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Jeremy Weaver  
*Southern Adventist University*

Alexon Mwasi  
*Southern Adventist University*

Lindsay Weaver  
*Southern Adventist University*

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Improved Dairy Cattle
Impact and Distribution in
Rural Tanzania Communities

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Jeremy Weaver  
*Southern Adventist University*

jweaver@southern.edu

Alexon Mwasi  
*Southern Adventist University*

alexon_mwasi@wvi.org

Lindsay Weaver  
*Southern Adventist University*

lemartz@southern.edu

ABSTRACT
The goal of this research is to establish the true impact of improved dairy cattle (IDC) breeds on the lives of rural Tanzanian families. A secondary goal is to map the distribution of IDC in the Endabash region of northwestern Tanzania using GIS technology. 32 rural households were given a questionnaire and those results were combined with the findings from key informant interviews and focus group discussions held in three separate villages in the Endabash region. It was firmly established that IDC breeds are an invaluable resource to farms in rural sub-Saharan Africa. IDC breeds contribute to the creation of consistent streams of income, improve the nutrition of the family, and are sources of surplus-ready cash for their owners. Best distribution practices were established including: improved veterinary support, increased basic veterinarian training for owners, taking extra precaution when cattle are disturbed near nature preserves, and ensuring that the improved dairy cattle breed is suited to its environment. This research will serve to inform and improve future IDC distribution outcomes. [AUTHOR ABSTRACT]

**Keywords:** improved dairy cattle, impact, resilience, distribution, GIS, livestock
Introduction

Tanzania is endowed with abundant natural resources including: fertile land, dense foliage, and a large livestock resource base. According to Njombe and Msanga (2011), out of the total 88.6 million hectares of land resource, 60 million hectares are rangelands suitable for livestock grazing, able to carry up to 20 million livestock units. More than 90% of the livestock population in the country is of indigenous types, kept in the traditional sector, has characteristically low productivity, yet is well adapted to the existing harsh environment including resistance to diseases.

According to the Livestock Sector Development Strategy (2010), livestock farming is one of the major agricultural activities in the country contributing to the achievement of the development goals of the National Growth and Reduction of Poverty (NSGRP). This is why there are concerted efforts by the national government and other stakeholders in the sector to increase adoption of dairy farming technology.

Njombe and Msanga (2011) noted that dairy farming is a source of animal protein, income, and employment. The sector has great potential for continuing to improve the living standards of the rural and urban poor through improved nutrition, and consumption of milk and milk products. It is with this in mind that we undertake this study using Geographic Information System (GIS) to establish the factors affecting dairy farming technology adoption trends, as well as impacts at the household level. This case study was carried out in three villages located in the Endabash Division in the Northern Region of Tanzania.

World Vision has been working in the Endabash area since 2009. In partnership with the Ministry of Livestock, an improved livestock breed technology initiative was implemented two years ago (2012), which was meant to promote improved livestock technology adoption as well as improve household income and nutrition. The project initially targeted 30 farmers from different villages who were organized in groups, trained and supported with improved breeds. The ultimate goal was to benefit 90 farmers through a merry-go-round distribution system and the larger community through replication and diffusion. The study was carried out once the scholars received the necessary approvals from the World Vision Tanzania Endabash program as well as the Southern Adventist University’s Institutional Review Board (IRB).

The objective of the research was to study the current distribution trends and technology adoption of improved livestock breeds and their impacts in the community using GIS analysis and factors affecting the same. The study is comprised of individual farmer questionnaires administered to 28 households of farmers that have benefitted from the project. Four households that had not benefitted were questioned as well (these will serve as a control group in order to isolate and assess the impact of the project). The survey data was complemented by focus group discussions as well as interviews with key informants within the villages.

The study addressed:

- What the effect of improved dairy livestock is on the wellbeing of the rural farmers in question.
- What current best practices are in the keeping and distribution of improved livestock.
- What guiding lessons can be learned from the implementation of the improved dairy cattle program.
• Whether there is a correlation between certain owner characteristics and success in raising productive improved dairy cattle.
• GIS mapping of current distribution households for more effective future planning of distribution efforts.

The results are intended to help the World Vision Tanzania Endabash Area Development Program (ADP) and other stakeholders with interest in the sector re-design their strategy of engagement with rural farming communities on improved livestock breeds distribution, adoption, and keeping.

Literature review

State of Smallholder Farming in Tanzania
Smallholder farming makes up a significant portion of Tanzania’s economic landscape. According to a country report by the World Bank (2000), more than 80% of the population lives rurally. The same report found that 90% of rural dwelling females and 78% of rural dwelling males work in the agricultural sector. The majority of these people work on smallholder farms, which are often owned by relatives. In 1995, The World Bank published a paper that noted that 55% of the rural African labor force participates in non-wage agriculture. A review of the literature (Salami, Kamara, & Brixiova, 2010) showed that smallholder farmers are responsible for 75% of the agricultural production in Tanzania. This is a significant contribution.

As Salami, Kamara, & Brixiova (2010) pointed out, the definition of “smallholder farmer” is highly varied economically in the literature; earnings as high as 50,000 USD to purely subsistence farming are included in the definition. The physical size of a smallholder farm is also generally vague, but the above authors defined this entity as “farming systems with a family unit as the center of planning and implementation, operating within a network of relations at the community level. This definition also includes farms which cultivate less than 2 hectares of land and own only a few heads of cattle or other livestock (2010).

