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*IDRC GRANT / SUBVENTION DU CRDI : - CLIMATE-SMART INTERVENTIONS FOR SMALLHOLDER FARMERS IN ETHIOPIA (CULTIAF-2)*

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Contents



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## 1. Executive Summary

Sorghum in Ethiopia is primarily grown for human consumption where more than 70% of the grain is consumed at the household level. In Ethiopia sorghum value chain is well developed which resulted to the low adoption of improved sorghum production technologies. On the other hand, the food and feed demand in the country has shown an increasing trend due to the increasing population and change in livelihood. As sorghum is a climate resilient crop and produces high biomass per unit volume of water and considered as a potential crop to address the food and feed demand in Ethiopia. In spite of the increasing trend in sorghum production, the production trend does not match with population growth. This mismatch could be related to low access to improved technologies, poor value chain and climate change related production constraints. Hence, it is critical to create access for improved technologies, as well as linking the product with the market for farmers, enabling them to get better income to support improved technologies, thereby changing their livelihoods. In the meantime, the poultry sub-sector in Ethiopia is a livelihoods activity mainly undertaken by women and children of the household all over the country to meet their immediate cash expenditure needs. These shows the importance of poultry in intra-household gender equality, and for development outcomes where incomes managed by women have been found to result in improved outcomes for family, particularly for children, for example, in terms of health, nutrition and education. However, poultry production has suffered more than any other livestock industry because of inadequate supply and high cost of feed. In comparison to maize, sorghum is drought tolerant and grows successfully on relatively poor soils with lower moisture condition, and it is among the main cereal crops that are used as food and feed. So, the project's goal is to promote the use of more advanced climate-resilient sorghum production technologies to reduce the risk of climate change and boost sorghum productivity and create link in order to alter smallholder farmers' way of life. During the project period it was planned to conduct nutritional profiling of sorghum grain varieties, on-station feeding trials on layer and broiler chickens and to demonstrate the on-station result on-farmers' chicken management condition by supplementing the scavenging feed resource. At the same time it was planned to produce least cost chicken feed recipe and recommended to use improved sorghum varieties in the layer and broiler rations, respectively up to 40% and 50% in the diet formulation for better egg production and carcass yield.

## 2. The research problem

Sorghum is primarily produced for local consumption by smallholder farmers and smaller proportion of produced sorghum traded in the urban market. The crop is predominantly grown in the dry lowlands where it provides food and is also a major source of animal feed, fuel and building material. The production of surplus sorghum grain is possible through the use of improved technologies. Across all intervention regions and gender, factors constraining sorghum production include extended drought, limited access to drought tolerant and improved varieties, limited access to product market and inputs, and shortage of capital/credit.

In poultry feed industry about 50% of the formulated diet contained maize as main energy source. However, due to its multiple purposes being in high competition among human beings, livestock and industry, relatively higher moisture requirement for growth may make the use of maize in most parts of the country limited in the future. Sorghum is among the main cereal crops that are used as food and

feed. It is a mutual benefit for the sorghum farmers and poultry feed industry, creates market linkage. Furthermore, the population and economy of Ethiopia are growing rapidly, with increasing urbanization and diversification of the economy. This creates additional demand for cereals and animal products, opening up opportunities for economic advancement for farmers. There is also potential to increase production, driven by the growth of chicken egg and meat production (current egg prices being at an all-time high). This calls for market-based interventions to improve the livelihoods of sorghum growing smallholder farmers in the dry lowland areas of the country.

## 3. Progress towards milestones

**Developing and demonstrating sorghum-based feeds for chicken farms to address the increasing chicken feed demand in the country**

There is a growing poultry farming industry in Ethiopia, with a high local demand for low-cost chicken meat and eggs. Chicken meat and eggs have the potential to provide a significant proportion of the daily protein requirement in Ethiopia. However, meat and egg prices are currently very high with limited product being available on the market. One of the barriers to expansion of the poultry industry is access to high quality, low-cost chicken feed. In many countries globally, sorghum is a significant component of chicken feed. This project activity aims to answer the question as to whether sorghum can become a viable element of the chicken feed supply industry in Ethiopia, given the use of sorghum in human food. This will involve research into the nutrient profile of sorghum varieties in Ethiopia, including the high-lysine sorghum varieties that are available in Ethiopia, and chicken feed conversion ratios of diet mixes with other grains, in addition to an economic analysis of the value-chain, considering both small holder farmer enterprises, linking with larger-scale poultry farming enterprises.

