

Dairy Nutrition Short Courses - Project ET109

**Dr. Richard Otto Wiegand
Catholic Relief Services, Farmer-to-Farmer Volunteer
Wolkite University & Debre Berhan University, Ethiopia
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EXECUTIVE SUMMARY

Otto Wiegand conducted three training sessions over three days each at Wolkite and Debre Berhan Universities. The train-the-trainer sessions focused on dairy nutrition at a university staff and student level. Topics included ration-balancing, local feedstuffs, common forages, tree forages, grazing, and farm management with a host of other smaller issues discussed. Because the students already had basic courses in animal nutrition, Wiegand started with rations and addressed educational gaps as needed.

There were an average of 48 students and 15 staff at Wolkite, and an average of 38 students and five staff at Debre Berhan. There were seven female participants in Wolkite and 20 at Debre Berhan. Sessions lasted 2.5-3.0 hours. At Wolkite, Wiegand visited the University farm, and met with the University President, Vice-President, and the Dean of the College of Agriculture and Natural Resources. At Debre Berhan, Wiegand met the Dean, visited the University farm, and taught one hour to students and staff in the barn. With some staff, he also visited the Debre Berhan Research Station and a private farm.

The students did not appear to be familiar with how to do Excel spreadsheets or Power Point presentations. None of the students planned to go into farming. There were good discussions about feed supplements, tannins, climate change, soil conservation, milking techniques and grazing management. Both Universities claimed to train Extension personnel and reach out to farmers. The administrators wanted further collaboration with Farmer-to-Farmer and the University of Wisconsin.

During his vacation week, Wiegand visited Bahir Dar University. He was given a tour of the campus, and taken to see the research station and a dairy processing plant. Bahir Dar and Hawassa Universities have already been communicating with the University of Wisconsin. Bahir Dar wants to arrange similar Farmer-to-Farmer training for their students. They are also interested in longer-term collaborations.

BACKGROUND (from the Scope of Work)

The Farmer-to-Farmer (F2F) East Africa program leverages US volunteer's expertise to assist smallholder farmers and small-scale processors in East Africa to improve their business practices through volunteer assignments conducted with host organizations. Through F2F intervention, CRS will improve the livelihoods and nutritional status of significant numbers of low income households by: 1) broadening their participation in established commodity value chains as producers and service providers, 2) strengthening community resilience to challenges such as droughts that adversely affect livelihoods, and 3) preserving / enhancing natural resources upon which most rural communities depend. CRS will also increase the American public's understanding of international development programs and foster increased cross-cultural understanding between host countries and US volunteers.

Agriculture is the foundation of Ethiopia's economy, accounting for half of gross domestic product (GDP), 83.9% of exports, and 80% of total employment. In the agriculture sector, livestock play a crucial economic role in the country. Ministry of Finance and Economic Development (MOFED) estimates place livestock's contribution at about 25% of total agricultural GDP. If the value of ploughing services is included, the sector contributes up to 45% of agricultural GDP.

Livestock are an important and integral part of farming systems in Ethiopia. Almost the entire rural population in the highlands and lowlands is involved in some form of animal production, which provides food, cash, traction, transportation and fuel. In lowland pastoral and agro-pastoral areas, livestock form the main source of livelihood and social prestige. They are also a 'living savings bank' and serve as a financial reserve for periods of economic distress and crop failure. Increasing urbanization and income growth are also changing food consumption patterns of people living in and around major cities, often leading to an increase in the consumption of livestock products.

Ethiopia has a huge potential for dairy development in Africa. The large and diverse livestock genetic resources, existence of diverse agro-ecologies suitable for dairy production, increasing domestic demand for milk and milk products, better market opportunities, and proximity to international markets enhance the potential for dairy development in the country. Dairy production in the country depends mainly on indigenous livestock genetic resources, more specifically on cattle, goats, camels and sheep. Cattle have the largest contribution (81.2%) of the total national annual milk output (CSA 2014).

Despite its potential, dairy development has been hampered by multi-faceted, production system-specific constraints. These constraints are related to genotype (low genetic potential of the indigenous national herd), inadequate feed resources and feeding systems, poor livestock husbandry, lack of access to services and inputs, and low adoption of improved technologies and marketing. Even though Ethiopia has the

largest inventory of milk producing animals (cattle, sheep, goats and camels) in Africa, per capita consumption of milk is low compared to many Sub-Saharan countries.

