feed to fatten sheep. On average, income of Birr 1,759 was obtained from the sale of a sheep last year, compared with Birr 1,102 at baseline.

As also mentioned in previous sections, few households (2%) owned and fattened goats. These households sold 414 fattened goats and earned Birr 743,615. The average proceeds obtained from sale of a fattened goat was Birr 393, compared with 142, a 174% increase from baseline.

2.1.7.2. Quantity of Dairy Products Sold and their Value

The percentage of households that sold milk declined slightly over the past five years from 19% at baseline to 14% at endline. Similarly, the proportion of households that sold 1,000 liters or below per year declined to 5% at endline compared to 17% at baseline. In contrast close to 7% of the households sold over 1,000 liters of milk over the past year before the endline survey, compared with just 2% at baseline. This may suggest that even if the proportion of households that sold milk declined, the amount of milk sold at endline was much higher than the baseline. Indeed, endline

respondents sold 504,756 liters of milk and earned over 7.4 million Birr, which was 2.5 and 5.4 times the baseline results, respectively. On average, a household earned Birr 3,954 during the year preceding the survey, compared to just Birr 610 at baseline (see Table 31 below). It is important to also note that price of milk increased by over 83% over the past five years. Hence, a significant portion of the change in value of income earned from sale of milk is attributed to the increase in price of milk. Even at baseline prices, however, average income from sale of milk increased by over 200%. In sum, increased production and productivity of milk as well as some market access and increased price were said to have contributed to the significant increase in income from sale of milk. Qualitative and quantitative findings also associated the dramatic increase in productivity and income from milk to the integrated interventions of the project as explained in the different sections of this report.

Table 31: Distribution of Households by Quantity of Milk Sold and Corresponding Value of Sales from Milk at Baseline and Endline

Amount of milk sold in liter	Amhara		Oromia		SNNPR		Tigray		Total		% change
Amount of milk sold in liter	<i>Baseline</i>	<i>Endline</i>	<i>Baseline</i>	<i>Endline</i>	<i>Baseline</i>	<i>Endline</i>	<i>Baseline</i>	<i>Endline</i>	<i>Baseline</i>	<i>Endline</i>	
No milk sold	88	96.5a	84.6	79.7b	63.6	83.4b	87.5	85.4b	81	86.3	-5.3
<=1000liter/ year	10.7	2.1a	12.5	6.7b,c	36.2	11b	9	5.8c	17	6.4	-10.6
> 1000liter/ year	1.3	1.5a	2.9	13.6b	0.2	5.6c	3.5	8.8b,c	2	7.3	5.3
Total HHs (n)	478	478	480	462	477	471	479	464	1,914	1,875	
Liters of milk sold last year	16,950	13,272	63,101	260,100	8,478	65,208	57,243	166,176	145,773	504,756	246
Total sales collected from milk sale (birr)	91,732	154,920	498,336	3,418,098	73,970	991,080	504,002	2,848,860	1,168,042	7,412,958	535
Average proceeds per HH from milk sale	192	324.1a	1,038	7398.5b	155	2104.2 a,b	1,052	6139.78b,c	610	3,954	548

Note: Values in the same row and subtable not sharing the same subscript are significantly different at $p < .05$

The proportion of households that sold butter did not change from baseline. As summarized in Table 32 below, only a third of household sold 22,170 kgs of butter and earned close to Birr 4 million at endline. Amount of butter sold and income earned from it was much lower. On average, a household earned Birr 2,106 from sale of butter at endline, compared to 667 at baseline, a 215% increase over the past four years.

Table 32: Distribution of Households by Quantity of Butter Sold and the Value of Sales and Region at Baseline and Endline

Amount of butter sold (kg) last year	Amhara		Oromia		SNNPR		Tigray		Total	
	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline
No butter sold (% of HHs)	60.6	52.5a	70.9	61.6b	68.2	79.1c	67.8	69.8b	66.8	65.8
<100 kg/year (% of HHs)	37.5	45.6a	28	34.9b	31.5	19.9c	32	29.1b	32.3	32.4
>100 kg/year (% of HHs)	1.9	1.9a	1.1	3.4a	0.2	1.0a	0.2	1.1a	0.9	1.8

Total HHs (n)	478	480	480	464	477	483	479	467	1,914	1,894
Amount of butter sold (kg) last year	3,819.9	7,111	3,867.3	6,857	1,298.8	5,035	2,277.3	3167	11,263.1	22,170
Total sales collected from butter sale, birr	419,706	1,105,038	437,256.5	1394305	153,769.5	808,760.0	266,584	680615	1,277,316	3,988,718
Average proceeds per HH from butter sales	878	2,302.2a	911	3,005a	322.4	1,674.5a,b	556.5	1,457.4b	667.4	2,106

Note: Values in the same row and subtable not sharing the same subscript are significantly different at $p < .05$

2.1.7.3. Sales of Poultry and Poultry Products

As few as 12% of households sold 1,236 pullets during the 12 months before the endline survey, and earned income of Birr 178,294, compared to Birr 413,207 at baseline. The number of pullets sold declined three-fold at endline and income from sale of pullets also declined by 57%. The decline is attributed to the fact that one respondent at baseline sold 67% (3,181 pullets of 4741) of the total number of pullets sold by all respondents, which was not observed at endline. This was also noted in the baseline report (see Table 33 below).

Table 33: Distribution of Households by Number of Pullets Sold and the Value of Sales and Region at Baseline and Endline

Number of pullets sold	Amhara		Oromia		SNNPR		Tigray		Total	
	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline
No pullets sold (% of HHs)	85.1	73.5a	81.5	95.3b	86	96.7b	79.1	86.7c	82.9	88.0
1-4 pullets sold (% of HHs)	9	21.9a	13.5	3.4b	10.9	1.9b	14.4	4.9b	12	8.1
5-9 pullets sold (% of HHs)	4	2.9a,b	4	.9a	1.9	.8a	4.4	4.7b	3.6	2.3
10+ pullets sold (% of HHs)	1.9	1.7a,b	1	.4a	1.3	.6a	2.1	3.6b	1.6	1.6
Total HHs (n)	478	480	480	464	477	483	479	467	1914	1894
Total number of pullets sold last year	387	352	3181	87	291	140	882	657	4741	1236
Total sales collected from sale of pullets (birr)	24,629.4	41,224	270,348	14,320	20,089	21,610	98,141	101,140	413,207	178,294
Average proceeds per HH from pullet sales (birr)	51.5	85.9	563.2	30.9	42.1	44.7	204.9	216.6	215.9	94.13

Note: At baseline one individual in Oromia sold 2,850 pullets.

Values in the same row and subtable not sharing the same subscript are significantly different at $p < .05$

The proportion of households that earned income from sale of broilers declined from 23% at baseline to 11% at endline. The number of broilers sold during the 12 months before the endline survey (1,550) was also lower than the baseline (1,941). Even so, endline respondents earned Birr 275,449, which was much higher than the income of Birr 190,093 at baseline. Households on average earned

income of Birr 145 from sale of broilers, compared to Birr 99 at baseline, an over 46% increase over the past five years (see Table 34 below).

Table 34: Distribution of Households by Number of Broilers Sold and Value of Sales and Region at Baseline and Endline

Number of broilers sold	Amhara		Oromia		SNNPR		Tigray		Total	
	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline
No broilers sold (% of HHs)	77	86.7a	79.6	84.5a	80.3	98.1b	70.6	85.4a	76.9	88.8
1-4 broilers sold (% of HHs)	16.5	10.2a	14.6	8.8a	16.8	.8b	22.5	8.4a	17.6	7.0
5-9 broilers sold (% of HHs)	5.2	1.9a,b	4.2	3.9a	1.7	.4b	4.2	2.4a,b	3.8	2.1
10+ broilers sold (% of HHs)	1.3	1.3a,b	1.7	2.8a,b	1.3	.6a	2.7	3.9b	1.7	2.1
Total HHs (n)	478	480	480	464	477	483	479	467	1914	1894
Total number of broilers sold last year	439	260	439	429	292	69	771	792	1941	1550
Total sales collected from sale of broilers (birr)	37,854.3	46327	44,715	100108	27,825	7995	79,699	121019	190,093	275449
Number of HHs sold broilers	110	64	98	72	94	9	141	68	443	213
Average proceeds per HHs from sales of broilers (birr)	79.2	96.5a	93.2	215.8b	58.3	16.6c	166.4	259.1a,b	99.3	145.4

Note: Values in the same row and subtable not sharing the same subscript are significantly different at $p < .05$

2.1.7.4. Sale of Spent Hens (Old hens)

About 19% of households earned income from sale of spent hens at endline, compared to 13% at baseline. Households, on average, earned Birr 203 from sale of spent/old hens, compared to Birr 29 at baseline. Income from sale of old hens also grew by seven-fold over the past five years (see Table 35 below).

