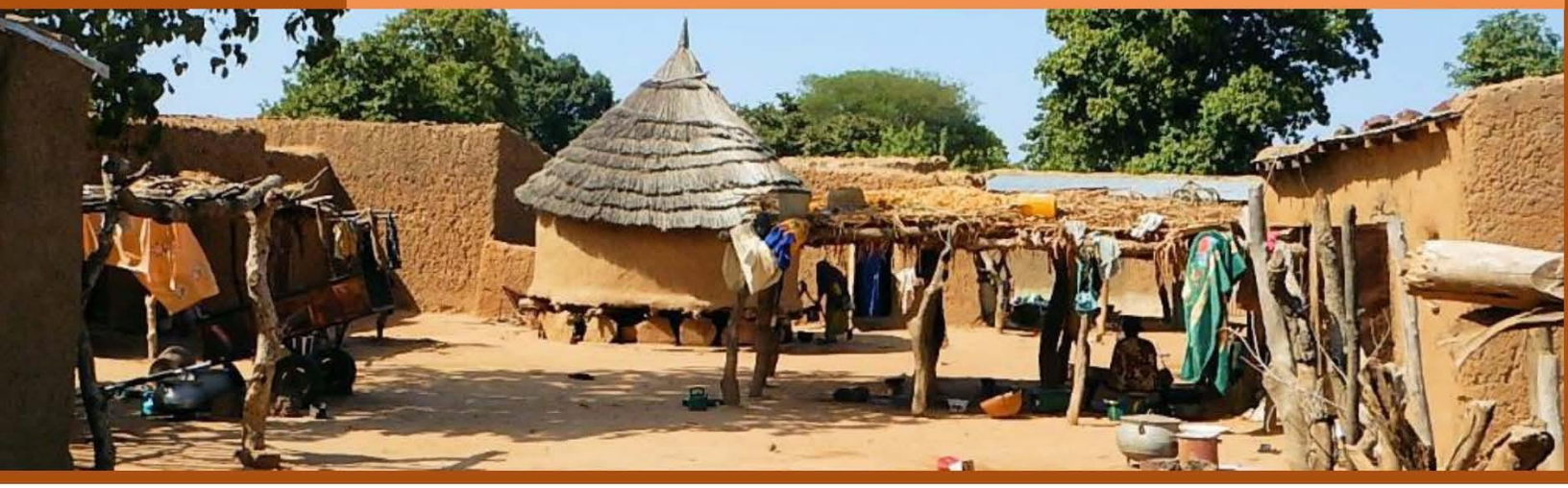
# IMPROVING THE SUSTAINABILITY OF MALIAN SHEEP AND GOAT FARMING

## FINAL REPORT

**Volunteers for Economic Growth Alliance Special Program Support Project**
**Browse and Grass Growers Cooperative: Farmer-to-Farmer Mali**
**March 23, 2015 – March 22, 2016**



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FARMER-TO-FARMER

VEGA Volunteers for Economic Growth Alliance

# Improving the Sustainability of Malian Sheep and Goat Farming

## Common Pastures Initiative

### Farmer-to-Farmer Mali
### VEGA Special Program Support Project
### Final Report

Browse and Grass Growers Cooperative
N12835 County Road Q, Downing, WI 54734
March 23, 2015 - March 22, 2016
Contact Name: Judith Moses
Tel: 715.265.7637
Email: BuyGrassFed@gmail.com
jmoses@pacer.org
www.commonpastures.org