## 4. Synthesis of Research Results to Date

### Nutrient Profile of Sorghum Varieties in Ethiopia

During the project period it was planned to test the nutrient profiles (dry matter, crude fiber, crude protein, total ash and amino acids lysine, tryptophan and methionine). Except the amino acids (which were unable to send sample to Kenya for analysis), were analyzed in commercial laboratory (Jije Laboglass P.L.C) in Ethiopia. The results presented in Table 1 below.

**Table 1**. Nutritional contents of sorghum grain (variety Degalit yellow and Melkam)

| **Nutrients** | **%** |
|---|---|
| Dry matter | 91–94 |
| Crude protein | 10.4–13.4 |
| Crude fiber | 2.30–3.92 |
| Ether extract | 2.94–3.64 |

| | |
|---|---|
| Total ash | 1.42–1.70 |
| Nitrogen free extract | 71.7–72.3 |

**Feeding value of sorghum grain on the layer and broiler performances**

On-station feeding trials on layer and broiler chickens were done at Debre Zeit Agricultural Research Center (DZARC) to test the feed conversion efficiency, growth, egg production and carcass yield. Bovans Brown layer hens and a-day old Cobb-500 broiler chicks were used as animal unit. The feeding trials were lasted for 12 and 8 weeks, respectively for the layer and broiler chickens during which daily feed intake, egg production, weekly body weight and at last broiler carcass cuts were measured. The experiments were arranged in completely randomized design. Treatments in the layer feeding trial were T1 (control diet: maize based diet), T2 (20% inclusion of sorghum variety Melkam (SVM) in the diet), T3 (30% inclusion of SVM in the diet) T4 (40% inclusion of SVM in the diet) T5 (20% inclusion of sorghum variety Degalityellow (SVD) in the diet) T6 (30% inclusion of SVD in the diet) T7 (40% inclusion of SVD in the diet). Treatments arrangement in the broiler chicken feeding trial were T1 (control diet: maize based diet), T2 (20% inclusion of SVM in the diet), T3 (30% inclusion of SVM in the diet) T4 (40% inclusion of SVM in the diet) T5 (50% inclusion of SVM in the diet). Results were presented below in Table 2, 3 and 4.

**Table 2**: Performances of hens fed different levels of sorghum grain

| Parameters | Treatments (T)* | | | | | | | P-value | Sig |
|---|---|---|---|---|---|---|---|---|---|
| | T1 | T2 | T3 | T4 | T5 | T6 | T7 | | |
| Feed intake (g) | 117 | 113 | 111 | 112 | 115 | 110 | 119 | 0.62 | NS |
| BW change (g) | $109^{cd}$ | $76^{e}$ | $90^{de}$ | $93^{cde}$ | $110^{c}$ | $210^{a}$ | $161^{b}$ | 0.00 | ** |
| FCR | 1.8 | 1.9 | 2.0 | 1.6 | 1.8 | 1.7 | 1.6 | 0.27 | NS |
| Egg weight (g) | $58^{ab}$ | $59^{a}$ | $57^{ab}$ | $58^{ab}$ | $58^{ab}$ | $57^{b}$ | $57^{ab}$ | 0.04 | * |
| HHEP (%) | $75^{ab}$ | $73^{abc}$ | $68^{bc}$ | $64^{c}$ | $76^{ab}$ | $76^{ab}$ | $79^{a}$ | 0.04 | * |
| Haugh Unit | $90^{a}$ | $87^{a}$ | $88^{a}$ | $88^{a}$ | $88^{a}$ | $79^{b}$ | $75^{b}$ | 0.00 | ** |
| MRR | - | -1.62 | -2.15 | -0.96 | -0.75 | -0.84 | 0.16 | | |

*Treatments (T) 1= the control diet (maize based diet), 2, 3, 4 = 20%, 30% and 40% inclusion of sorghum variety melkam (SVM) and 5, 6, 7= 20%, 30% and 40% inclusion of sorghum variety Degalityellow (SVD) in the layer hen ration formulation; BW: body weight; FCR: feed conversion ratio; HHEP: Hen-housed egg production; MRR: marginal rate of return

