

**Agriculture and Food Security (AFS) Program  
Interim Technical Report**

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**Project Title: Integrating Dairy Goat and Root Crop Production for  
Increasing Food, Nutrition and Income Security of  
Smallholder Farmers in Tanzania**

**IDRC Project Number (a 6-digit number):** Grant No. 106512-001

**Research Institutions:**

- Sokoine University of Agriculture (SUA), Tanzania
- University of Alberta, Canada
- International Livestock Research Institute (ILRI), Kenya

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**By:** Sokoine University of Agriculture, Morogoro, Tanzania

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- Annex 4.3.21: Jeffrey Andrews (2014). Long term behavioral and community effects of drought. Presented at the Canadian International Food Security Research Fund (CIFSRF) "Research to Feed Africa" Symposium, June 23 - 27, 2014, Great Rift Valley Lodge, Naivasha, Kenya
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- Annex 4.3.28: Marcoul P., Mohapatra S., Luckert M. and Zigah G. (2014). Blood is thicker than water: The economic ramification of gift-giving in social network – Theory and Empirical evidence from Tanzanian villages.

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## **Executive Summary:**

This project was conducted with the main purpose of improving household income, food security and well being of poor and women-headed households through the introduction of a community-based crossbreeding programme for dairy goats, and improved participatory farm trials for cassava and sweet potato varieties. Specifically, the project was intended to improve the milk production potential of indigenous goats through crossbreeding, improved management and control of major diseases, test and evaluate improved sweet potato and cassava varieties that have the dual purpose of improving food security and nutrition at household level and the development of locally available and cost-effective rations for dairy goats, investigate the livelihood strategies, production potential, and marketing possibilities of local goats and crops in the study areas and analyze the impacts of integrating improved goat breeds with sweet-potatoes and cassava into an agro-pastoral farming system.

The project distributed a total of 229 dairy goats to 108 rural poor farmers in the semi-arid districts of Kongwa and Mvomero, Tanzania. The project distributed Toggenburg and Norwegian dairy goats. At the end of this project, the total number of dairy goats has increased to 362 goats with some farmers reaching up to 9 dairy goats through community-based breeding. The dairy goats have provided an opportunity for rural poor farmers to consume milk. Milk production per doe per day ranged from 0.6 to 0.8 litres and the average lactation length was 104 days. The average lactation yield per doe ranged from 82 to 105 litres. Statistical analysis of the milk data revealed that Toggenburg dairy goats produced relatively higher amounts of milk than the Norwegian goats. Similarly Toggenburg goats were found to be more tolerant to common diseases than the Norwegian. Therefore, the Toggenburg goats seem to be better suited to the environmental conditions of semi-arid areas. The project has developed recording cards for monitoring breeding activities, milk production, kid growth and disease incidences and treatment/control for dairy goats kept by small-scale farmers. These cards can be used in other areas of Tanzania for tracking critical details related to dairy goat systems. Most of the milk (70%) was consumed at home, but some farmers sold the milk to other farmers in the village. Where milk was sold, farmers earned about US\$ 160 per year from milk sales.

The marketing channels of dairy goats and their products were assessed in the project villages. A total of 106 dairy goat farmers (58 farmers from Kongwa and 48 farmers from Mvomero) were involved in a study. The results of the study revealed that the products produced and sold by the farmers were fresh milk, natural fermented milk, weaned kids and manure. Among these products, fresh milk was the most commonly sold product and was mainly sold to the neighbours of the farmers. It was estimated that 30% of the fresh milk produced was sold, 5% was naturally fermented and consumed at home and the remaining 65% was consumed at home as fresh milk. Manure was the second product and it was estimated that about 3 tons per month of goat manure were produced, 64% of which was used by the farmers themselves to fertilize gardens and crop fields and the remaining 36% was given to the neighbours free of charge. In general, the value chain of dairy goats comprised the farmers, input suppliers, grain millers, food vendors and consumers.

The profitability and contribution of dairy goat keeping was studied in the project villages. The results showed that dairy goat milk was considered to be more nutritious than cows' milk. Consequently, the price for goat milk was 17% higher than that of cow milk. The revenue from milk sales contributed 64% of the income in poor households. The economic analysis showed that 30% of the farmers had positive gross margin, implying that they were able to recover the variable costs. In terms of net profit, the study found that 20% of the farmers were making profits. The small number of animals (2 animals per household) and the project contract that prohibited the farmers from selling offspring contributed to most farmers not being able to get profits. The study found that smallholder farmers requires 8 goats and each milking doe should produce 1.16 litre/day in order to benefit from milk sales besides other benefits such as selling of manure and male kids which are born. However, the study indicated that the technical efficiency for the project farmers was 0.75 under constant return to scale, implying that there is a room (25%) for increasing the production of outputs using the available resources. Since the farmers at the moment have little experience on dairy goats, it is expected that the productivity of dairy goats will increase in subsequent years and they will be able to make more profits.

The project introduced four (4) improved varieties of sweet potatoes (i.e. Simama, Ukerewe, Kiegea and Mataya) in the project villages and the varieties were tested for adaptability and acceptability by all participating farmers. In semi-arid areas of Kongwa district, Mataya had the highest mean yield of root tubers (4.8 t/ha), followed by Kiegea (4.6 t/ha), Simama (3.9 t/ha) and Ukerewe (2.8 t/ha). In the sub-humid areas (Mvomero district) Ukerewe had the highest yield (2.7 t/ha), followed by Mataya (1.57 t/ha). Hence, Mataya and Kiegea are better suited to the environmental conditions of semi-arid areas while Ukerewe is suited to sub-humid areas where there is adequate rainfall. After identification of the best two varieties, farmers were empowered through training and demonstration by project staff and have recently established seed multiplication plots. The plots serve as the source of planting materials within the local region.

The effects of leaf defoliation intensity and leaf harvesting frequency on root tuber and leaf yields of three sweet potato varieties (simama, mataya and kiegea) were assessed. The three sweet potato varieties were subjected to three leaf defoliation frequencies (i.e. 4, 6 and 8 weeks harvesting intervals) and leaf harvesting levels of 0%, 10%, 20%, 30%, 40%, 50%, 60% and 70%. Initial harvesting of leaves was done 50 days after planting. The subsequent leaf harvests were done after every 4, 6 and 8 weeks of growth until the plants were six months old when root harvest was done. The data were collected on yield of forage and root tubers. Results showed that leaf harvesting at four weeks intervals and four times per growing period gave the highest leaf forage production but, the root yield was decreased tremendously. Harvesting at eight weeks intervals and three times per growing period proved to be the best in leaf production as well as root yields. Mataya was superior to kiegea and simama both in terms of leaf and root yields. Hence, Mataya can be used for production of root tubers for human food and leaves for goat feeding.

The effects of leaf defoliation intensity and leaf harvesting frequency was also assessed on root tuber and leaf yields of two cassava varieties (Kiroba and Mumba). The two varieties were subjected to leaf harvesting intervals of four and eight weeks and defoliation levels of 0, 15, 30, 45 and 60%. The results showed that Mumba had higher tuber yield (7.23 t/ha) and leaf dry matter yield (6.35 t/ha) compared to Kiroba (4.40 t/ha tuber and 4.05 t/ha leaf yields). Mumba variety produced the highest tuber yield (9.58 t/ha) at leaf harvesting interval of eight weeks and defoliation level of 15%. For leaf yield, the highest yield was obtained at harvesting interval of four weeks and defoliation level of 45%. Since leaf yield was not affected by defoliation intensity, the harvesting interval of eight weeks and defoliation level of 15% can be used as a regime for growing mumba variety for both production of root tubers for human food and leaves for dairy goat feeding.

The use of cassava leaves and sweet potato vines as sources of protein in supplementary diets of dairy goats was assessed. Four supplementary diets were formulated and designated as D<sub>1</sub>, D<sub>2</sub>, D<sub>3</sub> and D<sub>4</sub>. All diets contained hominy meal (67%) and mineral premix (2%). In addition, D<sub>1</sub>, D<sub>2</sub>, D<sub>3</sub> and D<sub>4</sub> contained sunflower seed cake (31%), cassava leaf meal (31%), sweet potato vines (31%) and cassava leaf meal (15.5%) + sweet potato vines (15.5%), respectively, as sources of protein. Six animals were randomly assigned to each diet and the feeding trial was carried out for 90 days. The study found that supplementation of dairy goats with diet containing cassava leaf meal results into higher growth performance, better feed utilization and is more profitable than supplementation with sunflower seed cakes. Therefore, cassava leaf meal can be used to replace sunflower seed cake as protein sources in supplementary diets of goats and other ruminants.

Marketing systems of cassava and sweet potatoes in Kongwa and Mvomero districts were studied. The study revealed that most producers were men (54.8%) while most traders (70.1%) and processors (67.4%) were women. The study revealed further that farmers produce cassava mainly for home consumption and to a limited extent for sale. About 90% of cassava producers sold their produce at their farm gate while 4% of them sold their produce direct at the village markets. The study also revealed that selling cassava to the markets in towns is more profitable than selling within the villages. The actors in the cassava marketing channels were producers, retailers, cooking vendors, local processors and consumers. The highest gross margins (34,355 Tshs/bag) was obtained by local processors, followed by retailers (13,326 Tshs/bag). On average the farmer's share to the total consumer price was 40%.

The study also revealed that most producers for sweet potatoes were men (54.6%) while most traders (81.8%) were women. Women processors comprised 50% and the remaining 50% were men. The market actors in sweet potato marketing channels were producers, retailers, local processors and consumers. The study revealed that

most farmers produce sweet potato purposely for subsistence and to a limited extent for sale. Most farmers sold their produce either at the farm gate (55%) or at their homestead (39%). On average the farmer's share to the total consumer price was 44% and the remaining 56% was for traders.

The impact of the project on household nutrition was assessed. The study revealed that the introduction of dairy goats in the project villages increased consumption of milk in poor households. The result of the study show that 58% of the households consumed goat milk once to twice per day. This has resulted in improved nutritional status of children less than five years old in the study villages. The introduction of dairy goat in the project village has led to decline of underweight and wasting cases by 4% and 8%, respectively, among the children under five years old.

Gender and intra-household dynamics were analyzed. The results revealed that decision-making on goat and crop management has changed as a result of project interventions and gender training workshops. Before the start of the project goats belonged to men and the decisions with regard to goat management and use of the income from goat production were made by men. Based on training and gender sensitization efforts within the project, results show that women and men who adopted the new goat breeds and new cassava and sweet potato varieties often made joint decisions on management of dairy goats and root crops. Decision-making on revenue from milk and root crop was also shared between men and women.

Anticipated environmental impacts of the introduced dairy goats and improved varieties of sweet potato and cassava in the four project villages were assessed. Farmers in the project villages had the opinion that the intervention of the project will have large positive impacts in terms of household food security and income. The anticipated benefit of the new varieties of root crops was to increase crop yield and food security. Moreover, farmers felt that the introduction of dairy goats would improve household nutrition and income. Anticipated environmental challenges were (1) lack of access to fodder during the dry seasons, (2) severe shortage of local water resources in the villages, (3) lack of ownership of land for some poorer farmers, thereby limiting their ability to participate in project activities, (4) a general lack of planning at the village level on the use and management of local resources such as crop farming and fodder, and (5) ongoing conflicts between farmers and pastoralists may limit the success of the project interventions.

In conclusion, the distribution of 2 dairy goats per household has resulted in increase in dairy goat numbers, milk consumption and income of the project farmers within a short time. The dairy goats and improved varieties of cassava and sweet potatoes have created additional food and income sources for poor households. Instead of exploiting natural resources in communal lands, farmers are generating more income through selling of dairy goat products and root crops. This has contributed to additional livelihood strategies and a reduction of stress on the environment. Moreover, the project has empowered village environment committees with the relevant knowledge for conducting environmental impact assessment for both crop farming and livestock keeping projects. The farmers can judge reasonably the anticipated environmental risks and make decisions to grow this aspect of their livelihood portfolio as dairy goats continue to increase within these regions.

## 1. The research problem:

Goats are an important component of the agricultural sector in Tanzania and are kept by small-scale farmers in rural areas for provision of meat, milk, skins and manure. Also, goats serve as saving and living banks for the resource poor rural people, since they can easily be converted into cash when needed. Local goat breeds, which are predominantly kept under the smallholder production system, have a low growth rate, small mature size, low carcass weight and low milk production. Hence, goat production based on local breeds cannot contribute effectively to poverty alleviation and food security of the rural poor people. This project intended to introduce improved dairy goat breeds adapted to tropical environment that can be used for milk production in rural areas and for crossbreeding programmes to improve the milk production potential of local breeds.