Issues and Challenges to the Current Smallholder Landscape in Tanzania.
Smallholder farmers, particularly in a rural context, face a number of market and coordination challenges that directly affect not only their ability to expand and compete in a rapidly globalizing economy, but also their ability to provide for their families from a subsistence standpoint. In their 2005 bulletin, written for the Institute of Development Studies, Dorward, Kydd, and Poulton discussed a number of the challenges rural African Smallholder farmers face, such as: poor connection to markets (roads and vehicles), poor telecommunications, lack of financing for agricultural businesses, high transaction cost, poor human health, seasonal cash flow, high risk, and lack of development and diversity in local economies. They also pointed out that it is vital for all players to enact policies that further promote market liberalization and bolster small and diversified agribusiness (2005).

Improved Dairy Cattle
One niche of agribusiness that is currently underdeveloped in rural Tanzania is smallholder dairy agribusiness. Delgado, Rosegrant, Steinfeld, Ehui and Courbois (2001) made a compelling case for the important role that livestock (including dairy livestock) are playing in
Southern and Eastern Africa’s development, both in creating healthier micro-economy and in bolstering the nutrition of the poor. Additionally, it has been determined that there are many ways that livestock are critical to the rural poor in developing countries (Delgado, Rosegrant, Steinfeld, Ehui & Courbois, 2001). From an economic perspective, livestock allow for the sale of dairy, meat, and breeding rights, which are an important (and regular in the case of dairy) source of ready cash. In some places they are one of the few assets that can be owned, especially by women. They supply manual power for moving carts and plowing, as well as manure for use as fertilization. Livestock provide income variability and consistency to a rural farmer who may be otherwise relying on an individual crop for income. From a nutritional perspective, meat and dairy products provide valuable nutrition to rural farmers in a relatively sustainable and consistent manner.

**For and Against Livestock as a Means of Development**

A review of the current literature, published in the Journal of Animal Sciences, highlighted the debate regarding dedicating feed to livestock as being resource effective or not (Randolph et al., 2007). The paper addresses many of the arguments against focusing on bolstering livestock production as a good overall means of development in poor countries and suggests that many of these criticisms are at least partially misguided.

For example, one argument against a focus on livestock is that livestock use a disproportionately large amount of resources that could be otherwise consumed directly by humans and are time and labor intensive. This argument hinges on “western methods” of raising cattle. However, in the developing world context, many livestock are left to free graze and feed off uncultivated land that would otherwise be unused for food production purposes (Randolph et al., 2007).

Another argument is that overconsumption of livestock leads to health concerns. Again, this argument also hinges on the “western” context where animal products are consumed at such high levels that they become a health concern. Many people in poor, developing countries have the opposite problem of not having enough regular access to such macronutrients as fat and protein. In this case, a glass of milk and a few eggs can go a long way toward meeting daily nutrition requirements (Randolph et al., 2007).

**Diffusion of Technology in East Africa**

Dissemination, adoption, and adaptation of new technologies in East Africa has occurred more slowly than in other developing parts of the world. There are a number of factors influencing this slow diffusion including: limited access to technological infrastructure, strong counterproductive traditional beliefs, harsh environmental, lack of capital, and lack of advanced education (Musa, Meso, & Mbarika, 2005).

In their 2005 paper on the psychology of technology adoption in sub-Saharan Africa, Musa, Meso, & Mbarika (2005) pointed out that there are a number of factors limiting the dissemination of technological innovation in Africa, such as the ones mentioned above. Despite all the struggles that East Africans face when it comes to diffusion of innovation, the authors also stated that there is a very real “desire to improve” found among many sub-Saharan Africans.
There is also positive global pressure driving innovations such as incorporating improved dairy cattle raising techniques into local markets.

**Methodology**

According to Hulme (2000), there are several methodological options for conducting impact assessments which can be roughly grouped into two different paradigms: the scientific method and the humanities tradition. The scientific method seeks, through experimentation, to ensure that outcomes can be directly attributed to inputs. In the social sciences, however, controlled experiments are difficult and often impossible to arrange. Therefore, most social scientists have come to rely on the control group method, which involves comparisons between a “treatment” group and an identical group (or as nearly identical as possible) that did not receive the treatment. This method allows for stronger estimations of program impacts and more robust conclusions of causality.

This study, therefore, employed the control group method. The study was comprised of individual farmer questionnaires (through a GIS platform) administered to 30 households that had benefitted from the project, as well as 10 that had not benefitted, but belong to the farmers group (who serve as a control group in order to isolate and assess the impact of the project). The survey data was complemented by focus group discussions as well as interviews with key informant interviews (KII) within the villages.

Prior to the field data collection, the collection team trained together on geographic information system (GIS) technology and how it could be used to aid in data collection and presentation. GIS experts and practitioners initially trained the team on the use of the mobile application collector for GIS mapping at the World Vision Tanzania Headquarters. This application was chosen for its wide use within the organization and robust features. Once the team returned to the field site, another set of sessions was conducted on the use of the electronic form for interviews. One of the team members had undergone further extensive training and field application of GIS, and thus supported the others. A Samsung Galaxy Tab 2 tablet was used to set up the necessary mobile application, including ODK Collect, an open-source collecting application for mobile devices that is widely used by NGOs and other agencies and known for its flexibility and popularity (Esri, 2014). During the experiment, a hybrid data collection model using both GIS technology and manually recorded data was used. The study was carried out once the scholars (team) received the necessary approvals from World Vision Tanzania Endabash Program as well as the Southern Adventist University’s Institutional Review Board (IRB) (Appendix A).

