

Aldai Moi Farmers Cooperative Society - Project KE95

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Nandi County, Kenya
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EXECUTIVE SUMMARY

Otto Wiegand visited 21 dairy farms and gave three presentations for the Aldai Moi (or Mooi) Farmer's Cooperative Society in Nandi County in Western Kenya from November-December 2016 as a Farmer-to-Farmer (F2F) volunteer for Catholic Relief Services (CRS). He also visited two other milk collection organizations, Lessos Cooperative and Lelchego Company, and visited two farms for Lelchego. The majority of farmers visited owned less than five acres, less than five cows and sold about 10 liters of milk per day. The dairy cattle were of European origin with Friesian and Ayrshire the predominant breeds. Inadequate dairy cattle nutrition appeared to be the major constraint to higher milk production. Dairy rations were short of energy and protein. Outside sources of energy and protein were expensive. Although maize, a good energy source, was grown on all farms and maize silage was found, the energy provided to cows was not sufficient to boost milk production. Protein sources such as herbaceous legumes and tree legumes could easily be grown on farms in sufficient amounts to boost milk production, but were rare. Molasses, a potential source of energy, was also rare. Small farm size may also be a threat to long-term dairy viability in the region. Tea appeared to more profitable per acre, therefore competing against the dairy industry for land. Cattle genetics could be improved, but was not a major issue for the moment. Zero-grazing has been proposed to free up land for more crops. The failure of the predecessor company of Aldai Cooperative with money still owed to farmers created a pessimistic attitude among several of the farmers toward the current organization.

Wiegand provided an example ration balancer to show how various feed resources could be used to improve milk production. He developed dairy and tea budgets. He explained rotational grazing and compared it with zero or confinement grazing. Wiegand conducted an informal survey of the 23 farms that he visited, explaining what enterprises were found or not found. He promoted the use of herbaceous and tree legumes, bean or pea residues for farm-grown protein in cattle rations. Because there is a large sugar cane industry toward Lake Victoria just down the escarpment from Nandi, molasses should be readily available as a cheap energy source. In one of his presentations, Wiegand explained aspects of ruminant nutrition, including intake, rumen fill, fiber, protein and energy. Soil erosion issues were briefly covered. Women made up about one-third of meeting participants and one-half of farm participants.

Another CRS volunteer, Karen Jacobsen, DVM, working with the neighboring Lessos Cooperative at the same time, provided additional valuable insights for Wiegand for his project. In addition to CRS, the project was supported through East African Dairy Development (EADD) by Heifer International, the International Livestock Research Institute (ILRI), American Breeders Service, Technoserve, and the International Centre for Research in Agroforestry. Wiegand has had previous experience with each of the organizations, having donated two heifers to Heifer International, conducted graduate research at ILCA/ILRI in Addis Ababa, having used ABS semen on his own farm and toured their facilities near Madison, Wisconsin, obtained educational materials from Technoserve, and visited ICRAF in Nairobi twice as part of his tree forage research.

PROJECT OVERVIEW (from the Scope of Work)

What is today the Aldai Moi Farmers' Cooperative Society was previously known as Kapcheno Multipurpose Company Limited (KMCL). KMCL was initiated in 2009 to include share capital as well as milk marketing based on a target given by East African Dairy Development (EADD) for partnership. The vision of the company was to be the leading dairy company in North Rift region in the provision of high quality products and services. Its mission was to improve the productivity and living standard of the dairy farmers through the provision of high quality and sustainable services in Nandi County. KMCL served the Kaptumo Division.

The name Kapcheno has its roots in the history of a hero by name KAPCHENO from the days of old. He was the leader of the people in 1895 that resisted the take-over of the land by the white settlers. Kapcheno is associated with heroism and KMCL was expected to have a cutting edge as a brand and leave a lasting impact just as the hero Kapcheno.

However, KMCL failed and still owes debts of 7.8 million Ksh to farmers for milk. Property, including the office itself, and membership are still under Kapcheno, but the core business of milk collection, bulking, chilling and marketing has been transferred to the Aldai Moi Cooperative. Aldai Cooperative is in the registration and legalization process.

Some of the challenges facing Aldai Moi Farmers Cooperative Society include:

- Inadequate knowledge of general dairy management practices.
- Low quality feeds (and inadequate rations) leading to low milk production.
- Milk price fluctuation, especially during dry seasons.
- Competitive enterprises, e.g. tea industry.

ISSUE DESCRIPTION (Scope of Work)

The main challenge facing Aldai Moi farmers' Cooperative Society is lack of knowledge and skills in dairy management, especially on dairy nutrition, forage rationing and feeding for maximized productivity. As a result, farm owners are not earning expected profit margins. Discussion with the cooperative manager revealed that low milk production and income are a result of inadequate knowledge in areas such as forage rationing and feeding, nutrition, housing, herd management, among others. Poor animal nutrition is a key barrier to increased productivity and to the income that livestock can generate throughout the years. The cooperative is eager to acquire knowledge and skills to address its current challenges in milk production. Therefore, the cooperative has requested CRS for a Farmer-to-Farmer (F2F) volunteer expert to conduct training for the cooperative farmers on dairy cattle management.

OBJECTIVES OF THE ASSIGNMENT (Scope of Work)

The main objective is to build capacity of the cooperative members on dairy cattle management through training of farmers on dairy nutrition, forage rationing and feeding, housing and herd management. Key activities to be undertaken by the F2F volunteer expert will include:

- Review Aldai Moi staff and farmers' knowledge and skills on dairy management especially on nutrition and forage rationing, housing, herd management etc.
- Conduct field visits and meetings with Aldai Moi farmers to review their knowledge and skills on basic dairy management such as nutrition, forage rationing, housing herd management etc.
- Develop training materials and a schedule based on gaps identified.
- Conduct dairy nutrition, feeding and forage rationing, herd management trainings to Aldai Moi staff and dairy farmers.
- Provide hands-on training on all aspects of forage rationing practices to Aldai Moi staff and community facilitators.
- Train selected farmers on dairy nutrition and simple rules for better feeding.
- Facilitate development of basic dairy management practices training guidelines.
- Identify other recommendations to the Aldai Moi farmers' cooperative society.

Host contribution – The cooperative has committed to mobilize farmers to attend the training at various villages. The cooperative will also avail key personnel to work closely with the volunteer, during the preparations and actual trainings, to ensure that key staff are trained and will continue training farmers on dairy nutrition, fodder establishment and preservation.

