



INNOVATIONS FOR AGRICULTURAL VALUE CHAINS IN AFRICA: APPLYING SCIENCE AND TECHNOLOGY TO ENHANCE CASSAVA, DAIRY, AND MAIZE VALUE CHAINS

Dairy Value Chain Overview

The Science and Innovation for African Agricultural Value Chains project is bringing together leading scientists and innovators (Science Team) with key players in the maize, cassava and dairy value chains (Value Chain Partners and Participants) in Kenya and Ghana. The project goal is to identify out-of-the-box, innovative technology options that would add significant value for smallholder farmers (i.e., those farmers earning \$1 - \$2 per day) by reducing primarily post-harvest inefficiencies in these value chains in Africa. A value chain can be described as a series of sequential activities where at each step in the process, the product passing through this chain of activities gains some value. Generally, the chain of activities gives the products more added value than the sum of the added values of all activities.

The purpose of this paper is to highlight key constraints in the dairy value chain with a particular focus on the cattle dairy sector in Kenya; this project will not include other dairy sources (e.g., goats, camels). To provide context for those constraints, the paper begins with an overview of the dairy sector in Africa and highlights key issues such as gender and market dynamics. The paper concludes with a list of market inefficiencies and potential technological innovations that will be the focus for the Science Team. It should be noted that team members will be encouraged to consider potential cross-over technologies between value chains.

The successful adoption by smallholder farmers of technology-based solutions often raises considerable challenges. Meridian Institute has contracted with New Growth International to write a paper that will include an overview of historic lessons regarding technology development and deployment for smallholder farmers and case studies to illustrate key lessons learned. Although the overview paper will not go into further detail, we anticipate that the lessons learned paper, combined with information from our value chain and gender partners will help provide important cultural information and information about current practices that may affect adoption of specific solutions.

Dairy Value Chain Overview

Livestock ownership currently supports or sustains the livelihoods of an estimated 700 million rural poor, approximately 70% of the world's rural poor population (PPLPI, 2001). The dairy cow is one of the most important investments a farmer can make to improve their standing (ILRI, 2003) because of their inherent value, the nutritional valuable milk produced, the work they can perform, and the way it can help diversify farming activities. The importance of the

dairy cow is expected to increase as food imports to sub-Saharan Africa (SSA) are projected to more than double by 2030 under a business as usual scenario (The World Bank, 2008). Not only does livestock currently contribute up to 80 percent of the agricultural gross domestic product in developing countries (ILRI, 2007), The World Bank classifies livestock as a high-value market and reports this market is the fastest-growing agricultural market in most developing countries (The World Bank, 2008).

Livestock provides rural farmers with a way to increase assets, a method to diversify, and income and nutrition. The horticulture agro-industry in Ethiopia often provides workers with milk believed to counter pesticide poison. Kenyan HIV sufferers often receive goat milk and school lunch programs are important and increasing markets in many countries. Livestock is also an important tool to address poverty, enhance agricultural development, and create employment opportunities beyond an immediate household or smallholder dairy operation. Livestock is a development tool because it “widens and sustains three major pathways out of poverty: (1) securing the assets of the poor, (2) improving smallholder and pastoral productivity and (3) increasing market participation by the poor” (ILRI, 2007, p. 12). Pro-Poor Livestock Policy Initiative (PPLPI)¹ expects that the following trends will affect livestock production, particularly rural, small-scale livestock producers:

- Increasing pressure on common grazing and water resources;
- A shift in livestock production from a local, multi-purpose activity to an increasingly market-oriented and vertically-integrated business; and
- Strong growth of industrial production units reliant on the use of cereal based feeds close to urban centers.