**Qualitative and Quantitative Data Collection Methodology**

**Qualitative methodology**

The nature of this particular research topic yielded itself to qualitative research methods. Most of the in-depth discoveries were made using this modality because the research questions are dealing with people and their lives. The following qualitative approaches were used:

(a) **Focus group discussion.** During the study, the team held focus group discussions with the farmers group leaders, village elders, and the local government administrators in each village to capture their insights on the subject matter. A
moderator steered the focus group discussions through the use of a structured discussion guide (Appendix B) and another team member took notes. Respondents in this category included both male and female farmer group members.

(b) Field Visit observations. During the field visits to households with dairy cows, the team observed the general health status of the animals as well as took photographs to further augment the documentation of the data.

(c) Key informant interview (KII). In this study, the team conducted KIIIs with the Livestock Officer for the Endabash Division to get his expert perspective on dairy farming adoption, challenges and opportunities.

Quantitative methodology

The data collected using this method served to add veracity to the qualitative methods used. The team’s goal for the qualitative portion of data collection was to capture such details as: locations, amounts, time periods, and other exact figures pertaining to the keeping of the improved dairy cattle.

a) Literature/desk review of the World Vision Endabash Area Development Program (ADP) project proposal and reports

b) Questionnaire data collection from individual farmers on GIS platform.

Sampling technique

In this study, the team used purposive sampling whereby participants were selected by the World Vision ADP staff in collaboration with the team (farmer group members who benefitted from the project). The respondents were not expressly selected randomly but through a multi-stage sampling approach by using specified criteria based on location, participation in project activities, group member, etc. This sampling technique was applied for both qualitative and quantitative respondents during the study.

Data analysis

Data of a quantitative nature concerns numeric information. In this study, the team used the GIS platform to analyze the locations of improved dairy cattle and correlate them to data sets. A limited amount of data correlation was done using IBM SPSS Statistics Version 22 and charts and graphs were made using Excel for Mac Version 14.4.3. The qualitative data for this study was done using various forms of content analysis and conclusions from direct observation. Captured qualitative responses were themed and tabulated and conclusions were drawn from this processed data. The same team members who collected the data were involved in the analysis of the data to ensure that qualitative nuance was maintained.

Study Limitations

There are several study limitations that the research may have faced. The following are the limitations that had the greatest potential impact on the validity of the findings and the ability to answer the research questions:

Data was collected from 27 families who were recipients of a World Vision project that involved the distribution of cows in three nearby villages. Of those three villages, the team returned to only one to collect data on the economic effects of not owning an IDC. Having a
larger sample size (both experimental and control) would have strengthened our validity. Secondly, due to the time of day the research was conducted, a missing “head of household” was encountered several times. In these cases, information was collected from a child in the house. Thirdly, these families could have been asked how they rated their children’s nutrition status to be able to compare it with other data collected. Finally, it was a challenge to measure impact in some cases where IDCs, whether it be adult or calf, were dying before the family could experience the benefits of owning one.

The team partnered with World Vision (WV) Tanzania, Endabash ADP, to arrange for the research to be completed on individuals who had received an IDC from a WV distribution. It was requested of them to arrange these visits since they were the project implementers and had already established a trusted presence within each of these villages. Though the data was collected from World Vision recipients, it was later discovered that other organizations had done similar projects in these villages as well. It was also assumed that anyone who had an IDC had obtained it from a distribution program, which wasn’t the case; some had saved money to purchase an IDC without assistance. If data had been collected from those who received or purchased the cattle through means other than a WV distribution, the sample size would have significantly increased.

The team was in Endabash, TZ during the beginning of the rainy season, which meant high-velocity farming time and because of this, sticking to the arranged dates was very important. This added to the difficulty of adjusting the research as needed to include items that had been missed in the initial planning.

Collecting data during the rainy season affected all aspects of the research. The existing conditions of the road, in combination with heavy precipitation, meant that getting to data collection sites took much longer than expected and punctuality became an impossibility. Rainy season is also planting season and the farmer’s crops (rightly so) took precedence over our interview. When the team arrived to find only the children of the house present, they were only able to GIS map the location of the cow, record the name of the recipient, how many occupants were living in the house, the gender of the cow, and the condition of the cow and its environment.

When entering data into SPSS, it was realized that comparing the production of milk results against a Likert scale would have provided more insight into how improved dairy cattle had directly impacted the nutrition of the family. The recipients of the IDC were asked to rate the health of his family on a scale 1-5, both before receiving the cattle and then a few months after. Time restrictions did not allow for pre and post-test surveys. With such data it would then have been possible to compare the scales with other data such as milk production levels, how long the cow had been in their ownership, or which breed of cattle they owned.

Quantitative Results

Individual Demographics

Of the 32 individuals from three villages who were surveyed, 22 were male and 10 were female. All reported a marital status of “married” except one female who was a widow. The ages ranged from 28 to 71 with an average age of 43.8 and median age of 43.8. The 32 respondents
ranged over three villages (Getamock, Buger, and Ayalaliyo in the Endabash Region of NW Tanzania).

**Farm and Income Demographics**

All 32 of the respondents indicated that they participated in farming (agriculture and livestock) as a means of income. Eight of the respondents indicated that some of their income came from alternate sources. The two highest reported earners were involved in the local government. Yearly income was reported in either cash earned or bags of maize produced. Of those who reported income in cash value, the average yearly income was 593,750 TSH which is equal to approximately $357 USD. Of those who reported yearly income in bags of maize, the average was 13.72 bags, with the highest being 40 bags and the lowest being five.