ANTICIPATED RESULTS FROM THE ASSIGNMENT (Scope of Work)

The anticipated deliverables from the volunteer assignment include:

- Trainings conducted and people trained.
- Basic dairy management training guidelines developed.
- PowerPoint presentations.
- Debriefing with USAID and in country group presentations after assignment.
- Field trip report.
- Outreach activity, a press release and a media event back in US.

ACTIVITIES / FARM VISITS

Nov 29 - Aldai Moi Farmers Cooperative Society

The Cooperative is currently undergoing a reorganization from a private company (Kapcheno Multipurpose Company, Ltd.) to a registered legal cooperative. Kapcheno Company was formed out of a former cooperative that was dissolved as a result of IMF-directed liberalization of the Kenyan economy in the 1990s. Kenyan farmers were not prepared for the realities of private enterprise in marketing of milk and many got out of the dairy business. The company was also a victim of poor management, corruption and inability of clients to control management. Many farmers are still owed money for milk marketed through Kapcheno.

Nandi County was the origin and is still the home of many of Kenya's famous Olympic runners. The capital city is Kapsabet, about 85,000 in population. Aldai is located just a few miles north of the Equator. Much of the terrain is hilly and 2,000-2,500 meters (roughly 6,000-8,000 feet) above sea level. The temperature ranges from 15-25 degrees C. Rainfall reaches up to 2,000 mm (80 inches) per year. Compared to many parts of Kenya, Nandi stays greener during the dry season. There are two rainy periods with a principal dry season from December to February. Most farmers speak English in addition to Kalenjin and Swahili.

Aldai Cooperative has 385 member farmers, five employees and a board of nine directors representing nine zones, Kaboi, Chepkong'ony, Kaptumo, Kesagon, Koyo, Ndurio, Kapsaos, Kapkolei, and Kibwareng, in the cooperative catchment area. The General Manager is Florence Jesang. A transitional extension team of 12 Facilitators is headed by Executive Director Wilson K. Ng'etich. Septimus Kabigen, the Extension Director, was the main Cooperative contact for Wiegand. The average farmer owns 3-4 dairy cows and sells 5-10 liters of milk per day to the Cooperative. The Cooperative also uses a system of brokers and hawkers to procure milk. The current milk price per liter paid to members is 30 Ksh (about US\$13.00 per gallon). The price received by the Cooperative from the New Kenya Cooperative Creameries (NKCC) is around 35 Ksh. Milk quality is tested at collection for added water, bacterial activity and components

(protein, fat and lactose). There are no premiums paid for components, however. Somatic cell count is not tested. Farmers deliver only morning milk to the cooperative and achieve more morning milk by milking on an 8:16 hour schedule.

Concerns and ideas expressed by Mr. Kabigen included the cost of tick and worm control in cows, zero-grazing versus rotational grazing, and wet versus dry matter intake limitations in cow diets. Veterinary treatment and supplies are sub-contracted to technicians (CAVES) from Con-Agra. Artificial insemination services provided though the Cooperative have ceased for time being. NKCC is competing in Kenya against at least three private dairy processors. Two of them are Brookside, owned by the President of Kenya, and Daima, both located in the nearby city of Eldoret. A Ugandan dairy company called Lato is delivering milk to Kenya in the Lake Victoria region.

Nov 30 - Julius and Esther Korir Farm

Julius keeps three excellent crossbred Friesian cows and tea on a well-kept farm with 10 acres of land. He is one of the Nandi “culture of runners”, having won the gold medal in the steeplechase in the Los Angeles Olympics in 1984. He is a retired military veteran. We were served chai. Julius preferred tea over dairy and admitted a lack of confidence in the dairy industry. He is one of the Cooperative Directors.

Nov 30 – Anthony Rotich Farm

Mrs. Rotich met the visitors (Wiegand, Kabigen and driver) and appeared to be running the five-acre farm. She had three Friesian dairy cows on four acres. The cows were grazing on a recent corn field that was full of weeds, but another field had good grass. There was a silage pit with corn silage and Napier under plastic and dirt. There was some spoilage due in part to the square shape of the pit. Not enough silage face could be removed each day for the few cows to prevent some spoilage. She also raised a lot of chickens, onions and other vegetables. There were some Calliandra trees for forage.

Nov 30 – Edward and Jane Bungei Farm

Jane Bungei, a teacher, showed the visitors around the seven-acre farm, fed them milk and gave Wiegand a chicken as a gift. This was another very elite cooperative member with a few good cows and a diversity of crops on small acreage. They were making Boma Rhodes grass hay when we arrived. They also dry and store bean hay which is ground for daily silage with Napier grass. The family raised sheep, corn, beans, pumpkins, mango and had some Sesbania for forage. The family believed strongly in high education with a lawyer, doctor, professor and current college student in the family.

Nov 30 - Isaac Njoroge Farm

Mrs. Njoroge was there. The farm borders a stream valley. The wife, husband, son and daughter-in-law run a small diversified farm with three Friesian / Ayrshire cows, sheep, and several different crops including Calliandra, bananas, beans, Boma Rhodes and Napier grass. Wiegand saw cow #1 and Cow #7, interesting because in the US one often sees cow numbers in the thousands. They had a calving stall, forage grinder and a bio-digester. Silage is made in black plastic bags for storage. Njoroge also makes daily silage with a small diesel chopper. They feed a variety of supplements to the cows. Mrs. Njoroge fed the visitors lunch. Issac, who is retired, was in Eldoret for the day.

Dec 1 – Dorcas Misoy Farm

Dorcas is a milk quality analyst for the cooperative. She runs her parent's 16-acre farm with seven Ayrshire and Friesian dairy cows. She uses free grazing, dairy meal, buys hay and grows tea.

Dec 1 – Presentation to Cooperative Facilitators

Wiegand gave a Power Pt. presentation describing the components and principles of dairy nutrition. These included water, protein, energy, minerals, vitamins, intake, digestibility, bypass, dry matter, NDF and ADF fiber, lignin, cellulose, hemicellulose, rumen bacteria, lactation curve, lactation peak, dry period, etc. Feedstuffs discussed included Boma Rhodes, Napier, sugar cane, sorghum, millet, oats, Calliandra, Sesbania, sunflower cake, peanut hay, etc. Silage and hay-making were discussed as well as storage methods. Grazing height, bite size, and the rumination and mastication process was described. The participant's farms ranged from $\frac{1}{4}$ to 10 acres and 1-2 up to seven cows. The genetic potential of the cows for milk was a concern. Wiegand assured them that the current genetics had a higher potential for milk than realized, and that nutrition was more of a limiting factor.