To advance the livestock sector, improving the capacity of practitioners and professionals is crucial. Higher-learning institutions are the sources of knowledge and skills to enhance agricultural productivity and transfer technologies among stakeholders. The majority of universities in Ethiopia, including Wolkite and Debre Berhan, have agricultural departments that teach, do research and conduct community outreach activities. Being among the new and upcoming higher-education institutions, both Wolkite and Debre Berhan Universities have a need for support and cooperation to build their capacity and undertake their mandates. Wolkite University has seven colleges with the College of Agriculture having eight departments. Debre Berhan University has 10 colleges with 41 undergraduate programs and 17 post-graduate programs. The College of Agriculture and Natural Resources (CoANR) is one of the biggest colleges in the university which has 650 students in five different departments.

ISSUE DESCRIPTION (Scope of Work)

Although Ethiopia has huge potential for livestock, the contribution of the sector to the rural economy has not been commensurate with the number of animals or the extent of land resources available. Thus, in order to mitigate challenges that limit productivity and thereby exploit the untapped potential, it is necessary to identify major constraints along the value chains and devise practical strategies to alleviate the problem and improve dairy production in the country.

Overall productivity is generally low because the country is characterized by traditional production systems that rely on indigenous livestock genetic resources and poor-quality feeds. Especially feed deficits in both quality and quantity are a major constraint affecting animal production in the highland areas. The major roughage feed resources for dairy animals across all the different production systems include natural pasture / grasslands, crop residues, non-conventional feed resources (e.g. leaf and stem of enset¹, banana and sugarcane crop thinning) and crop aftermath (with the exception of urban dairy producers). The contribution of these feed resources, however, depends on the agro-ecology, the types of crops produced, accessibility, and production system.

Even the available natural pasture, which is the dominant feed resource for dairy animals, is hampered due to various factors, of which overgrazing and invasion by weeds are the main ones. The crop residues are characterized by high fiber fraction, low digestibility and low available nutrients such as crude protein and metabolizable energy, which hardly support dairy animal performance. In addition, there is lack of awareness concerning feed conservation which is one of the components of feed management to ensure year-round feed availability.

¹ Enset: *Ensete ventricosum*, commonly known as the Ethiopian banana, Abyssinian banana, or false banana.



Figure 1: Fogera breed



Figure 2: Zebu breeds



Figure 3: Cross-bred

OBJECTIVES OF THE ASSIGNMENT (Scope of Work)

Livestock play a crucial economic role in Ethiopia. The Livestock Sector Analysis results show there are about 11.4 million livestock producing households in Ethiopia in 2013 (CSA, 2013). The livelihoods of large numbers of food-insecure households both in the highland and lowlands are based on livestock. Despite of the enormous livestock resource and great potential for increased livestock production, the productivity is disproportional lower. The universities are key to demonstrate and promote better management of dairy cattle nutrition and the related benefits to stakeholders including the surrounding community.

Therefore, the objective of this particular volunteer assignment is to provide a short course on applied dairy nutrition to relevant College staffs and students. The volunteer may touch upon some of the following dairy nutrition information:

- Application of basic principles of nutrition in developing rations Emphasis appropriate use of forages, ration formulation techniques, development of profitable rations, and ration delivery
- Diet formulation and evaluation
- Dairy meal preparation
- Nutritional evaluation of dairy rations and feeding management
- Body condition scoring
- Feeding techniques of dairy cows
- Interactions of diet and feeding management
- Fiber digestibility and its use in ration formulation
- Formulating for improved nitrogen and amino acid efficiencies

Although the host and CRS have developed a particular SOW, the volunteer can fine-tune through her / his professional qualification to successfully carryout this dairy nutrition short course program.

Host contribution

Wolkite and Debre Berhan Universities will select attendants from staff and agricultural students / candidates. Prior to lecturing hours, the Colleges will provide the volunteer with the course topics and outlines where the volunteer will integrate into her / his prior prepared training and advising materials from overseas. The colleges will also ensure that the necessary classrooms and local training aids and other teaching materials are in place. The hosts will assign a focal person who can guide and facilitate the volunteer specialist during the assignment period. The hosts will also provide office space and office furniture as well as vehicle if any travel is required during the assignment duration or request CRS to arrange a vehicle for the assignment period. If the Universities arrange vehicles and requested reimbursement for fuel, CRS will reimburse the cost against receipts as per its financial procedure.