The average acreage of usable land on farms surveyed was three acres with the largest being 20 and the smallest being one. All except one respondent had previously owned livestock. Types of previously owned livestock were a combination of local cattle (Zebu), goats, sheep, pigs, and donkeys, with Zebu, goat, and sheep being the three most commonly owned local livestock.

**Improved Dairy Livestock: Breeds**

Only two types of improved dairy cattle (IDC) were reported among those surveyed. These two types were Friesian and Ayrshire. Friesians are a breed of high producing dairy cow originating in Holland and Northern Germany with distinctive black and white markings. They are known for their udder quality, milk production, and are the largest dairy breed. The Ayrshire is the second largest dairy breed, native to Scotland, with red (brown) and white markings. They were also bred primarily for milk production, but also for hardiness and grazing abilities (University Breeds, 1995). Six of the improved dairy cattle were Ayrshire and 21 of them were Friesian.
Improve Dairy Livestock: Milk Production and Breed Trends

The average milk production for the Friesian breed was seven liters per day. The average production of the Ayrshire cows (four total) was 7.25 liters/day. It should be noted that the top three producers in the study were Friesian with the top producer estimated at 12 liters/day.

After completing the entire survey process and visually inspecting every cow in the study, it was noted that the Ayrshire breed tended toward better health. There was more variability in the health of the Friesian livestock, which can be evidenced by the greater variability in their milk production. Tsetse flies, parasites and diseases affected Friesians at a greater frequency than it did Ayrshires.

We also surveyed four members of the improved livestock co-operative in the village of Buger who had not yet received an improved breed livestock. All of them were keeping local cattle (Zebu) for the purpose of milk and draft power. The average production of Zebu per day was one liter. However, the Zebu cattle require little to no maintenance, are extremely hardy, and are rarely affected by disease.

Qualitative Results

Two focus group discussions took place during the course of the research. The first focus group discussion was not a typical “round table” discussion, but rather a synthesis of open-ended questions that were asked to each of the 32 households across three villages. Of the 32 people questioned, four had not yet improved the better-quality breed; the questions for this group were modified. The general questions that were asked (with follow ups) were as follows:

1. How has this new livestock breed impacted your life?
   a. How has this new breed of livestock impacted your family?
   b. How has this new breed impacted your community?
2. What challenges did you face with the improved livestock?
   a. What is your recommendation for solving these challenges?

The second focus group discussion was a traditional round-table discussion with livestock group leaders and government officials from the village of Buger. Similar questions were asked, but the follow-up to those questions was more in-depth.

Synthesis Focus Group

The above questions were asked to all the people questioned and their answers were themed and tabulated. The results can be viewed in the following three charts (see Charts 2, 3, & 4).
Chart 2. Perceived Impact

- Higher milk production
- Milk year round/consistant
- Sells milk to hotels/neighbors
- Improved health children/household
- Sale of milk provides extra income
- Breeding provides income
- Manure for crop

Chart 3. Challenges

- No qualified vet within reach
- Vet cost high (travel, medicine, etc.)
- None
- Challenge to feed
- High disease prevalence
- Death
- Tsetse flies, ticks, other pests
The two largest perceived impacts that affected the owners of improved dairy breeds were improved income generated by the sale of milk (29%) and improved health of the family/children (24%). Anecdotally, owners mentioned that the extra income was able to pay for things such as sending children to school, school uniforms, supplemental food, re-investing in the improved cattle, and even building a new house. It was very clear to the researchers from direct observation that in many cases, a producing improved breed dairy cow had a transformative effect on the rural households in question.

The single largest challenge (34%) was high disease prevalence among improved breed dairy cattle. The two second-most noted challenges were dealing with pests (Tsetse and Ticks in particular) and the high cost and inaccessibility of vet care required by the improved cattle. Many of the owners were quick to mention, however, that the increased income generated by the animals more than covered any expenses incurred from vet care and medications. Among recommendations given by the owners, the need for expansion of the livestock distribution project was at the top of the list with 33% of respondents mentioning it.

Improved livestock group members from Buger village who had not yet received an IDC were also asked what the predicted impact and challenges associated with an IDC would be. All four respondents mentioned both higher milk production and higher income from milk sale as impacts. Two mentioned the zero grazing\(^1\) requirements of these breeds as favorable. All except one of the respondents in this category predicted no challenges with an IDC.

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\(^1\) Zero grazing is a method used to raise certain breeds of livestock that involves growing specific grasses to be fed to the cattle within their enclosure.
Some Noteworthy Field Observations

Of the owners who reported that disease was a challenge, many specifically mentioned that disease prevalence is highest in the winter (wet season) months. Many of the same owners noted that finding adequate food and water for the improved breeds proved difficult during the summer months (dry season). Problems with pests (Tsetse flies and ticks) were reported at higher frequency in the village that was nearest to Lake Manyara National Park. Napier grass was recommended multiple times as a local feed of choice and those that fed their improved livestock this species of grass seemed to benefit from a healthier animal and higher milk production.

Traditional Focus Group Discussion (FGD)

Similar questions mentioned above were used in a round-table discussion held with several of the leaders from the livestock project and government of Buger on April 23, 2014 at 11:30 am. The follow-up questions were somewhat more in-depth than the individual questionnaires.

One impact that immediately surfaced during the FGD was the fact that milk was readily available in town. This was evidenced by the fact that chai maziwa (milk with tea) is always available in the local restaurants and hotels and this happened in concert with the initiation of the livestock project. The group also pointed out that finding adequate grazing grounds for the local breed had been very difficult because they are near a protected forest that borders a national park (Lake Manyara). With the new breed, there is a zero grazing requirement, which is a distinct advantage in this situation. A third observation that was commonly expressed was that the huge jump in milk quantity available in the community is having a globally positive effect.