Traditional and Commercial Markets

The dairy sector can be classified into two systems: the ‘traditional system’ including small-scale, subsistence and household production with informal market systems and the ‘commercial system’ which represents large-scale industrialized production with integrated markets, predominant in developed countries (Staal, Pratt, & Jabbar, 2008). While the traditional system dominates SSA, it is important to note that both markets exist and play a key role in dairy development. Kenya is the largest milk producing country in SSA with a cattle herd larger than all of the rest of East and Southern Africa, and dairy is the single largest agricultural sub sector (14%) in the country (Staal, Pratt, & Jabbar, 2008). Despite this volume of production and the extensive formal marketing network in Kenya (Kenya Cooperative Creameries; private processors; dairy co-operatives), estimates show that currently approximately 85-90% of marketed milk is not processed or packaged, but instead is bought by the consumer in raw form. The factors driving the continued importance of the informal market are traditional preferences for fresh raw milk, which is boiled before consumption, and unwillingness to pay the costs of processing and packaging. By avoiding pasteurizing and packaging costs, raw milk markets offer both higher prices to producers and lower prices to consumers (Thorpe et al. 2000). Kenya’s dairy system can be described as dominated “by smallholders in crop-livestock systems in areas of high and medium cropping potential.” The

¹ <http://www.fao.org/ag/againfo/programmes/en/pplpi/home.html>

temperate East African climate allows the cross-breeding of local cows with European dairy breeds to raise productivity (Holloway et al IFPRI 1999). It is important to note that not all households have access to high productivity cross-bred stock.

In Kenya, generally 1-2 dairy cows (mostly Holstein Friesian or Ayrshire) comprise 50% of the herd, the other half consisting of female calves and heifers. In the high potential areas feeding is mainly cut-and-carry with planted Napier grass and crop residues, especially from maize and bananas, supplemented by forage gathered from common properties around the farm. On average total daily milk output is 10 kg per farm (Thorpe, et al. 2000, p.1). These smallholder dairy farms are generally located close to urban areas that provide a market for the unprocessed and unrefrigerated milk. Key factors impacting productivity gains in traditional markets include:

- The level of market infrastructure, especially transportation linkages that influence time to market
- The level of availability of cross-bred stock
- Access to extension services including for animal health
- The availability of water
- Access to quality feed
- Variable quality of milk output across seasons

Traditional markets are projected to retain importance in dairy development despite attempts to grow the agricultural sector and commercial system. Empirical evidence suggests this is due to *demand* for traditional market products that is not likely to change with increased levels of disposable income. Thus, policy makers should productively engage with traditional systems rather than exclusively concentrate on investment in formal dairy processing capacity (Staal, et al. 2008). Attempts to foster commercial system development, and discourage traditional markets, have been advocated by officials concerned about health risks from unpasteurised milk consumption. It is suggested that a different development focus should concentrate on the needs of local farmers and consumers (ILRI, 2003; Farrington & Mitchell, 2006). For these reasons this project will focus primarily on innovations in the traditional market sector, though project partners are encouraged to consider innovations that can also help smallholder farmers connect to the commercial sector.² For example, cooperative selling units have met success in the past in helping smallholders enter commercial markets.

Smallholder Farmers' Market Participation and the Development of Collective Action

There is ample evidence to suggest that smallholder dairy producers are generally competitive and are likely to endure for some time, particularly where the opportunity costs of family labor and wages remain low. Furthermore, dairy as an enterprise is an option available to landless and socially marginalized groups. (Staal, 2008)

² Potentially, this project could explore innovations in the traditional market that would allow smallholder farmers to better link to the commercial sector, or innovations in the commercial sector that would enable this sector to tap into the traditional markets as a source of milk (supply).

Dairy co-operative development has the potential to further develop the dairy markets in Kenya. Co-operatives can reduce transaction costs for smallholders and encourage more widespread participation in markets. In Kenya, evidence suggests that dairy co-operatives played a significant role in fostering dairy development, primarily by providing a stable market environment and delivering services to farmers. However, dairy co-operative development is heavily dependent on good co-operative management, honest and effective investment of resources and accountability to the interests of the farmer members, and political and governmental influence in co-operatives needs to be minimized. Further, dairy co-operatives often cannot easily tap into the strong demand for traditional products and raw milk and generally remain tied to demand for formally processed products. While traditional demand remains the driving force, dairy co-operatives face the same growth impediments as the formal private sector. (Staal, 2008)