ANTICIPATED RESULTS FROM THE ASSIGNMENT (Scope of Work)

As a result of the volunteer assistance, it is anticipated that this assignment will result in capacity building of the two hosts through a livestock nutrition short course. Thereby staffs and students will better understand the nutrient requirements of dairy cows at various stages of lactation and be to understand able the mixing and delivery of rations. The college dairy farms can also serve to demonstrate and promote best practices to stakeholders including surrounding communities.

The course is provided for two institutions at two sites: Wolkite and Debre Berhan. Depending on the available time, the course will be also offered to government employees and surrounding farmers.

The anticipated deliverables include:

- Initial presentation done (outlines/list of activities, plan, approach, etc.)
- Training module for this dairy course prepared and discussed with the college / university fraternity for review and adoption as a training curriculum for this course
- Proceedings for dairy nutrition short courses prepared and shared
- Field report with recommendation submitted to CRS
- Presentation to CRS staff and USAID
- Completed trip reports
- Outreach events conducted in the US

ACTIVITIES

Wolkite University

In 1990-92 when Wiegand did his research at ILCA / ILRI, there were about four universities in Ethiopia. Now there are 31 with intended numbers to reach 44. Each of the universities, in addition to basic courses, will have their focus areas. Wolkite University was founded in 2011. The long-term strategy on the agricultural side is to focus on bio-technology with a concentration on tissue culture to improve yields on key crops (WKU Biotechnology Institute Initiative).

After a day of orientation with a visit to the University dairy farm, Wiegand taught three sessions over three days lasting about 2.5-3.0 hours each. There were an average of 48 students and 15 staff members in attendance. Staff members asked a lot of good questions, but students tended to be shy. Wiegand met with the College Dean, Vice President and President of the University. The President expressed a strong interest in further collaboration with the University of Wisconsin.

The focus was dairy nutrition, as planned, but also covered other topics. The formal presentations included a simple Excel spreadsheet used to illustrate ration-balancing. Power Points included the detergent and proximate analyses systems for analyzing feeds, by-product feeds, crop residues, legumes, drought strategies, feed storage, rotational grazing, forage species, forage testing and tree forages. There was an example of a forage analysis, examples of dairy supplements, and a spreadsheet for farm financial evaluation. Side discussions based on questions from participants included the concept of overgrazing, soil erosion and compaction, climate change, carbon sequestration, no-till or minimum tillage, silage, hay, round bales, feed supplement formulas, milking techniques, body condition scoring, lactation curves, stage of lactation rations, dairy breeds, cross-breeding, mastitis, milk markets, prices for milk and feeds, extension and university outreach, the current status of Ethiopian dairy farms, milk collection and processing, information technology, and mechanization.

It was discovered that students were not familiar with Excel, could not do Power Points, and did not have much farm financial management training. Dairy nutrition on a farm does not happen in a vacuum, but is one component of management. The computer lab did not have enough computers for everyone and the room was very crowded. Wiegand explained the workings of the Excel ration-balancer spreadsheet. Training in Excel should be included in computer training or left to students to learn on their own time, as Wiegand did. A flash drive with all of Wiegand's trainings, plus an entire batch of Power Points on basic nutritional concepts, was left with the Department. These could be loaded on computers and used in the present courses. There were 12 Holstein cows at the farm with a small proportion of Zebu genetics. The cows were in good condition, with a BCS in the 3 to 3+ range (range 0-5, with 5 being obese) and shiney coats, reflective of the linseed / flax in the ration. Cows were pastured on native grass and supplemented with a reject-maize and other grain product, wheat bran, linseed and a cake consisting of noug and sunflower. Rations for each cow were

posted on the wall as well as daily milk production. Cows gave 5-10 litres of milk per day. The farm manager considered the cows to be well-fed, and they appeared to be, but production should have been higher. It may have been a mineral or protein issue. Sesbania trees were recently planted on the farm for forage.