Challenges that were expressed were largely similar to the above-mentioned challenges. A new challenge that arose from this FGD was that there was a technical gap in the knowledge of the IDC owners. The basic knowledge of animal care was provided with the animals, but more in-depth care knowledge was required to successfully care for these improved animals. Proper housing for the IDCs was also mentioned among challenges. It was specifically pointed out that in Buger, where the elevation is higher and weather is colder than the surrounding areas, attention should be paid to selecting cold-hardy breeds during the distribution.

There were two recommendations gleaned from the FGD in Buger. The first is that a village member be sent for further veterinarian training in Endabash so that they could help care for the IDCs during the less technical medical emergencies. The second was that the existing veterinarian (located in Endabash) be put on rotation for monitoring and check-up visits among the owners of the improved livestock breeds.

Correlations

After Pearson correlations were run on the data in IBM SPSS version 22 the following correlations were discovered. A strong positive correlation (.401/.155) was found between the average estimated price of milk and the liters of milk per day that were sold. There was also a strong positive correlation (.532/.061) between the length (in months) the IDC had been owned and the liters per day of milk being sold.
Discussion

The original intent of the research was to determine the methods of diffusion of each generation of IDC since the WV livestock project implementation. Even though we were able to map all the current owners of IDCs, there wasn’t enough comparative data to contrast with. Because the comparative could not be established, the focus of the study was shifted from diffusion of innovation to IDC impact. The value added of using GIS technology was that a previously unmapped area was mapped and the first GIS comparative data was established. This will give future researchers comparative markers.

Of the data collected on the impact of IDC, there were a few individual findings that deserve further highlighting. The first came from a female owner of a male cow (she was the only person in the original distribution to receive a male cow). The data we collected on her household showed no liters of milk sold or improved nutrition, yet she was very satisfied with her IDC. She was able to greatly supplement her income by selling breeding rights. The rules of the livestock group stated that she was to offer the first two rounds of breeding to the owners of the female IDCs for free and after that she was allowed to profit from it. After those two rounds, she began charging 5,000 TSH per insemination and had no shortage of business. When asked if she would rather have a female, she said no because she was the only one so far that owned a male and the increased profit was worth more than the absence of milk production.

Another observation was made from witnessing an IDC owner who chose to reinvest his initial earnings back into the animal. His cow’s pen not only had a separate shelter with four walls and a roof, but a cement floor as well. Mastitis is a common issue found amongst the IDC in these villages, and the biggest contributor to it is sleeping in wet, muddy, urine-filled pens. He was also able to invest in planting a small lemon grass field, which provided abundant and nutritious feed for his IDC. By reinvesting his initial milk-sale earnings into an improved shelter and feed, he was able to benefit from a very high milk yield and healthy animal.

The zero grazing feature of these IDCs lends itself to an important by-product: manure. Traditional cattle are free ranging and thus manure is not collectable in one location. The improved breeds are generally kept in a pen, and this allows the owners to collect substantial amounts of manure to be used as fertilizer.

When recipients were asked what challenges they had faced since owning the improved breed, it was unanimous among all three villages that proper medical care and/or the presence of a veterinarian was very hard to come by. Though it was a requirement to go through training on proper care of this particular breed in order to receive it, the training was minimal. When a veterinarian is needed, the cost to have him or her come is either too high or he is so far away that the animal dies before any actions can be taken to save the animal. The local breeds of cattle (Zebus) have a major advantage over the improved breed in this respect as they are incredibly resilient to weather, disease, and indigenous pests.

The village of Getamock is located directly next to Lake Manyara and Lake Manyara National Park. This led to higher levels of pest infestations than the other villages. The Tsetse fly proved to be a major problem for the IDC in this area as a vector for disease. Data could not be collected for a few homes in which one or more cattle had died from disease.

This was less of an issue in the village of Buger; in comparison to Getamock, the IDC in Buger were thriving. This can possibly be attributed to the presence of a communal cattle dip,
which helps to prevent pests and diseases (Buger was the only village that had a community cattle dip). The livestock owners in Buger also took a higher degree of ownership over their own cattle, going so far as to pay a veterinarian to come from Endabash and vaccinate their cattle.

Cows need to be 15 months old to have their first calf and start producing milk. If a cow never makes it to maturity to produce a calf and start producing milk, an invaluable resource is lost for that family. Future strategies should be aimed on building individuals’ capacities to care for their IDCs. During one of the focus group discussions, suggestions were made for how to build this capacity. One suggestion was to have a rotating veterinarian that would make regularly scheduled visits to all three villages. Another suggestion was to elect one member from each village to go and receive more extensive training on treating the most common medical issues that these particular breeds are susceptible to. This trainee would then become the trainer of their village for those who own an IDC.

During a key informant interview with the livestock program chairperson of Ayalaliyo, an issue of a lack of ownership among IDC recipients was raised. Since the distributed cows were donated and not bought, when issues would arise with the IDC, the owner would look back to the distributing entity to solve these issues. If an animal died, the distributing entity was blamed. The key informant asserted that since they had not put their own resources at stake to obtain the animals, they didn’t take ownership when issues arose. This is an issue to be addressed in further studies and distributions.