Another problem facing goat production in Tanzania is poor nutrition. Goats kept in rural areas depend on natural pastures as the major source of feed. The natural pastures are limited both in quantity and quality, particularly during the dry season. Animals reared based on natural pastures are unable to meet their maintenance and production requirements, especially for protein. This leads to low growth rates, low conception rates, high neonatal losses and animals easily succumb to diseases, a situation that gives overall low productivity. Conventional protein supplements, such as oil cakes and fishmeal, are not readily available and are too expensive for small-scale livestock keepers in rural areas. Cassava leaves and sweet potato vines are locally available and rich in protein, hence, they can be used as alternative protein supplements for dairy goats kept by small-scale farmers. The use of these plant resources can lower the feed cost and hence increase the profitability of dairy goat enterprises. This project aimed at developing supplementary rations for dairy goats based on cassava leaf meal and sweet potato vines as protein sources to replace conventional oil cake supplements for dairy goats.

Traditionally, cassava and sweet potatoes are grown exclusively for the purpose of tuber production, mainly for human consumption, and the forage (aerial parts) are not utilized in efficient ways after harvest. Using new improved varieties that have a dual purpose role (production of root tuber for human consumption and leaves for animal feed) will improve food security as well as increase the productivity of dairy goats.

Although improved dairy goats have been successfully introduced to a number of highlands regions in Tanzania, the introduction of this local food system into semi-arid and resource poor regions is less well understood. Therefore, our primary research questions were focused on ways to enhance food security in agro-pastoral communities which are resource constrained.

**General objective:** Working within semi-arid and resource poor regions of Tanzania, the main objective of the project was to improve household income, food security and well being of poor and women-headed households through the introduction of a community-based crossbreeding programme for dairy goats, and improved participatory farm trials for cassava and sweet potato varieties.

### **The specific objectives:**

- To improve the milk production potential of indigenous goats through crossbreeding, improved management and control of major diseases.
- To test and evaluate improved sweet potato and cassava varieties that have the dual purpose of improving food security and nutrition at household level and the development of locally available and cost effective rations for dairy goats.
- To investigate the livelihood strategies, production potential, and marketing possibilities of local goats and crops in the study areas
- To analyze the impacts (productivity, environmental, gender and empowerment, food security and nutrition) of integrating improved goat breeds with sweet-potatoes and cassava into an agro-



pastoral farming system

## 2. Progress towards 42 months milestones:

### 42 months: Final technical report with the following attachments:

**Milestone 4.1:** All project study areas have completed written reports based on empirical results from the project study sites (SUA/UA)

Reports on various thematic areas have been prepared and submitted to IDRC and results discussed in different fora including project meetings, dissemination workshops, national and international conferences and public media houses. Details of reports are included in this narrative report together with attached annexes.

**Milestone 4.2:** Graduate student theses completed (UA/SUA)

Five Masters students (4 students from SUA and 1 student from University of Alberta) completed their theses. Three Alberta students (1 masters and 2 PhD) and one SUA masters student will complete their thesis research in December 2014. The titles of the theses (studies) are: (1) Child nutrition and gender relations: case of dairy goat and improved root crops project in Mvomero and Kongwa district (Annex 4.2.1); (2) Cassava and sweet potato value chains in Mvomero and Kongwa Districts, Tanzania (Annex 4.2.3); (3) Effect of supplementing cassava tops and sweet potato vines on performance of growing goats (Annex 4.2.4); (4) Production and market performance of dairy goats and their products in Kongwa and Mvomero Districts, Tanzania (Annex 4.2.2); (5) Impact of household gifting behaviour on their agricultural productivity: Empirical evidence from districts of Tanzania; (6) Impacts of gift giving behaviour on food security outcomes in rural Tanzania; (7) Linkages between drought, egalitarianism and tolerance for inequality in rural Tanzania; (8) Local strategies to secure food, with a focus on gendered mobility and how it can privilege or limit access to food by men and women; (9) Effect of leaf harvest intensity and frequency on growth, yield and quality of both cassava and sweet potato by a Masters student at SUA

**Milestone 4.3:** At least another 2 studies developed, presented in national and international conferences and publishable papers prepared for scientific journals (UA/SUA)

Research results from the dairy goat - root crop integration project have been communicated to the stakeholders, both locally and internationally. A total of four papers have been published in internationally recognized journals (annexes 4.3.1, 4.3.2, 4.3.3 and 4.3.4). In addition, one manuscript has been submitted (Mason, R.F., P. Ndlovu, J.R. Parkins and M.K. Luckert. Gender, Resource Ownership and Food Consumption in Rural Tanzania. *Agriculture and Human Values*) and 12 paper drafts (Annexes 4.3.5 – 4.3.18) have been prepared for publication in peer reviewed journals.

Project researchers from SUA, ILRI, ARI-Kibaha and University of Alberta shared to a wider audience their research findings in different forums including: (1) Dialogue on International Food Security 2014, held at the University of Alberta, Canada, (2) Canadian Association for the study of Sustainable International Development (CASID), Brock University, St. Catharines, Ontario (May 27<sup>th</sup> - 29<sup>th</sup>, 2014), (3) Canadian Economic Association 2014 Annual Conference (Simon Fraser University, British Columbia), (4) End of Project Symposium on 'Research to Feed Africa' that was held from 23<sup>rd</sup> to 27<sup>th</sup> June 2014 in Naivasha, Kenya and also during (5) End of Project Workshop that was held from 19<sup>th</sup> to 21<sup>st</sup> August 2014 in Morogoro. Highlights on the project outcomes and challenges were also presented in a poster form during Research to Feed Africa Policy Dialogue held in Addis Ababa, Ethiopia on 1st September 2014. (Annexes 4.3.20 – 4.3.27). Furthermore, the project has four published newsletters and one Swahili brochure (Annexes 4.3.28 – 4.3.32).

**Milestone 4.4:** End of project evaluation of changes as a result of the project interventions done and results presented at an end of project workshop involving all stakeholders including farmers/group representatives (SUA)

End of project survey was carried out to assess the effects of the interventions introduced by the project. The

main findings were:

- Improved gender relations and sharing of roles in dairy goat and root crop production at household and community levels
- Improved nutrition status of under five years old children amongst project farmers
- Increased household income among dairy goat farmers in the project villages
- Increased value of assets/properties
- Adoption of improved varieties of sweet potato and cassava
- Improved skills in dairy goat farming (heat detection, diseases control, feeding, etc.) and root crop management
- Postharvest value addition of cassava and sweet potatoes (processing and preparation of different recipes)
- Improved nutrition knowledge and skills on dietary diversification (using goat milk, cassava and sweet potato).
- Community-based environmental impact assessment has resulted into adoptions of measures that have positive impact on the environment including zero grazing and use of goat manure to improve soil fertility
- Engendered approach has enabled fast and equitable improvements in income and nutrition in households

The project outputs were presented at the End of Project Workshop which was held from 19<sup>th</sup> to 21<sup>st</sup> August 2014 at Kingsway Hotel, Morogoro, Tanzania (Annexes 4.4.1 – 4.4.14). The workshop was attended by 40 stakeholders, including Researchers from SUA (18), ILRI (3), University of Alberta (1) and Agricultural Research Institute-Kibaha (2). Other participants included key policy makers, NGOs (SURUDE), media personnel -REGALIA Media (1), Tanzania Livestock Research Institute (1), Heifer International-Tanzania (1), district representatives and extension staff (6), farmers (8). During this workshop best farmers from each research village were awarded.

**Milestone 4.5:** Analytical report to empirically assess progress toward targeted development outcomes (SUA/UA):

- *Output 1: Increased local availability of cross-bred goats and goat milk production (output per goat) due to better breeds, better health, and reduced disease*
  - Two breeds of dairy goats (Toggenburg and Norwegian) were introduced into four project villages. In total 229 dairy goats were distributed to farmers and at the end of August 2014, the number of dairy goats was 362. These animals have provided alternative source of dairy goats in Tanzania taking into account that the demand of dairy goat in the country is high and there is no reliable source. The male offspring existing in the project villages can be used in a crossbreeding programme.
  - The introduced dairy goats have provided opportunity to rural poor farmers to get milk. In the first lactation, disposable milk yield ranged from 0.6 – 0.8 litres per goat per day. This was the milk harvested after feeding the kid. This amount is expected to double in the following lactations.
- *Output 2: Improved participation of local associations in goat breeding and milking, and increased access to, and use of, methods to reduce diseases in goats*
  - In each village farmers formed local association with elected leadership and their associations have been registered. All members of the associations were introduced to a farmer field school approach whereby the members of the group/association meet regularly to discuss a particular development issues. Through this approach the group coherence has been enhanced. The knowledge and skills of farmers on goat housing, feeding, breeding, milking and disease control have been improved through training workshops and exchange visits.
  -
- *Output 3: Improved varieties, productivity, and processing of cassava and sweet potato crops*
  - Four improved varieties of sweet potato (Mataya (Orange fleshed), Kiegea (Orange fleshed), Simama (Cream), Ukerewe (Cream with orange background) and one variety (Kiroba) of cassava were introduced in the project villages and participatory evaluated for productivity and quality. Farmers

have been empowered on processing of cassava and sweet potatoes.

- The effects of leaf defoliation intensity and frequency on root and leaf yields of three sweet potato varieties (simama, mataya and kiegea) were assessed. Harvesting at eight weeks intervals and three times per growing period was found to be the best in leaf production as well as root yields. Mataya variety was superior to kiegea and simama both in terms of leaf and root yields. Hence, Mataya is recommended to be used for production of root tubers for human food and leaves for goat feeding.

▪ *Output 4: Increased household food and nutritional security through the consumption of locally produced goat milk, sweet potato, and cassava*

- The consumption of dairy goat milk, cassava and sweet potato has resulted into reduced underweight status (by 4%) and wasting (by 8%) cases among children under-five years of age.
- An increased number of meals per day and diversification of diets to include sweet potato, cassava and goat milk has been observed in the project households.

▪ *Output 5: Improved marketing systems for goats and root crops for men and women, and ability of women to independently participate in various stages of the value chains collective and participatory enforcement of more effective land utilization methods by community members*

- With increase in number of dairy goats in the villages and production of cassava and sweet potatoes, value chains are being gradually developed for these products. However, given the distance to markets and the relatively low level of production at this point in the project, markets are available mostly at the village level.

**Milestone 3.1:** A community based seed multiplication system developed and number of farmers and volumes of seed produced and disseminated documented (ARI/District Councils)

Following challenges of drought in Kongwa district, the project villages identified nearby villages with regular supply of water for establishing their community seed multiplication plots. Plots of improved varieties of sweet potato have been established in the nearby village. These plots serve as source of planting materials in the project villages.

### 3. Synthesis of research results:

Food security among small-holder farmers in Tanzania is a top priority of the government. Malnutrition is a big challenge with the highest rate in Dodoma region (stunting - 56.2%, underweight - 26.8%, wasting - 5.2%) and Morogoro region (stunting rate - 44.4%, underweight - 16% and wasting - 5.3%) (Annex 4.3.11). All four research sites for the CGP Tanzania project are located within the two regions mentioned above. In order to address the food insecurity among the marginalized households in agro-pastoral areas, an innovative integration of dairy goat keeping and growing of improved varieties of drought tolerant cassava and sweet potatoes was introduced in two districts of Kongwa and Mvomero. Studies in this system of integrating dairy goats (Toggenburg and Norwegian breeds) with production of cassava and sweet potatoes have led to production of several outputs/outcomes as highlighted below:

*3.1. To improve the milk production potential of indigenous goats through crossbreeding, improved management and control of major diseases.*

#### **3.1.1. Improved milk production, improved management and control of major diseases**

The project started by selecting randomly 120 farmers from four villages (30 farmers per village) and training them. However, only 108 farmers attended the training and 35.2% were women. The farmers were trained on improved goat husbandry practices, including feeding system, good house, feeds and feeding, breeding, health management and record keeping. After the training, the farmers constructed improved goat houses using locally available materials. Then Toggenburg and Norwegian dairy goats were distributed to farmers and each farmer received two female goats under the condition that he/she will pass-on two female goats to new project farmers. In total 10 males and 113 females belonging to Norwegian dairy goat breed were distributed to half of the farmers in each village and for the Toggenburg breed 10 males and 96 females were distributed to the other half of the farmers in each village. Therefore, a total of 229 dairy goats were distributed to 108 farmers. The project distributed pure breed of Toggenburg and Norwegian dairy goats because it was foreseen that the result of crossbreeding would not be realised within the project period. The pure bred dairy goats were to be multiplied by farmers and form a base population for crossbreeding with local goats in the project villages and other areas in the future. Thus, no attempt was made to initiate a crossbreeding programme. Over the 3½ years of the project, 290 kids were born and the female offspring were to be used for pass-on to other farmers. A total of 40 new farmers were trained on improved goat husbandry and asked to construct improved goat house after the training. Out of the 40 farmers, 33 (82.5%) farmers constructed the improved goat house. Each farmer was given one female goat, hence, a total of 33 female goats were distributed to the new project farmers. The goats had the age of 8 to 12 months. The number of project farmers has therefore increased from 108 to 141. Most of these are poor farmers who formerly could not afford to get milk for their households. The project has enabled these rural poor farmers to get access to milk and hence, contributed to improvement in household nutrition, especially children nutrition. Some farmers are selling the milk to earn cash income that is used to meet various needs in the household. Moreover, the goat manure is collected and applied in crop field. Hence, indirectly the project has contributed to improvement in crop production, especially maize and vegetables.