Gender

Milk production and sales are one sector where women are involved, but it is important to note that gender biases remain prevalent in the dairy sector (The World Bank, Food and Agriculture Organization, and International Fund for Agricultural Development, 2008). The International Fund for Agricultural Development (IFAD) has created four broad categories to describe involvement in the market system (commercial and traditional) based on gender and age: "(i) those systems in which there is no involvement by women with livestock; (ii) those in which women are responsible only for processing livestock products; (iii) those in which women are responsible for managing and processing small stock and other animals kept at the homestead; or (iv) those in which women are responsible for managing and herding large stock and other animals, and processing the products" (Niamir-Fuller, 1994). It is challenging and potentially misleading to make generalizations related to gender and market activity, but it appears that women usually provide the labor and have the right to use dairy cattle but do not own the animals or make decisions regarding them or their disposal. While milk production appears to be one of the sectors where women are universally involved, increased control of product sales and market access is desirable.

IFAD made the following recommendations over a decade ago to address the gender bias that are still relevant today (Niamir-Fuller, 1994):

- Encourage research into women livestock managers;
- Enhance women's participation in livestock projects;
- Support indigenous technical knowledge systems;
- Emphasize research into appropriate technologies for women in livestock production;
- Change national policies to reverse the causes and adverse effects of local, national and regional constraints;
- Make locally managed credit facilities available to women for livestock production activities;
- Improve market facilities and livestock prices to enhance women's involvement;
- Direct training and extension services at women involved in livestock production; and
- Ensure that gender issues are reflected in all aspects of lending operations.

Market Dynamics

The ILRI 2007 Annual Report, published in December 2008, included a special section on the impact of record high food prices. They report that the increasing diversion of grains and oilseeds to produce bio-fuels is further raising food prices and Africa will be the continent most dramatically affected. The price of milk has more than doubled in some countries (ILRI, 2007) and the fluctuations and rise in commodity prices will reduce food access for the poor (FAO, 2008).

Models predict that livestock populations will increase dramatically from 2010 – 2050, but smallholder producers may have difficulty taking advantage of this increase due to lack of credit and access to markets and new technologies (ILRI, 2007). The increase in livestock herds may also have negative environmental effects and increase the risk of animal disease transmission.

Inappropriate policies also disadvantage smallholder farmers, fail to address economic disparities and limit market access. Conversely, policy reforms can also greatly benefit smallholder dairy producers. For instance, policy reforms in Kenya's dairy sector since 2004 have enabled many of Kenya's nearly 40,000 small-scale milk vendors to enter formal milk markets. An independent panel of experts in 2008 estimated that these reforms are annually delivering to the Kenyan economy direct benefits of \$33.5 million as well as a further \$130 million a year in indirect benefits, such as the new jobs generated by the newly enabled smallholder dairy sector and the better nutrition achieved in millions of poor households through greater consumption of highly nourishing, but cheap, milk products. (ILRI, 2007)

Market Inefficiencies & Potential Technologies/Approaches

This section provides an overview of inefficiencies or constraints in the value chain and potential technologies or approaches to address the constraints. The target end user is the smallholder dairy farmer. For this reason the project will focus on technological enhancements and innovations that can contribute to higher incomes for smallholder farmers through their adoption primarily in the dominant traditional markets. For purposes of this project, it is important to recognize that labor saving devices are not a high priority and the focus will need to be on technologies that increase value or output without adding significant cost. It should also be noted that many technologies only deliver when part of a systemic approach to improving care of dairy cattle and dairy products (for instance, improved breeds underproduce unless given adequate feed and husbandry attention).

While there are a broad range of key issues in the dairy value chain³, this project will focus primarily on the following:

³ Key issues identified for the dairy value chain include feed sources, feed storage, disease and emerging infectious diseases, erosion of genetic resources, degradation of lands, access to and quality of water sources, storage, sterilization and sanitation, road infrastructure, access to markets, access to credit, access to knowledge, development of co-operatives, and recognition of the interplay between commercial and traditional markets.