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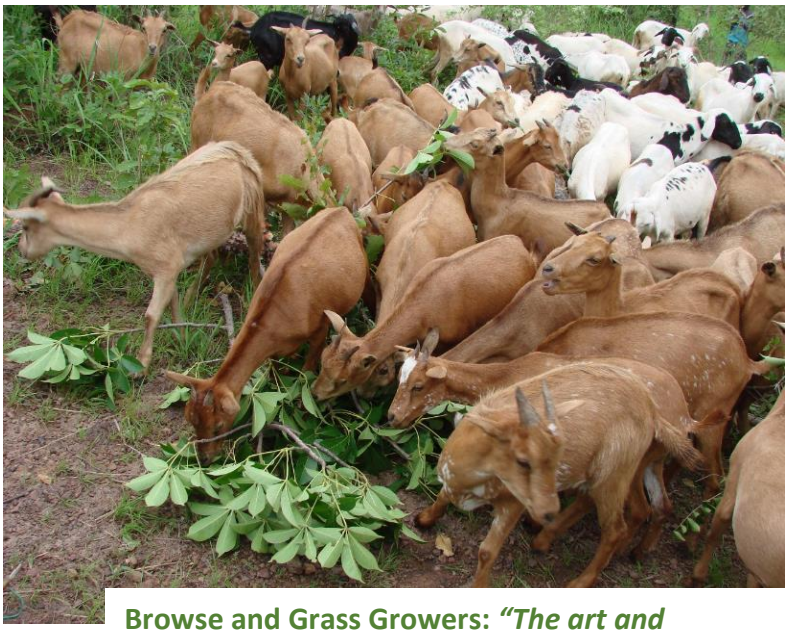
**COMMON PASTURES: Sustaining flocks, farms, and families initiative** is implemented by the U.S. based Browse and Grass Growers Cooperative as a Volunteers for Economic Growth Alliance (VEGA) Special Program Support Project funded by the U.S. Agency for International Development (USAID).

This report marks the end of the first year's successful Farmer-to-Farmer (F2F) initiative in Mali, West Africa, actualizing the **concept of farmers helping farmers and cooperatives helping cooperatives**.



**Browse and Grass Growers: *"The art and science of integrating grazing animals, with trees, shrubs, crops and pasture."***

**CHALLENGE:** The nomadic or semi-nomadic grazing traditions and techniques are quickly becoming less effective and not transferrable to the smallholder farmers' more confined flocks. This is due to many factors including: climate change and sparse grazing areas being broken up by increased violence and drought in the north; large landholders, open pit mining and foreign investors in the south, Grazing is basic nutrition for ruminants and is a critical asset for low-resource livestock farmers.

Internationally, improving small ruminant production and marketing practices through information, technical training, and value-chain development is a primary need for small-holder farmers and is critical for Mali farmers.

*Meet some of the program beneficiaries and members of the Mali team on the self-funded video by volunteers at [www.youtube.com/watch?v=eJmVhjOdm5k](www.youtube.com/watch?v=eJmVhjOdm5k)*

**The Goal** of this project was to enhance the quality of life for farmers and their families through information, training, and cost-effective implementation of sustainable small ruminant production, management, and marketing practices.

**The Program Beneficiaries** are small-holder, low-resource, cooperative members, potential members, and their families, including youth, single and widowed women, farmers with disabilities, and students attending agricultural schools.

**Hosts** are smallholder, low-resource, farmer cooperatives, and agro-pastoral institutes in the Koulikoro, Sikasso, and Ségou regions of Mali, West Africa.

There is a high regional demand for Malian livestock and meat. Mali possesses the most important livestock population in West Africa. Livestock products rank among the top 10 agricultural commodities produced in Mali and the combined value accounts for approximately half of Mali's agricultural GDP (FAO, 2014). Small ruminants are especially important in rural Mali as 80% of the population own sheep and/or goats and depend on their contribution to family income and food security. They are a socially acceptable business for women, with low initial investment, minimal labor demand, and easy market access. Youth and young children safely interact and share in the daily care of sheep and goats, keeping both out of trouble for much of the daylight hours outside of school.

**And yet**, livestock inventories over the last 20 years have not been increasing in productivity and are far behind the productivity rates in other developing countries. The demand for animal products in Mali is only partially being met while the demand for meat is predicted to grow steadily in coming decades (FAO, 2014). The productivity of Malian herds will need to improve dramatically to prevent the gap between demand and supply from increasing further.