#### **3.1.2. Monitoring of dairy goat breeding, birth, milk yields and growth**

For the dairy goat component, a routine monitoring programme was initiated in June 2012 to evaluate the production performance and the adaptability of the two dairy goat breeds introduced in the research villages. The project developed a simple recording scheme and distributed recording cards to each farmers participating in the project. The data collected include records on breeding activities (dates of heat and mating, dam and sire used for breeding), goat kidding (date of birth, birth weight, type of birth (single/twins)), goat deaths and causes, daily milk yield and disease treatment and control. These parameters were recorded by the farmers on daily basis as the events happen. The data were recorded on

recording cards. The data from all project farmers in the research sites were collected on a monthly basis by the staff and technicians responsible for the goat research component. The project staff also measured body weight of all goats on monthly basis. The record cards developed by the project are available and can be used in other areas for monitoring and evaluation.

### 3.1.2.1. Status of dairy goats in the project villages

In total, 229 dairy goats were distributed to farmers since the project started, out of which 123 (53.7%) were Norwegian goats and the remaining 106 were Toggenburg goats. Each farmer received two females. The records on the number of goats up to the end of August 2014 indicate that 75.1% (172 animals) of the goats distributed were still alive while 57 (24.9%) animals died. A significantly higher proportion of Norwegian goats (29.3%) died compared to Toggenburg goats (19.8%). More Norwegian goats died than the Toggenburg goats because of the differences in weather conditions between Mgeta, the area where Norwegian goats were obtained, and the project villages. Mgeta is a highland area and have cool climate while the project villages are located in semi-arid and sub-humid areas and experience high temperature ranging from 26 to 30<sup>0</sup>C and small amount of rainfall (600 – 1200 mm per year). The causes of death were respiratory diseases, diarrhoea, bloat, poisoning and stress due to transportation. A total 290 kids were born during the project period. Kid mortality was slightly higher for Toggenburg goats (27.3%) than for Norwegian goats (23.1%). The overall kid mortality rate was 25.2%. Kid mortality rate observed in this project is higher than the recommended kid mortality of 10%. However, the kid mortality rate observed in the project villages is lower than the mortality rate of 17 – 33% reported at SUA farm for Norwegian goats. The high mortality rate in the present project could be attributed to poor management. Some farmers were not adhering to the management practices introduced by the project such as using raised slatted goat house and proper feeding and disease control. Some of the causes of death such as excessive eating of cassava leaves and insecticide-treated maize, plastic bag impaction and starvation could have been prevented if the farmers adhered to best management practices for dairy goats. This underlines the need for more training of the farmers on improved animal husbandry practices and health care. Despite the slightly higher kid mortality, the number of dairy goats in the project villages has increased, from an average of 2 to 3 animals per household. The number of animals per household is still low because most does have kidded only once. This is due to the fact that most of the goats distributed to the farmers had the age of 6 to 9 months. Relatively young animals were purchased by the project due to unavailability of sufficient number of mature dairy goats. Consequently, the goats distributed to the farmers took a longer time to attain the breeding age. This situation has contributed to the observed low number of does that have kidded and also affected the rate of flock growth in the households participating in the project. Also, the low kidding rate can be attributed to the failure of the farmers to detect heat signs at the right time for the does to mate with bucks. This shortcoming was addressed by intensive training coupled with training of Community Animal Health Workers (CAHWs).

### 3.1.2.2. Milk yield

Two breeds (Norwegian and Toggenburg) of dairy goats were introduced in the project villages with the aim of comparing the lactation performance and identifying the breed most suited in the study areas. Daily milk yield was recorded by the farmers. The statistical analysis of milk yield data indicated that there was no significant difference ( $P > 0.05$ ) between Norwegian and Toggenburg goats in terms of daily milk yield. However, Toggenburg goats produce slightly higher amount of milk (0.8 litres per day) than the Norwegian goats (0.6 litres per day). The lactation length was 104 days and total milk production per lactation was slightly higher for Toggenburg (104.6 litre) compared to Norwegian (82.3 litre). The average daily milk yield observed in the project villages for Toggenburg does is lower than the mean milk yield of 1.7 and 2.2 litre/day reported for Toggenburg goats in Babati, Tanzania (Jackson *et al.*, 2014) and Meru, Kenya (Ahuya *et al.*, 2003), respectively. Similarly, the average daily milk yield of Norwegian does is lower than the mean yield of 1.0 and 0.9 litre/day reported for pure and 75%

Norwegian goats, respectively, in Mgeta, Tanzania (Safari *et al.*, 2008). The difference between the results of the current study and previous studies could be due to differences in the age of the animals, management and environmental conditions. Normally milk production is lower during the first lactation and it increases gradually from the first to the fourth lactations. The goats in the project villages were either in the first or second lactation. It is anticipated that in subsequent lactations, milk production will increase to the levels comparable to those observed elsewhere. Moreover, Meru, Babati and Mgeta are highland areas with cool temperature and adequate rainfall; hence, their climatic conditions could be more favourable for raising dairy goats compared to the conditions in the project villages. The details are contained in annex 4.3.18.

### 3.1.2.3. Growth performance of the offspring

Body weight of kids was measured at birth by village extension workers and then every month up to 12 months by the researchers responsible for the goat component. Data collected indicate that among the kids born, 74.7% were born as single and 25.3% were twins. The mean birth weight of single kids ( $3.04 \pm 0.1$  kg) was not significantly different ( $P > 0.05$ ) from that of twins ( $2.93 \pm 0.15$  kg). Similarly, the overall growth rate of singles ( $60.84 \pm 3.15$  g/day) was not significantly ( $P > 0.05$ ) higher than that of twins ( $54.92 \pm 4.34$  g/day). The mean birth weight of Norwegian kids ( $3.07 \pm 0.13$  kg) was slightly higher compared to that of Toggenburg ( $2.91 \pm 0.13$  kg) but not significantly different ( $P > 0.05$ ). However, the growth rate of Norwegian kids ( $54.26 \pm 4.33$  g/day) from birth to one year of age was lower ( $P \leq 0.05$ ) than that of Toggenburg kids ( $61.50 \pm 4.38$  g/day). The average birth weight of male ( $3.03 \pm 0.11$  kg) and female kids ( $2.95 \pm 0.14$  kg) did not differ significantly ( $P > 0.05$ ), but in terms of growth performance for the first 90 days, male kids had higher ( $P \leq 0.01$ ) growth rate ( $113.13 \pm 5.89$  g/day) than female kids ( $91.16 \pm 7.39$  g/day). The average birth weight and growth rate of Toggenburg kids are lower compared to the birth weight of 3.2 – 3.6 kg and growth rate of 104 – 127 g/day reported in Meru, Kenya (Ahuya *et al.*, 2003). For the Norwegian goats, the mean birth weight observed in the project villages is slightly higher than that reported in Mgeta (2.5 – 2.8 kg) (Safari *et al.*, 2008), but the kid growth rate is lower than the growth rate of 65 – 118 g/day which has been reported for Norwegian goats in Mgeta. The differences could be attributed to the differences in climatic conditions and age of the dam (mother). The details are contained in annex 4.3.18.

### 3.1.2.4. Monitoring of diseases and parasites

Field visits were made every month to the project villages since June 2012 as part of a longitudinal disease monitoring programme. The diseases of interest were gastrointestinal nematodes (GINs), coccidiosis and haemoparasites and general health conditions of all dairy goats in the project villages. During field visits, all goats in the project households were examined for presence of clinical and/or surgical conditions and sick animals were treated accordingly. Faecal samples were collected monthly from all animals in order to determine the presence of nematode eggs per gram of faeces (EPG) and *Eimeria* oocysts per gram of faeces (OPG). Blood samples were also collected monthly and screened for haemoparasites i.e. Trypanosoma, Babesia and Anaplasma. Furthermore, haematological parameters (packed cell volume and haemoglobin concentration) were determined every month as complementary tests for parasitism. Laboratory results indicated low level of both GINs and coccidian infections. All animals screened tested negative for haemoparasites. The highest mean prevalences of GINs and coccidiosis in the screened goats were 54.8% and 57.4% respectively in April 2013. The prevalence of GINs was higher during the rainy season than in the dry months and in Norwegian goats than in Toggenburg goats. The mean eggs per gram of faeces (EPG) in the screened animals was 250.15 (range of 0 to 31200.00) and mean oocysts per gram of faeces (OPG) was 597.13 (range of 0 to 51600.00) for the Norwegian breed while for Toggenburg goats the mean of EPG was 185.00 (range of 0 to 7100.00) and mean of OPG was 503.87 (range of 0 to 44400.00). The common genera of GINs in the study areas were *Haemonchus spp*, *Bunostomum spp* and *Strongyloides spp*. Screening for brucellosis and haemoparasites (Trypanosoma, Babesia and Anaplasma) revealed negative results for all goats. The

prevalence of Contagious Caprine Pleuropneumonia (CCPP) in the screened animals was 26.4%. The observation in the present study supports the findings of previous studies which have reported on the existence of CCPP in Tanzania (Msami *et al.*, 1998; Noah *et al.*, 2011). The disease is one of the major limiting factors for improved goat production in Eastern Africa. The disease causes direct economic loss due to high mortality, reduced milk and meat production, costs of diagnosis, treatment, vaccination and surveillance. Also, it causes indirect loss resulting from trade restrictions. As an effort to control CCPP in the project villages, a vaccination programme was initiated and all goats of the project farmers were vaccinated against CCPP every year starting in January 2013. Cases of sick animals were reported by the farmers to the village Livestock extension workers who were responsible for treating the animals. The study has revealed that the Norwegian goats were more susceptible to diseases than Toggenburg goats. This suggests that the Toggenburg dairy goats are more suited to the climatic conditions of the study villages. One of the challenges noted on animal health issues was timely treatment of sick animals. Some farmers reported the sick animals late and sometimes the farmers were not ready to bear the costs of treatments. Detailed information on animal health is presented in the paper (Annex 4.3.3).

**4.2** *To test and evaluate improved sweet potato and cassava varieties that have the dual purpose of improving food security and nutrition at household level and the development of locally available and cost effective rations for dairy goats.*

#### **4.2.1 Development of feeding packages for dairy goats**

An on-station study was carried out to assess the effects of supplementing diets containing cassava leaf meal and sweet potato vines as protein sources on feed intake and growth performance of Norwegian crossbred goats. Four supplementary diets were formulated and designated as D<sub>1</sub>, D<sub>2</sub>, D<sub>3</sub> and D<sub>4</sub>. All diets contained hominy meal (67%) and mineral premix (2%). In addition, D<sub>1</sub>, D<sub>2</sub>, D<sub>3</sub> and D<sub>4</sub> contained sunflower seed cake (31%), cassava leaf meal (31%), sweet potato vines (31%) and cassava leaf meal (15.5%) + sweet potato vines (15.5%), respectively, as sources of protein. Six animals were randomly assigned to each of the four supplementary diets. All animals were fed *Brachiaria brizantha* hay *ad libitum* as a basal diet and water was made available at all the time. The experiment was carried out for 90 days. Results show that the type of diet significantly ( $P \leq 0.01$ ) influenced total dry matter (DM) intake. Goats supplemented with a diet containing sweet potato vines had the highest total dry matter intake (507.66 g DM/day), followed by those supplemented with the diet containing cassava leaf meal (501.64 g DM/day) while those supplemented with the diet containing sunflower seed cake had the lowest (483.99 g DM/day). The goats supplemented with the diets containing cassava leaf meal showed significantly higher ( $P \leq 0.05$ ) growth rate (39.0 g/day) and better feed conversion ratio (FCR) (11.76) compared to those fed diets containing sweet potato vines (growth rate of 30.56 g/day and FCR of 15.57), and sunflower seed cakes (growth rate of 34.0 g/day and FCR of 13.81). It was concluded that cassava leaf meal and sweet potato vines can be used as protein sources in diets of dairy goats. (More details are presented in Annex 4.3.10)

#### **4.2.2 Evaluation of sweet potato varieties**

Four sweet potato varieties - Mataya (Orange fleshed), Kiegea (Orange fleshed), Simama (Cream), Ukerewe (Cream with orange background) - were disseminated to farmers. On-farm results for the performance of sweet potato varieties in terms of tuber yield and foliage yield showed that the variety Mataya had the highest root yield than the rest of the varieties in Masinyeti village, while in Ihanda village variety Kiegea recorded the highest yield. For foliage weight, variety Simama was the best in Masinyeti village and variety Kiegea in Ihanda village. In Mvomero, variety Ukerewe performed better in foliage and roots weight than the other three varieties. Generally yields were very low; this was due to shortage of rains in Kongwa district. (Annex 4.3.19).