Table 35: Distribution of Households by Number of Spent Hens Sold and Value of Sales and Region at Baseline and Endline

Number of spent (old) hens sold	Amhara		Oromia		SNNPR		Tigray		Total	
	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline
No spent hens sold	93.3	68.5a	84.4	84.7b	82	95.9c	89.6	76.2d	87.3	81.4
1-4 spent hens sold	5.9	27.5a	14	8.8b	15.3	2.9c	7.5	13.3b	10.7	13.1
5-9 spent hens sold	0.6	2.5a	1.5	3.4a	2.3	.4b	2.3	5.4a	1.7	2.9
10+ spent hens sold	0.2	1.5a	0.2	3.0a,b	0.4	.8a	0.6	5.1b	0.4	2.6
Total HHs (n)	478	480	480	464	477	483	479	467	1914	1894
Total number of spent hens sold last year	82	446	187	465	231	107	170	998	670	2016
Total sales collected from sale of spent hens (birr)	6,491	72,633	16,656	101,095	18,847	18,000	13,100.75	193,395	55,093.8	385,123

Average proceeds per HH from spent hen sales (birr)	13.6	151.3a	34.7	217.9 a,c	39.5	37.3b	27.4	414.1c	28.8	203.3
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Note: Values in the same row and subtable not sharing the same subscript are significantly different at $p < .05$

2.1.7.5. Sale of Eggs

Close to 58% of households sold eggs during the 12 months period before the endline survey, an increase of 7% from baseline. Income earned from sale of eggs rose over 13-fold. But it is important to note here that part of the increase in income was caused by increase in price by 74% in the past five years (inflation). On average, a household received Birr 4,075 from sale of eggs at endline, which was an over 26-fold increase from baseline. Such dramatic changes can be largely attributed to improved productivity caused by increased ownership of improved chickens and use of improved feed and poultry management practices. Hence, the changes can be mainly attributed to the FEED II project interventions (Table 36).

Table 36: Number of Eggs Sold and Value of Sales from Eggs in the Last Year by Region at Baseline and Endline

Sale value of eggs	Amhara		Oromia		SNNPR		Tigray		Total	
	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline
HHs that sold eggs last year (%)	56.7	77.1a	55.4	61.6b	40.3	30.8c	49.7	61.5b	50.5	57.7
Number of eggs sold	36,254	557,856	24,065	242,052	38,375	185,160	54,666	324,912	153,351	1,309,980
Sale value of eggs	60,405	1,718,166	47,045	780,465	74,334	652,647	100,017	1,033,719	281,802	4,184,997
Average proceeds per HH that sold eggs	126	5083.3a	98	2858.8b	156	4763.8a,c	209	3705.1b,c	147	4,075

Note: Values in the same row and subtable not sharing the same subscript are significantly different at $p < .05$

Overall, there were significant changes in income from livestock and poultry over the past five years. Many beneficiaries have experienced increased household income from sale of milk, eggs and fattened animals in the past five years largely due to the projects intervention in raising livestock productivity such as better-quality forage and manufactured feeds and improved animal management.

2.2. Relevance

Relevance of the project was mainly assessed considering the level of participation of stakeholders throughout the project implementation cycle and their satisfaction with its results, and alignment of the project with government and target group priorities.

2.2.1. Alignment of project initiatives with government and target groups priorities

Ethiopia has the largest livestock population in Africa and the fifth largest in the world. The livestock subsector contributes nearly 20 percent of total GDP and foreign exchange earnings of the country, and some 35 to 40 percent of agricultural GDP. However, Ethiopia has not experienced significant

productivity gains in the livestock sub-sector. Meat and milk production and productivity have remained low. Milk yield averages 1.5 liters per day, which is about one-eighth of the milk yield for improved dairy breeds. Average daily milk yield from crossbred cows was also 8 liters per cow per day in 2014/15.

Similarly, there is a substantial productivity difference between local and improved poultry breeds. The local poultry breeds lay only 50 eggs per year, which is one-third the number laid by modern breeds. As a result of these low productivity levels, the livestock sector is characterized by relatively high greenhouse gas (GHG) emissions per unit of product. Average GHG emissions are 19 kg CO₂ eq/kg milk among mixed crop-livestock systems in Ethiopia, against an average of ca. 9 kg CO₂ eq./kg milk in Sub-Saharan Africa¹¹.

According to the World Bank, the key challenges that continued undermining the performance and potential of the livestock sub-sector include: reduced availability and access to communal grazing and natural pasture; insufficient access to forage, forage seeds and feed supply; poor animal health due to disease prevalence; and low livestock genetic make-up. Limited adoption of improved livestock practices and poor provision of livestock support services are also major sources of low productivity levels. The public sector dominates livestock support service delivery, which is weak for animal health, breeding, feed, and extension services. In addition, the sector has a low commercial market off-take due to inadequate processing and marketing infrastructure. Most farmers do not participate in the livestock market and household livestock production is ultimately consumed within the household or sold on the local market (World Bank, 2017).

Cognizant of its challenges and potential, the livestock sub-sector has been made a priority in the government's Second Growth and Transformation Plan (GTP II) from 2016-2020. In the GTP 2 period, the livestock sub-sector is seen as critical in achieving priority goals of the government including contributing to overall economic growth, contributing to poverty reduction, improving food security, and supporting the country's green growth priorities. These objectives are reflected in the recently-approved Livestock Master Plan (LMP). The investments proposed in the LMP include appropriate combinations of genetic, feed and health interventions and related policy changes to improve livestock productivity and the performance of the value chains. The interventions are meant to transform traditional family farms into improved market-oriented systems, to improve household incomes, food security, livestock product consumption and nutrition, and to contribute to national economic growth.

As clearly stated in the GTP 2 and the 2015-2020 Ethiopia Livestock Master Plan¹², the high cost and low availability of good quality animal feed from forage and fodder is one of the major constraints, if not the most critical constraint, to increasing productivity of livestock in dairy farms and feedlots, improved family and specialized poultry, and smallholder mixed crop-livestock and extensive livestock production systems. Against this background, the government has aimed to increase average daily milk yield from crossbred cows from 8 liters per cow per day in 2014/15 to 12 liters

¹¹ The World Bank. 2017. Livestock and Fisheries Sector Development Project (P159382)

¹² International Livestock Research Institute (ILRI). 2015. Ethiopia Livestock Master Plan: Roadmaps for Growth and Transformation (2015-2020)

per cow per day by 2019/20. GoE has also targeted to increase average meat production/cattle carcass yield from 107 kg in 2014/15 to 138 kg by 2019/20. Total eggs production is also projected to increase from 163 million in 2014/15 to 3,938 million by 2019/2013.

To deal with the challenges and achieve targets set for GTP II, different implementation strategies have been devised and implemented, including improving the genetics of livestock, and improving supply of livestock feed, integrated implementation of livestock value chain efficiency. In the GTP 2 period, the GoE has targeted to increase the number of cattle with improved genetics from 902,390 in 2014/15 to 4,902,000 by 2019/20. The findings showed that farmers are increasingly adopting improved practices such as investing on crossbreed livestock and poultry while reducing their stock of local livestock and poultry.

The 2015-2020 Ethiopia Livestock Master Plan also recognized shortage and unavailability of quality purchased concentrate feed and roughage; and lack of effective feed quality control and standards enforcement mechanisms as critical specific challenges to dairy productivity and strategized to deal with the challenges by making land available for commercial forage production by investors; enforcing feed quality standards, quality monitoring and control; promoting the establishment of flour mills to make more concentrate ingredients available; and promoting domestic production of cooking oil to replace the importation of cooking oil, and limiting or banning the exportation of oilseeds that affect availability of concentrate feeds. In this regard, the FEED II project was also found well aligned and highly relevant to the execution these government strategies. The project supported the establishment and expansion of feed manufacturing at cooperative unions, which increased the supply and affordability of formulated feed. It also strengthened the capacity of regulatory bodies to enable them formulate and enforce animal feed laws and standards.

With the aim to improve production and productivity of livestock and poultry, the government has been working on improvement of supply of livestock feed. In this regard, the government has targeted to increase from 68 million tons in 2014/15 to 184 million tons by 2019/20. Livestock feed from industrial by-products was also projected to increase from 1.5 million tons in 2014/15 to 3.3 million tons by 2019/2014. Given that the goal of FEED II is to increase the incomes of Ethiopian smallholder livestock producers by improving access to, and use of consistent, affordable, high quality animal feed that can support greater livestock productivity and efficiency, it is clear that FEED II is very supportive of this target of the government. The project improved supply of improved forage and formulated feed through capacity building, provision of seeds and seedlings, establishment of union-based feed manufacturing plants and nursery sites, promotion of improved on-farm feeding practices, and others.