**Table 3:** Performances of hens fed different sorghum varieties

| Parameters | Control | Sorghum Varieties* | | P-value | Sig. |
|---|---|---|---|---|---|
| | | SVM | SVD | | |
| Feed intake (g) | 117 | 112 | 115 | 0.45 | NS |
| BW change (g) | $108^{b}$ | $86^{b}$ | $161^{a}$ | 0.00 | ** |
| FCR | 1.81 | 1.81 | 1.69 | 0.59 | NS |
| Egg weight (g) | 58 | 58 | 58 | 0.35 | NS |

| | | | | | |
|---|---|---|---|---|---|
| HHEP (%) | 75[ab] | 68[b] | 77[a] | 0.01 | * |
| Haugh Unit | 90[a] | 88[a] | 81[b] | 0.01 | * |
| MRR | - | -1.5 | -0.38 | | |

Sorghum Varieties*= sorghum varieties Melkam (SVM) and Degalityellow (SVD); the control diet = maize based diet; BW: body weight; FCR: feed conversion ratio; HHEP: Hen-housed egg production; MRR: marginal rate of return

**Table 4:** Performances of broiler chickens fed different sorghum grain Melkam variety

| Treatment* | Starter (1-21 days) | | | Finisher (22-56 days) | | | Carcass Yield | | | | | Partial budget |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total Feed Intake | Final BW | FCR | Total Feed Intake | Final BW | FCR | Slaughter weight | Dressing % | Breast weight | Thigh weight | Drumstick weight | MRR |
| T1 | 790 | 386.68 | 2.28 | 3600 | 1880[b] | 2.81[ab] | 1940 | 72 | 590 | 114 | 103 | - |
| T2 | 780 | 376.92 | 2.27 | 3570 | 1840[b] | 2.80[ab] | 2030 | 74 | 650 | 123 | 109 | -1.80 |
| T3 | 800 | 377.38 | 2.28 | 3570 | 1870[b] | 2.75[ab] | 2060 | 70 | 630 | 129 | 100 | -1.13 |
| T4 | 840 | 392.38 | 2.29 | 3610 | 2010[a] | 2.56[bc] | 2040 | 73 | 636 | 130 | 102 | 0.036 |
| T5 | 790 | 380.03 | 2.45 | 3600 | 2070[a] | 2.12[c] | 2050 | 74 | 688 | 131 | 103 | 0.37 |
| SEM | 10.14 | 5.56 | 0.02 | 22.9 | 4.52 | 0.03 | 5.39 | 12.9 | 5.40 | 3.51 | 10.6 | - |
| P-Value | NS | NS | NS | NS | * | * | NS | NS | NS | NS | NS | - |

*Treatments (T) 1= the control diet (maize based diet), 2, 3, 4 and 5 = 20%, 30%, 40% and 50% inclusion of sorghum variety melkam in the broiler chicken ration formulation; BW: body weight; FCR: feed conversion ratio; MRR: marginal rate of return

**Establishment of linkage between sorghum producing farmers and poultry farming enterprises**

On the CultiAF II results dissemination workshop, guests were invited from different stakeholders and created attention between sorghum producing farmers and poultry farming enterprises. Broiler and layer chicken feeding guide that bases sorghum grain was prepared in brochure and disseminated among the participants. Five alternative broiler feed recipe and poster paper were presented and showed for the participants.

**On-farm demonstration of sorghum based scavenging feed supplement**

In sorghum growing belt areas, 10 women farmers were selected and supported with 10 laying hen each and sorghum based scavenging feed supplement for their scavenging chicken, maize based feed also used as a reference. The farmers were selected purposively that had the interest to participate in the experiment and a month egg production was tested. The sorghum based scavenging feed supplement results were very promising, and finally, farmers' perception were assessed on a day workshop though questioner.



## 5. Project research output

- Nutrient composition of sorghum variety melkam and degalityellow was documented
- Feeding value of sorghum grain in the broiler and layer ration was evaluated.
- Optimum levels of sorghum inclusion were known and is 40% in the layer ration and 50% in the broiler ration
- It is optimum to support egg production of the scavenging system of supplement sorghum grain
- Two journal articles were produced and are in press

## 6. Challenges encountered / Actions taken

The main challenge encountered during the implementation of the project was the occurrence COVID19 pandemic and security problem in project implementing regions mainly in Tigray and partially in Amhara region, even difficult to move from place to place. The project management team designed strategy to overcome the risk of infection and implement the majority of the project activities. However, the security problem happened at critical stage of the season created serious challenge and on-station as well as on-farm feeding the trials was delayed due to lack of harvested sorghum grain for the feeding chickens. As the security problem was improved, the plan was revised and brought sorghum for feed trials.