Dec 2 – Davies and Winnie Boor Farm

Winnie showed the visitors around. Davies works for ConAgra, the veterinary supplier working with the Cooperative and attended the training the day before. The farm has seven acres and three cows. They use a community water supply that is gravity-fed.

Dec 2 – Kimeli and Neddy Chepsiror Farm

Kimeli is a retired Kenya Government official. The farmstead is beautiful with many buildings, gardens, and two cars. The farm includes 10 acres with rotational grazing, three dairy cows, a bull, several youngstock, tea and fruit trees. Kimeli is planning to plant more tea. Kimeli is long-time friend of one of Wiegand's Peace Corps friends from Lumakanda Settlement in 1970, Alan Johnston.

Dec 2 – Wilson K. and Pauline Ng'etich Farm

Wilson is the Executive Director of the Facilitators of the Aldai Cooperative. His farm is only ½ acre, but he has two dairy cows, a donkey, Boma Rhodes grass, bananas, coffee, tobacco, pumpkins. His brothers own neighboring plots.

Dec 5 – Benson Kimeli Farms (2)

Wiegand visited two Kimeli farms, one run by the father and one by the son. Each had four cows. The Kimelis raised a lot of different crops including potatoes, parsley, local green vegetables, maize, Napier, tea, forage trees. They fed silage daily to Ayrshire cows. The silage was chopped with a machete. Wiegand spent an hour here gathering information on dairy versus tea budgets.

Dec 5 – Presentation at Aldai Collection Centre, Kesogon

Wiegand met with seven farmers at the collection center in Kesogon, one of the Aldai Cooperative zones. They discussed the types of feeds and management programs used in each farm. Milk production was generally higher than in previous farm visits.

Elizabeth Jerono - this farmer had two cows, 18 liters, fed sunflower and wheat bran.

Isaac Kessio - three cows, 14 liters, 3.5 acres, fed Napier, Rhodes, local grass, dairy meal.

Geoffrey Choge - four cows, 10 liters, 10 acres, fed Rhodes, local grass, dairy meal.

Marta and David Yego – zero-grazing, three cows, 15 liters, 1.8 acres, fed maize silage, dairy meal, Napier, Sesbania (15 trees), maize, purchased outside feeds.

Rosa Busiene – five cows, seven liters, dry now, fed Napier, local grass, maize bran, dairy meal.

Aaron Kirorei – two cows, 24 liters, seven acres, fed local grass, Desmodium, Napier, maize stover, bean hay, dairy meal.

Dec. 5 - Ezekiel and Anna Meli Farm

Meli had worked as the farm manager for over 30 years at the ILRAD / ILRI Research Farm in Kabete. He and Wiegand, who did his graduate research at ILRI, knew people in common. Meli had 6 very good-looking Friesian and Ayrshire cows. The farm was very high and not far north of the Equator. He was building a new cow shed. Rotational grazing was implemented on about 6 paddocks.

Dec. 6 - Caroline and Wilfred Too Farm

Caroline had two daughters and two sons at home. They had a commercial maize grinder. There were three Ayrshire cows on two acres.

Dec. 6 - Sarah Korir Farm

Sarah had two cows and two calves. A cousin helps with the farm. Cows graze freely.

Dec. 6 - Sarah Samoei Farm

They had coffee, a gold mine, three dairy crossbreds, Sesbania, four acres and a sizeable coffee field. Local grade-school students were harvesting the coffee.

Dec. 6 - Leah and Joseph Manyim Farm

The daughter Vivian had just completed a Bachelors Degree in Crop Science from Kenyatta University and was going to start her Masters in Sept. They had five acres, mostly coffee and worked a gold mine. Wiegand collected some nuggets here.

Dec. 6 - Hoseah Sang Farm

Hoseah was also mining gold on his farm. Dynamiting in underground shafts was going on in the neighborhood. The farm had a small solar panel. The visitors drank milk with charcoal. A gold processing plant is next door where ore is ground and precipitated with mercury.

Dec. 6 - Joseph Mitei Farm

They had two cows, a bull, seven acres, mostly tea.

Dec. 6 - Safina Sirma Farm

Vivian took the visitors there. They are located on the escarpment with a beautiful view of the Kisumu Valley and Lake Victoria. Wiegand suggested they build a resort.

Dec. 6 - Wesley Koech Farm

They had two good cows, much tea, Calliandra, Rhodes hay. The visitors were served milk. They were grinding bean husks, but the grinder needed some repairs. The driver took the mechanic to Kaptumo.

Dec. 7 – Ruth Kosgei Farm (Lelchego)

Ruth is a Director of the Lelchego Company. She had a beautiful house and four-acre farm. Three cows were grazing at another location. She took us around to visit cooperative facilities and the Nellie Sum Farm. Lelchego sells to both NKCC and Brookside. Gabriel Mbokothe of CRS accompanied the visitors for the day. The visit with Lelchego occurred in part because Wiegand requested to see an example of a stronger cooperative / company and a larger dairy farm.

Dec. 7 – Nellie Sum Farm (Lelchego, Larger Dairy Farm)

Nellie's family had just purchased cows in the past year after having left dairying in 1999. The farm has established a limited liability company (corporation) that includes the children. Nellie is a member of Lelchego Company. Nellie raises 19 milking Friesian and Ayrshire cows on 8.5 acres, and harvests maize, sorghum and Napier silage from ten acres rented (10,000 Ksh per acre per year) nearby. Cows currently produce 84 liters per day. They use AI. Nellie sells about 3,000 liters of milk per month. Lelchego pays 28 Ksh per litre. The Lelchego milk is sold to Brookside Dairy in Eldoret. Twenty liters of the evening milk is sold directly to Moi University for 50 Ksh per litre. Cows are rotated on five paddocks. Another paddock has Boma Rhodes for hay. There are plans to increase herd numbers.

The farm includes a bedded shed (barn) with sawdust, a new freestall shed with concrete, a raised calf barn, milking area, two milking machines with gas engine, feed grinder, feed pulverized, mixer, tractor and plow. The used Massey-Ferguson tractor cost 300,000 Ksh, the De Laval double milking machine 350,000? Ksh, the two sheds (barns) about 900,000 Ksh each, the pulverizer 43,000 Ksh, the hand grinder 15,000 Ksh, and the two milk cans at 10,000 Ksh each.