### 4.2.3 Effect of leaf defoliation on leaf and root tuber yields

The effects of leaf defoliation intensity and frequency on root tuber and leaf yields of three sweet potato varieties (simama, mataya and kiegoa) were assessed. The study was conducted from February to August, 2014 at Sokoine University of Agriculture (SUA) - Morogoro. Each variety was grown in a plot of 11.2 x 9.6 m<sup>2</sup> and replicated three times. The total area for the nine experimental plots was 1461.6 m<sup>2</sup>. Sweet potato vines with the length of 20 - 25 cm were used as planting materials and were planted at a spacing of 70 x 40 cm, giving a population of 35714 plants/ha. Weeding was done monthly and no commercial fertilizer (N-P-K) was applied.

The three sweet potato varieties was subjected to four leaf defoliation regimes (i.e. 4, 6 and 8 weeks leaf harvesting interval). For each harvesting interval leaves were harvested at a rate of 0%, 10%, 20%, 30%, 40%, 50%, 60% and 70%. Initial harvesting of leaves was done 50 days after planting. The subsequent leaf harvests were done on the same plants at intervals of 4, 6 and 8 weeks until the plants were six months old when root harvest was done. The data were collected on yield of forage and root tubers.

Results showed that the leaf yield was significantly influenced by variety ( $P \leq 0.05$ ), defoliation level ( $P \leq 0.01$ ) and harvesting interval ( $P \leq 0.001$ ). For Simama variety the highest DM yield of fresh sweet potato vines (above ground biomass) was obtained at harvesting interval of 4 weeks and 40% defoliation (15.5 tonnes ha<sup>-1</sup>) while the lowest (4.7 tonnes ha<sup>-1</sup>) was observed at harvesting interval of 4 weeks and 70% defoliation. For Mataya variety the DM yield of fresh sweet potato vines was highest (7.3 tonnes ha<sup>-1</sup>) at leaf harvesting interval of 6 weeks and 50% defoliation and the lowest was observed at harvesting interval of 6 weeks and 40% defoliation (4.7 tonnes ha<sup>-1</sup>). For Kiegoa variety the DM yield of fresh sweet potato vines was highest (8.2 tonnes ha<sup>-1</sup>) at harvesting interval of 8 weeks and defoliation rate of 40% and lowest (3.8 tonnes ha<sup>-1</sup>) at harvesting interval of 6 weeks and 30% defoliation.

Leaf harvesting interval significantly affected root yield ( $P < 0.001$ ). For simama root yield was 5.15, 2.70 and 3.40 tonnes ha<sup>-1</sup> for leaf harvesting interval of 4, 6 and 8 weeks, respectively. The root yield of 21.63, 12.88 and 20.90 tonnes ha<sup>-1</sup> were obtained for mataya at leaf harvesting interval of 4, 6 and 8 weeks, respectively. For kiegoa the root yield were 15.55, 10.69 and 15.36 tonnes ha<sup>-1</sup> for leaf harvesting interval of 4, 6 and 8 weeks, respectively.

Leaf harvesting at four weeks intervals and four times per growing period gave the highest leaf forage production but, the root yield was decreased tremendously. Harvesting at eight weeks intervals and three times per growing period proved to be the best in leaf production as well as root yields. Mataya was superior to kiegoa and simama both in terms of leaf and root yields. Hence, Mataya can be used for production of root tubers for human food and leaves for goat feeding.

For cassava, root tuber and leaf yields were compared for two varieties (Kiroba and Mumba) subjected to two leaf harvesting intervals (four and eight weeks) and five defoliation levels (0, 15, 30, 45 and 60%). The results showed that Mumba had significantly ( $P \leq 0.001$ ) higher tuber yield (7.23 t/ha) and leaf dry matter yield (6.35 t/ha) compared to Kiroba variety (4.40 t/ha tuber and 4.05 t/ha leaf yields). Leaf harvesting interval did not influence ( $P > 0.05$ ) both root tuber and leaf yields, though the cassava plants harvested at four week intervals showed slightly higher tuber yield (6.20 t/ha) and lower leaf dry mater yield (5.04 t/ha) compared to those harvested at the interval of eight weeks (5.43 t/ha tuber yield and 5.36 t/ha leaf yield). Defoliation level significantly ( $P \leq 0.001$ ) affected root tuber yield but did not influence leaf yield ( $P >$

0.05). The highest tuber yield was observed at leaf harvesting intensity of 15% (6.40 t/ha), followed by harvesting intensity of 30% (4.60 t/ha). Generally, the variety mumba was superior to kiroba and produced the highest tuber yield (9.58 t/ha) at leaf harvesting interval of eight weeks and defoliation level of 15%. For leaf yield, mumba showed the highest yield when it was subjected to harvesting interval of four weeks and defoliation level of 45%. Since leaf yield was not affected by defoliation intensity, the harvesting interval of eight weeks and defoliation level of 15% can be used as a regime for growing mumba variety for both production of root tubers for human food and leaves for dairy goat feeding.

### **4.3** *To investigate the livelihood strategies, production potential, and marketing possibilities of local goats and crops in the study areas*

#### **4.3.1 Assessment of marketing systems for dairy goats, cassava and sweet potatoes**

An assessment of performance of cassava and sweet potato marketing systems was conducted in two districts of Kongwa and Mvomero. Data were collected through individual interview, focus group discussion and key informant interviews. A total of 63, 25, 21 and 36 producers, traders, local processors and consumers were involved in the study. Most producers were men (54.8%) while most traders (70.1%) and processors (67.4%) were women. The study revealed that farmers produce cassava mainly for home consumption and to a limited extent for sale. About 90% of cassava producers sell their produce at their farm gate while 4% of them sell their produce directly at the village markets. The study also revealed that selling cassava to the markets in towns was more profitable than selling within the villages. The actors in the cassava marketing channels were producers, retailers, cooking vendors, local processors and consumers. The highest gross margins (34 355 Tshs/bag) was obtained by local processors, followed by retailers (13 326 Tshs/bag). On average the farmer's share to the total consumer price was 40%. (More details on Annexes 4.3.5 and 4.3.7).

For sweet potatoes a total of 51, 15, 4 and 30 producers, traders, local processors and consumers, respectively, were involved. Most producers were men (54.6%) while most traders (81.8%) were women. Women processors comprised 50% and the remaining 50% were men. The market actors in sweet potato marketing channels were producers, retailers, local processors and consumers. The study revealed that most farmers produce sweet potato purposely for subsistence and to a limited extent for sale. Most farmers sell their produce either at the farm gate (55%) or at their homestead (39%). On average the farmer's share to the total consumer price was 44% and the remaining 56% was for traders. (More details on Annexes 4.3.6).

For dairy goats, a total of 106 dairy goat farmers (58 farmers from Kongwa and 48 farmers from Mvomero) were involved in a study to assess marketing channels of dairy goats and their products. The results of the study revealed that the products produced and sold by the farmers were fresh milk, natural fermented milk, weaned kids and manure. Among these products, fresh milk was the most commonly sold products and was mainly sold to the neighbours of the farmers. It was estimated that 30% of the fresh milk produced was sold, 5% was naturally fermented and consumed at home and the remaining 65% was consumed at home as fresh milk. Manure was the second product and it was estimated that about 3 tons per month of goat manure were produced, 64% of which was used by the farmers themselves to fertilize gardens and crop fields and the remaining 36% was given to the neighbours free of charge. In general, the value chain of dairy goats comprised the farmers, input suppliers, grain millers, food vendors and consumers. (More details on Annexes 4.3.8 and 4.3.9).

It is recommended that future plan for cassava, sweet potato and dairy goat value chain should assess the market beyond the district level. That is to assess possible market linkages in major cities such as Dodoma, Morogoro, Arusha and Dar es Salaam.

#### **4.3.2 Livelihood strategies**

Most of the research conducted by researchers at the University of Alberta was focused on livelihood strategies of various kinds. This includes work on gift giving behaviour or farmers and intra-household decision making associated farmers (summarized below). Also, a PhD student at Alberta, Jeff Andrews, worked on the adaptation strategies of societies in Africa in response to disaster such as drought. His work provides an important historical perspective on adaptation. Research on economics, marketing and livelihoods in this project focused on data that were collected during the baseline survey and subsequent research study on market potential. Our efforts focused on determinants of food security and livelihood diversification, gift giving behaviour (as a key aspect of the informal economy), and market potential for dairy goats, cassava and sweet potatoes. The finding on the food security research indicates that the households with higher number of males have higher levels of food consumption and are more food secure compared to female headed households, suggesting that the female headed households have lower levels of food security. Female ownership of livestock, however, leads to higher levels of food consumption which is an important insight from our livelihood analysis and emphasizes the importance of female and joint owned livestock as a strategy to improve food security. Much of our work was also focused on livelihood diversification in order to see how the introduction of new food systems will impact these diversification strategies at the household level. Research indicates that more farmers are seeking livelihoods outside of agriculture, and diversification is out of choice within agriculture and desperation led across activities. Our work was also focused on diversification strategies beyond Tanzania with a comparative multi-country study that includes IDRC-project datasets in India and South Africa. Research on these datasets is ongoing but in the next few months we hope to learn more about the multinational dimensions of diversification as it relates to household livelihoods and well-being. Research on gift giving is a novel and important area of development research because the majority of economic transactions are informal within the project villages. Gifting is a way of supporting family, securing alliances, maintaining status, and maintaining long-standing social relations at the village level. Our study on gift giving behaviour will help to improve the structure of future project agreements with farmers to secure optimal conditions for “passing on gifts” such as dairy goats to other farmers in the village. Finally, production analysis was done by researchers at Sokoine University of Agriculture, assessing optimal conditions for goat and root crop development. The study recommends that smallholder farmers requires 8 goats in order to benefit from milk sales besides other benefits such as selling of manure and male kids which are born. (More details on Annexes 4.2.5, 4.2.6, 4.3.13, 4.3.14 and 4.3.15).

*4.4 To analyze the impacts (productivity, environmental, gender and empowerment, food security and nutrition) of integrating improved goat breeds with sweet-potatoes and cassava into an agro-pastoral farming system.*

**4.4.1 Environmental impact assessment**

Focus group discussions were conducted in the four project villages to assess anticipated environmental impacts of the introduced dairy goats and improved varieties of sweet potato and cassava. Focus group participants included members of village environment committees, project farmers and non-project farmers, with almost equal number of male and female participants in each group. Participants had the opinion that the project will have large positive impacts in terms of household food security and income. The participants expected that the introduction of new varieties of root crops will increase their agricultural production and food security. Moreover, participants felt that the introduction of dairy goats and root crops created more opportunities and income generating activities through selling of dairy goat products and root crops (sweet potatoes and cassava). According to the participants the project impacts on local resources such as water, fodder and soil are expected to be minimal. Several environmental challenges were identified that will require more focused attention. These included: (1) lack of access to fodder during the dry seasons, (2) severe shortage of local water resources in the villages, (3) lack of ownership of land for some poorer farmers, limiting their ability to participate in project activities, (4) a general lack of planning at the village level on the use and management of local resources such as land use for

crop farming and fodder production, and (5) ongoing conflicts between farmers and pastoralists that may limit the success of the project interventions. (More details on Annex 4.3.1).

#### 4.4.2 ***Food security and nutrition assessment***

A cross-sectional study was carried out in the project villages (Masinyeti and Ihanda – Kongwa district, Kunke and Wami-Luhindo - Mvomero district) to assess the nutritional status of children below five years and their mothers. A total of 107 households were purposively selected from which 107 adult respondents and 74 children below five years of age participated in the study. Structured questionnaire was used to collect information on dietary pattern and gender relations in the households. Body heights and weights were measured from the children below five years of age and their mothers. Chronic malnutrition was found to be more pronounced in the study area, especially in Kongwa district. It was more pronounced in male children with the age of 12 to 24 months than female children. Factors associated with malnutrition were location where the child lives, age of the child, educational level of mothers, timing for introducing complementary foods, type of complementary food and feeding frequency. Most decisions making and ownership of resources were undertaken by men, thus hindering women to make decisions that could influence nutritional status of the family including the children (Annex 4.3.11).

Availability of dairy goats at household level has introduced and increased consumption of milk over project life span. This has resulted into improved nutritional status of children less than five years old in the study villages. Such improvement was revealed by the follow-up study conducted in 2013 which showed that 58 % of the households consumed goat's milk once to twice per day. Findings from the study revealed further that fresh goat's milk was mixed with tea or fermented and consumed with *ugali* or mixed with other foods by the children and other household members. (Annex 4.3.21).

#### 4.4.3 ***Gender and empowerment.***

The project was designed with gender mainstreaming approach. Throughout the implementation of the project, special attention was given to gender and empowerment of the participants. Study findings on gender relations among the project farmers revealed that:

- Women developed interest in keeping dairy goats after introduction of the goats in the project villages by the project
- Women's participation in decision making positions is still negligible especially for those in male-headed households.
- Women's involvement is higher in the case of non-cashable farm activities, such as, forage collection, cleaning and feeding of animals whereas men's approach is more in soft activities related to cashable activities, such as selling of cassava and sweet potatoes.
  