**Method:** Technical support, training, and resources were provided with a focus on integrating small ruminant production and nutritional needs with crops and browse (e.g., renewable, high protein, legume trees). A holistic management system was supported that combines best practice and humane livestock protocols with sustainable land management.

**Activities addressed by the volunteers included:**

1) Identification of opportunities to improve pastoral land use;
2) Application of feed supplementation strategies; and
3) Upgrading of healthcare, breeding, nutrition, and farm management practices.

Identifying opportunities to improve pastoral land use, browse, and forages.

Volunteer
Andres Cibils


## Results

**$190,040** Value of volunteers time leverage on assignments.

**$13,214** Contributed by hosts.

**$111,526** Additional leveraged and donated funds from community supporters.

**1,611** Small farmers trained.

**1,925** Persons directly benefited.

**16** Hosts benefited.

**78** Professionals trained.

**400** Students and youth trained in the village and at Agro pastoral schools.

**32** Farmers with physical disabilities trained.

**3,000** High-protein forage, legume trees donated, planted, and set up demonstration site.

**10** Breeding rams and bucks donated. Valued at $4,000.

**4** New agro-pastoral school partnerships established.

**2** Private veterinary organization new partnerships.

**2** University students completed 10-month internships and received stipends to provide follow up support to the hosts.

# Improving Pastoral Land and Forage Use

Above: Volunteer Moses planting legume sapling. There is increasing human and livestock pressure on the available land and forage resources. The efficiency with which livestock can convert feed into meat and milk is greatly reduced when only poor quality forage is available. This results in major weight loss, stunting, and high death loss.

**Legume & Forage Trees:**
Leucaena leucocephala, Glyricidia sepium, and Moringa oleifera

***"We never thought to grow trees to feed animals."*** Village Elder

Below left: Planted over 3,000 legume trees including a donation of 2,000 trees from *Asher Plants Trees*, 11-year-old grandson of a volunteer. Below right: New seedlings

## High Nutrient Tree Forage

**Moringa oleifera** is one of the amazing trees common to Mali. It is known for its high nutritional value for people. Rare for a plant source, it contains all the essential amino acids (proteins). Gram-for-gram it contains seven times the vitamin C of oranges, four times the Vitamin A of carrots, and four times the calcium of milk. It is also said to increase the milk production of goats.

Moringa, Leucaena, and Glyricidia grow readily from seeds or cuttings, in marginal soil, and with very little water. They produce fruit and leaves within 8 months.

### Utilizing local feed as supplements:

- High protein legume forages, (testing +/- 25%)
- Urea treated crop residues,
- Cassava silage,
- Molasses blocks.

Three assignments focused on legume trees:

- "*Facilitate the intercropping of legume forage trees on small farms and establishment of a demonstration site,"* by Margaret Summerfield, Ph.D. with donation assistance from grandson Asher Plants Trees;
- *"Improving small ruminant nutrition through local forage trees,"* by Thierno Hady Diallo;
- *"Improving Small Ruminant Nutrition through local forage and cassava,"* by Harouna Maiga, Ph.D.

### Legume Forage Tree Demonstration Site

at the Village of Katibougou.

- 1 Hectare
- Fenced
- Well
- Pump
- Irrigation being prepared
- Water storage tower in process (photo on right)