The University dairy farm is considered to be an income-generating unit, not administered under the College. There was no indication that the students had ever been there. Hands-on training such as body-condition scoring or crop identification could have been done by Wiegand, but these would have taken considerable time away from other topics, and should easily be done by college staff. A feed milling facility has been planned for the University.

Among the recommendations given for the College:

1. Teach ration-balancing
2. Explore more dairy feed resources for the region and Ethiopia
3. Add training or courses in computer science, particularly in Excel
4. Add training or courses on farm business management
5. Improve and use the university farm as a training facility
6. Train Extension personnel
7. Reach out to farmers

Debre Berhan University

Debre Berhan University was established in 2010. The Departments of the College of Agriculture include Animal Science, Plant Science, Horticulture, Soil Science, and Natural Resources.

The focus of teaching was dairy nutrition, as planned, but also covered other topics. Topics discussed were similar to those covered in Wolkite. The formal presentations included a simple Excel spreadsheet used to illustrate ration-balancing. Items discussed included the detergent and proximate analyses systems for analyzing feeds, by-product feeds, crop residues, legumes, rotational grazing, forage species, forage testing and tree forages. There was an example of a forage analysis for teff hay. Side discussions based on questions from participants were similar to Wolkite and included the concepts of soil erosion and compaction, climate change, carbon sequestration, no-till or minimum tillage, silage, hay, round bales, feed supplement formulas, milking techniques, body condition scoring, lactation curves, stage of lactation rations, dairy breeds, cross-breeding, mastitis, milk markets, prices for milk and feeds, extension and university outreach, the current status of Ethiopian dairy farms, milk collection and processing, information technology, and mechanization. A flash drive with all of Wiegand's trainings plus an entire batch of Power Points on basic nutritional concepts was left with the Department.

There were 9 Holstein cows at the University farm with a very small proportion of Zebu genetics. Six of the cows were in poor condition, with a BCS in the 1+ to 2+ range with rough coats, indicative of parasites and nutritional problems. Cows were pastured on native grass for only an hour each day and supplemented largely with wheat bran. Cows gave 5-10 liters of milk per day. This University dairy farm was administered under the College and used as a teaching tool. Wiegand took the students to the barn on the second day of training to discuss the cow nutrition, health and general management. Students were asked to estimate the body-condition score of the cows.

Debre Berhan Research Station

One of the student participants was also an employee of the Debre Berhan Research Station, so it was decided to visit the Station on the second day of training. Wiegand had visited the Station in 1992 when it was part of the ILCA. The Station, established about 40 years ago and turned over by ILCA 12 years ago, consists of 261 hectares, dozens of buildings, 300+ sheep, and 50+ cattle. Seven CRS and University staff toured parts of the station, including the sheep pasture and nutrition diagnosis laboratory. The laboratory is fully equipped to do routine forage and feed analyses, covering eight parameters, for 265 Birr per sample. This laboratory is a good local resource for the University, both for forage composition research, as well as a potential training facility.

Private Dairy Farm

One of the training participants was a veterinarian who owned a dairy farm and managed a legal partnership group of 25 farmers for the purpose of milk collection, purchase and marketing. The partnership represents about 50 cows, collects and tests milk for quality, boils the milk, produces and sells fluid milk and yoghurt in a shop in Debre Berhan, and pays dividends to producers.

The farmer had a barn large enough for nine cows, but due to mastitis and other health issues, had only three cows. The three cows produced 25-30 liters of milk per day. Artificial insemination was used. There was no bedding for cows in the barn because mature hay and straw were used as feed, a practice typical in Ethiopia. After milking, the cows' teats were sprayed with a disinfectant. The barn floor was washed weekly with a bleach solution.

The milk price to the farmer is about 12-15 Birr per liter. One of the constraints to increasing herd size is the purchase price of a dairy cow, around 14,000 Birr, probably affected by high national demand for meat.