- Women are left with the task of taking care of dairy goats which are zero-grazed.
- Women do not mind the added task in dairy goat management as they see the value in the form of milk and manure.
- There are increased consultations and shared labour and awareness creation on gender equity and capacity building.
- Both men and women shared roles in order to relieve women and girls from the work burden
- Women make decisions on the use of goat milk and expenditure of income from milk sales.
- There are changes in power relations, increased capability of women to negotiate, more women now hold leadership positions and influence decision-making. (More details on Annex 4.3.4).
-

#### ***4.4.4 Assessment of Knowledge, Attitude and Practices of project farmers***

Knowledge, Attitude and Practices (KAP) surveys were conducted to find out what farmers perceived as changes in their knowledge, attitudes and practices as a result of the project interventions. The major results that were revealed during the discussions included:

- Both women and men farmers have changed their practices of planting and harvesting the promoted root crops (e.g. planting the cassava roots vertically, tilling the soil around the stem and harvesting roots and leaves with minimum damage)
- New housing, feeding, health, milking and breeding strategies for the dairy goats have been widely adopted.
- Farmers adopted strategies of managing goats (e.g. providing supplementary feeds and routine control of diseases) and these have been extended to local breeds.
- There is also a general change in the mind-set of the farmers about consuming goat milk: most of the farmers are consuming the milk in fermented form as stew for their meals and also with their tea. Both men and women in Ihanda and Masinyeti in Kongwa district reported that they see greater benefits in milk consumption by their children than in selling the milk.

Cassava and sweet potatoes were cultivated in three villages and consumed in two villages, both as food and feed. In a third village, the crops were consumed as food only. In the fourth village the crops failed due to problems with the delivery of planting material leading to late planting.

In terms of social organization the introduction of the dairy goats affected the gender-based division of labour: in most households in Kongwa the women and children are mostly in charge of the new goats – kept at home – while men herd the other livestock which are grazed away from home in communal lands. Children are mostly involved in looking for goat feed after school hours. In Mvomero district goat management is shared among women, men and children.

The introduction of the new varieties of sweet potato and cassava had only little effect on the division of household labour in crop management: both crops are generally managed by women, both in the field and during post-harvest activities including marketing. However, some women maintained that with the introduction of these new crop varieties their husbands were contributing more to the work than in the past.

In another development, the gender and intra-household dynamics were analyzed as part of the August 2013 focus group discussions. The discussions revealed that decision-making on goat and crop management has changed due to the novelty of the introduced activities: i.e. the women and men who had adopted the new goat breeds and the new root crops took joint decisions regarding their daily management. Decision-making on milk and crop revenues varied: most households in Mvomero reported that decision-making was shared between men and women. However, most women in Kongwa maintained that their men folk would probably take over the control of the revenues once the household would start selling milk or root crops (the current produced quantities are small and have not attracted men's attention). The findings also show that some households share household chores related to goat and crop management more than before. The women farmers attributed these changes to the project's gender roles and relationship training. An empowerment pathway approach was suggested as a strategy to, on one hand, support further changes towards gender equity and on the other; ensure the implementation of clear strategy connecting gender-equity principles into development outcomes.

## **5 Synthesis of results towards AFS outcomes**

The project introduced dairy goats and improved drought tolerant cassava and sweet potato varieties as new technologies in the four villages. The dairy goats introduced in the project villages produce 0.6 – 0.8 litre of milk per goat per day. The milk is consumed by the members of the households. The consumption of goat milk has contributed to improvement in household nutrition of rural poor farmers, especially children. This is supported by the decline in underweight and wasting cases by 4% and 8%, respectively, for the children under five years of age. Poor households are now able to consume both carbohydrate and protein food. In addition, goat manure is being used to fertilize gardens and crop fields of the project farmers and other farmers in the villages, hence, it has contributed to increased crop yield and reduction of food insecurity.

The introduced technologies (dairy goats and improved cassava and sweet potato varieties) together with gender training workshops have led to change in gender relations and decision-making in the households participating in the project. Women and men who had adopted the new technologies are now making joint decisions regarding daily management of goats and the use milk and cash income as opposed to the situation before the implementation of the project. Before the start of the project goats belonged to men and the decision with regard to goat management and use of the income from goat production were made by men. The survey at the end of the project has revealed that in most households decision-making is shared between men and women.

The introduction of dairy goats and improved cassava and sweet potato varieties has contributed to increase of household income through sales of milk, live animals and cassava and sweet potatoes. The increased income has led to increased ability of farmers to pay for social services such as school and medical fees. On the other hand, the introduction of improved cassava and sweet potato varieties has reduced the level of food insecurity in poor households. The pass on gift based on 2 dairy goats per household has resulted in tremendous increase in dairy goat numbers and thus contributed to household food security.

Implementation of the project in the research villages created alternative food and income source. Instead of exploiting natural resources in communal lands, farmers are now generating income through selling of dairy goat products and root crops. This has contributed to the reduction of stress to the environment. Moreover, the project has empowered village environment committees with the relevant knowledge for conducting environmental impact assess for both crop farming and livestock keeping projects. The farmers can judge reasonably the anticipated environmental risks and make rational decisions.

## **6 Problems and Challenges:**

Some of the challenges faced were:

- Poor management of dairy goats. Most farmers consider dairy goat production as a secondary economic activity and hence put little efforts in managing the goats. This has contributed to lower milk production and higher mortality rate than would otherwise be the case.
- Difficulties of maintaining cassava and sweet potato planting materials from one growing season to the next in semi-arid areas. Drought prevented the establishment of root crop multiplication plots within the project sites. There was erratic rainfall in Kongwa district and this affected yields of sweet potatoes and cassava in the on-farm trials and caused loss of planting materials.
- Maintenance of a sustainable breeding system. An appropriate breeding programme requires a knowledgeable breeder with close monitoring of the programme. This may be a limitation in the local communities that will require ongoing farmer training.

## **7 Recommendations:**

- This project has developed a two-dairy goat model integrated with cassava and sweet potatoes, which shows promising results in terms of supplying milk to the household and increasing income. Therefore this model is recommended for its adaptability to a wide range of climatic conditions in Tanzania.
- The utilization of cassava leaves and sweet potato vines as sources of protein in goat diets is a viable option for supplementing dairy goats. This use of cassava leaf meal and sweet potato vines in place of expensive oil cakes should be promoted for wider adoption. Feeding dairy goats is a challenge, especially, in semi-arid regions and requires an adaptive approach. In some cases cassava and sweet potato may be appropriate but in other cases agroforestry systems (dryland areas), crop residues (semi-arid areas) or household residues (peri-urban areas) may be more important. Therefore we recommend a more flexible approach to goat feeding, particularly within semi-arid lands.
- Intensive farmer training and group training is crucial to maintaining project impacts as a way to overcome persistent challenges through collective efforts in disease management, goat milk and product marketing, the development of local feeding systems and community based breed management. To achieve these capacity building objectives, close collaboration with development NGOs is recommended.
- Clustering dairy goat project villages within a relatively small area, working closely with a collection of farmer groups will facilitate regional development of the dairy goat sector. Accordingly, given the high demand for dairy goats, market chains need to focus on live animals as well as milk and meat products.
- Particularly in remote and semi-arid areas, the development emphasis needs to be nutritional outcomes at the household level. Further research on nutritional outcomes and the promotion of dairy goat systems through government extension systems is recommended.

## **8 Annexes**

### **Annex 1: Monitoring AFS Expected Outcomes**

This section refers to how the project and its results are contributing to AFS program outcomes. It is not expected that every AFS project will respond to ALL of these outcomes.

\*Note: Quantitative and qualitative evidence of the outcomes should be specified as much as possible. A strong claim of an outcome will be supported by evidence.

1. **New technologies and/or farming systems and practices.** *How is the project testing, adopting and adapting new agricultural technologies and/or farming systems and practices that increase food production?*

- The project has introduced improved varieties of cassava and sweet potato. These varieties (four varieties of sweet potatoes and one variety of cassava) were tested under farmers' conditions. Female farmers have adopted improved varieties of sweet potatoes leading to increasing yield from 2t/ha to a range of 3-6t/ha.
- Effect of harvesting of sweet potato and cassava leaves for goat feeding was tested. For sweet potatoes, harvesting leaves at eight weeks intervals and three times per growing period was found to be suitable for leaf production as well as root tuber yields and the variety mataya was found to be better suited for leaf and root tuber production. This variety is recommended to farmers for adoption. For cassava, mumba was found to be the best variety in terms of root tuber and leaf yields. Leaf harvesting interval of eight weeks and defoliation level of 15% can be used as a regime for growing mumba variety for both production of root tubers for human food and leaves for dairy goat feeding.
- Dairy goats were introduced in the two districts and farmers have adopted a zero grazing system and improved husbandry. The research has demonstrated that the introduction of dairy goats in semi-arid regions leads to increased consumption of milk in poor families, increase in income by USD 160 per household per year.
- Technologies for feeding dairy goats were developed through on-station studies. The results show that goats supplemented with a diet containing sweet potato vines had the highest total dry matter intake (508g DM/day), followed by those supplemented with the diet containing cassava leaves (501g DM/day) while those supplemented with the diet containing sunflower seed cake had the lowest (484g DM/day). The goats supplemented with the diets containing cassava leaves showed significantly higher growth rate (39 g/day) and better feed conversion ratio (FCR of 12) compared those fed diets containing sweet potato vines (growth rate of 31 g/day and FCR of 16), and sunflower seed cakes (growth rate of 34 g/day and FCR of 14). As protein sources (sunflower cake) are expensive and not easily affordable, the good results obtained with cassava leaves and sweet potato vines provide a strategy for feeding the dairy goats.
- The combined interventions of dairy goats and root crops have thus increased household food production and in the future they will contribute significantly to the household income.
- Project farmers diversified their diets to include goat milk, cassava and sweet potatoes. This model of two dairy goats per household appears to be suitable for smallholder farmers in semi-arid areas and the feeding strategy of using root crops as part of the package improves the sustainability of the farming system through provision of both food and feed.

2. **Dietary diversity & nutrition.** *How is the project contributing to dietary diversity/balanced diets, particularly for women and children?*

Project farmers are now diversifying their diets by including goat milk, sweet potato and cassava leaves. Goat milk is fed to children and sick people and also included in their daily meals that contribute to balanced diet and improving their nutritional status. Women process goat milk to fermented milk and this is consumed with staple food such as *Ugali*. The traditional diet of cereals is deficient in protein and some vitamins and minerals. Supplementation of goat milk greatly improves the intake of high quality protein. Farmers also benefit by getting more vitamins and minerals from the introduced varieties of sweet potato. This kind of diversification has a great impact on mental and physical growth of children and lactating mothers.



3. **Engagement of Canadian researchers with Southern researcher organizations (for CIFSRF-funded projects only).** *Is there increased use of Canadian knowledge and resources to address environmentally sustainable agricultural productivity and nutrition problems in developing countries?*
  - All the Canadian researchers were involved in the design of the livelihoods and markets component of the household surveys. John Parkins was involved in the training of enumerators on data collection. He has led the project on the Canadian side. Once a month, the 3 PIs were engaged in Skype discussions to discuss both the research and the implementation of the project. Graduate students from Canada supervised by researchers from Canada conducted their studies in the research sites contributing immensely to knowledge generation and sharing. Marty Luckert and Marcoul Philippe attended project meetings and are all involved in supervision of graduate students working in the project. Canadian researchers were part of the project environmental team and have contributed significantly to developing a community-based environmental strategy.
4. **Research groups.** *How is the project contributing to stronger research groups for improved food security policies and decision-making?*
  - The research teams included researchers from different backgrounds, both social and natural sciences. This has brought about knowledge complementarities and a more balanced decision making. The multi-disciplinarity of the team has brought in different specialities relevant to food security.
5. **Food distribution.** *How is the project contributing to more equitable food distribution for environmentally sustainable food security?*
  - The distribution of planting material for improved cassava and sweet potato varieties and eventual establishment of multiplication plots is expected to contribute to this.
6. **Food processing and storage.** *How is the project contributing to improved food processing and storage for environmentally sustainable food security?*
  - Farmers in the project villages have been trained on various methods for cassava and sweet potato processing.
7. **Risk-mitigation.** *How is the project contributing to better risk-mitigation for environmentally sustainable food security?*
  - In each village an environmental conservation committee was formed and planned activities with the research team devising risk-mitigation strategies.
8. **Access to resources.** *How is the project contributing to improved access to resources for environmentally sustainable food production? E.g. land tenure, extension and credit, market access.*
  - The project is working closely with other stakeholders including the extension staff, NGOs as a means of facilitating the access to resources in the villages and from outside the villages.
  - Women in the project areas had limited access and ownership of resources. As a result of the interventions through the project, out of the 111 households, 45 are female-headed households that own dairy goats. Both Female-headed Households and women in Male-headed Households own dairy goats, control sales of milk and make joint decisions on the overall dairy goat management and sales.
  - Women apportion milk for consumption to feed the children and other members of the family; in the past this was not a practice. They also make decisions in diversifications of their meals.
  - Women also are free to accept extension and technical service providers without waiting for permission from their spouses. Generally, both men and women have joint ownership and decision making on other production resources.
9. **Income generation.** *How is the project contributing to improving vulnerable/poor people's ability to purchase more and better quality food, in particular for the benefit of women and children?*