1. Animal Health and Disease
 - a. Vaccine Development
 - b. Vaccine Delivery
 - c. Curative Dairy Health
2. Milk Production
 - a. Genetics (artificial insemination)
 - b. Feed, Fodder & Water (dry season complications)
 - c. Milking Machines (low priority)
 - d. Diversification (beyond staple dairy production)
3. Milk Quality: Testing & Linked Systems
4. Milk Preservation, Sanitization & Transport
 - a. Cooling Centers & Linked Systems
 - b. Packaging Materials
5. Non-Liquid Dairy Markets

This list was generated in consultation with the foundation based on other investments and input from Value Chain Partners and Experts.

1. Animal Health and Disease

While this project focuses primarily on “post-harvest” technologies, therapeutics and husbandry should not be ignored. Available technologies such as dry cow tubest, teat dipping, California mastitis tests and penside diagnostics for common diseases can help improve animal health. These technologies should be reviewed along with alternative delivery systems (community animal health) and efforts to develop appropriately packaged and labeled medicines that smallholder farmers can provide onsite without necessitating veterinary involvement.

a. Animal Health and Disease: Vaccine Development

Disease has a significant impact on dairy development, especially in developing countries (ILRI, 2007). There are a host of prevalent and emerging diseases that impact the dairy sector, including: foot-and-mouth; elephant grass disease, trypanosomosis, spread by the tsetse fly; pathogenic avian influenza (HPAI); Rift Valley fever, East Coast fever; and emerging diseases including those influenced by climate change.

Technology Consideration

- Advancements for reducing costs of compliance with safety standards for livestock products and sanitary and phytosanitary standards (SPS)

b. Animal Health and Disease: Vaccine Delivery

Vaccines are generally susceptible to temperature extremes experienced through transport on the African continent. PATH has recently announced the development of vaccine stabilization technologies such as spray drying of vaccines, freeze stabilization, and new formulations to

increase protection from heat (PATH, 2009). Furthermore, in many instances only licensed veterinarians or technicians are authorized to provide vaccinations. Since veterinarians are frequently in short supply, this is an additional limitation to vaccine delivery. New technologies are needed to both stabilize vaccines for transport, reduce the size of vaccine batches to reduce cost, and simplify the vaccine delivery method to make it accessible to the smallholder dairy farmer.

Technology Consideration

- New vaccine stabilization methods, in particular for thermal stability.
- New, simplified vaccine delivery mechanisms accessible to smallholder dairy farmers

c. Animal Health and Disease: Curative Dairy Health

Low productivity of cattle often results from high levels of endemic diseases (e.g., trypanosomosis, tick-borne diseases, helminthiasis) and malnutrition. Control of these diseases has historically been the remit of state veterinary services, which have been contracting as a result of budget cuts and are often difficult to access for resource-poor farmers. Increasing responsibility falls on the farmer, animal health assistants and other extension workers. In some areas of Kenya, community based animal health care (CBAHC) initiatives are providing alternative animal health service involving semi-trained personnel in areas where no government veterinary services are available.

Some challenges associated with animal disease treatments are related to the correct diagnosis of the common, important cattle diseases. Appropriate drug use and other disease control strategies depend on correct diagnosis and a working understanding of the suitability of therapeutic options. Existing techniques for diagnosis of these diseases are often too costly. In addition, disease treatments are not accessible to smallholder farmers (e.g., due to high cost, complexity, etc.).

Technology Consideration

- Affordable and easy to use disease diagnostics for cattle diseases
 - For instance, California mastitis test is affordable and can be used penside. However, it is not accurate enough to indicate the specific bacteria causing mastitis. Thus, veterinarians are often inclined to prescribe a broad spectrum antibiotic in cases where a more targeted and cheaper version could have sufficed.
- New (thermal neutral) drug stabilization methods
- New drug delivery mechanisms accessible to smallholder dairy farmers

2. Milk Production

a. Milk Production: Genetics and Breeding

Poor genetics and decreasing genetic stock is responsible for mortality and low dairy production. Cross-breeding with European dairy genes has enhanced dairy development in Kenya but has not been widespread elsewhere (Baltenweck, 2000; Thorpe, et al. 2000). Extensive focus on genetics is outside the focus of this study and is being addressed in other

projects funded by the Bill and Melinda Gates Foundation (BMGF) and other foundations. The relevant concern for this project is storage and transport of semen for artificial insemination.