The regions and woredas in which the project was implemented were also considered appropriate as they are among those woredas with higher potential for livestock and poultry production. Most importantly, livestock being the major source of livelihood for most smallholder farmers in the project regions and woredas, the project was well received by farmers. Government bodies as well

¹³ Federal Democratic Republic of Ethiopia, National Planning Commission (NPC). 2016. Growth and Transformation Plan II (GTP II) (2015/16-2019/20); Volume I: Main Text

¹⁴ *ibid*

as target beneficiaries found the project very relevant and well aligned with their priorities. Below is what an official of a regional agriculture bureau said which also represents the views of most stakeholders:

'Project activities are well aligned with the national as well as the regional government's policies, strategies and initiatives for the livestock sector. The regional livestock development initiative recognizes animal feed improvement both in quality and quantity as the primary area of development intervention. There is acute feed shortage in the region as determined by feed balance surveys that indicated a deficit of 25%. The region has long standing policy to reduce free grazing of livestock in favor of on-farm feeding with improved quality of feedstuff thereby reducing the intensity of environmental degradation. Therefore, the activities of the FEED II project are in support of these policies and initiatives of the regional government. The project is also well aligned with the priority needs of the farmers. With the current shrinking grazing resource, farmers are showinginterest in better quality feeds that can be fed on-farm.'

The project activities are directly related with the routine plan and duties of agriculture/livestock offices at regional and woreda levels. Their development strategy aims to improve livestock productivity and increase the contribution of livestock to family nutrition and income generation. FEEDII project supported livestock development by facilitating knowledge transfer, supporting adoption of improved technologies, improving supply and access to formulated feed and improved forage and other mechanisms. An official of another regional agriculture bureau said the following in this regard.

'The project activities were highly or smartly aligned with our existing programs, policies and strategies to solve the existing bottleneck in feed development and animal feeding practices. Farmers in our region are highly interested in livestock development, but the critical problem we face in livestock development in our region is the shortage of feed both in quality and quantity. As the main objective of the project is to improve the livelihood of the farmers through increasing the productivity of their livestock by the improving the feed availability and quality, and animal feeding practices of the farmers. Therefore, I believe that the Feed-II project has addressed the basic limiting factor in livestock development of farmers in our region and the country at general level by providing grant to unions to establish for feed processing plants and forage development, training the farmers and organize experience sharing events.'

Considering smallholder farmers' limited access to land for production of forage seed and forage, the project promoted backyard forage cultivation, and equipped farmers with the knowledge and skills needed to improve their forage growing systems. The project also provided improved seeds and vegetative materials to model farmers that helped them understand the value of using improved forage and obtain additional sources of feed. The capacity building support provided to farmers has also enabled them to utilize their feed efficiently, and properly feed and manage their animals. Alongside the promotion of improved forage at smallholder farmers, the project has also established forage nursery sites that could serve as sources of forage seed and seedlings to model and follower farmers over the long-term. These project activities contributed to improved livestock and poultry production and productivity, which has remained the critical priorities of the Government of Ethiopia. Farmers that participated in FGDs were also consistently stating how valuable and

important the project was to improve their productivity of their livestock on which their lives mainly depend.

The establishment of feed manufacturing plants under the unions was also accepted as both appropriate and innovative. Unions are associations of producer farmers established to improve the livelihoods of its members by closely working with them. The establishment of the feed plants under the jurisdiction of the unions is considered by all respondents from their perspectives as taking this new dimension of promoting concentrate feed production and utilization close to the beneficiaries. Farmers unions have gained the confidence of members thus making the process of adoption easier. The unions also have experience in business management by engaging in other enterprises. Farmers also have experience in using the services of unions. This was considered to be a recipe for success.

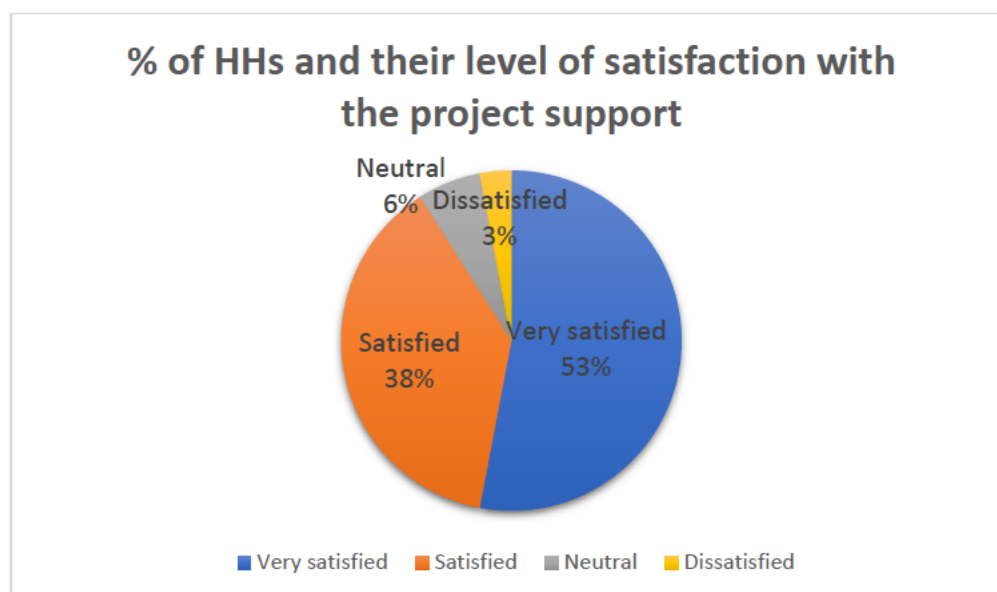
2.2.2. Stakeholders' participation in project implementation and satisfaction with the its results

The implementation approach was viewed as comprehensive and participatory. The project's mutually supportive/ complementary intervention components that included provision of training (feed production/plant management, business/accounting skills), follow up technical support, material support, advisory support, support to poultry/dairy/fattening enterprises that utilize the manufactured feeds, promotion of improved on-farm feeding practices, creation of market linkage for input supply and product sales, exchange visits to facilitate knowledge exchange/peer learning, capacity building of government and association support staff at different levels were also appreciated.

The project engaged stakeholders at all levels in the initiation and implementation of the project. Development of the knowledge horizon at different levels including the level of the technical staff (DAs) cascaded down to the level of the beneficiary farmers was considered to be a prime contribution. Job creation and encouragement of private sector participation were addressed by the project. Besides, the project has been operating in conformity with the communities' cultural, economic, and social context.

Almost all stakeholders consulted for the final evaluation expressed their satisfaction with the project results. 'Generally, the project contribution can be rated as excellent in feed manufacturing and increasing of livestock productivity in our region,' a regional agriculture office head said. Farmers that participated in the FGDs were also unanimous in stating their satisfaction with the project support. 'We are very satisfied with the support we got from the project. It has given us adequate training on concentrate feed and improved forages. We are also very happy as we are practically using the training we got from the project,' farmers that participated in one of the FGDs said. This opinion was shared by beneficiaries across project intervention areas. As shown in Figure 11 below, 93% of direct beneficiary farmers were satisfied or very satisfied with the project support. But beneficiary farmers' satisfaction seems to vary from one project intervention to another. Some are satisfied with the improved forage related activities of the project while others are happier with the improved livestock/poultry and feed management techniques they learned from the project.

Figure 11: Level of satisfaction of direct beneficiary farmers with the project support



2.3. Sustainability

Sustainability is about whether the positive outcomes of the action and the flow of benefits are likely to continue after the project funding ends. The fact that the project was very aligned with the government priorities implies that its outcomes and initiatives are more likely to be sustained. Project activities are well aligned with the national as well as the regional government's policies, strategies and initiatives for the livestock sector of the national economic development program. The regional livestock development initiative recognizes animal feed improvement both in quality and quantity as the primary area of development intervention. There is acute feed shortage in the regions as determined by feed balance surveys. The regions have long standing policy to reduce free grazing of livestock in favor of on-farm feeding with improved quality of feedstuff thereby reducing the intensity of environmental degradation. Therefore, the activities of the FEED II project are in support of these policies and initiatives of the regional government. The alignment has also helped government officials own the project interventions. Intervention woredas have been providing necessary support to nursery sites established with the support of the project and many continued supporting the sites by even allocating budget. Some have already started replicating the project initiatives in non-project kebeles. Experience sharing sessions among model farmers have also been recorded in videos, with the aim to use it to train other farmers in the future.

The project is also well aligned with the priority needs of the farmers. With the current shrinking grazing resource, farmers are showing attitudinal change in a favorable way, which implicates an interest in better quality feeds that can be fed on-farm. The project also built capacity of government experts to provide necessary support to smallholder farmers. The trainings given to government experts will contribute to sustainability. The development of training support materials like videos

by FEED II will go a long way to pursue capacity building effort by the extension service and possibly by the feed plants themselves to sustain building capacity beyond the project.

Most stakeholders, including farmers and government stakeholders, identified improved feeding techniques and use of feeder troughs; awareness created on production and use of improved forage; improved dairy, poultry and fattening practices; and manufacturing of compound feed and continued use of manufactured feeds as most likely to be sustainable and scalable across regions. Knowledge transferred to farmers on improved forage production and use, and other technologies promoted by the project could also be equally sustainable as the farmers start practicing what they have learned.

'The community has a good understanding about animal nutrition, so better livestock nutrition management will be sustained even if the project ends. In addition, farmers realize the benefit of concentrate feeds, especially to dairy and fattening. Therefore, improved fattening and dairy feeding systems also will be sustained,' a woreda agriculture officer said.