Among the recommendations given for the College:

1. Improve and use University farm as a training facility
2. Teach and use ration-balancing
3. Include Excel in computer training
4. Explore more dairy feed resources for the region and Ethiopia
5. Increase study of new forages, particularly legumes
6. Collaborate more with Crop Sciences
7. Collaborate more with Debre Berhan Research, local breweries, outside institutions
8. Train Extension personnel
9. Reach out to farmers

DAIRY NUTRITION

Dairy nutrition in Ethiopia, observed mostly from a distance on this project, was highly dependent on grass, often too mature, and on very minimal supplementation. The size of the land base was not so much of an issue, but rather the poor use of land for animals. For example, no rotational grazing was observed. Given the prevalence of animal (oxen) traction and hand harvesting, Ethiopia has a long way to go in the dairy sector. Wiegand did observe large-scale, mechanized cropping in some areas, particularly in teff, chickpeas and other field crops. Feeding grains such as maize to animals is generally not socially acceptable, although poultry are fed grains in large-scale operations. Dairy cows in Ethiopia suffer first from a lack of energy, then protein, and often minerals.

FORAGE SITUATION

Dairy cattle often graze local, un-improved grasses. Whatever hay is made is done with very mature, low-quality grasses. No silage was seen. Legumes are lacking in cattle diets, although one can find occasional tree lucerne and Desmodium. Sesbania trees are found everywhere except Debre Berhan (frost problem), but often not recognized as a forage. Improved grass species and legumes represent an incredible potential increased dairy production. Legumes not only provide protein, but also fix nitrogen in the soil, reducing the need for fertilizer.

APPROPRIATE TECHNOLOGIES

Although tractors are hired for plowing, mechanization is minimal on many Ethiopian dairy farms. There is no electric power to most farms. Wiegand recalls seeing farmers in the 1990s, bending over and cutting grain with small, curved knives. He once

encountered two farmers in 1992 with scythes left over from the Italian occupation. Why scythes, which greatly increase harvest rate and reduce the stress of bending over, were not widely adopted, has always been a mystery. A similar situation was encountered in Kenya. Post-hole diggers, made of two shovels hinged together, could not be found. Many Ethiopian farmers are discouraged by up-front costs, even for simple technologies. The response to electric fencing, useful and simple for rotational grazing, in Wiegand's class was the same – up-front cost. Small-holder financing might be a way to get past the first step.

WOMEN'S ISSUES

It was encouraging to see so many women studying agriculture in the Debre Berhan class. One of Wiegand's key contacts at Debre Berhan was a woman, Professor Fana. Wiegand made a criticizing comment about a small, older woman having to clean the manure out of the University barn at Debre Berhan, reflecting his particular bias about the proper role for women on farms. Women still do a lot of the hand-milking and herding in Ethiopia.

RECOMMENDATIONS FOR CRS / FARMER TO FARMER IN ETHIOPIA

- Secure another USAID bid for East Africa – you are great to work with!
- Debre Berhan University asked for assistance in fruit and vegetable crops.
- Expand to include Bahir Dar, Gondor, Hawassa and other Universities teaching animal science.
- Hire a volunteer to work with Extension services.
- Hire a volunteer to look at micro-credit, farm financial management.
- Hire a volunteer to teach grazing planning.

REALIZED TIMETABLE OF WORK

Sat. Nov 11 – Arrival in Addis Ababa

Sun. Nov 12 – Day Off

Mon. Nov 13

AM – Meeting at CRS Office, Addis Ababa

PM – Travel to Wolkite

Tues. Nov 14

AM – Meeting with Agricultural Dean and Staff at Wolkite University

AM – Meeting with University Vice President

PM – Visit to Wolkite University Farm

PM – Work on Training Materials

Weds. Nov 15

AM – Dairy Nutrition Short Course, Part 1

PM – Work on Training Materials

Thurs. Nov 16
AM – Work on Training Materials
PM – Dairy Nutrition Short Course, Part 2
PM – Meeting with University President

Fri. Nov 17
AM – Dairy Nutrition Course, Part 3
PM – Work on Report

Sat. Nov 18
AM – Travel to Addis Ababa
PM – Work on Report

Sun. Nov 19
AM – Visit to the Ethiopia Bazaar in Addis Ababa
PM – Travel to Debre Berhan
PM – Work on Report

Mon. Nov 20
AM – Meeting with Agricultural Staff at Debre Berhan University
AM – Visit to University Farm
PM – Work on Report and Training Materials

Tues. Nov 21
AM – Work on Report
PM – Dairy Training Course, Part 1
PM – Work on Report

Weds. Nov 22
AM – Dairy Training Course, Part 2, at the University Farm
PM – Visit to Debre Berhan Agricultural Research Station
PM – Visit to Private Dairy Farm
PM – Work on Report