A cheap approach to sexing semen may also be a useful focus for this project. It appears that the current cost of sexing is prohibitively high, but the benefits of sexing in order to produce preferred female offspring could be high. In addition, an accurate pregnancy test for cows would benefit smallholder farmers. Currently, most smallholder farmers may miss several estrus cycles because they are unable to confirm whether a cow is pregnant early in the pregnancy. A higher pregnancy ratio will generally add value for farmers.

Technology Consideration

- Storage, transport and delivery of semen for artificial insemination
- Cheap approaches for sexing semen
- Cheap pregnancy tests

b. Milk Production: Feed, Fodder & Water

While the focus of this project is on “post harvest” technologies, lack of feed and fodder can have a dramatic impact on milk production. Production can drop by 75% from the wet to the dry season due to lack of adequate water storage systems and other related reasons (Polak, et al. 2008). Improvement of water storage systems could reduce this inefficiency as well as creating linkages with the maize and cassava value chains since byproducts can be important feed and fodder sources. Generally, current grain and feed storage practices brings risks. For instance, the use of rejected maize seed (due to poor quality and presence of mold) for cattle feed can contribute to bioaccumulation of aflatoxins in milk. This issue can be exacerbated if the feed is not stored properly and aflatoxin infestations increase due to improper storage of the grains.

Existing technologies such as small-scale silage and urea blocks could play a role in improving access to feed during the dry season. However, existing small-scale silage approaches have seen very little adoption by smallholder farmers, possibly because of the tendency for silage to rot instead of ferment.

Simple, in particular if the protein content of the feed could be increased.

Technology Consideration

- Water storage improvements
- Connections with maize and cassava value chains to utilize byproducts as feed sources and provide smallholder farmers with adequate instructions for proper feed formulations.
- Consider ways to improve the supply of supplementary feeds of reliable quality
 - Efficacy of concentrate usage on smallholder farms (concentrate re-allocation)
 - Improve ‘calf gruel’ technology by linking with feed companies to commercially produce finely ground maize and beans
 - Ration formulation using locally available ingredients
 - Using feed supplements to improve utilization of poor quality roughages

- Improving small-scale silage technologies
- Simple tests to detect the presence of aflatoxins.
- Simple tests to measure protein content in concentrates (inconsistent quality of concentrates bought on the market are a problem).

c. Milk Production: Milking Machines

Milking machines have been used to increase efficiency in some locations, but they are not currently recommended for this project. The initial and maintenance cost have a payback period that generally exceeds ten years. For most smallholder farmers that rate of return does not warrant the investment due to low labor cost (Polak et al. 2008). Milking machines, therefore, will most likely not be included in the focus of this project.

d. Milk Production: Diversification

Many institutions recommend that smallholder farmers diversify beyond staple production and integrate dairy production into crop systems (Thorpe, et al. 2000). For example, using dairy manure as fertilizer can assist with the implementation of high value dry season intensive fruit and vegetable gardens (Polak et al. 2008). Furthermore, use of biodigesters to produce biogas energy and fertilization byproducts may be feasible. Small scale biogas/biodigester projects are currently being implemented in developing countries such as Costa Rica (Rural Costa Rica, 2009).

Technology Consideration

- Explore connection with maize and other value chains to create synergies (as above)
- Use of manure for fertilization of higher value crops
- Biodigesters for biogas energy production and fertilization byproducts

3. Milk Quality

a. Milk Quality: Quality Testing and Linked Systems

Milk is often sold for less than its full value due to lack of access to markets, poor road infrastructure, lack of co-operatives, inability to transport long distances due to spoilage concerns, and unscrupulous traders who add water or other fillers. Since milk is frequently unpasteurized it is commonly boiled before consumption for sterilization purposes. It is not uncommon for milk to be boiled between 2 and 3 times before consumption, drastically reducing taste, economic and nutritional value (Polak, Kuhlmann, & Covarrubias, 2008). Boiling also utilizes costly and scarce energy resources. While many of these impediments are outside the scope of this project, advancements that would improve the quality of milk without adding expense would be well received. There are also potential opportunities to implement low cost milk quality testing technology and linking this process with weighing and payment systems.