One observed method of increasing ownership is the implementation of a group-owned distribution plan. In the improved dairy breed group in the village of Buger, IDC owners must give away their first two female calves to another group member. Males are given back to the group to decide where to sell them to prevent inbreeding, and profits are shared. In Ayalaliyo, IDC group members can choose to keep their first males for breeding purposes. If they own a female cow, they must also give the first two to other group members. If a cow dies of natural causes or of causes a member was unable to treat, they can receive another once everyone in the group has received one. IDC can also be repossessed and relocated if they are mistreated or not looked after properly. One case of repossession and redistribution was recorded.

**Conclusion**

Improved dairy cattle are recognized as an integral part of improving the livelihoods for the rural and urban poor in developing countries. The aim of this research was to measure impact, reveal challenges, map distribution, and establish recommendations for moving forward in improved livestock distribution initiatives. The methods consisted of a hybrid model using both quantitative and qualitative modalities, especially focusing on personal interviews, focus group discussions, field observation, and GIS data capturing. GIS-based comparisons could not be made because of a lack of available GIS demographic data for the area. The combined modalities approach (especially the in-depth interviews and FGD) allowed an accurate picture of impact to emerge. Overall, IDC had an overwhelmingly positive effect on the lives of the owners, especially in the areas of increased income and nutrition for the family. The main challenges faced by owners of IDC were the higher disease prevalence found in the IDC (Friesian and Ayrshire), susceptibility to pests (Tsetse Flies and ticks), and lack of affordable veterinary access. Increase in medical training of the improved livestock owners was suggested.
The study could have benefitted from a larger sample size (both experimental and control), longer time frame of study, and more flexibility to adjust while the experiment was in progress. Data would have been easier to collect outside of rainy season because of the myriad challenges it introduced.

There are several strengths of this study are important to mention. To begin with, this research project was that all the in-depth interviews were carried out on the premises of the owner. Also, all interviews were carried out in Swahili and were then translated to English by the interviewer himself to mitigate translation bias. Additionally, all the cattle in question were visually inspected in their natural habitat. The entire research project, from initial design to final edit, was undertaken by a team of three Masters in Global Community Development (MGCD) co-learners. This allowed for a consistent handling of the data and for a further mitigation of bias.

Organizations (such as World Vision) and government initiatives which are involved in livestock distribution, especially in East Africa, can draw a number of lessons from this research that could help establish future best practices. It would be advisable to provide further training in the healthcare of livestock during a distribution. If the ‘training the trainers’ approach was used, this would cut down on the expense involved in lengthy training for large groups. Also, care should be taken in the selection of breeds to ensure that hardier breeds are selected for more taxing environments. The possibility of breeding a hybrid dairy cow that combined the favorable traits of the Zebu (extreme hardiness) and high milk producer (high milk production and favorable breeding) should be further pursued.

Further research is warranted on the nutritional impact at the household level of improved dairy cattle. Effective technical livestock care training methods need to be developed and tested. Once baseline demographic data can be obtained for the Endabash region, a GIS map comparison should be made between key wellbeing indicators and the locations of improved dairy breeds as mapped in this research project.
References


Appendix A: IRB Form

FORM A
Not required for a literature review/academic exercise.
RESEARCH APPROVAL

Research Request:  _____Exempt   _____Expedited   _____Full Review  _____Other
(Animal/Plant)

Title of Research Project: A GIS Analysis of Technology Adoption: A Case Study of Smallholder Dairy Farms in Endabash Northern Tanzania

<table>
<thead>
<tr>
<th>Principal Investigator: Alexon Mwasi, Jeremy Weaver, Lindsay Weaver</th>
<th>E-mail Address: <a href="mailto:amwasi@southern.edu">amwasi@southern.edu</a>, <a href="mailto:jweaver@southern.edu">jweaver@southern.edu</a>, <a href="mailto:lemartz@southern.edu">lemartz@southern.edu</a></th>
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</thead>
<tbody>
<tr>
<td>Co-Investigator: Dr. Sharon Pitman</td>
<td>E-mail Address: <a href="mailto:spitman@southern.edu">spitman@southern.edu</a></td>
</tr>
<tr>
<td>Co-Investigator:</td>
<td>Phone #:</td>
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<tr>
<td>Co-Investigator:</td>
<td>E-mail Address:</td>
</tr>
<tr>
<td>Co-Investigator:</td>
<td>Phone #:</td>
</tr>
<tr>
<td>Department: Non-Departmental, Global Community Development Program</td>
<td>Faculty Supervisor: Dr. Sharon Pitman</td>
</tr>
<tr>
<td>Starting Date: Pending Approval</td>
<td>Estimated Completion Date: April 30, 2014</td>
</tr>
<tr>
<td>Cooperating Institutions: Is this research being done with any institutions, individuals or organizations not affiliated with SAU? If yes, please provide the names and contact information of authorized officials below.</td>
<td></td>
</tr>
<tr>
<td>Name of Institution: World Vision Tanzania</td>
<td>Address:</td>
</tr>
<tr>
<td>Contact Name: Gloria Mashingia</td>
<td>Phone #:</td>
</tr>
<tr>
<td>Contact E-mail: <a href="mailto:Gloria_mashingia@wvi.org">Gloria_mashingia@wvi.org</a></td>
<td></td>
</tr>
<tr>
<td>External Funding Agency: N/A</td>
<td>Identification # ( if applicable)</td>
</tr>
<tr>
<td>Grant Submission Deadline (if any)</td>
<td></td>
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</tbody>
</table>

Please attach all of the following items, making sure the entire application is completely filled out (where applicable) before submitting the application:

- Any research instruments (tests, surveys, questionnaires, protocols, or any form else used to collect data)
• All informed consent documents
• Permission from applicable authorities (principals of schools, teachers of classrooms, etc.) to conduct your research at their facilities on their School Letterhead.
• Students need signatures from their faculty advisor.