Thurs. Nov 23
AM – Dairy Training Course, Part 3
PM – Travel to Addis Ababa

Fri. Nov 24
AM – Wrap-up Meeting with CRS

Vacation Week

Sat. Nov 25 –
AM – Travel to Axum
PM – Visit to Axum Sites

Sun. Nov 26
AM – Travel to Lalibela
PM – Visit to Lalibela Sites

Mon. Nov 27
AM – Travel to Bahir Dar
PM – Visit to Bahir Dar University

Tues. Nov 28
AM – Visit to Blue Nile Falls

AM – Visit to Dahir Bar University Research Station
AM – Visit to Dairy Processing Plant
PM – Visit to Bahir Dar Sites
PM – Dinner with Dr. Firew
Weds. Nov 29
AM - Travel to Addis Ababa
PM – Visit to ILRI
Thurs. Nov 30
PM – Dinner with Dr. Getachew Gebru
Fri, Dec 1
AM – Flight to US

CONTACTS AND AGENCIES

CRS - Baltimore

Maria Figueroa – Recruitment Manager, CRS F2F Program
Teresa Monaghan – Project Assistant, CRS F2F (Retired)
Bruce White – Director, CRS F2F

CRS - Addis Ababa

Biruk Tesfaye – FTF Program Manager, 251-911-718450, biruk.tesfaye@crs.org
Lidia Retta - Program Officer, lidia.retta@crs.org
Zemed A. Zewdie – Head of Program, 251-911-50-73-05, zemed.zewdie@crs.org
John Shumlansky – Country Representative, 251-911-21-41-59,
john.shumansky@crs.org
Solomon _____ – Security Advisor, 0911-60-49-81
Dagnawi Melaku - Program Officer, 251-949-42-44-78, dagmawi.melaku@crs.org
Seleshi Tilahun – Driver
Tigist _____ - Travel planner, 0911-67-54-53
Richard Otto Wiegand, Volunteer, 715-416-0513, otto.wiegand@ces.uwex.edu
Ilan Bar – Volunteer, 407-718-5489, ilanbar@gmail.com
Saro Maria Hotel – 251-11-667-2167, reservations@saromariahotel.com
Samuel Omalia, General Manager, Saro Maria Hotel, 251-935-40-24-21,
Samuel.omalia@saromariahotel.com

Wolkite University

Dr. Teshome – Dean, College of Agriculture & Natural Resources
Dr. Sissay Shewamare – Vice President of Wolkite University Research & Community Services
Wondossen Ayalew - Chairman of Department of Animal Production & Technology, 251-913-95-74-32, wondessenayalew9@gmail.com
Abdul _____ - University Farm Manager
Dejene Ayele Tessema – President of Wolkite University, Professor of Environmental Analytical Chemistry, 251-11322-0276, president@wku.edu.et

Debre Berhan University

Getachew _____ – Acting Dean of College of Agriculture

Dr. Kaasahun – Community Outreach and Consultancy Head

Wondossen _____ - Lecturer

Fana Shiferaw - Lecturer, fanashiferaw@yahoo.com

Rekik Bekele – Lecturer, rekikbekele@gmail.com

Outside of The Project

Dr. Karen Jacobsen – DVM, Dairy Nutrition Consultant, former CRS F2F Volunteer in Ethiopia, Fayetteville, AR, 706-340-0999, klivet@gmail.com

Dr. Silvia Abel-Caines – DVM, PhD Dairy Nutrition, 630-234-6989, silvia.abel-caines@organicvalley.coop, sabelcaines@gamil.com

Dr. Heidi Busse – University of Wisconsin School of Human Ecology, Madison

Dr. Michel Wattiaux – Dairy Sci. Dept, University of Wisconsin

Dr. John Ferrick – International Programs, University of Wisconsin, Madison, john.ferrick@wisc.edu

Trisha Wagner – UW Extension Ag Agent, Jackson County, WI – FTF Volunteer, 715-284-4257 x4, trisha.wagner@ces.uwex.edu

Jennifer Blazek – UW Extension Ag Agent, Dane County, WI, 608-224-3717, jennifer.blazek@ces.uwex.edu

Dr. Philip LeBel – Wolkite Visiting Professor, Montclair State University, NJ, 410-603-1124, lebelp@mail.monclair.edu