Nellie has three bunker silos with maize silage containing 152 tons. The silage could last for more than one year at the current herd size. A custom operator chopped the

silage for 50,000 Ksh per acre (ten acres), and baled Rhodes hay for 70 Ksh per bale. There are 350 bales. Silage is fed twice daily. High-producing cows are fed individually. Nellie still purchases dairy meal, but intends to mix her own supplements. She already buys maize grain, sunflower meal, cottonseed cake and calf pellets from a company in Kitale and Nakuru. Dairy meal was purchased from Nakuru. Her son has a trucking company in Eldoret.

Dec. 8 – Septimus Kabigen Farm

The parents, father Simon Limo (86) and mom Winifred, own 100 acres of land. Three brothers share the land and equipment, including tractor, plow and feed grinder. There are 35 dairy cows plus youngstock. They use free grazing, Napier, dairy meal.

Dec 8 - Marta and David Yego Farm

Marta showed the visitors around. They have three cows and four very steeply-sloped acres. They employ zero-grazing, sell 15 liters of milk, use 1.8 acres for cows, feed maize silage, dairy meal, Napier, Sesbania (15 trees), maize, and purchased outside feeds. They raised Desmodium in the past and currently have a few lucerne plants. The farm has several innovations including a walled silo, silo leachate drain, manure drainage from the milking area to the field, main paddock drainage into the vegetable area, avocado trees, numerous vegetables, qat / chat (chewable narcotic), etc.

Dec. 8 – Kobujoi Institute of Developmental Studies

Wiegand and Septimus Kabigen stopped at the Kobujoi Institute where Kabigen studies and asked Lecturer Donmas to borrow a computer and projector for the Friday wrap-up meeting. Donmas expressed his concerns about the viability of increasingly smaller farms.

Dec. 9 – Wrap-up Meeting

Wiegand gave a wrap-up presentation to 19 people, including five women, at the Aldai Girls Secondary School across from the Aldai Cooperative. Most of the participants were farmers. Topics included an Excel ration program, a comparative budget for small dairies and tea, a summary of items seen on 23 farm visits, a Power Pt. on rotational grazing and a discussion of the benefits of zero-grazing vs. rotational grazing. Bismeth Maleya, the County Cooperative Officer, and David Maiyo, the Gender Officer, also gave brief presentations. The meeting lasted for three hours.

DAIRY NUTRITION

The dairy cows seen on the project were often thin with a body condition score (BCS) between 2.0-3.5. Milk production was low, from 2-10 liters per day. The genetic potential of the purebred or crossbred Friesians and Ayrshires that commonly exist should be at least 20 liters. There was an apparent shortage of energy and protein in the diets. Most cow herds were small, 1-5 animals, and farms were also small, from ½ to 5 acres. Just a few forages were used, as noted in the forage section below. Legumes were seldom found. Dairy supplements were expensive.

There was no ration-balancing for cows, in part because no one does it and in part because low herd numbers perhaps don't justify the activity. Wiegand created an Excel ration balancer with an example for three levels of production for two sizes of cows (see attached spreadsheet picture below – workable Excel spreadsheet is a separate attached file). The common roughages usually fed to cows do not support more than five liters of milk per day. Cows require 2% of their body weight as dry matter feed each day just for maintenance. Farmers should aim for 3% to achieve production.

The dairy meal supplements sold by the cooperatives and dealers in the region had no ingredient labels / tags on the bags. However, Wiegand was able to obtain a list of ingredients for four dairy meal mixes from Lelchego Company. He calculated the approximate protein contents of the meals (see table below). The Company specified the different mixes for different on-farm forage combinations. It was not clear if the lucerne in the third mix was included as leaf meal or fed as hay on farm. Leaf meal would have made that mix more valuable. The meals were all over 20% protein, but the cost of that protein varied a lot. A similar dairy meal sold by Lessos was said to have only 12-13% protein. The Lelchego supplements also provided some energy (not calculated) which may have factored into the varying supplement cost.

Wiegand's opinion was that not enough dairy meal was fed or that farmer estimates of its use may have been inflated. Farmers did not want to pay high prices for dairy meal or other supplements, which were 2-3 times more expensive than similar supplements in the US (see prices in table below). However, without a formal ration, farmers could be encouraged to incrementally increase dairy meal or other energy and protein sources to higher producing cows as long as there is a reciprocating milk response. Molasses from the sugar cane industry just an hour away should be available and cheap, but was not found on farms except in a few dairy mixes. Mineral supplements were available and used in small amounts, but again perhaps not in sufficient amounts.

FORAGE SITUATION

Aldai Cooperative is situated at an altitude, temperature zone, and rainfall area that is ideal for tea, coffee and dairy cattle. Common forages raised are Boma Rhodes grass, Napier grass, and maize stover, although forages such as Kikuyu grass, groundnut hay, sorghum, oat straw, whole maize silage, sugar cane, and tree legume forages such as

Calliandra and Sesbania can be found. Tree forages such as Moringa, also a medicinal for humans, and Leucaena were seen outside of the project. Farmers need to know that forages such as Sesbania and Leucaena can be maintained as a shrub, allowing for easier harvest and more leaf growth. The rule of thumb is to let the tree reach two meters in height, then cut the top meter off for forage. This prevents a tree trunk from emerging and forces the plant to coppice out at the base, creating more leafy material and more photosynthetic surface to maintain vigor and promote regrowth.

There were native grasses including Nandi Setaria. Apart from the tree forages which were sparingly used, there were no cowpeas, chickpeas, peanut forage, soybeans and other legumes that could conceivably be grown. Desmodium was found on one farm and a bit of lucerne on one farm. Rations for dairy cows could be greatly enhanced by farm-grown legumes. A list of forages found in the tropics is attached in the table below. One of the surprises in this project was the lack of diversity of forages. Farmers are highly dependent on Boma Rhodes, Napier and maize. Most but not all of the grass paddocks were overgrazed, not a good situation at the beginning of the dry season. Roadside grazing was also common and too-often depended on as a forage source.