All student applications must be signed by the faculty advisor then scanned and submitted electronically, or submitted directly by the faculty advisor. All applications should be submitted by email to irb@southern.edu.

Please be aware you cannot begin your research until it has been officially approved by the IRB.

Type of Research- Check all areas that apply

___ Dissertation/Thesis
___ Funded Faculty Research
___ General Faculty Research
___ Applying for ARC Funding
___x___ Student Research
___ Other: Animal/Plant

Background and Rationale for the Study: (This section should present the context of the work by explaining the relation of the proposed research to previous investigations in the field. Include citations for relevant research.)

This research will be carried out in Endabash area in Northern Tanzania. The main inhabitants are the Eraqws and Barbaings. Economically, the area predominantly practices small scale agriculture and to some extent livestock rearing, with about 98% of the population directly or indirectly engaged in farming as the main source of income. However, due to poor farming techniques, animal husbandry, as well as low price of their products most of the people earn relative low income. According to World Vision 2013 evaluation report findings, the proportion of households keeping local breed cows and goats is 71.6% and 65.8% respectively while proportion of households keeping improved cows and goats is only 5.5% and 2.2% respectively. This clearly shows that the uptake of modern improved livestock technology by farmers is still very low despite the efforts to increase the trend. World Vision Endabash ADP has been working with the Ministry of Livestock to train farmers on improved livestock technology adoption and has so far supported some farmers with improved breeds. This research therefore intends to study the current distribution trend and technology adoption using GIS analysis and factors affecting the same.

Purpose/Objectives of the Research: (Briefly state, in non-technical language, the purpose of the research and the problem to be investigated. When possible, state specific hypotheses to be tested or specific research questions to be answered. For pilot or exploratory studies, discuss the way in which the information obtained will be used in future studies so that the long-term benefits can be assessed.)
The objective of the research is to study the current distribution trend and technology adoption of improved livestock breed in the community using GIS analysis and factors affecting the same. The study will try to establish if:

- There is a relationship... between farm size and improved livestock technology adoption.
- There is a relationship... between household income and improved livestock technology adoption.
- There is a relationship... between distance from market center and improved livestock technology adoption.
- There is a relationship... between education level of the head of the household (HOH) and improved livestock technology adoption.
- There is a relationship... between arability of land and improved livestock technology adoption.

The information that will be obtained will be used by World Vision Enabash ADP to redesign their strategy of engagement with the community to improve livestock breeds to enable them increase household income for the well-being of children. The findings can also be used by other stakeholders in the area to plan how to enhance improved livestock adoption as a way of improving livelihoods.

Methods and/or Procedures: (Briefly discuss, in non-technical language, the research methods which directly involve use of human subjects. Discuss how the methods employed will allow the investigator to address his/her hypotheses and/or research question(s).)

The method to be used is secondary data review as well as visit to individual farmers who have benefitted from the trainings and improved livestock breeds from World Vision in the past two years to ascertain the distribution and adoption trends using GIS technology.

Description of Research Sample: If human subjects are involved, please check all that apply:

- Minors (if minors are involved please attach a Child’s Assent Form)
- Prison Inmates
- Mentally Impaired
- Physically Disabled
- Institutionalized Residents
- Anyone unable to make informed decisions about participation
- Vulnerable or at-risk groups, e.g. poverty, pregnant women, substance abuse population
- Health Care Data Information - be sure to attach any necessary HIPAA forms if this line is checked
- Other: Animals or plants will be used
- Other: please describe

Approximate Number of Subjects: ________

Participant Recruitment:

Describe how participant recruitment will be performed. Include how potential participants are introduced to the study (Please check all that apply)

<table>
<thead>
<tr>
<th>SAU Directory:</th>
<th>Postings, Flyers</th>
<th>Radio, TV</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-Mail Solicitation</td>
<td>How Were Addresses Obtained</td>
<td></td>
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<tr>
<td>--------------------------------------</td>
<td>-----------------------------</td>
<td></td>
</tr>
<tr>
<td>Web-based Solicitation</td>
<td>Indicate Site</td>
<td></td>
</tr>
<tr>
<td>Participant Pool</td>
<td>Indicate Site</td>
<td></td>
</tr>
<tr>
<td>Other, Please Specify</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Attach Any Recruiting Materials You Plan to Use and the Text of E-mail or Web-based Solicitations You Will Use

**Content Sensitivity:**

Does your research address culturally or morally sensitive issues?  ___Yes  _x___ No  If yes, please describe.

**Privacy and Confidentiality:**

Efforts will be made to keep personal information confidential. We cannot guarantee absolute confidentiality. Personal information may be disclosed if required by law. Identities will be held in confidence in reports in which the study may be published and databases in which results may be stored.

Will personal identifiers be collected?  ___Yes  ___ No

Will identifiers be translated to a code?  ___Yes  ___ No

Will recordings be made (audio, video)  ___Yes  ___ No  If yes, please describe.

Is Funding being sought to support this research?  __no____

Circle to indicate if the funding is: Internal or External Funding?  Is there a funding risk?  ___________

Who will keep the financial records?  ____________________________________________________________

Who will have access to data (survey, questionnaires, recordings, interview records, etc.)?  Please list below.