Dr. Mestawet Taye - Hawassa University

Dr. Azage - ILRI

Belachew Hurrissaq - Elemtu Dairy Processors, Ethiopian Soc. of Animal Producers

Aklilu Kidanu – Retired Health Professional, Businessman, Addis Ababa, mizhasab1996@gmail.com

Jeremy Watson – Director, Projects & Supply Chain, Ethiopia Chicken Company, 251-98-471-5253, Jeremy.watson@ethiochicken.com

Lorenz Wiegmann – Balaton Agro Investment PLC, Germany, 251-98-38-60-411, wiegmann@balaton-agro.com

Benedict Irwin – CARE Ethiopia, 251-911-34-64-76, ben.irwin@care.org

Euan Naude – Debre Berhan Brewery, South Africa

Sisay Yimer - Tour Guide, Hotel Manager, Axum, 0920-87-69-21

Eshetu Bedane – Manager, Top Twelve Hotel, Lalibela, 251-911-93-02-17, top12hotel@gmail.com

Sisay Yimer – Tour Guide, Hotel Manager, Axum, 251-914-74-40-02, dnsisay2@gmail.com, dnsisay@yahoo.com

Girum Tenelle – Tour Guide, Addis Ababa, 0929-90-18-60

Kirosabiy Tesfakiros – Tour Guide, Lalibela, 51-912-43-91-18, abiykuros@gmail.com

Getachew Gebru – President, Ethiopian Society of Animal Production, 0911- 23-76-39, ggebru09@gmail.com

Bahir Dar

Dr. Firew Tegegne Amogue – Dept. of Animal Prod. & Tech., Bahir Dar University,
firewtegegne@yahoo.co.uk

Dr. Baylie Damtie – President, Bahir Dar University, 251-09-918-340-164,
bayliedamtie@yahoo.com

Misganaw Walie – PhD Candidate, misganaw2000@gmail.com

Frank van Berkom – Amhara Region Irrigation Project, 251-09-6685-6940,
frankvberkom@gmail.com

ABREVIATIONS / ACRONYMS / DEFINITIONS

BCS – body condition score (1 = too thin, 5 = obese, 0 = dead)

Birr – Ethiopian Currency (\$1 = 27 Birr)

CoANR - College of Agriculture and Natural Resources, Debre Berhan University

CRS – Catholic Relief Services

CSA - ?

DNR – Department of Natural Resources

DVM – Doctor of Veterinary Medicine

F2F – Farmer to Farmer program

GDP – Gross Domestic Product

ILCA – International Livestock Center for Africa (Addis Ababa & Nairobi), now ILRI

ILRI – International Livestock Research Institute (Nairobi & Addis Ababa), formerly ILCA

IMF – International Monetary Fund

MOFED - Ministry of Finance and Economic Development

NGO – Non-Governmental Organization

NRC – National Research Council

SOW – scope of work

TMR – total mixed ration

USAID – United States Agency for International Development

USDA – United States Department of Agriculture

WKU – Wolkite University

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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 Silage	Zea mays	Chopped	Corn
Maize Stover	Zea mays	Chopped	Corn

Sorghum Sudan	Sorghum spp	Chopped	Sorghum-Sudan cross
King or Napier Grass	Pennisetum purpurem	Chopped	From Africa
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, From Africa
Alfalfa/Lucerne (Legume)	Medicago sativa	Grazed	From Asia
Clover (Legume)	Trifolium repens, other	Grazed	From Asia
Qat Residue			From Africa

FEEDSTUFFS / CROP RESIDUES (to be completed later)

Item	Crude Protein	Net Energy L		
Maize Grain	10			
Oats Grain				
Maize Germ				
Wheat Pollard				
Brewers Grains				
Wheat Bran				
Wheat Middlings				
Cottonseed Cake				
Cottonseed Meal	41			
Sunflower Seed Cake				
Sunflower Meal	32			
Soybean Meal	48			
Noug Cake				
Coffee Pulp				
Urea	281	0		
Bone Meal				
Meat & Bone Meal				
Fish Meal				
Fish Meal (60% CP)	60			
Lucerne / Alfalfa Hay	20			
Di-Calcium Phosphate	0	0		
Stock Lime	0	0		