FARM PROFIT

Most of the farmers visited had beautiful or at least comfortable houses, owned the land, owned a motorcycle or perhaps even a car, and had sufficient fencing, structures and equipment to maintain a small herd. It is hard to imagine that 2-3 cows could establish or maintain the farm. Ten liters of milk sold per day generates only about \$3.00 per day of gross income. This supports several family members, school fees and other costs. In fact, the money that established and often maintained the farm was largely old money or outside money. There are no income taxes, property taxes, or loan payments. Several of the farms also had small acreages of tea. Renting or purchasing additional land in the area was not common. Farms are inherited and rarely sold or purchased. When asked which enterprise was better, some farmers said tea, but most said dairy. Wiegand attempted to create a sample farm budget to see what the contribution of the dairy herd was (see table below). Tea appeared to be considerably more profitable than dairy per acre. The high labor requirement of tea was discouraging for many farmers. Drought was given as a reason for risk in tea, although rainfall in the area is generally quite good. That discussion could be changing with climate issues.

A study done by Ojango, et al. in 2011 (EADD) indicated that small-scale dairying in six locations in Kenya was profitable on a per liter basis. Average herd size, daily milk per cow and acres supporting the cows were not indicated. More information is needed.

ROTATIONAL GRAZING VS. ZERO GRAZING

Both Wiegand and Karen Jacobsen (the volunteer working with Lessos Cooperative) have considerable experience in managed rotational grazing and are strong proponents of the system. Rotational grazing, properly done, doubles or triples forage yields, builds topsoil and organic matter, increases soil water-holding capacity, increases soil microbial health, sequesters carbon and restores soil pH. With rotational grazing, pastures are allowed intervals of rest to photosynthesize and restore root reserves. Rotational grazing is both environmentally and financially advantageous. Labor is saved because animals harvest their own feed and spread their own manure. Bedding is not needed and muddy holding areas, often sources of mastitis, are generally avoided. Electric fencing would make rotations easier, but was not seen on any farm. Electric fencing is flexible and cheaper than permanent fencing.

Some members of the Cooperative communities are arguing for confinement or zero-grazing systems. Their arguments are also persuasive. Zero-grazing could reduce exposure to ticks and other parasites, reducing health risks and treatment costs. Zero grazing allows farmers to harvest hay at optimal maturity and can also allow for pastures to recover. If farmers could purchase a portion of their feeds from the outside, they may be able to dedicate some of their land to tea or other high-value crops such as vegetables or fruits, allowing for diversity of income and perhaps better utilizing existing on-farm labor. The current grazing systems and small acreages on most farms limit the number of cows to just a few. The additional fencing required for proper rotations may also discourage some farmers from proper grazing. Wiegand introduced the idea of movable electric fencing for paddocks.

Some farmers with more land practice free or continuous grazing with no paddocks. Most cattle also graze on roadsides. The condition of the grass in the area going into the dry season was generally poor, however some good pastures were seen. Stockpiling or saving tall grass for dry season use was not common.

COOPERATIVE SERVICES

Other than milk collection and some extension education, services provided by Aldai Cooperative were limited as compared to Lessos or Lelchebo. Artificial insemination services were suspended. Veterinary services and drug supplies were contracted out to six Con-Agra vet technicians (CAVES) in the town. There were no tractors or other equipment to be rented out. There were no credit services. And the previous organization still owed a lot of money to farmers. At some point when the Cooperative gets stronger, the above services can be restarted or added.

LAND DIVISION ISSUE / FARM SIZE

The professor at the Kobujoi Institute brought up the issue of land division. The traditional system is to divide the land for the sons. This has resulted in smaller and smaller parcels over time. Small parcels, at some point, lose their viability for surplus production. It has been reported, however, that small acreages in Central Kenya and other locations produce large quantities of milk sold because production per cow can exceed 40 liters per day. Renting of land was uncommon, but would generally cost about 10,000 Ksh per acre. Land values were said to be up to 1,000,000 Ksh (US\$ 10,000) per acre. Larger tracts of land suitable for large-scale mechanization did not exist in the area. Because of traditional ties to ancestral land, no taxes and free inheritance, land was seldom sold. The farmers at Aldai and most of Nandi were left to try to do what they could with their small acreages.

APPROPRIATE TECHNOLOGIES

Karen Jacobsen brought heart girth tapes and a copy of the chart guide for weighing cattle, one set of which was provided to Aldai. She brought dark plastic food can covers that can be used for mastitis detection and some bleach used for pre and post-milking udder wash. She also covered milking procedures and body condition scoring. Wiegand provided items for a cooperative library including a GrassWorks Grazing Manual, Dairy Cattle Feeding Guide, Hoards Dairyman and Wisconsin Agriculturalist magazines, a beef association membership directory, several Extension newsletters and a local foods guide. Both Jacobsen, www.KarenJacobsen.net, klivet@gmail.com, and Wiegand, www.spooner.ars.wisc.edu, otto.wiegand@ces.uwex.edu, suggest that Aldai and Lessos use their contact information to get more information and stay in touch.

WOMEN'S ISSUES

Women were prominent in the project and appeared to make farm and cooperative decisions. Florence Jesang is the Cooperative General Manager. Wives or women operators were present to show us around on about half of the farm visits. Two of the 12 Facilitators were women. There were four women staff involved in milk recording. One of them, Dorcas Misoy, also ran her family farm. At least two women had college degrees.

FARM VISITS

Wiegand visited more farms on this project (23) than he ever had on any F2F project before. Even the personal visit to the Obama's in Kongelo turned into another farm visit (5 cows, zero-grazing, maize, Napier, Moringa, greenhouse tomatoes, fruit trees and vegetables). There is a large shortage of milk in the Lake Victoria region.

Although Wiegand reached only a fraction of the farms, farm visits were probably more appreciated than anything else by the clients. Such visits were certainly key in the discovery process needed to ultimately make recommendations.