Technology Consideration

- Lactoperoxidase research
- Inexpensive digital quality testing
- Inexpensive and accurate butterfat tests to enable differentiated pricing for milk quality

- Lactometers
- Linking digital quality testing, payment systems, and weighing systems into one location and process, potentially in a cooling station (described below)
- Low cost milk fat testing systems that can be used at the village level⁴

4. Milk Preservation, Sanitization & Transport

More than 80% of the milk produced in Kenya and Uganda is not pasteurized (Polak et al. 2008), and this is similar across the continent. This is partially due to consumer preference. In Kenya, for example, there is a preference for raw milk particularly because it is generally 20-50% cheaper than pasteurized milk (Staal et al. 2008). Lack of low-cost and accessible sterilization technologies increases rates of spoilage, decreases the distance producers can travel thereby shrinking market access, increases the frequency of sales at less than optimal prices. Unpasteurized milk is frequently boiled, sometimes 2-3 times before consumption, reducing taste and nutritional value. There is an opportunity to develop sanitization and transportation techniques that do not increase cost significantly but increase the shelf life and nutritional value of milk. D-REV, in partnership with the Social Profit Network and BMGF, has been designing and testing the feasibility of providing low-cost ultraviolet sterilization techniques. Exploration of other techniques is also encouraged.

Technology Consideration

- UV sanitization techniques – portable
- UV sanitization techniques – larger scale
- Cross-over sanitization methods that could be applicable to purification of water
- Mass spectrometry techniques to provide low-cost on-site kits
- Other approaches to milk sanitization (e.g., through nanowire sensor technology)

a. Milk Preservation, Sanitization & Transport: Cooling Centers & Linked Systems

Development of inexpensive and accessible cooling centers could help integrate the traditional and commercial dairy markets. There may be an opportunity to utilize alternative energy, such as solar energy, to power cooling stations. At the same time, a cooling center could serve efforts to link digital systems to ensure milk quality, accurate weighing of product and equitable financial transactions with increased transparency. It should be noted that while milk co-operatives have played an important role in dairy development, there are also examples of market control and manipulation that should be considered, as with all technological advancements to equitably benefit smallholder dairy farmers.

Technology Consideration

- Develop alternative energy (e.g., solar) for powering cooling centers

⁴ Processors base payments on the level of fat in milk; prices range from as low as 20 taka/L to as high as 40 taka/L based on fat content. However, milk from many farmers (30 – over 100) is bulked before it arrives at the chilling plant, and processors base the payment on fat % at arrival. Thus, individual farmers have little incentive to manage their animals for increased fat %. The lowest cost fat testing tool available on the market costs ~\$800, much too expensive for our target group.

- Develop linked digital quality testing technology to ensure milk quality, accurate product weight, and equitable financial transactions
- Consider other non-digital methods
- Optimize efficiency of generator based chilling plants

b. Milk Preservation, Sanitization & Transport: Packaging Materials

It has not been uncommon for milk to be transported in old plastic containers that once contained oil, for example. Inexpensive, environmentally sensitive packaging technologies could enhance milk quality, sanitization, and increase distances traders are able to cover with milk products.

Technology Consideration

- Development or proliferation of inexpensive, sanitary milk packaging materials

5. Non-Liquid Dairy Markets

While the majority of dairy milk is consumed raw, there are non-liquid dairy value added markets. Two such examples are the butter market in Ethiopia and the Wagashi cheese market in West Africa. Attention should be given to technological advancements that could aid these markets with cross-over to other SSA countries.

Technology Consideration:

- Hand-operated and mechanized equipment to process milk into butter, cheese, or sour milk products.