- The baseline survey, established sources of incomes, who earns the incomes in the household and how it is managed including the proportion of income managed by women. This information has been used by researchers to conduct studies on how to improve the capacity of vulnerable groups.
  - Female farmers have adopted improved varieties of sweet potatoes leading to increasing yield from 2t/ha to a range of 3-6t/ha
  - Families with dairy goats are able to derive income of US 160 from sale of milk for the first lactation of two dairy goats. However, it is anticipated that this income will increase as production increases in subsequent lactations. Women control income earned from surplus milk sold and is used to purchase small household items such as salt, soap, cooking oil and children exercise books.
  - The two-dairy goat model has proved to be a suitable package for introduction of dairy goats to smallholder farmers with limited financial resources. An investment of one dairy goat worth USD 150 has a potential of providing an income of TAS 450,000 (USD 300) from sales of milk and Tsh 350,000 (USD 200) from sale of two young goats per annum, three years after introduction.
10. **Policy options.** *How is the project influencing the development and implementation of environmentally sustainable food security policies?*
- Through engaging policy makers in all project implementation activities, the project has been providing useful information to be incorporated in environmental and food policies. One of the policy options for smallholder farmers in semi-arid areas is to provide credit of two dairy goats to each household for improving household food security. The project developed a number of strategies to engage with local governments and the responsible ministries through stakeholder workshops, meetings and documentaries. These activities are aimed at improving policies related to food security using the various forums.
11. **ICTs.** *Has the use of ICTs contributed to increase access to information and improved environmentally sustainable food security for the most vulnerable?*
- The use of handset phones has enhanced smooth communication between the project implementation team and the project farmers.
12. **Gender.** *How is the project considering women's specific needs in the design of the research, participation of women in the research, and potential impact of research on women*
- Focus group discussions were held with men only groups, women only groups and mixed groups to identify key gender issues, constraints and opportunities that the project focused on. The technologies introduced will have a great impact on women income.
  - Men, women and youth now share roles and responsibilities in feeding, watering, cleaning, milking and general management of dairy goats and farm activities in improved cassava and sweet potato production. Women are involved in goat management. Women and men have accepted improved varieties and adopted best practices and sharing roles for cultivating sweet potatoes leading to yields of 3-6t/ha of tubers and 2-6t/ha of foliage. Also there has been sharing of some of the household chores - collecting water for domestic consumption and for goats, fodder, fuel wood and cleaning of the household surroundings – leading to reduced women workload.
  - Integrating root crops and dairy goats have changed and improved gender relations in terms of increasing women participation in project activities, gender division of labour, access, control, ownership of resources and decision making among the project farmers in Kongwa and Mvomero districts. Project interventions have led to dietary diversification that will improve nutritional status of women and children.
13. **Environment.** *How is the project improving the environment? What considerations have been given to the potential environmental impacts, both positive and negative, of the applications being developed?*

The project has introduced Community Based Environmental Assessment as a continuous activity to monitor changes in the environment. Farmers were trained on community based natural resource management with emphasis on environmental sustainability. While the root crops may have no negative effect on the environment and may possibly have positive effect, the introduction of zero grazing may contribute positively while the manure may enrich the soil.

## Annex2: Template for AFS Research Output Title and Abstract Page

Each research output submitted to IDRC must include a title page, abstract, and keywords. The kind of information that should be included is listed below. Items marked with an asterisk (\*) are particularly important and **must** appear. A blank title and abstract page follows.

**\*Title:** Child nutrition and gender relations: case of dairy goat and improved root crop project in Mvomero and Kongwa districts, Tanzania

**Subtitle:**

**\*By:** *Meana, Pamela Henry*

**Report Type:** MSc. dissertation

**\*Date:** 2014

**Published by:** *Sokoine University of Agriculture*

**Location:** *Morogoro, Tanzania*

**Series Name:**

**Number of Series part:**

**\*IDRC Project Number, and component number (if applicable):** Grant No. 106512-001

**\*IDRC Project Title:** Integrating Dairy Goat and Root Crop Production for Increasing Food, Nutrition and Income Security of Smallholder Farmers in Tanzania

**\*Country/Region:** *Tanzania*

**\*Full Name of Research Organizations:** *Sokoine University of Agriculture*

**\*Address of Research Organizations:** *P.O. Box 3000, Morogoro, Tanzania*

**\*Name(s) of Researcher/Members of Research Team:** F. P. Lekule, J. R. Parkins, S.W. Chenyambuga, J.G. Lyimo-Macha, D.B. Mosha, L.J. M. Kusiluka, J. R. Makindara, K. Mtunda and S. Nindi

**\*Contact Information of Researcher/Research Team members:** Sokoine University of Agriculture, P.O.Box 3004, Morogoro, Tanzania

**\*This report is presented as received from project recipient(s). It has not been subjected to peer review or other review processes.**

**\*Abstract:** *Research outputs should include an abstract of 150-200 words specifying the issue under investigation, the methodology, major findings, and overall impact.*

The nutritional status of children below five years of age is a sensitive indicator of a country's health status as well as economic condition. This descriptive cross-sectional study aimed at examining child nutritional status and gender relations among dairy goat and improved root crop project beneficiaries in Mvomero and Kongwa Districts in Tanzania. A total of 107 households were purposively selected whereby 107 adult respondents and 74 children below five years of age were involved. A structured questionnaire was used to determine dietary pattern of the households and gender relations while anthropometric measurements were taken to assess the nutritional status of the children below five years of age. Data were analyzed to obtain frequencies, percentages, means and standard deviation. Chi square test and ANOVA were used to assess association between child nutritional status and the independent variables considered in the study. Results showed that the mean age of the children was 27.8 months and of adult respondents was 38.5 years. The mean household size was 5.9 people. Majority of the respondents were primarily farmers, 35.5% in Kongwa and 35.5% in Mvomero District. There were more male children 55.4% than female children 44.6%. The prevalence of stunting was higher in Kongwa District (67.3%) than Mvomero district (33.3%). Stunting was high in children aged 12 to 23 months. 36.1% of children were introduced complementary feeding at early age of below six months. In Kongwa and Mvomero Districts, 56.1% and 27.4% of mothers respectively used maize porridge as complementary food. Staple food was stiff porridge and vegetables. Protein foods were rarely consumed while fruits were seldom consumed. Resource ownership, control and decision making were done by men. It is recommended that, training on nutritional education and importance of women contribution on decision making, control and ownership of resources should be provided.

**\*Keywords:** *Include up to six subject keywords separated by commas.*

**\*Title:** Production and market performance of dairy goats in Kongwa and Mvomero districts: Value chain option

**Subtitle:**

**\*By:** Mpelangwa, Eziacka Mathew

**Report Type:** MSc. dissertation

**\*Date:** 2014

**Published by:** *Sokoine University of Agriculture*

**Location:** *Morogoro, Tanzania*

**Series Name:**

**Number of Series part:**

**\*IDRC Project Number, and component number (if applicable):** Grant No. 106512-001

**\*IDRC Project Title:** **Integrating Dairy Goat and Root Crop Production for Increasing Food, Nutrition and Income Security of Smallholder Farmers in Tanzania**

**\*Country/Region:** *Tanzania*

**\*Full Name of Research Organizations:** *Sokoine University of Agriculture*

**\*Address of Research Organizations:** *P.O. Box 3000, Morogoro, Tanzania*

**\*Name(s) of Researcher/Members of Research Team:** *F. P. Lekule, J. R. Parkins, S.W. Chenyambuga, J.G. Lyimo-Macha, D.B. Masha, L.J. M. Kusiluka, J. R. Makindara, K. Mtunda and S. Nindi*

**\*Contact Information of Researcher/Research Team members:** *Sokoine University of Agriculture, P.O. Box 3004, Morogoro*

**\*This report is presented as received from project recipient(s). It has not been subjected to peer review or other review processes.**

**\*Abstract:** *Research outputs should include an abstract of 150-200 words specifying the issue under investigation, the methodology, major findings, and overall impact.*

This study determined production and market performance, through value chain analysis of dairy goats and its products with gender perspective in Mvomero and Kongwa districts, Tanzania. The specific objectives were: (i) To map key players of dairy goats and its products value chain (ii) To examine market performance of dairy goats and its product (iii) To assess effect of gender on dairy goat profitability and (iv) To examine the production performance of dairy goats. Data were collected from 106 farmers who kept 250 dairy goats, 40 processors/collectors and 60 consumers. Descriptive statistics, gross margin, net margin analysis and Data Envelope Analysis were carried with regard to each specific objective. The study found that the chain is comprised of five key players with three main products. These key players were farmers, input suppliers, grain millers, food vendors and consumers. The main products were fresh milk, manure, and offspring. Based on market structure the dairy goat milk was accepted based on its nutritious value. On market performance about 30% of the farmers had positive gross margin while 20% of farmers were making profit through having positive net margin. Based on gender effect on profitability, there was no sufficient evidence to reject the null hypothesis that there was no profit difference among different genders. For the case of production performance technical efficiency was 0.75 in both output and input orientations. This indicates that farmers were able to reduce 25% of the production cost to produce the same level of milk and manure, or they could increase the output by 25% using the same level of input. On other hand, scale efficient was 0.77 on input orientation. This further indicates that there was still a room to benefit on economic of scale, taking into consideration about 90% of the farmers were operating on increasing return to scale.

**\*Title:** *Cassava and sweet potato value chains in Mvomero and Kongwa districts*

**Subtitle:**

**\*By:** *Mkani Waziri*

**Report Type:** *MSc. dissertation*

**\*Date:** *2014*

**Published by:** *Sokoine University of Agriculture*

**Location:** *Morogoro, Tanzania*

**Series Name:**

**Number of Series part:**

**\*IDRC Project Number, and component number (if applicable):** Grant No. 106512-001

**\*IDRC Project Title: Integrating Dairy Goat and Root Crop Production for Increasing Food, Nutrition and Income Security of Smallholder Farmers in Tanzania**

**\*Country/Region:** *Tanzania*

**\*Full Name of Research Organizations:** *Sokoine University of Agriculture*

**\*Address of Research Organizations:** *P.O. Box 3000, Morogoro, Tanzania*

**\*Name(s) of Researcher/Members of Research Team:** *F. P. Lekule, J. R. Parkins, S.W. Chenyambuga, J.G. Lyimo-Macha, D.B. Masha, L.J. M. Kusiluka, J. R. Makindara, K. Mtunda and S. Nindi*

**\*Contact Information of Researcher/Research Team members:** *Sokoine University of Agriculture, P.O.Box 3004, Morogoro, Tanzania.*

**\*This report is presented as received from project recipient(s). It has not been subjected to peer review or other review processes.**

**\*Abstract:** *Research outputs should include an abstract of 150-200 words specifying the issue under investigation, the methodology, major findings, and overall impact.*

This study was conducted to analyze cassava and sweet potato value chains so as to identify potential areas for intervention in order to improve small-scale farmers' access to markets in Mvomero and Kongwa districts. The study was a cross sectional design. Data were collected from 245 cassava and sweet potato value chains actors using individual interview, focused group discussions and key informant interviews. The data collected was summarized using Statistical Package for Social Science (SPSS), Microsoft Excel and content analysis. Sub-sector mapping analysis was used to map cassava and sweet potato value chains. Results indicate that several constraints exist in all the two sub-sectors which among other things include low production, poor access to inputs, lack of market information, poor support services, poor linkages, lack of value addition and poor infrastructure. Profit and marketing margins along the cassava and sweet potato value chains were computed. Results indicate variations in gross margins with the highest gross margin of 34 355 Tshs/bag obtained by local processors while the farmers' gross margin was 24 709.31 Tshs/bag. For the case of sweet potatoes, the highest gross margin of 29 884.41 Tshs/bag was obtained by farmers while local processors' obtained the lowest gross margin of 3 050 Tshs/bag. Regression analysis model was used to analyse the determinants of cassava and sweet potato farmers' profitability. The findings show that farm size, experience of household head and farm location were the main determinants of cassava and sweet potato farmers' profitability. Convention method, Shepherd's method and Acharya's modified marketing efficiency methods were applied to determine the marketing efficiency at different channels of cassava and sweet potato marketing system. Results indicate that market efficiency in all the two sub-sectors decreases as the marketing costs and/or margins of intermediaries in the marketing channels increases and vice versa. In conclusion, the two sub-sectors in general face a number of challenges that hinder the development of a sustainable and profitable value chain. Therefore, it is recommended that the challenges need to be addressed by involving government, researchers and private parties in establishing a sustainable and profitable cassava and sweet potato value chains.