'Some activities are easy to adopt and implement and brought more return. From FEED II project livestock nutrition management, improved feeding systems, improved fattening and dairy are well understood by the community. The community can sustain these activities.' another woreda government official said.

Among project activities and outcomes, concentrate feed production and supply through union-based feed enterprises is the most sustainable and innovative, according to most people consulted for the final evaluation. Unions expressed that they will pursue the feed manufacturing operations post project. Many have shown this commitment through concrete steps of additional investments already in place and plans to do so. Some even intend to expand the operations beyond the current status by resolving the problems such as input supply shortages, power interruptions that limit production to fully utilize feed production capacity. A few expressed intentions to upgrade the current production capacity to produce more feed and a union like the Sidama Elto has already done so. Moreover, many unions also have the financial capacity and experience in running similar business enterprises to not only sustain but also expand the feed manufacturing operations.

The progressive increase in demand and income from enterprises have encouraged many unions to make further investments and give more attention to feed production. Some are working to establish complementary enterprises like flour mills that help to solve the problem of input supply. Unions like the Sidama Elto, are, for example, planning to establish complementary livestock production enterprises and a small factory that produces various sizes of packaging materials. The Bokra Union is engaged in livestock, poultry and dairy production as complementary enterprises and is about to establish a flour mill as part of an expansion plan.

The unions are also taking advantage of their member primary cooperatives to distribute their concentrate feed produces to farmers. The integrated approach of the project is also instrumental in sustenance of the concentrate feed manufacturing initiative. The project's approach covered the whole value chain ranging from building local capacity to manufacture feed mills and supply ingredients to linking input suppliers and output buyers with feed manufacturing enterprises to supporting livestock enterprises and creating awareness among farmers about the feed. Strong work

has been undertaken on both the demand and supply side that could sustain the project initiative and outcomes.

However, sustainability of some project activities and results may vary among the project regions. Nursery sites in Amhara region are being taken over by the regional government. The region has also started allocating budget to the nursery sites. When asked about this, one woreda official in the region said

“FEED II has already stopped its support. Currently, livestock office takes all responsibility to manage the nursery site. So far, the government office is able and willing to sustain the nursery site.”

In contrast, forage development was considered least sustainable in Oromia region. This is attributed to many factors; shortage of budget at woreda agriculture offices did not allow them to allocate funds to keep the nursery sites established by FEED II. Nursery sites visited by the field team were not functional at the time of the visit. Indeed, government officers indicated that the nursery sites have not been in operation during the last two years, which was the time the FEED II project has stopped providing funding for the sites. Stakeholders seem to agree that nursery sites would only be sustainable if the local government allocates budget to run them. Lack of clear ownership of nursery sites was also mentioned as another factor that challenges sustainability of the nursery sites. They are often established under unions that are supposed to work with woreda agriculture offices to manage them. However, there is no strong working relationship between unions and woreda agriculture/livestock offices. Unions are not also said to be that involved in the management of the nursery sites. These suggest that sustained access to improved forage seed and seedlings in the region would be challenged.

“The established nursery site has not been functional in the last two years because of lack of budget. They (FEED II) stopped funding the nursery site before the project phase-out. The annual budget allocated for the office can’t sustain the nursery site. There is also poor relation between union and livestock and fishery development office. But forage development can easily scale up if budget allocated.” A woreda government official in one of the project’s woredas in Oromia region said.

Farmers also consistently identified lack and/or unaffordability of improved forage seed/seedlings as a threat to the sustenance of growing improved forage in their plots. Although farmers are made aware of the value of improved forage, some were not also able to grow them as much as they wanted due to drought. The climatic condition of some of the project woredas was not that suitable for forage production without irrigation. Some improved forages also failed to germinate in some project areas. Among forage varieties promoted by the project, planting of improved forage crops especially Rhodes grass (*Chloris gayana*) was considered relatively more sustainable than others.

Although most of the project outcomes and activities are more likely to be sustainable, there are some risks that may challenge their continuation. Most of these risks were also identified in the mid-term review of FEED II. The costly nature of inputs used to manufacture concentrate feed has remained to

be a major challenge for unions to produce as much as they wanted and reduce the cost of feed to farmers. Some are trying to deal with the challenge by producing some inputs in house.

Others, and particularly those in Tigray region, are still struggling to find ingredients locally. Although the project did a great job in linking feed manufacturing enterprises with ingredient suppliers, some are still transporting important ingredients from Addis Ababa, which increases their cost of production and reduces competitiveness of their feed product. The price of concentrate feed was also considered not affordable to many farmers. This was mainly associated with the use of such improved feed on less productive local breeds and limited access to central markets to sell livestock products at better prices. Farmers also lack capital to adopt certain technologies such as purchasing cross-bred dairy cows (which nowadays cost birr 60,000 – 80,000) that respond favorably to feeding of improved forage crops introduced by the project. This was also mentioned as a risk to continued adoption of improved feeds and practices promoted by the project.

There are also some risks associated with dealers of manufactured feed. Some dealers of feed are shifting to selling raw materials such as noug cake rather than compounded feed mainly because of limited promotion by union, misunderstanding on feed quality, and unattractive return from sale of union-manufactured feed. Dealers find more profit from selling ingredients than concentrate feed as demand for ingredients are high due to relatively cheaper prices. Additionally, the distribution channel established by feed manufacturing enterprises is still very weak. Unions are still not adequately utilizing their member primary cooperatives to distribute their feed and make them accessible to farmers. In some areas, farmers buy the feed directly from feed manufacturing plants, which were found to have bureaucratic processes to manage sales.

Drought and shortage of land have been challenging the sustainability of improved forage production in many areas. In some areas, the drought did not allow farmers to cultivate improved forage on their land. The perennial grass could not resist shortage of water during the dry season. Most farmers also own land that is too small to grow improved forage. As a result, farmers in these areas were not able to observe changes that could be brought about by feeding improved forage to their livestock. Many farmers have also identified unavailability of improved forage seed as a major problem to continued cultivation of forage in their land. Those that were also able to source the seeds in the local market also found it unaffordable for them to buy. Like concentrate feed, many stakeholders also indicated that use of improved forage on local breeds would not be cost effective as their productivity is very low. The fact that some nursery sites have ceased to function could also mean that sustained access to forage seed supply will be curtailed. Although there are regional variations, some nursery sites were not operational during the field visit due to lack of budget. Some particularly in Oromia region ceased their operation immediately after the project stopped its funding. Hence, many stakeholders question whether nursery sites will continue in the absence of a clear owner and continued project support. In sum, interruption of forage seed supply which is likely when the project ends will be a major risk to sustainable production and use of improved forage.

The fact that the project was implemented through the existing government structure and staff created strong sense of ownership, which is also instrumental for sustainability of project outcomes.

However, the government staff are not providing the required follow-up and support to smallholder farmers. Some training sessions particularly on improved forage were not also followed by provision of seed/seedlings. To many farmers, the provision of training and materials may not guarantee achievement of desired results unless the project ensures that the farmers have put the knowledge and technologies transferred through the project into practice. These limitations have hindered adoption of some improved practices and technologies by some farmers.

Limited access to markets might also have negative impact on sustainability of some project initiatives. Many farmers that were able to improve their livestock productivity and production with the use of improved forage were unable to sell their livestock products at better prices. The project's work on livestock enterprises was an initiative in the right direction. But the scope of the initiative was not found to be large enough to create access to market to livestock farmers.

2.4. Cross-Cutting Issues

The FEED II project took gender as a cross-cutting issue. It aimed to ensure that at least 30% of its beneficiaries are women. Gender disaggregated data has also been gathered to track progress towards the target. Project progress reports show that 34% of the 43,607 direct beneficiary households were women. Analysis of survey data also suggests that some of the responsibilities that used to be left for women are increasingly getting shared by men, and women are also increasingly involved in some livestock and poultry activities that used to be left for men. Although key household decisions such as livestock feed purchasing and selling of cows and calves are still mainly made by men, the findings showed that some activities such as feed collection and feeding that used to be undertaken by men or women alone have become more of a joint responsibility of men and women. A relatively similar pattern was also observed in poultry management. In sum, many responsibilities that used to belong to either men or women alone are increasingly becoming joint responsibilities, which is a positive development towards gender equality.

3. LESSONS LEARNED, CONCLUSIONS AND RECOMMENDATIONS

- i. The establishment of forage nursery sites under cooperative unions while also ensuring woreda agriculture/livestock office provide technical support and provide land could be considered an appropriate strategy to run the sites. This strategy worked well in most cases. However, unions are not as involved in the nursery site management and seem to lack ownership. This is partly because nursery sites in most cases are currently providing services free of charge to farmers and does not generate income for unions. This is a disincentive for union management to get involved in the management of nurseries. The project also tried to transfer the ownership of nursery sites to government and/or unions depending on their level of involvement and ownership. Governments in some regions have allocated budget to run the nursery sites. While this makes sense, it is likely that nursery sites managed by these

entities will be challenged by inadequate financial capacity of local governments or lack of commitment from officials. The lesson that might be taken here is probably the need to run nursery sites as commercial entities under the ownership of private enterprises that will be fully committed to sustain and keep them operational.