Potential Crossovers

During the idea generation and business plan development phases of this project, Project Partners should consider technology enhancements and innovations in the context of the overall dairy producing system (i.e., systems view). As described in more detail in the Lessons Learned document, there are numerous non-technical factors that affect the adoption of new technologies. Furthermore, potential technologies that could benefit more than one value chain should be considered. While this project focuses specifically on the maize, cassava and dairy value chains, cross-over opportunities with other value chains and processes should be considered. It is likely that ideas generated during the field trip will be considered outside the scope of this project. While these ideas will not be advanced through the business planning stage, they will be captured and noted for potential future projects. The following examples forms the beginning of a list that is expected to build through the project.

- Linkages: Many technologies only deliver when linked or considered holistically. For example, improved breeds underproduce unless given adequate feed and husbandry attention.
- Soy: There may be opportunities for synergistic development of a high value soy crop products and related processing operations (e.g., soy milk).

- **Fruit Juice:** There may be opportunities for synergistic development of cooling and storage technologies to allow fruit juices to be kept (i.e., fruit ripens and is available when in season; much of it goes to waste).
- **Grain Storage:** Lack of grain storage creates market price fluctuations for key livestock/dairy input.
- **Maize:** Utilization of byproducts for cattle feed and fodder.
- **Global Climate Change:** Links to methane reduction efforts.

Project Partners

International Livestock Research Institute

The International Livestock Research Institute (ILRI) works at the crossroads of livestock and poverty, bringing high-quality science and capacity-building to bear on poverty reduction and sustainable development. ILRI works in Africa, Asia and Latin America, with offices in East and West Africa, South and Southeast Asia, China and Central America.

All ILRI work is conducted in extensive and strategic partnerships that facilitate and add value to the contribution of many other players in livestock research for development work. ILRI employs an innovation systems approach to enhance the effectiveness of its research. Fundamental change in culture and process must complement changes in technologies to support innovations at all levels, from individual livestock keepers to national and international decision-makers.

ILRI's strategic intention is to use livestock as a development tool, one that widens and sustains three major pathways out of poverty: (1) securing the assets of the poor, (2) improving smallholder and pastoral productivity and (3) increasing market participation by the poor. ILRI conducts research in five themes—Targeting research and development opportunities; Enabling innovation; Improving market opportunities; Using biotechnology to secure livestock assets; and People, livestock and the environment—and coordinates the Systemwide Livestock Programme of the Consultative Group on International Agricultural Research (CGIAR).

ILRI is supported by the CGIAR, an association of more than 60 governments and public- and private-sector institutions supporting a network of 15 agricultural research centres working to reduce poverty, hunger and environmental degradation in developing countries. The co-sponsors of the CGIAR are the World Bank, the United Nations Development Programme, the Food and Agriculture Organization of the United Nations and the International Fund for Agricultural Development.

East Africa Dairy Development Project

The East Africa Dairy Development Project (EADD) is a regional industry development program implemented by Heifer International and a consortium of partners including TechnoServe, ILRI, The World Agroforestry Center (ICRAF) and ABS TCM. The project is

funded by the Bill & Melinda Gates Foundation as part of an agricultural development grant designed to boost the yields and incomes of millions of small farmers in Africa and other parts of the developing world so they can lift themselves and their families out of hunger and poverty.

The vision of success for the East Africa Dairy Development project is that the lives of 179,000 families—or approximately one million people—are transformed by doubling household dairy income by the 10th year through integrated intervention in dairy production, market access and knowledge application.

Key components of the EADD Project:

- The development of 27 milk collection hubs, including chilling plants for bulking and holding milk for pickup by processors in refrigerated milk trucks.
- The formation of farmer business associations that will own and manage the plants and develop hubs of dairy business services;
- The use of artificial insemination to improve local breeds of dairy cows to produce more milk per day per cow. It will also focus on animal nutrition and health for better milk quality and
- Extensive training provided by Heifer International and its partners in dairy animal husbandry, business practices, and other subjects needed to for successful operation of a business to produce, process and market dairy products.

The project operates in specific districts chosen for their suitability for smallholder dairy development in Kenya, Uganda and Rwanda with the goal of doubling incomes of participating families in those areas.

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