  *Southern Adventist University*

  *World Vision*

**Participant Compensation and Costs**

Are participants to be compensated for the study?  ___Yes  _x___ No

If yes, what is the amount, type and source of funds:

Amount $___________  Type:____________________Source ________________________
Will participants who are students be offered class credit?  ____ Yes  _x_  No  ____ NA

Are other inducements planned to recruit participants?  ____ Yes  _x_  No  If yes, please describe

Are there any costs to participants?  ____ Yes  _x_  No  If yes, please explain ____________________

Other: Animals/Plants

Are the animals/plants being studied on the endangered list? ___n/a___

Are Scientific Collection Permits required, i.e. Tennessee Wildlife Resources Agency? ___n/a_____

Have the animal(s) utilized in this study already been used in a previous study (non-naïve animals)?  ___n/a___

Will the animal(s) used in this study be used in a future study? ___n/a___

Where will the animals be housed? ___________n/a_____________

Will the rodents (if applicable) be housed in wire bottom cages? ___n/a___

Will plants be used for instructional purposes as part of teaching a course? ___n/a___

Are there any risks involved with this study?  ____Yes  _x_  No

Are there any potential damage or adverse consequences to researcher, participants, or environment?  These might include physical, psychological, social, or spiritual risks whether as part of the protocol or a remote possibility.  Please indicate all that apply.

  ____ Physical Risk: May include pain injury, and impairment of a sense such as touch or sight.  These risks may be brief or extended, temporary or permanent, occur during participation in the research or arise after.

  ____ Psychological Risk: Can include anxiety, sadness, regret and emotional distress, among others.  Psychological risks exist in many different types of research in addition to behavioral studies.

  ____ Social Risk: Can exist whenever there is the possibility that participating in research or the revelation of data collected by investigators in the course of the research, if disclosed to individuals or entities outside of the research, could negatively impact others’ perceptions of the participant.  Social risks can range from jeopardizing the individual’s reputation and social standing, to placing the individual at-risk of political or social reprisals.

  ____ Legal Risk:  Include the exposure of activities of a research subject “that could reasonable place the subjects at risk of criminal or civil liability”.

  ____ Economic Risk: May exist if knowledge of one’s participation in research, for example, could make it difficult for a research participant to retain a job or find a job, or if insurance premiums increase or loss of insurance is a result of the disclosure of research data.
Spiritual Risk: May exist if knowledge of one’s spiritual beliefs or lack of, could be exposed which in turn could invoke an economic, social and or psychological risk.

Risks: In your opinion, do benefits outweigh risks?  **x** Yes  **___** No

Results:

The results will be disseminated as:

**______**Classwork only  **______**Student conference  **______** Professional conference  
**___x____** Published article  **______** Other  If other, please specify: ________________________

Signatures: If submitted by a faculty member, electronic (typed) signatures are acceptable. If submitted by a student, please print out completed form, obtain the faculty advisor’s signature, scan completed form, and submit it via e-mail. Only Word documents or PDF files are acceptable submissions.

Alexon Mwasi, Jeremy Weaver, Lindsay Weaver  March 17, 2014

Principal Investigator (PI) or Student  Date

Faculty Advisor (for student applications)  Date

All student applications must be signed by the faculty advisor then scanned and submitted electronically, or submitted directly by the faculty advisor. All applications should be submitted by email to: irb@southern.edu

Additional Special Requirements or Attachments to the Application

Approvals from other IRBs

Cooperative research projects involve research that involves more than one institution. In these instances, federal law holds each institution responsible for safeguarding the rights and welfare of human subjects and for complying with federal policy; therefore, SAU IRB applications must be made even if there is another institution conducting a review of the same research project. When a study is being carried out at a non-USA site, and approval from other institutional review boards at the foreign site must be sought. The IRB recommends that a copy of each IRB approval be submitted.

Questionnaires/Other Instruments

Any questionnaires, tests, survey instruments or data collections sheets which are not standard and well known must be submitted as part of the application. Structured interview questions and outlines for unstructured interviews also must be included.

Advertisements/Notices/Recruitment Flyers

The text of any advertisement, video display, notice, sign, brochure or flyer used to recruit subjects either should be included as an attachment.
Appendix B: Research Questionnaire

Demographic Questions for household GIS collection

1. What is the name of your village?
2. Who is the head of the house?
3. Age?
4. Current Marital Status?
5. Highest level of formal education for head of household?
6. How many people live in this home?
7. What is the primary source of income for this home?
   a. What is your approximate income level.
      i. Ranges
8. How many acres of land do you farm?

Quantitative Questions for household GIS collection

1. What livestock did you previously own before WV’s distribution?
   a. What activities were these livestock used for?
   b. Why did you switch to the improved breed?
2. What type of improved livestock do you have?
   a. Cow/Goat
3. What breed is your improved livestock?
   a. Fresian Cow/ Jersey Cow/ Toggenburg Goat/ Cross breed/ Other
4. What date did you receive the improved animal/s?
5. From whom did you receive the improved animal/s?
   a. WV/ Gift from individual/ Purchase from individual/ Crossbreeding/ Received from group/ Purchased from market/ Other
6. What training where you given in relation to these animals?
   a. Animal medical training/ Breeding training/ Livestock nutrition/ Enterprise training/ None
7. What purposes do your improved animals serve? (choose all that apply)
   a. Milk for home use/ Milk for sale/ Breeding/ Farmyard Manure/ Biogas production/ Meat/ other
8. How many liters of milk does you improved animal produce per day.
9. How many liters of milk, out of the total, do you sell?
10. What is the average price of milk per per liter?

Qualitative Questions for FGD

3. How is this new livestock breed impacted your life?
   a. How has this new breed of livestock impacted your family?
   b. How have these new breeds impacted your community?
4. What challenges did you face with the improved livestock?
   a. What is your recommendation for solving these challenges?