- ii. Establishing forage seed multiplication nurseries at strategic locations and entities plays pivotal role in sustained supply of new forage varieties. Nursery sites established in Tigray region were not successful. That was said to relate to the entities under which they were established. Unlike other regions in which nurseries were established under cooperative unions, nursery sites in Tigray were established under primary cooperatives that were established by unemployed youth upon the request of the regional government. These primary cooperatives were, however, not that strong and able to sustain the nursery sites. As a result, three nursery sites established in the region have failed. While the need to establish nursery sites as commercial entities is strongly suggested, it can also be inferred that attaching nurseries to more stable organizations such as cooperative unions is vital.
- iii. The project was considered much different from other projects in the practical training and support it provided. Stakeholders were impressed with the behavioral change brought about among farmers following the training. Beneficiaries put what they learned into practice and achieved greater results. Hence, though it sounds a general truth, the lesson drawn here is the learning that it was 'possible to change the attitude of the farmer through practical training from the traditional beliefs such as keeping many unproductive animals towards keeping lesser number of productive animals commensurate with available feed resource,' as one government official put it.
- viii. The implementation of integrated initiatives made the project very successful in achieving its targets and helping target groups improve their livelihood. Even so, it was learned that increasing livestock and poultry productivity through improved forage and feed cannot be a standalone objective unless the intervention includes or partners with initiatives that improve access to market and improved breeds. FEED III may need to work more on improving access to improved breeds and market to sell products by including these activities in its package or partnering with other organizations that work on artificial insemination (AI), animal health, and markets. There is a need to consider linking the feed distribution and farmer capacity building effort with areas where such complementary interventions like breed improvement (AI service) and health interventions to benefit from enhanced benefits from the combined interventions. More work is also needed in the future to create awareness among farmers about manufactured feed to create demand for these products while at the same time improve their livestock and poultry productivity.
- iv. Establishment of feed manufacturing enterprises under cooperative unions was an effective strategy that can be emulated elsewhere. This strategy worked well in improving accessibility of manufactured feed by using a network of member primary cooperatives that are close to smallholder farmers. Being farmer owned, unions are also discharging their membership and social goals by producing quality feed and selling them at prices lower than those charged by traders.
- v. Price of technology promoted by the project and its cost-effectiveness was found to have significant influence in adoption of the technologies. Many farmers and stakeholders agreed that the current price of manufactured feed is too high and less cost effective for farmers that largely herd local breeds which are less responsive to improved feed. As a result of the high

price, farmers are resorting to other options. Hence, efforts need to be exerted in the future to make price of concentrates more affordable and cost effective by supporting feed enterprises to increase their capacity utilization and expansion, and implementing strategies to reduce prices of ingredients. Among others, this might include the need to consider integration of feed manufacturing with other complementary factories like oil and flour mills to be established where feasible/appropriate. In connection with this, it may be important to explore/promote the possibility of union member PCs to engage in the production of feed ingredients like maize, soybean, etc. possibly based on a contractual agreement with the feed plant where feasible/appropriate;

- vi. Government bodies are very much interested in scaling up feed manufacturing and nursery sites in the future. But it is likely that they may be constrained by financial and technical capacity limitations. Hence, future interventions are advised to support scaling up of the project initiatives inside and outside the FEED II project interventions. Part of this effort may focus on documenting and disseminating the project activities and achievements to relevant policy makers and other executive organs. Future interventions are also recommended to create mechanisms to link existing feed manufacturing enterprises and nursery sites to woredas with no feed manufacturing enterprise or nursery sites.
- vii. The project catalyzed increased private sector investment in manufactured feed production. While this is a positive development in terms of increasing supply and ultimately reducing price of such feed, it also brings challenges along with it particularly for union-based feed manufacturing plants established by the project. The increased private sector investment will make the market very competitive, which might not be easy for unions to win. Hence, there is a need for continued support to unions to enhance the capacity of their management to be able to compete with the growing private investors that are expected to be flexible and market oriented while at the same time more efficient with increased production and economies of scale.
- viii. The evaluation study design did not allow adequate attribution of outcomes to the project intervention. This was because there was no control group at baseline and endline. Hence, future interventions may need to consider the use of quasi-experimental evaluation design to better measure achievements and draw conclusions.
- vi. The adaptation and poor germination problems of some of the forage varieties observed in some of the study area suggests that suitable varieties (make adaptation trial first) and technologies needs to be carefully selected before popularization to beneficiaries.
- ix. Free supply of seeds by NGOs for farmers could create dependence at farmers level and farmers becoming reluctant to buy seeds and seedling which also the concern raised by the respondents and needs to be considered.
- x. For forage production, good quality land with better fertility, access to irrigation and other facilities such as road and proximity to market are required. Investment in seed production business may need access to finance. But the major challenge in forage seed multiplication is lack of information on the future demand of seeds and planting materials. Alternatives are possible to meet the high demand for forage seeds/seedlings: 1) expand the nursery operation in other places with abundant space and irrigable water 2) out-source/ engage farmers in seed production with technical backstopping and quality control, 3) increase

awareness of farmers about forage seeds, splits and cuttings is better way to sustain the nursery sites, 4) ensure access to finance.

- xi. Government bodies need to allocate sufficient budget to nursery site management and follow up of other interventions. Unions should also own the nursery sites that are established under them and work closely with government to operate them.
- xii. Strengthen the capacity of primary cooperatives so that they can distribute formulated feeds to their members and beyond; and engage agro-dealers more intensively in the distribution system.
- xiii. Foster contractual agreements with input suppliers to avoid intermittent supply of inputs. Foster linkages with financial institutions to help cater for the capital limitations expressed by some feed plants to expand to meet increasing demand.
- xiv. Provide support to ease the bureaucratic operations of the procurement, distribution and routine management through promoting more autonomy to the feed plants commensurate with the growth in their operations to foster faster decision making which may include, but not limited to, revisiting or modifying some procurement rule and regulation of the union to allow the feed plant to buy inputs on its own; and assigning professional managers, accountant and other staff dedicated to the feed manufacturing operation as warranted by the level of development of the feed plant.
- xv. Adequate dedicated storage both at the factory and distribution sites has been a serious limitation. Fostering expansion of storage capacity will substantially improve the volume of input purchase at appropriate times, continuous availability of formulated feed at points demanded.

ANNEXES

Annex 1) FEED II Project's Achievement on Outcome Indicators and Targets

Outcome-1: Increased Agricultural Productivity		Definition			
Indicator-1	Percent increase in unit productivity of fattened cattle	Percentage increase in productivity of fattened cattle per head over the measured baseline.			
		Unit: Percent			
		Cattle Fattening	Total		Percentage Change
			Baseline	Endline	
		Total cattle fattened	1,293	1709	32%
		Cattle fattened per 100 households	12.93 ¹⁵	17.1	32%
Indicator-2	Percent increase in unit productivity of poultry	Percentage increase in productivity of local and exotic/ improved poultry, by counting the total number of poultry (all types) raised over baseline.			
		Unit: percent			
		Average number of poultry owned by a household by breed	Baseline	Endline	% Change
		Local	5.8	3	-48%
		Improved	3.1	7.08	128%
Indicator-3	Percent increase in unit productivity of milk	This indicator will measure the percentage increase in productivity of milk, by counting liters of milk produced and calculating the percentage increase over the measured baseline.			
		Unit: Percent			
		Milk Productivity	Baseline	Endline	% Change
		Average maximum amount of milk collected (liters/cow/ day)	2.95	6.02	104%
		Average Minimum Amount of milk collected (liters/cow/ day)	1.42	3.6	154%

¹⁵ The baseline report stated 17.2 instead of 12.93

		Average milk collected (liters/cow/ day)	2.185	4.81	120%
Outcome-2: Expanded Trade of Agricultural Products					
Indicator-1	Percent increase in sales of agricultural products (fattened cattle, poultry, feed, milk/milk products and eggs) by project beneficiaries	This indicator will calculate the gross sales of these five products by beneficiaries at various points over the life of project to compare. Unit: Percent			
		Sales items	Baseline	Endline	
		Total birr collected from sale of fattened oxen	8,356,726	20,934,293	
		Total sales collected from sale of fattened cow (birr)	940,868	1,997,148	
		Total sales collected from milk sale (birr)	1,168,042	7,412,958	
		Total sales collected from butter sale, birr	1,277,316	3,988,718	
		Total sales collected from sale of pullets (birr)	413,207	178,294	
		Total sales collected from sale of broilers (birr)	190,093	275449	
		Total sales collected from sale of spent hens (birr)	55,093.80	385,123	
		Sale value of eggs	281,802	4,184,997	
		Total	12,683,148	39,356,980	
		Sales per year per household	6,626.51 ¹⁶	20,562.69	
		% change	210%		
Indicator-2	Return on investment from livestock feed related activities	This indicator will calculate the change in gross revenues as a percent of expenditures associated with a commercial activity. Unit: Percent			
		Investment category	Rol		
		Feed Manufacturing	23.3		
		Livestock and Poultry Enterprises	26		
		Average Rol	24.65		

¹⁶ The baseline report reported ETB 9,744.14 as the value of products/year/ HH (birr) while the evaluation team computed ETB 6,626.51 from the baseline dataset.