ESTIMATED ITEMS FOUND ON FARMS – TOTAL 23 VISITED FROM TWO ORGANIZATIONS

Item	Farms	Comment
Dairy Cows	23	
Maize	23	
Boma Rhodes	23	
Napier Grass	23	
Vegetables	23	
Outside Money	23	
Feed Dairy Meal	23	
Cell Phone	23	
Retirement Farms	5	
Limited Company	1	Formal corporation
Multiple Families	8	
Dairying Full-Time	15	
Artificial insemination	12	
Bulls	11	
Property or Income Tax	0	
Rented Extra Land	3	
Fruit Trees	15	
Rotational Grazing	15	Most not more than 3 paddocks
Rotational Grazing	3	More than 3 paddocks
Zero-Grazing	5	
Free grazing	5	
Tea	8	
Coffee	5	
Sorghum	2	
Sesbania	4	
Calliandra	3	
Lucerne	1	
Desmodium	1	Previously

Moringa	1	Outside of project
Leucaena	1	Outside of project
Kikuyu Grass	0	
Tractor	3	
Plow	3	
Grinder / Chopper	7	For forages
Mixer	1	
Pulverizer	2	For maize
Storage Silo	6	Pit, bunker or bags
Daily Silage	10	Napier, some maize
Hay-Making	10	Rhodes
Hay Bales	1	
Milking Machine	1	
Commodity Feeds	1	
Gold Mining	3	On-farm shafts
Higher Education	7	Principle operators, beyond secondary
Bio-Digester	2	One not working
Electric Fence	0	
Solar Panel	1	
Soil testing	0	Government lab in Eldoret
Forage testing	0	Government lab in Eldoret
Computers, Internet	2	

RECOMMENDATIONS FOR DAIRY FARMERS

This is a summary of recommendations that were given at the presentations and farm visits:

- Balance rations, increase energy and protein
- Add legumes to the pasture and forage mix
- Use more cut and carry forages like Napier, sorghum, maize, sugar cane
- Use more cut and carry tree forages such as Sesbania, Calliandra, Moringa
- Use more field legumes such as Desmodium, lucerne, peanut forage, bean hay
- Use supplemental feeds such as dairy meal, maize, cakes, molasses, urea
- Feed calves and heifers better, don't breed too early – cows are undersized
- Use more pasture rotations
- Graze at the proper forage height
- Rest pastures properly, use sacrifice areas if necessary
- Don't overstock
- Make more silage, and hay if possible
- Use tape measures to estimate animal weights

- Use body condition scoring
- Most cattle already have genetic potential for higher production
- Use soil testing
- Use forage testing
- Use irrigation, water conservation, water capture techniques
- Use better udder washing techniques, teat dips, fore-stripping
- Coops should add somatic cell testing for milk quality
- Keep records on production, expenses and income
- Spend time (1/2 hour) each day studying, getting information, making decisions
- Save money for emergencies
- Excess manure should be spread on fields for fertility
- Install a bio-digester if practical
- Hire and keep good employees
- Understand that climate may become more unpredictable
- Try to make value-added products on the farm
- Improve and expand cooperative extension education

RECOMMENDATIONS FOR CRS / FARMER TO FARMER IN KENYA

- Procure a volunteer for value-added dairy products
- Procure a volunteer for cooperative development and management
- Procure a volunteer for farm information technology / internet development
- Procure a volunteer for farm water diversion, capture and irrigation systems
- Procure a volunteer for farm eco-tourism or agro-tourism
- Procure a volunteer for beekeeping
- Procure a volunteer for soil conservation
- Procure a volunteer for dairy farmers in Nyanza
- Procure a volunteer in sustainable livestock farming on Rusinga and Mfangano

RESULTS / REFLECTIONS

Aldai farmers may be at a crossroads, considering their small farm size and more viable alternatives to dairying. The potential for doubling or tripling milk production per cow exists, given better rations and the current genetics, favorable climate for cows and ability to grow and store forages. The potential for doubling or tripling forage yields may also exist, depending on land and crop management choices. Without larger land bases or cheaper inputs, substantial production increases, mechanization or economies of scale are not possible. Early innovators get the message the first time and figure out where their “gold mine” is. The average farmer needs to hear the information more than once or copy the neighbor, so extension education and other sources of information are needed.

REALIZED TIMETABLE OF WORK

Sat. Nov. 26 – Arrival in Nairobi

Sun. Nov. 27 – Day Off, Work on Report

Mon. Nov 28

Meeting at CRS Office, Nairobi

Travel to Kapsabet

Tues. Nov 29

AM – Meeting with Gabriel Mbokothe and Karen Jacobsen

AM - Visit to Lessos Farmers Cooperative Society

PM – Visit to Aldai Moi Farmers Cooperative Society

Weds. Nov 30

AM – Visit to Aldai Cooperative Milk Collection Centre

AM – Visit to Julius Kiror Farm

AM – Visit to Anthony Rotich Farm

AM – Visit to Edward Bungei Farm

PM – Visit to Isaac Njoroge Farm

PM – Meeting with Karen Jacobsen

Thurs. Dec 1

AM – Visit to Dorcas Misoy Farm

AM/PM – Presentation to Aldai Cooperative Facilitators

Fri. Dec 2

AM – Visit to Davies and Willy Boor Farm

AM – Visit to Kimeli and Neddy Chersisor Farm

PM – Visit to Wilson K. Ng'etich Farm

Sat. Dec 3 – Visit to Eldoret and Kipkarren (Jackson Sikolia Farm) – Personal Day

Sun. Dec 4 – Work on Report at Hotel

Mon Dec 5

AM – Visit to Benson Kimeli Farm

AM – Visit to Benson Kimeli Farm 2

AM – Presentation to Farmers at Aldai Collection Centre, Kesogon

PM – Visit to Ezekiel Meli Farm

Tues. Dec 6

AM – Visit to Caroline Too Farm

AM – Visit to Sarah Korir Farm

AM – Visit to Sarah Samoei Farm

PM – Visit to Leah Manyim Farm (Vivian)

PM – Visit to Hosea San Farm (Gold)

PM – Visit to Joseph Mitei Farm

PM - Visit to Safina Sirma Farm (Hotel)

PM – Wesley Koech Farm

PM – Meeting with Gabriel, Peterson, Septimus Kabigen, Karen and Michael

Weds. Dec 7

AM – Visit to Ruth Kosgei Farm (Lelchego Company)