**\*Title:** Effect of supplementing cassava tops and sweet potato vines on performance of growing goats

**Subtitle:**

**\*By:** *Ngunga, David Peter*

**Report Type:** MSc. dissertation

**\*Date: 2014**

**Published by:** *Sokoine University of Agriculture*

**Location:** *Morogoro, Tanzania*

**Series Name:**

**Number of Series part:**

**\*IDRC Project Number, and component number (if applicable):** Grant No. 106512-001

**\*IDRC Project Title: Integrating Dairy Goat and Root Crop Production for Increasing Food, Nutrition and Income Security of Smallholder Farmers in Tanzania**

**\*Country/Region:** *Tanzania*

**\*Full Name of Research Organizations:** *Sokoine University of Agriculture*

**\*Address of Research Organizations:** *P.O. Box 3000, Morogoro, Tanzania*

**\*Name(s) of Researcher/Members of Research Team:** *F. P. Lekule, J. R. Parkins, S.W. Chenyambuga, J.G. Lyimo-Macha, D.B. Masha, L.J. M. Kusiluka, J. R. Makindara, K. Mtunda and S. Nindi*

**\*Contact Information of Researcher/Research Team members:** *Sokoine University of Agriculture, P.O.Box 3004, Morogoro, Tanzania*

**\*This report is presented as received from project recipient(s). It has not been subjected to peer review or other review processes.**

**\*Abstract:** *Research outputs should include an abstract of 150-200 words specifying the issue under investigation, the methodology, major findings, and overall impact.*

Thirty six growing crossbred of Norwegian and local goats were used in a 90 days study to evaluate the effect of supplementing Cassava tops and Sweet potato vines on feed intake, growth and digestibility. Twenty four goats (12 males and 12 females) with mean body weight of  $11.4 \pm 0.65$  kg were used for growing and intake study whereas twelve (12) male goats with mean body weight of  $14.5 \pm 0.54$  kg were used in the in vivo digestibility study. The goats were assigned to four supplementary diets in a randomized complete block design. The supplementary diets consisted of hominy meal (67%), Premix (2%), and either SSC (31%), CT (31%), SPV (31%) or CT+SPV (31%). The goats were fed a basal diet consisting of *Brachiaria brizantha* hay *ad libitum* and water was available all the time. Daily average dry matter intake (DMI) was similar between treatments and was about 501g/goat/day. Similarly no significant difference was observed for crude protein (CP) intake between all treatments during study period. A significant difference ( $P < 0.01$ ) in ME intake was observed during experimental period. Growth ranged between 30.56 and 39g/day and was significantly different ( $P < 0.05$ ) between treatments. Significant differences ( $P < 0.05$ ) in feed conversion ratio (FCR) between treatments were observed. The digestibility study showed differences in DM, OM, CP, NDF between treatments ( $P < 0.05$ ). Goats supplemented with CT (T2) had higher revenue value obtained from live weight gain/animal compared to T1, T3 and T4. Goats supplemented with CT supported better growth and feed conversion, high N retention and revenue from live weight gain compared with SPV, SPV + CT and SSC. It was concluded that Cassava tops and Sweet potato vines can be used as potential protein sources to growing goats and other ruminants when poor quality roughages hay fed to small ruminants.



**\*Title:** Impact of household gifting behaviour on their agricultural productivity: Empirical evidence from districts of Tanzania

**Subtitle:**

**\*By:** *Godwin Zigah*

**Report Type:** MSc. dissertation

**\*Date:** 2014

**Published by:** *Department of Resource Economics and Environmental Sociology, University of Alberta*

**Location:** *Alberta, Canada*

**Series Name:**

**Number of Series part:**

**\*IDRC Project Number, and component number (if applicable):** Grant No. 106512-001

**\*IDRC Project Title:** **Integrating Dairy Goat and Root Crop Production for Increasing Food, Nutrition and Income Security of Smallholder Farmers in Tanzania**

**\*Country/Region:** *Canada*

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**\*This report is presented as received from project recipient(s). It has not been subjected to peer review or other review processes.**

**\*Abstract:** *Research outputs should include an abstract of 150-200 words specifying the issue under investigation, the methodology, major findings, and overall impact.*

Informal institutions such as social networks are often drawn upon in order to protect households from market failures. Social networks often involve gift giving both within and outside the family network to cope with production uncertainties and food insecurity. But some community members avoid giving out gifts to either family members or outsiders. Following literature reviewed, there are three key reasons or motivations for gifting – altruism, reciprocity, and social norms. Although all three motivations may be for any gifting between households, each motivation is more associated with different types of households than others. In this thesis, I assume gifting between households of the same family network is more likely motivated by altruism, or social

norms that create obligations, whereas gifting between households of different families is more likely motivated by reciprocity. However, these gifting behaviors may involve behavior such as free-riding or investment in social capital. As such, gift transfers within or outside family networks can affect the productivity activities of those who give and receive gifts. Therefore, this paper seeks to examine how gifting behavior of farmers, among friends and family networks in the Kongwa and Mvomero districts in Tanzania, affects their productive activities. To do so, using primary data obtained from 552 households from 4 villages in each of two districts in Tanzania, a probit model is run to examine the determinants of a household decision to give gifts or not. Also, I estimate a tobit model with household weeding effort and an OLS model with agricultural crop yields as a function of different family types while holding constant other factors that affect agricultural productivity. My results support the idea that the formal economy (i.e. access to formal institutions, or services such as savings and credit institutions) is a substitute to social networks in these rural areas. I also provide estimates that suggest that productive efforts of farmer households differ depending on whether they are engaged in gifting with members of another household unit but within the same family network, or outside their family network. To be specific, the empirical evidence suggests that, relative to households not engaged in gifting, nonfamily gifting households have higher yields whereas family gifting households invest lower productivity efforts by weeding less.

**\*Title:** Making community based environmental impact assessment work: Case study of a dairy Goat and Root Crop Project in Tanzania

**Subtitle:**

**\*By:** *D.B. Kilemo, J.R. Parkins, Kerario ,  
S.J. Nindi*

**Report Type:** Journal paper

**\*Date:** 2014

**Published by:** *ISDS LLC, Japan*

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**\*IDRC Project Title:** **Integrating Dairy Goat and Root Crop Production for Increasing Food, Nutrition and Income Security of Smallholder Farmers in Tanzania**

**\*Country/Region:** *Tanzania*

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**\*Name(s) of Researcher/Members of Research Team:** *F. P. Lekule, J. R. Parkins, S.W. Chenyambuga, J.G. Lyimo-Macha, D.B. Masha, L.J. M. Kusiluka, J. R. Makindara, K. Mtunda and S. Nindi*

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**\*This report is presented as received from project recipient(s). It has not been subjected to peer review or other review processes.**

**\*Abstract:** *Research outputs should include an abstract of 150-200 words specifying the issue under investigation, the methodology, major findings, and overall impact.*

Community Based Environmental Assessment (CBEA) is an approach used to collate information in order to identify and analyze the environmental impacts of planned, on-going and completed community development activities. This study was conducted with four villages in the Kongwa and Mvomero Districts of Tanzania where dairy goats and root crops were introduced as project interventions. The study addressed three key research questions. (1) What are key environmental challenges in the project villages? (2) What are the likely environmental impacts from this project? (3) What could be the community-perceived mitigation and enhancement measures for such impacts? Participatory appraisal methods including focus group discussions, participatory village resource mapping, transect walks and pair wise ranking were used in the field research. Research revealed several environmental challenges and depicted a number of environmental impacts (both negative and positive) including shortage of pasture, deforestation, conflicts between farmers and pastoralists and loss of biodiversity. In contrast to conventional regulatory environmental assessments that are required for larger-scale industrial projects in many countries, this study offers experiences from a small-scale development project where environmental impacts are assessed. Such methods could be applied to other small-scale development initiatives where positive or negative environmental impacts can be enhanced or ameliorated.

**Keywords:** Community Based Environmental Assessment; Environmental Impact Assessment; Participatory Rural Appraisal

**\*Title:** Breed preference and breeding practices for goats in agro-pastoral communities of semi-arid and sub-humid areas in Tanzania

**Subtitle:**

**\*By:** *S W Chenyambuga and F P Lekule*

**Report Type:** Journal paper

**\*Date:** 2014

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**Location:** *Colombia*

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**\*IDRC Project Title:** **Integrating Dairy Goat and Root Crop Production for Increasing Food, Nutrition and Income Security of Smallholder Farmers in Tanzania**

**\*Country/Region:** *Tanzania*

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**\*This report is presented as received from project recipient(s). It has not been subjected to peer review or other review processes.**

**\*Abstract:** *Research outputs should include an abstract of 150-200 words specifying the issue under investigation, the methodology, major findings, and overall impact.*

A study was carried out to determine farmers' preferences for goat breeds, desired traits, management and breeding practices in agro-pastoral communities of central and eastern Tanzania. A total of 552 goat keepers from semi-arid and sub-humid areas were involved. Information on goat flock size, breed preferences, breeding practices, traits preferred and husbandry practices was collected using a well structured questionnaire. Out of the 552 household heads, only 21.3% were women. Most of the farmers kept indigenous goats belonging to the Small East African breed and the mean number of goats per household was  $8.9 \pm 1.0$ . The majority of the farmers (53.4%) preferred to keep the Small East African goat breed rather than the exotic breeds. The Small East African breed was preferred to exotic breeds because the animals are easier to feed, prolific, tolerant to drought and endemic diseases. Most farmers (70.8%) practiced uncontrolled mating using bucks from either their own flock (66.7%) or neighbours' flocks (33.3%). Uncontrolled mating was preferred because it is easier to practice (41.2%) and cheaper (41.2%). The buck to doe ratio was 1:3 in semi-arid and 1:2 in sub-humid areas. Breeding males were selected based on body size by the majority (85%) of the goat farmers. It is concluded that livestock keepers in semi-arid and sub-humid areas in Tanzania prefer the Small East Africa goats because the animals are abundantly available and well adapted to the local environmental conditions.

**Keywords:** *desired traits, mating practices, Small East African goat breed, Tanzania*

**\*Title:** Animal Health Constraints in Dairy Goats Kept Under Smallholder Farming Systems in Kongwa and Mvomero Districts, Tanzania

**Subtitle:**

**\*By:** *Dismas Said Ngasa Shija, Lughano  
Jeremy Moses Kusiluka, Sebastian Wilson  
Chenyambuga, Deogratias Shayo and  
Faustin Paul Lekule*

**Report Type:** Journal paper

**\*Date:** 2014

**Published by Livestock** *Journal of Veterinary and Animal Health*

**Location:** USA

**Series Name:**

**Number of Series part:** *Volume 6 (11): 268 - 279*

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**\*IDRC Project Title: Integrating Dairy Goat and Root Crop Production for Increasing Food, Nutrition and Income Security of Smallholder Farmers in Tanzania**

**\*Country/Region:** *Tanzania*

**\*Full Name of Research Organizations:** *Sokoine University of Agriculture*

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**\*Name(s) of Researcher/Members of Research Team:** *F. P. Lekule, J. R. Parkins, S.W. Chenyambuga, J.G. Lyimo-Macha, D.B. Moshia, L.J. M. Kusiluka, J. R. Makindara, K. Mtunda and S. Nindi*

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**\*This report is presented as received from project recipient(s). It has not been subjected to peer review or other review processes.**

**\*Abstract:** *Research outputs should include an abstract of 150-200 words specifying the issue under investigation, the methodology, major findings, and overall impact.*

This study was conducted to determine animal health constraints for dairy goats kept by small-scale farmers in Kongwa and Mvomero districts, Tanzania. A total of 129 dairy goats belonging to 108 farmers were screened for gastrointestinal nematode (GIN) infection, coccidiosis, haemoparasites, brucellosis and contagious caprine pleuropneumonia (CCPP) over a period of 11 months. Other clinical diseases and mortalities were recorded. The goats used were Norwegian crosses and Toggenburg crosses. The mean prevalence of GIN infection and coccidiosis in all goats were 54.8% and 57.4%, respectively. Prevalence of GIN infection was higher ( $P \leq 0.05$ ) during the rainy months than in the dry months, but the prevalence of coccidiosis did not differ ( $P > 0.05$ ) between the dry and rain seasons. The Norwegian crosses had higher mean eggs per gram (EPG) of faeces ( $211.78 \pm 0.02$  EPG) and mean oocysts per gram (OPG) of faeces ( $664.23 \pm 0.03$ ) than the Toggenburg crosses ( $129.51 \pm 0.02$  EPG and  $492.93 \pm 0.03$  OPG). The EPG in goats did not differ ( $P > 0.05$ ) between Kongwa ( $169.79 \pm 0.03$  EPG) and Mvomero ( $171.51 \pm 0.04$  EPG) districts, but the OPG differed significantly ( $P \leq 0.05$ ) with values of  $793.15 \pm 0.04$  (Kongwa) and  $364.02 \pm 0.05$  (Mvomero). The most predominant nematode genus was *Bunostomum* (57.67%), followed by *Haemonchus* (24.97%) and *Strongyloides* (17.36%). The common species of *Eimeria* were *Eimeria arloingi*, *Eimeria parva* and *Eimeria ninakohlyakimovae*. The prevalence of CCPP in the goats was 26.4%. Other clinical diseases included respiratory diseases, infectious keratoconjunctivitis and orf (scabby lesions around mouth and nostrils). Both tests for haemoparasites and brucellosis indicated negative results for all goats tested. Mortality rate during the study period was 15.5% and the major causes of deaths were respiratory diseases, bloat and food poisoning. In conclusion, gastrointestinal nematodes are prevalent in both districts, but the burdens are relatively low to justify mass treatment. The Norwegian goats are more susceptible to GIN infection and coccidiosis compared to Toggenburg goats.