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Annex 3) Sample Beneficiary Households' Sex, Age, Education Status, Family Size and Membership in Cooperatives Disaggregated by Region

		Tigray		Amhara		Oromia		SNNP		Total	
		N	%	N	%	N	%	N	%	N	%
Gender of the household head	Male	388a,b	83	422a	88	405a	87	385b	80	1600	85
	Female	79a,b	17	58a	12	59a	13	98b	20	294	14
Gender of the respondent	Male	359a	77	373a	78	297b	64	311b	64	1340	71
	Female	108a	23	107a	22	167b	36	172b	36	554	29
Age of the household head	Less than 30 years	32a	7	21a,b	4	12b	3	20a,b	4	85	5
	30 – 40 years	127a	27	137a	29	154a	33	159a	33	577	31
	41 - 50 years	138a	30	192b	40	151a,b	33	163a,b	34	644	34
	Over 50 years	170a	36	130b	27	147a,b	32	141a,b	29	588	31
Education status of the Head	None	173a	37	142a,b	30	111b,c	24	97c	20	523	28
	Read & Write	53a	11	187b	39	54a	12	139c	29	433	23
	Primary	197a	42	127b	27	178a	38	181a	38	683	36
	Secondary	39a,c	8	23a	5	100b	22	54c	11	216	11
	Above secondary	5a,c	1	1a	0	21b	5	12b,c	3	39	2
Membership in cooperatives	Member	301a	65	377b	79	373b	80	297a	62	1348	71
	Non-member	166a	36	103b	22	91b	20	186a	39	546	29
Cooperation Type	Livestock	17a	6	2b	1	153c	41	71d	24	243	18
	Multipurpose	278a	92	364a	97	186b	50	217c	73	1045	78
	Both	6a	2	11a	3	34b	9	9a	3	60	5
		Mean	N	Mean	N	Mean	N	Mean	N	Mean	N
Average Household Size of Households Disaggregated by Region	Male	3.15 _a	467	3.14 _a	480	3.30 _a	464	3.96 _b	483	3.39	1894
	Female	2.92 _a	467	2.92 _a	480	2.91 _a	464	3.65 _b	483	3.10	1894
	Total	6.07 _a	467	6.05 _a	480	6.21 _a	464	7.61 _b	483	6.49	1894

Note: Values in the same row and subtable not sharing the same subscript are significantly different at $p < .05$

Annex 4) Percentage of Households and their Ownership of Mature Cows by Size of Holdings, Region and Breed Type at Baseline and Endline

Regions		Amhara		Oromia		SNNPR		Tigray		Total	
N	Baseline	478		480		477		479		1914	
	End line	480		464		483		467		1894	
Mature cows	Term	Indigenous	Crossbreed	Indigenous	Crossbreed	Indigenous	Crossbreed	Indigenous	Crossbreed	Indigenous	Crossbreed
No mature cow	Baseline	22.8	84.1	19	67.9	23.3	74.6	20	83.3	21.3	77.5
	Endline	15.2	67.1	34.7	50.9	26.7	59.4	35.3	70.2	27.9	61.9
1-2 head	Baseline	57.1	14.9	62.1	24.2	65.2	23.5	65.3	15.2	62.4	19.4
	Endline	53.8	31.5	48.3	32.8	54.0	31.5	45.8	23.6	50.5	29.8
3-4 head	Baseline	16.5	1	16.3	6.9	9.4	1.7	9.8	0.8	13	2.6
	Endline	26.9	1.3	11.0	11.6	12.6	8.1	12.0	4.9	15.7	6.4
5-9 head	Baseline	3.6	-	2.5	0.8	1.7	0.2	3.5	0.6	2.8	0.4
	Endline	4.0	0.2	5.6	4.1	5.8	1.0	4.7	0.9	5.0	1.5
10-19 head	Baseline	-	-	0.2	0.2	0.4		1.3		0.5	0.1
	Endline	0.2	0.0	0.4	0.6	0.8	0.0	1.5	0.2	0.7	0.2
20 and more	Baseline	-	-	-	-	-	-	-	-	-	-
	Endline	-	-	-	-	-	-	0.6	0.2	0.2	0.1
Cow count (number)	Baseline	754	110	752	340	636	174	729	127	2871	751
	Endline	942	213	660	551	785	357	794	302	3181	1423
Mean cow holding	Baseline	1.57	0.2	1.56	0.7	1.3	0.4	1.7	0.3	1.5	0.4
	Endline	1.96	0.44	1.42	1.19	1.63	0.74	1.70	0.65	1.68	0.75

Annex 5) Percentage of Households by Size of Bull/Ox Holding and Region at Baseline and Endline

Regions		Amhara		Oromia		SNNPR		Tigray		Total	
N	Baseline	478		480		477		479		1914	
	End line	480		464		483		467		1894	
Heads of Mature bull/ox	Term	Indigenous	Crossbreed	Indigenous	Crossbreed	Indigenous	Crossbreed	Indigenous	Crossbreed	Indigenous	Crossbreed
No mature bull/ox	Baseline	24.9	91.4	17.1	80.4	35.8	93.9	27.8	95.4	26.4	90.3
	End line	12.3	84.0	21.8	71.6	37.1	93.2	21.8	84.6	23.3	83.4
1-2 head	Baseline	52.1	7.9	51.7	17.1	54.5	5.9	57.6	3.8	54	8.7
	End line	54.4	15.4	48.7	22.0	55.1	6.6	49.5	11.1	52.0	13.7
3-4 head	Baseline	19.5	0.4	24.4	2.5	6.9	0.2	11.3	0.4	15.5	0.9
	End line	27.5	0.6	23.1	5.2	7.0	0.2	19.5	3.4	19.2	2.3
5-9 head	Baseline	3.1	0.2	6.5	-	2.5	-	2.1	0.4	3.6	0.2
	End line	5.6	-	6.5	1.1	0.6	-	7.1	0.9	4.9	0.5
10-19 head	Baseline	0.4		0.4		0.2		0.8		0.5	-
	End line	0.2	-	-	0.2	0.2	-	2.1	-	0.6	0.1
20 and more	Baseline	-	-	-	-	-	-	0.4	-	0.1	-
	End line	-	-	-	-	-	-	-	-	-	-
Bull/Ox count	Baseline	803	56	1020	157	555	37	778	42	3156	292
	End line	1054	93	935	258	537	38	1000	150	3526	539
Mean bull/ox holding	Baseline	1.7	0.1	2.1	0.3	1.2	0.1	1.6	0.1	1.6	0.2
	End line	2.20	0.19	2.02	0.56	1.11	0.08	2.14	0.32	1.86	0.28

Annex 6) Percentage of respondents who have access the different feed items in terms of how far is the nearest distribution point

		Regions																			
		Amhara					Oromia					SNNPR					Tigray				
	How far is the nearest distribution point the feed items?	<16 km	16-30 km	30 km or more	No distribution point in the area	I do not know	<16 km	16-30 km	30 km or more	No distribution point in the area	I do not know	<16 km	16-30 km	30 km or more	No distribution point in the area	I do not know	<16 km	16-30 km	30 km or more	No distribution point in the area	I do not know
FEED ITEMS	Concentrates (factory formulated and mixed feed)	6.5 _{a,b}	25.6 _a	10.3 _{a,b}	4.7 _{a,b}	5.5 _b	52.7 _a	23.8 _{a,b}	44.0 _{a,b}	34.6 _{a,b}	25.6 _b	64.9 _{a,b}	42.9 _a	44.4 _{a,b}	53.5 _{a,b}	78.9 _b	43.7 _a	43.0 _a	37.8 _{a,b}	11.8 _b	40.0 _b
	Agro-industrial by-products (wheat bran, oilseed cake, molasses, brewers grain, etc)	45.7 _{a,c,d}	23.1 _{a,b,e}	52.6 _c	25.6 _{b,d,e}	15.4 _e	24.2 _a	47.6 _a	24.0 _a	46.2 _a	17.9 _a	6.7 _a	10.7 _a	11.1 _a	3.0 _a	.0 ¹	31.9 _a	12.8 _b	29.7 _{a,b}	67.6 _c	6.7 _b
	Other high quality feeds (atela, grains)	82.6 _a	94.9 _a	89.2 _a	76.7 _a	81.3 _a	79.5 _a	61.9 _a	76.0 _a	61.5 _a	79.5 _a	16.3 _a	10.7 _{a,b}	44.4 _b	18.2 _{a,b}	26.3 _{a,b}	86.7 _a	80.2 _{a,b}	73.0 _{a,b}	88.2 _a	46.0 _b
	Green forage, grass, hay, silage	93.5 _a	97.4 _a	71.1 _b	97.7 _a	100.0 ¹	86.4 _a	85.7 _a	96.0 _a	84.6 _a	87.2 _a	96.6 _a	100.0 ¹	100.0 ¹	91.9 _a	100.0 ¹	100.0 ¹	96.5 _a	94.6 _a	100.0 ¹	100.0 ¹
	Crop Residue (teff straw, wheat straw, maize stover)	93.5 _a	94.9 _a	93.8 _a	97.7 _a	100.0 ¹	95.8 _a	100.0 ¹	88.0 _a	96.2 _a	92.3 _a	98.6 _a	89.3 _b	100.0 ¹	94.9 _{a,b}	100.0 ¹	99.3 _a	94.2 _b	100.0 ¹	100.0 ¹	100.0 ¹

Note: Values in the same row and sub table not sharing the same subscript are significantly different at $p < .05$ in the two-sided test of equality for column proportions. Cells with no subscript are not included in the test. Tests assume equal variance.