AM – Visit to Lelchego Company Agro-Supply Store and Credit Office

PM – Visit to Nellie Sum Farm (Lelchego Cooperative)
 PM – Visit to Lelchego Company Collection Centre
 Thurs. Dec 8
 AM – Visit to Septimus Kabigen Family Farm
 AM – Visit to Marta and David Yego Farm
 PM – Visit to Kobujoi Institute
 Fri. Dec 9
 AM/PM – Aldai Cooperative Wrap-up Meeting at Aldai Girls Secondary School
 PM – Work on Report
 Sat, Dec 10 – Personal Day
 AM – Travel to Kongelo
 PM – Visit to Marsat Onyango Obama Farm
 PM – Visit with Relatives President Barak Obama
 PM – Travel to Rusinga Island
 Sun. Dec 11 – Personal Day
 AM – Visit to Tom Mboya Mausoleum
 AM – Visit to Rusinga Lodge
 PM – Work on Report with Septimus Kabigen
 Mon. Dec 12 – Independence Day – Personal Day
 AM – Visit to Ruma National Park
 PM – Work on Report
 Tues. Dec 13 – Personal Day
 AM – Visit to Mfangano Island
 PM – Meeting with Dennis Siroh, Rusinga Island Organic Farmers
 Weds. Dec 14
 AM – Travel to Kisumu
 Thurs. Dec 15
 AM – Travel to Nairobi
 Fri. Dec 16
 AM – Report to CRS
 Sat. Dec 17 – Personal Day
 AM/PM – Visit to Treetops in Nyeri
 Sat -Sun. Dec 17-18 – Return to US

CONTACTS AND AGENCIES

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ABBREVIATIONS / ACRONYMS / DEFINITIONS

ABS – American Breeders Service (DeForest / Madison, Wisconsin)
 BCS – body condition score (1 = too thin, 5 = obese, 0 = dead)
 CAVES- Community Agrovet Entrepreneurs
 CFs - Community Facilitators
 Coop - cooperative
 CRS – Catholic Relief Services
 EADD – East Africa Dairy Development
 F2F – Farmer to Farmer program
 ICRAF – International Centre for Research in Agro-Forestry (Nairobi)
 ILRI – International Livestock Research Institute (Nairobi & Addis Ababa)
 IMF – International Monetary Fund
 Ksh – Kenya Shillings (100 / US\$)
 \$ - US\$
 TMR – total mixed ration
 USAID – United States Agency for International Development
 USDA – United States Department of Agriculture

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Wiegand, R.O. and K.A. Albrecht – Nicaragua Tree Report, 2010, Partners of the Americas Farmer-to-Farmer Project, 25 pp.

LIST OF FORAGES

Common Name	Scientific Name	Use	Notes
Brachiaria Grass general	Brachiaria brizante	Grazed	Common in Latin Amer.
Toledo Grass	Brachiaria brizante	Grazed	Common in Latin Amer.
Tanzania Grass	Brachiaria brizante?	Grazed	Common in Latin Amer.
Caribbean Grass	Brachiaria mutica	Grazed	Common in Latin Amer.
Diamond Grass	Brachiaria brizante	Grazed	Common in Latin Amer.
Peludo Grass	Brachiaria decumbens	Grazed	Common in Latin Amer.
Wire Grass	Brachiaria humidicola	Grazed	Common in Latin Amer.

Dictyonuera Grass	Brachiaria dictyonuera	Grazed	Common in Latin Amer.
Angleton Grass	Dichanthum anistatum	Grazed	Common in Latin Amer.
Angleton Grass	Andropogon spp.	Grazed	Common in Latin Amer.
Gambu Grass	Andropogon guyanus	Grazed	Common in Latin Amer.
Jaragua Grass	Andropogon rufus	Grazed	From S. America
Jaragua Grass	Hyparrhenia rufa	Grazed	From S. America
German Grass	Echinochloa polystachia	Grazed	
Star Grass	Cynodon plectostachyus	Grazed	From Africa
Star Grass	Cynodon nlemflurasil?	Grazed	From Africa
Star Grass	Cynodon dactylon/spp.	Grazed	From Africa
Mombasa Grass	Panicum maximum	Grazed	From Africa
Tanzania Grass	Panicum maximum	Grazed	From Africa
Angelica Grass		Grazed	
Mar Alfalfa / Mara Alfalfa	Pennisetum x Paspalum	Chopped	From Colombia
Forage Sorghum	Sorghum vulgare	Chopped	Sorghum
Maize	Zea mays	Chopped	Corn
Sorghum Sudan	Sorghum spp	Chopped	Sorghum-Sudan cross
King or Napier Grass	Pennisetum purpurem	Chopped	
Taiwan Grass	Pennisetum purpurem	Chopped	
Sugarcane	Saccharum officinarum	Chopped	
Guatemala Sugarcane	Saccharum spp.	Chopped	Sugarcane for cattle
Guasimo (Legume)	Guazuma ulmidora	Cut & Carry	Tree, pods
Peanut Forage (Legume)	Arachis pintoi	Grazed	Groundnut family
Peanut Forage (Legume)	Arachis glabrata	Grazed	Groundnut family
Leucaena (Legume)	Leucaena leucocephala	Cut & Carry	Tree forage, C. America
Gliricidia (Legume)	Gliricidia sepium	Cut & Carry	Tree forage, C. America
Guanacaste (Legume?)	Enterolobium cyclocarpum	Cut & Carry	Tree forage, pods
Albizia (Legume)	Albizia saman	Cut & Carry	Tree forage
Erythrina (Legume)	Erythrina poeppigiana	Cut & Carry	Tree forage, pods?
Rhodes Grass	Chloris gayana	Grazed	From Africa
Setaria Grass	Setaria sphacelata	Grazed	From Africa
Guinea Grass	Panicum maximum	Grazed	From Africa
Kikuyu Grass	Pennisetum spp.	Grazed	From Africa
Desmodium (Legume)	Desmodium spp.	Grazed	
Chickpea (Legume)	Cicer arietinum, other	Cut & Carry	Hay, garbanzo bean
Cowpea (Legume)	Vigna sinensis, other	Cut & Carry	Hay
Alfalfa/Lucerne (Legume)	Medicago sativa	Grazed	From Asia
Clover (Legume)	Trifolium repens, other	Grazed	From Asia

FEEDSTUFFS – PRICES OBTAINED FROM LELCHEGO COMPANY

Item	Price - Ksh	Size	\$ / US Ton Equivalent	US Price / Ton Dec 2016 Feedstuffs / Other
Maize / Corn Grain #2				125
Oats Grain				110
Maize Germ	800	50 kg	145	
Wheat Pollard	1250	50 kg	227	
Wheat Bran	650	40 Kg	148	100-200
Wheat Middlings				100
Cottonseed Cake	3500	50Kg	636	
Cottonseed Meal (41% CP)				275
Sunflower Seed Cake	2600	40 Kg	591	
Sunflower Meal (32% CP)				150
Soybean Meal (48%)	100	1 Kg	909	357
Bone Meal	500	10 Kg	455	
Meat & Bone Meal				210
Fish Meal	150	2 kg	682	
Fish Meal (60% CP)				1400
Lucerne / Alfalfa Hay	70	1 Kg	636	136
Di-Calcium Phosphate	110	250 grams	1222	300-400
Stock Lime	350	50 Kg	64	15-35