**Keywords:** *Coccidiosis, Diseases, gastrointestinal nematodes, mortality, Norwegian goats, Toggenburg goats*

**\*Title:** *Improved Dairy Goats Farming in Transforming Gender Relations among Agro-pastoral Societies in Kongwa and Mvomero Districts, Tanzania*

**Subtitle:**

**\*By:** *D. B. Moshia-Kilave and J. G. Lyimo-Macha*

**Report Type:** Journal paper

**\*Date:** 2013

**Published by** *Journal of Continuing Education and Extension*

**Location:** *Tanzania*

**Series Name:**

**Number of Series part:** *Volume 4(2): 377-395*

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**\*IDRC Project Title: Integrating Dairy Goat and Root Crop Production for Increasing Food, Nutrition and Income Security of Smallholder Farmers in Tanzania**

**\*Country/Region:** *Tanzania*

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**\*Name(s) of Researcher/Members of Research Team:** *F. P. Lekule, J. R. Parkins, S.W. Chenyambuga, J.G. Lyimo-Macha, D.B. Masha, L.J. M. Kusiluka, J. R. Makindara, K. Mtunda and S. Nindi*

**\*Contact Information of Researcher/Research Team members:** *Sokoine University of Agriculture, P.O.Box 3004, Morogoro, Tanzania*

**\*This report is presented as received from project recipient(s). It has not been subjected to peer review or other review processes.**

**\*Abstract:** *Research outputs should include an abstract of 150-200 words specifying the issue under investigation, the methodology, major findings, and overall impact.*

This study was conducted to investigate the position of improved dairy goats farming in transforming gender relations among pastoral societies in Kongwa and Mvomero districts in Tanzania. Specifically, the study examined the extent to which integration of improved goats within agro farming systems enhanced women's access to resources and their participation in decision making at intra-household level. Data were collected using focus group discussions, structured interviews and participatory gender analysis. Quantitative data were analyzed using SPSS while content analysis was used for qualitative data. The findings revealed that both men and women were engaged in dairy production with women participating more on foliage collection, cleaning barns and feeding livestock while men were involved in watering and health management of the animals. Joint decision making has become a common phenomenon in most households in the districts because of gender mainstreaming in most project activities. However, the study showed a clear gender disparity in decision making, land and cattle ownership with the women being disadvantaged. It is thus recommended that development practitioners should engage more on empowering both men and women to enhance their participation in decision making and enhance respect for women's opinions among community members.

**Keywords:** Gender relations, dairy goat, root crops, Kongwa, Mvomero

## Annexes attached in separate files

### THESIS

- Annex 4.2.1: Meena P.H. (2013). Child nutrition and gender relations: Case study of dairy goat and improved root crop project in Mvomero and Kongwa district, Tanzania. MSc. dissertation, Sokoine University of Agriculture, Morogoro, Tanzania
- Annex 4.2.2: Mpelangwa E.M. (2013). Production and market performance of dairy goats in Kongwa and Mvomero districts: Value chain option. MSc. dissertation, Sokoine University of Agriculture, Morogoro, Tanzania.
- Annex 4.2.3: Mkani W. (2013) Cassava and sweet potato value chains in Mvomero and Kongwa districts. MSc. dissertation, Sokoine University of Agriculture, Morogoro, Tanzania.
- Annex 4.2.4: Ngunga D.P. (2014). Effect of supplementing cassava tops and sweet potato vines on performance of growing goats. MSc. dissertation, Sokoine University of Agriculture, Morogoro, Tanzania.
- Annex 4.2.5: Godwin Zigah (2014). Social Networks and Economic Behavior: Impacts of gifting in Tanzania. MSc. Thesis, Department of Resource Economics and Environmental Sociology, University of Alberta

### SYNTHESIS REPORTS

- Annex 4.2.6: Patience Tshuma, Jeremiah Makindara, and John Parkins (2014). A report of economic, market chain and livelihood research at the University of Alberta and Sokoine University in Tanzania.
- Annex 4.2.7: Eileen Omosa and John Parkins (2014). Synthesis Report on Gender-based Activities in the Crop and Goat Project, Tanzania.
- Annex 4.3.19: Kiddo Mtunda (2014). Final technical report on root crops

### PUBLISHED PAPERS

- Annex 4.3.1: Kilemo, D.K, I. Kerario, J.R. Parkins, and S.J. Nindi. (2014). Making Community Based Environmental Impact Assessment Work: Case Study of a Dairy Goat and Root crop Project in Tanzania. *International Journal of Development and Sustainability*, 3(4): 767 – 783.
- Annex 4.3.2: Chenyambuga S W and Lekule F P (2014). Breed preference and breeding practices for goats in agro-pastoral communities of semi-arid and sub-humid areas in Tanzania. *Livestock Research for Rural Development*. Volume 26, Article #117. Retrieved September 15, 2014, from <http://www.lrrd.org/lrrd26/6/chen26117.html>
- Annex 4.3.3: Shija, D. S.N., Kusiluka, L. J. M., Chenyambuga, S. W., Shayo, D. D., and Lekule F.P. (2014). Animal Health Constraints of Dairy Goats Kept Under Smallholder Farming Systems in Kongwa and Mvomero Districts, Tanzania. *Journal of Veterinary Medicine and Animal Health*, 6(11): 268 – 279.

Annex 4.3.4: Mosha-Kilave, D. B. and J. G. Lyimo-Macha (2013). Improved Dairy Goats Farming in Transforming Gender Relations among Agro-pastoral Societies in Kongwa and Mvomero Districts, Tanzania. *Journal of Continuing Education and Extension, Vol.4(2): 377-395*

#### **SUBMITTED MANUSCRIPTS**

Annex 4.3.14: Mason, R.F., P. Ndlovu, J.R. Parkins and M.K. Luckert. Gender differences in household headship and resource ownership as determinants of food security in Tanzania. *Agriculture and Human Values*, March 2014.

#### **DRAFT MANUSCRIPTS**

Annex 4.3.5: Waziri, M. D. and J. R. Makindara . Assessment of Performance of cassava marketing system in Mvomero and Kongwa Districts, Tanzania.

Annex 4.3.6: Waziri, M. D. and J. R. Makindara . Assessment of Performance of sweet potato marketing system in Mvomero and Kongwa Districts, Tanzania

Annex 4.3.7: Waziri, M. D. and J. R. Makindara . District market-linked cassava value chain in Mvomero and Kongwa and Districts, Tanzania.

Annex 4.3.8: Mpelangwa, E. M. and J. R. Makindara. Market Performance of Dairy Goats and their Products in Mvomero and Kongwa Districts, Tanzania.

Annex 4.3.9: Mpelangwa, E. M. and J. R. Makindara. Performance Assessment of Dairy Goats in Kongwa and Mvomero districts, Tanzania.

Annex 4.3.10: Ngunga D P, Mutayoba S K, Chenyambuga S W and Lekule F P. Effects of supplementation of cassava tops and sweet potato vines on feed utilization and growth performance of goats fed *Brachiariabrizantha* hay.

Annex 4.3.11: Meena, P.H., J. G. Lyimo-Macha and C. N. Nyaruhucha. Nutritional status of under five years old children in selected villages of Mvomero and Kongwa districts, Tanzania.

Annex 4.3.12: Meena, P.H., J. G. Lyimo-Macha and C. N. Nyaruhucha. Gender relations and nutrition as seen in Mvomero and Kongwa districts.

Annex 4.3.15: Ndlovu, P., P. Tshuma, M. Luckert and J. Parkins. Diversification Across and Within Livelihood Activities: A Case Study of Rural Households in Tanzania

Annex 4.3.16: A multi country analysis of the impact of diversification on household income in countries with different rural household income levels and underlying social assistance programs.

Annex 4.3.17: Chenyambuga S. W., Shija D. S., Kusiluka L. J. M. and Lekule F. P. Comparison of production performance and tolerance to helminthosis of Toggenburg and Norwegian crossbred goats under smallholder production system in Tanzania

#### **PRESENTATIONS**

Annex 4.3.20: J. R. Makindara, E. M. Mpelangwa and D. D. Shayo (2014). Break Even Analysis for Smallholder Dairy Goat Keeping Practice in Mvomero and Kongwa Districts, Tanzania. Presented at the Canadian International Food Security Research Fund (CIFSRF) "Research to Feed Africa" Symposium, June 23 - 27, 2014, Great Rift Valley Lodge, Naivasha, Kenya

Annex 4.3.21: Jeffrey Andrews (2014). Long term behavioral and community effects of drought. Presented at the Canadian International Food Security Research Fund (CIFSRF) "Research to Feed Africa" Symposium, June 23 - 27, 2014, Great Rift Valley Lodge, Naivasha, Kenya

Annex 4.3.22: F. P. Lekule, S. W. Chenyambuga, J. Parkins, D. Shayo, J. G. Lyimo-Macha, J. R. Makindara & K. Mtunda Integrating Dairy Goat and Root Crop Production for Increasing



Food, Nutrition and Income Security of Smallholder Farmers in Tanzania: Project achievements.

Annex 4.3.23: J. G. Lyimo-Macha and D. B. Mosha (2014). Nutritional status of under five years old children in selected villages of Kongwa and Mvomero districts, Tanzania. Presented at the Canadian International Food Security Research Fund (CIFSRF) “Research to Feed Africa” Symposium, June 23 - 27, 2014, Great Rift Valley Lodge, Naivasha, Kenya

Annex 4.3.24: Chenyambuga S. W., Shija D. S., Shayo D., Kusiluka L. J. M. and Lekule F. P. (2014). Comparison of production performance of Toggenburg and Norwegian crossbred goats under semi-arid and sub-humid conditions in Tanzania. Presented at the Canadian International Food Security Research Fund (CIFSRF) “Research to Feed Africa” Symposium, June 23 - 27, 2014, Great Rift Valley Lodge, Naivasha, Kenya.

Annex 4.3.25: M. D. Waziri, J. R. Makindara and D. Shayo. (2014). Assessment of the Performance of Sweet Potato Marketing Systems in Mvomero and Kongwa Districts, Tanzania. Presented at the Canadian International Food Security Research Fund (CIFSRF) “Research to Feed Africa” Symposium, June 23 - 27, 2014, Great Rift Valley Lodge, Naivasha, Kenya.

Annex 4.3.26: D. B. Mosha and J. G. Joyce Lyimo-Macha (2014). The role of gender in ensuring improved Nutrition: a Case of Dairy Goat Project in Kongwa and Mvomero Districts, Tanzania. Presented at the Canadian International Food Security Research Fund (CIFSRF) “Research to Feed Africa” Symposium, June 23 - 27, 2014, Great Rift Valley Lodge, Naivasha, Kenya .

Annex 4.3.27: F. P. Lekule, , J. Parkins, S. W. Chenyambuga, J. G. Lyimo-Macha, D. B. Mosha, Kusiluka L. J. M, J. R. Makindara, K. Mtunda, S. Nindi, D. D. Shayo, D.S. Shija and L. George. Integrating Dairy Goat and Root Crop Production for Increasing Food, Nutrition and Income Security of Smallholder Farmers in Tanzania: Project overview.

Annex 4.3.28: Marcoul P., Mohapatra S., Luckert M. and Zigah G. (2014). Blood is thicker than water: The economic ramification of gift-giving in social network – Theory and Empirical evidence from Tanzanian villages.

## **NEWSLETTERS AND BROCHURES**

Annex 4.3.29: Ujue Mradi wa ufugaji wa mbuzi wa maziwa na uzalishaji wa mazao-mizizi (CGP – Tanzania)

Annex 4.3.30: Crop and Goat Project Newsletter. 2013, Volume 1

Annex 4.3.31: Crop and Goat Project Newsletter. 2013, Volume 2

Annex 4.3.32: Crop and Goat Project Newsletter. 2013, Volume 3

Annex 4.3.33: Crop and Goat Project Newsletter. 2014, Volume 4