1. This category is not used in comparisons because its column proportion is equal to zero or one.

2. Tests are adjusted for all pair wise comparisons within a row of each innermost sub table using the Bonferroni correction.

Annex 7) Return on Investment and Gross Margin of Feed Manufacturing Enterprises

FCU ¹⁷	Total investment	2016					2017					2018				
		Sales	Total cost	Return	ROI (%)	GM (%)	Sales	Total cost	Return	ROI (%)	GM (%)	Sales	Total cost	Return	ROI (%)	GM (%)
Enterprise 1	1,549,288	1,657,425	1,614,080	89,362	5.8	2.6	2,169,135	2,072,063	97,072	6.3	4.5	3,357,250	3,207,809	149,441	9.6	4.5
Enterprise 2	1,502,955	3,230,789	2,829,048	401,741	26.7	12.4	1,498,458	1,453,970	44,488	3.0	3.0	3,322,644	2,433,905	888,739	59.1	26.7
Enterprise 3	1,549,288	1,996,220	1,782,838	213,382	13.8	10.7	379,421	523,098	-143,677	-9.3	-37.9					
Enterprise 4	1,765,140						5,578,214	5,126,801	451,412	25.6	8.1					
Enterprise 5	1,552,947	1,374,733	1,298,443	76,443	4.9	5.5	2,339,258	2,134,801	204,457	13.2	8.7					
Enterprise 6	1,556,002						1,181,430	1,009,158	172,272	11.1	14.6	1,876,698	1,700,282	176,416	11.3	9.4
Enterprise 7	1,725,878						2,595,967	2,416,780	179,187	10.4	6.9					
Enterprise 8	1,562,529						2,537,826	2,264,625	273,201	17.5	10.8	3,299,510	2,812,774	486,736	31.2	14.8
Enterprise 9	1,562,529						2,986,328	2,642,189	344,139	22.0	11.5					
Enterprise 10	1,617,791						2,018,054	1,886,952	131,102	8.1	6.5	1,818,550	1,700,409	118,141	7.3	6.5
Enterprise 11	1,531,963						1,544,148	1,479,205	64,943	4.2	4.2					
Enterprise 12	1,549,254						2,465,974	2,376,437	89,537	5.8	3.6					
Total	19,025,565	8,259,167	7,524,409	734,758	11.9	8.9	27,294,211	25,386,079	1,908,132	10.0	7.0	13,674,652	11,855,179	1,819,473	9.6	13.3
Investment by the project	15,605,565.45															
Investment by unions	3,420.00															

Source: ACIDI/VOC FEED II Project

¹⁷ The evaluation team chose to not to identify enterprises by name as the financial data are confidential.

Annex 8) Return on Investment of Livestock/Poultry/Forage Enterprises¹⁸

YR	ITEM	NAME OF ENTERPRSE															G.Total	
		DAIRY								POULTRY				FATTNING				
		Firm 1	Firm 2	Firm 3	Firm 4	Firm 5	Firm 6	Firm 7	Total	Firm 8	Firm 9	Firm 10	Total	Firm 11	Firm 12	Total		
2016	Investment	582,713	785,282	529,175	605,160		704,609	399,059	3,605,998	937,093	816,393	801,525	2,555,010	472,746	-	472,746	6,633,754	
	CASH IN (Revenue)	1,024,036	812,355	115,689	40,100		223,468	322,748	2,538,396	554,879	176,400	292,666	1,023,945	339,000		339,000	3,901,341	
	CASHOUT (expense)	930,417	729,559	285,631	107,795		127,168	305,807	2,486,375	365,600	139,662	190,657	695,919	290,340		290,340	3,472,634	
	NET CASH	93,619	82,797	(169,942)	(67,695)		96,301	16,942	52,021	189,279	36,738	102,009	328,026	48,660		48,660	428,707	
	ROI	16%	11%	-32%	-11%		14%	4.2%	1.4%	20%	5%	13%	13%	10%		10%	6%	
2017	New investment	153,000	128,500	59,463	450,000	1,983,000	64,390	84,381	2,922,734	-	-	-	-	-	1,490,000	1,490,000	4,412,734	
	T-Investment	735,713	913,782	588,638	1,055,160	1,983,000	768,999	483,441	6,528,732	937,093	816,393	801,525	2,555,010	472,746	1,490,000	1,962,746	11,046,489	
	CASH IN (Revenue)	1,521,463	1,453,409	344,415	245,151	1,800,045	223,468	483,636	6,071,586	956,855	275,443	614,000	1,846,298	402,760	437,480	840,240	8,758,124	
	CASHOUT (expense)	1,389,358	1,309,140	341,937	292,151	669,100	137,874	466,543	4,606,104	620,715	212,848	351,931	1,185,494	713,254	579,718	1,292,972	7,084,570	
	NET CASH	132,104	144,269	2,477	(47,000)	1,130,945	85,594	17,093	1,465,482	336,140	62,595	262,069	660,803	(310,494)	(142,238)	(452,732)	1,673,553	
	ROI	18%	16%	0%	-4%	57%	11%	3.5%	22%	36%	8%	33%	26%	-66%	-10%	-23%	15%	
2018	New investment					117,000		880	117,880						-	-	117,880	
	T-Investment					2,100,000		484,321	2,584,321						1,490,000	1,490,000	4,074,321	
	CASH IN (Revenue)					1,526,550		320,403	1,846,953						284,000	284,000	2,130,953	
	CASHOUT (expense)					722,700		258,838	981,538						343,487	343,487	1,325,024	
	NET CASH					803,850		61,566	865,416						(59,487)	(59,487)	805,929	
	ROI					38%		13%	33%						-4%	-4%	20%	
Sum	Total Investment	735,713	913,782	588,638	1,055,160	2,100,000	981,665	484,321	6,859,279	937,093	816,393	801,525	2,555,010	472,746	1,490,000	1,962,746	11,377,035	

¹⁸ The evaluation team chose to not to identify enterprises by name as the financial data are confidential.

	CASH IN (Revenue)	2,545,499	2,265,764	460,104	285,251	3,326,595	446,936	1,126,787	10,456,935	1,511,734	451,843	906,666	2,870,242	741,760	721,480	1,463,240	14,790,418
	CASHOUT (expense)	2,319,775	2,038,699	627,568	399,946	1,391,800	265,042	1,031,187	8,074,017	986,315	352,510	542,588	1,881,413	1,003,594	923,204	1,926,798	11,882,228
	NET CASH	225,723	227,065	(167,465)	(114,695)	1,934,795	181,895	95,600	2,382,918	525,419	99,333	364,078	988,829	(261,834)	(201,724)	(463,558)	2,908,189
	ROI	31%	25%	-28%	-11%	92%	19%	20%	35%	56%	12%	45%	39%	-55%	-14%	-24%	26%

Annex 9) List of Key Informants Consulted

Amhara Region						
S.N.	Full Name	Organization	Position in the Organization	Telephone	Woreda	Region
1	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
2	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
3	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
4	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
5	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
6	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
7	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
8	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
9	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
10	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
11	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
12	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
13	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
14	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
15	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
16	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
17	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
18	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
19	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
20	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
21	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
22	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
23	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
24	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
25	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
26	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
27	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
28	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
29	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
30	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]

[illegible]