DAIRY MEAL TMR RATIONS / MIXES* – LELCHEGO COMPANY

Item – Total Mixed Ration	A	B	C	D
Napier Grass – Provided on Farm	40%			
Rhodes Hay – Provided on Farm		36%	40%	
Lucerne Hay – Provided on Farm		12%		
Dairy Meal – Price / 50 Kg	1800 Ksh	2000 Ksh	1500 Ksh	1800 Ksh
Maize Germ	30%	34%	30%	30%
Wheat Pollard				20%
Wheat Bran				20%
Cottonseed Cake	16%	12%	16%	13%
Sunflower Seed Cake	12%			15%
Soybean Meal			12%	
Fish Meal		2%		
Bone Meal		2%		
Di-Calcium Phosphate	2%	2%	2%	
Stock Lime				2%
Protein Content of Dairy Meal Mix	24.6%	22.7%	28.8%	20.7%
Ksh Per % Protein	73	88	52	87

***Protein Contents Used (Assume DMs equal at 90%, range 87-94):**

Maize Germ = 14%

Wheat Pollard = 15% (more of an energy source)

Wheat Bran = 17%

Cottonseed Cake = 45%

Sunflower Seed Cake = 28%

Soybean Meal = 49%

Medium Grade Fish Meal = 71%

Bone Meal = 11%

Comparative Dairy and Annual Tea Budgets - Per Acre Basis

Item	Dairy	Tea
Income		
Ave 30 Ksh / liter, 5 cows, 10 liters sold per day, 5 liters consumed, 5 acres (30 x 15 x 365 / 5)	32,850	
Cull cow, 1 / year, 40,000 Ksh each (40,000 / 5)	8,000	
Initial payment, 900 kg / month, 20 Ksh / kg (900 x 12 x 20)		216,000
Second payment, 10-40 Ksh per kg, 900 kg / month (900 x 12 x 10)		108,000
Pruning loss, 2 months each 3 years (-900 x 2 x 20, - 900 x 2 x 25)		(81,000)
Total	40,850	243,000
Expenses		
Labor to run dairy, 3,000 Ksh / month, ave farm (3000 x 12)	36,000	
Worms, 220 Ksh / cow / 3 months (220 x 4)	880	
Ticks, 450 / month, herd (450 x 12 / 5)	1080	
Detergents, 120 Ksh / month (120 x 12 / 5)	288	
Dairy Meal, 1,700 Ksh / month (1700 x 12 / 5)	4080	
Mineral salt, 300 Ksh / month (300 x 12 / 5)	720	
Fence, maintenance / year, 2,000 Ksh (2,000 / 5)	400	200
Purchased cow, 1 / 2 years, 80,000 Ksh (80,000 / 5 / 2)	8,000	
Harvest 7 Ksh / Kg, 900 Kg / month (7 x 900 x 12)		75,600
Ammonium sulfate, 200 Kg / acre, 2,500 Ksh / 50 Kg (2,500 x 4)		10,000
Weeding, 1,500 Ksh / 3 months (1500 x 4)		6000
Roundup, 1200 Ksh / acre		1200
Bags, 3 / year, 170 Ksh each (3 x 170)		510
Total	51,448	93,510
Profit / Acre	(10,598)	149,490

Dairy Cow Ration - BW 350 KG																
Rumen Capacity = 50 Kg, Minus Rate of Passage, Minus Water				Provided Nutrients							Nutrient Composition					
	Kg / Day As Is	% DM	Kg / Day DMI	g / Day C. Protein	g / Day C. Fiber	MJ / Day ME	MJ / Day NE	g / Day Ca	g / Day P		g / Day C. Protein	g / Day C. Fiber	MJ / Day ME	MJ / Day NE	g / Day Ca	g / Day P
Napier, Fresh, 40 cm	5.0	20	1	98	29	8	5	4	3		98	29	7.9	5.2	3.6	2.9
Maize Silage	9.4	32	3	210	60	32	21	6	5		70	20	10.8	7.1	1.9	1.8
Rhodes Grass, Med Maturity	12.0	25	3	282	105	27	16	9	8		94	35	9.0	5.3	3.1	2.6
Rhodes Hay	1.2	86	1	89	37	8	5	4	3		89	37	8.0	5.3	3.8	2.9
Kikuyu Grass	0.0	20	0	0	0	0	0	0	0		151	29	9.7	6.6	3.7	9.0
Sesbania Leaves	3.8	26	1	244	12	12	8	15	3		244	12	11.5	7.7	15.0	3.3
Caliandra	0.0	15	0	0	0	0	0	0	0		220	13	7.7	5.1		1.5
Desmodium	0.0	25	0	0	0	0	0	0	0		151	32	7.4	4.9	8.5	2.2
Lucerne, Med	0.0	20	0	0	0	0	0	0	0		180	24	12	8.0	2.2	9.0
Maize Stover	0.0	28	0	0	0	0	0	0	0		69	30	9.3	6.2	3.7	2.0
Oat Straw	0.0	87	0	0	0	0	0	0	0		102	34	8.3	5.5	4.7	2.0
Cottonseed Meal	0.0	92	0	0	0	0	0	0	0		450	10	13.2	8.8	2.0	12.4
Fish Meal Med	0.0	92	0	0	0	0	0	0	0		706	18.4	13.6	10.8	43.4	27.9
Soybean Cake	0.0	90	0	0	0	0	0	0	0		493	4	14.7	9.9	4.6	7.2
Wheat Bran	1.1	87	1	173	10	11	7	11	14		173	10	11	7.4	11.1	14.0
Wheat Pollard	0.0	90	0	0	0	0	0	0	0		150	7.0	11.5	7.7	1.0	7.0
Molasses	0.0	73	0	0	0	0	0	0	0		55	0.0	13.0	10.0	7.0	6.0
Dairy Meal	0.0	90	0	0	0	0	0	0	0		156	12.0	9.1	6.0	6.0	4.5
Provided	33	50% Min.	10	1096	253	98	63	49	36							
Required for 5 Kg Milk			10	806		72		27	27							
Required for 10 Kg Milk			11	1093		97		42	36							
Required for 15 Kg Milk			13	1393		123		57	45							

- Blue cells protected
- To use ration balancer, see accompanying Excel file.