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57	58	59	60	61	62	63
64	65	66	67	68	69	70
71	72	73	74	75	76	77
78	79	80	81	82	83	84
85	86	87	88	89	90	91
92	93	94	95	96	97	98
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148	149	150	151	152	153	154
155	156	157	158	159	160	161
162	163	164	165	166	167	168
169	170	171	172	173	174	175
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183	184	185	186	187	188	189
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218	219	220	221	222	223	224
225	226	227	228	229	230	231
232	233	234	235	236	237	238
239	240	241	242	243	244	245
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253	254	255	256	257	258	259
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274	275	276	277	278	279	280
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323	324	325	326	327	328	329
330	331	332	333	334	335	336
337	338	339	340	341	342	343
344	345	346	347	348	349	350
351	352	353	354	355	356	357
358	359	360	361	362	363	364
365	366	367	368	369	370	371
372	373	374	375	376	377	378
379	380	381	382	383	384	385
386	387	388	389	390	391	392
393	394	395	396	397	398	399
400	401	402	403	404	405	406
407	408	409	410	411	412	413
414	415	416	417	418	419	420
421	422	423	424	425	426	427
428	429	430	431	432	433	434
435	436	437	438	439	440	441
442	443	444	445	446	447	448
449	450	451	452	453	454	455
456	457	458	459	460	461	462
463	464	465	466	467	468	469
470	471	472	473	474	475	476
477	478	479	480	481	482	483
484	485	486	487	488	489	490
491	492	493	494	495	496	497
498	499	500	501	502	503	504
505	506	507	508	509	510	511
512	513	514	515	516	517	518
519	520	521	522	523	524	525
526	527	528	529	530	531	532
533	534	535	536	537	538	539
540	541	542	543	544	545	546
547	548	549	550	551	552	553
554	555	556	557	558	559	560
561	562	563	564	565	566	567
568	569	570	571	572	573	574
575	576	577	578	579	580	581
582	583	584	585	586	587	588
589	590	591	592	593	594	595
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603	604	605	606	607	608	609
610	611	612	613	614	615	616
617	618	619	620	621	622	623
624	625	626	627	628	629	630
631	632	633	634	635	636	637
638	639	640	641	642	643	644
645	646	647	648	649	650	651
652	653	654	655	656	657	658
659	660	661	662	663	664	665
666	667	668	669	670	671	672
673	674	675	676	677	678	679
680	681	682	683	684	685	686
687	688	689	690	691	692	693
694	695	696	697	698	699	700
701	702	703	704	705	706	707
708	709	710	711	712	713	714
715	716	717	718	719	720	721
722	723	724	725	726	727	728
729	730	731	732	733	734	735
736	737	738	739	740	741	742
743	744	745	746	747	748	749
750	751	752	753	754	755	756
757	758	759	760	761	762	763
764	765	766	767	768	769	770
771	772	773	774	775	776	777
778	779	780	781	782	783	784
785	786	787	788	789	790	791
792	793	794	795	796	797	798
799	800	801	802	803	804	805
806	807	808	809	810	811	812
813	814	815	816	817	818	819
820	821	822	823	824	825	826
827	828	829	830	831	832	833
834	835	836	837	838	839	840
841	842	843	844	845	846	847
848	849	850	851	852	853	854
855	856	857	858	859	860	861
862	863	864	865	866	867	868
869	870	871	872	873	874	875
876	877	878	879	880	881	882
883	884	885	886	887	888	889
890	891	892	893	894	895	896
897	898	899	900	901	902	903
904	905	906	907	908	909	910
911	912	913	914	915	916	917
918	919	920	921	922	923	924
925	926	927	928	929	930	931
932	933	934	935	936	937	938
939	940	941	942	943	944	945
946	947	948	949	950	951	952
953	954	955	956	957	958	959
960	961	962	963	964	965	966
967	968	969	970	971	972	973
974	975	976	977	978	979	980
981	982	983	984	985	986	987
988	989	990	991	992	993	994
995	996	997	998	999	1000	1001
1002	1003	1004	1005	1006	1007	1008
1009	1010	1011	1012	1013	1014	1015
1016	1017	1018	1019	1020	1021	1022
1023	1024	1025	1026	1027	1028	1029
1030	1031	1032	1033	1034	1035	1036
1037	1038	1039	1040	1041	1042	1043
1044	1045	1046	1047	1048	1049	1050
1051	1052	1053	1054	1055	1056	1057
1058	1059	1060	1061	1062	1063	1064
1065	1066	1067	1068	1069	1070	1071
1072	1073	1074	1075	1076	1077	1078
1079	1080	1081	1082	1083	1084	1085
1086	1087	1088	1089	1090	1091	1092
1093	1094	1095	1096	1097	1098	1099
1100	1101	1102	1103	1104	1105	1106
1107	1108	1109	1110	1111	1112	1113
1114	1115	1116	1117	1118	1119	1120
1121	1122	1123	1124	1125	1126	1127
1128	1129	1130	1131	1132	1133	1134
1135	1136	1137	1138	1139	1140	1141
1142	1143	1144	1145	1146	1147	1148
1149	1150	1151	1152	1153	1154	1155
1156	1157	1158	1159	1160	1161	1162
1163	1164	1165	1166	1167	1168	1169
1170	1171	1172	1173	1174	1175	1176
1177	1178	1179	1180	1181	1182	1183
1184	1185	1186	1187	1188	1189	1190
1191	1192	1193	1194	1195	1196	1197
1198	1199	1200	1201	1202	1203	1204
1205	1206	1207	1208	1209	1210	1211
1212	1213	1214	1215	1216	1217	1218
1219	1220	1221	1222	1223	1224	1225
1226	1227	1228	1229	1230	1231	1232
1233	1234	1235	1236	1237	1238	1239
1240	1241	1242	1243	1244	1245	1246
1247	1248	1249	1250	1251	1252	1253
1254	1255	1256	1257	1258	1259	1260
1261	1262	1263	1264	1265	1266	1267
1268	1269	1270	1271	1272	1273	1274
1275	1276	1277	1278	1279	1280	1281
1282	1283	1284	1285	1286	1287	1288
1289	1290	1291	1292	1293	1294	1295
1296	1297	1298	1299	1300	1301	1302
1303	1304	1305	1306	1307	1308	1309
1310	1311	1312	1313	1314	1315	1316
1317	1318	1319	1320	1321	1322	1323
1324	1325	1326	1327	1328	1329	1330
1331	1332	1333	1334	1335	1336	1337
1338	1339	1340	1341	1342	1343	1344
1345	1346	1347	1348	1349	1350	1351
1352	1353	1354	1355	1356	1357	1358
1359	1360	1361	1362	1363	1364	1365
1366	1367	1368	1369	1370	1371	1372
1373	1374	1375	1376	1377	1378	1379
1380	1381	1382	1383	1384	1385	1386
1387	1388	1389	1390	1391	1392	1393
1394	1395	1396	1397	1398	1399	1400
1401	1402	1403	1404	1405	1406	1407
1408	1409					

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Annex 10)List of Farmers that Participated in Group Discussions

S.N.	Full Name	Sex	Kebele	Woreda	Region
Amhara Region					
1					
2					
3					
4					
5					
6					
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97					
98					
99					
100					

1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
6	6	6	6	6	6
7	7	7	7	7	7
8	8	8	8	8	8
Oromia Region					
9	9	9	9	9	9
10	10	10	10	10	10
11	11	11	11	11	11
12	12	12	12	12	12
13	13	13	13	13	13
14	14	14	14	14	14
15	15	15	15	15	15
16	16	16	16	16	16
17	17	17	17	17	17
18	18	18	18	18	18
19	19	19	19	19	19
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39	39	39	39	39	39
40	40	40	40	40	40
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42	42	42	42	42	42
43	43	43	43	43	43
44	44	44	44	44	44
45	45	45	45	45	45
46	46	46	46	46	46
47	47	47	47	47	47
48	48	48	48	48	48
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94	94	94	94	94	94
95	95	95	95	95	95
96	96	96	96	96	96
97	97	97	97	97	97
98	98	98	98	98	98
99	99	99	99	99	99
100	100	100	100	100	100

[illegible]

[illegible]

[illegible]

[illegible]

Annex 11)List of beneficiaries on Whom Case Stories were Built

Amhara Region					
■	■■■■■	■	■■■	■■■■	■■■
■	■■■■■	■■■	■■■	■■■	■■■
■	■■■■■	■	■■■	■■■■	■■■
■	■■■■■	■	■■■	■■■	■■■
■	■■■■■	■■■	■	■■■■■	■■■
■	■■■■■	■	■■■	■■■■	■■■
■	■■■■■	■	■■■	■■■	■■■
Oromia Region					
■	■■■■■	■	■■■	■■■	■■■
■	■■■■■	■	■■■■	■	■■■
■	■■■■■	■	■■■■	■■■■	■■■
■	■■■■■	■■■	■■■ ■	■■■	■■■
SNNP Region					
■	■■■■■	■	■■■■■	■■■■■	■
■	■■■■■	■	■■■■■	■■■■■	■
■	■■■■■	■	■■■	■■■■	■
■	■■■■■	■■■	■■■■	■■■	■
■	■■■■■	■	■■■■	■■■	■
Tigray Region					
■	■■■■■	■	■■■■■	■■■■■	■
■	■■■■■	■	■■■	■■■■	■
■	■■■■■	■	■■■■■	■■■■■	■
■	■■■■■	■	■■■■	■	■
■	■■■■■	■	■■■	■■■■■	■

Annex 12) List of Project Woredas and Unions Visited for the Final Evaluation

Region	Zone	Woreda
[REDACTED]	[REDACTED]	[REDACTED]
		[REDACTED]
	[REDACTED]	[REDACTED]
		[REDACTED]
	[REDACTED]	[REDACTED]
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	[REDACTED]	[REDACTED]
		[REDACTED]
	[REDACTED]	[REDACTED]
		[REDACTED]

Annex 13) List of FEED I Unions Visited/Consulted

Region	Name of Union	FEED Project that supported the union	Zone	Woreda	Town
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]