# Silage Improves Nutrient Value of Crop Byproducts

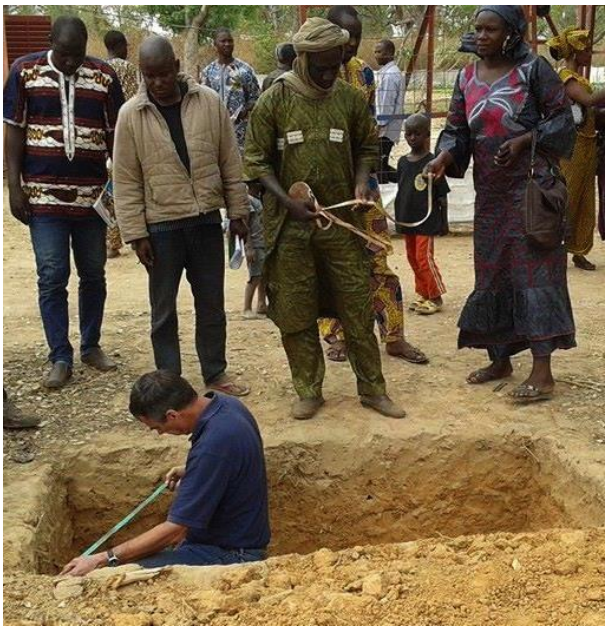
**Treating low quality crop residues** such as maize or wheat straw with urea is an easy method to increase digestibility and productivity of livestock. It is commonly done below the ground in lined pits or above the ground in bags. After mixing urea, water and straw, the pits are sealed for at least 3 weeks. The treatment of crop residues can be done any time as long as the residue, water and urea required for the treatment are available. The best period recommended, however, is just after harvest as the forage supplies are readily available at this time.

Ammonia is released through urea degradation done by the action of microorganisms. These microorganisms are normal inhabitants of low quality roughage and produce urease in the presence of moisture. With adequate moisture and suitable temperature, urea is degraded to ammonia which then permeates through and binds the straw. The nitrogen is released through the process and is used as the building block for the production of protein by the animals' digestion process and the rumen microbes. The treated roughage will be significantly higher in digestibility and crude protein than the untreated material.

**Why Urea?** Fertilizer-grade urea is readily available in many developing counties. It improves the nutritional quality of roughages such as crop residue. It is very simple and effective process to improve the intake of poor quality feed. Begin urea treatment when crop residues are plentiful before needed during the dry season.

**Recommendation:** It is recommended that farmers feed urea-treated roughage to their animals with the highest nutritional requirements, such as lactating or fattening animals. Other farmers may find it beneficial to feed limited amounts of the treated roughage as a supplement, with the remainder of the animals' diet being untreated roughage or grazed forage.

Below Left: Volunteer Gipson checks the dimensions of the in-ground silo. Crop residues (e.g., bush straw, corn stalks, sorghum stover, or rice straw) being treated with urea. Residues from corn or sorghum should be chopped to provide a greater surface area for the treatment process and to increase subsequent intake by the animal.



**Method:** Suggested level of urea is 5 kg per 100 kg of material. The moisture level in the roughage determines how much water should be added may range from 0.3 to 1 liter of water per kg straw. The moisture level can be estimated by handling. Dry (95%) will be brittle, whereas wet (85%) will be sticky and bend in hand. Urea is weighed and dissolved in a measured quantity of water. Then the urea-water solution is sprinkled on the residue and added to the pit in batches. Removing air from the pit is important and involves packing before covering with plastic, or leaves such as banana, and then soil.

Finished, covered silage pit.

There are many different designs of pits or trenches for urea treatment. A common recommendation is 1 m wide, at least 2 m long and 1 m deep and will typically hold between 150 to 200 kg of roughage with the top of the pile being slightly above ground level (see above). It is useful to construct more than one adjacent pit so that treated roughage from one pit can be used while the next pit is being treated. This helps to ensure continuous supply.

Apart from pits or trenches plastic bags (see cassava silage project, page 9) that can hold 20 to 25 kg of treated straw may be used. Such bags have the advantage in that individual bags can be opened when needed to feed animals and resealed to prevent mold contamination.

**A family of 4 can treat about 1 ton of straw in 4 hours.**

**Success!** Below Left: Treated crop residue after being allowed to ferment for two months tightly covered to prevent air contamination. The results were excellent with no signs of mold.

Above: The sample on the left is crop residue treated with urea to increase the nutrient value.

In comparison, the sample on the top right is untreated and has minimal nutrient value except as a source of roughage. Small ruminants will not maintain body condition or produce milk on a low nutrient, roughage heavy diet.

# Processing Cassava Byproducts for Silage


> *"Meeting feed and forage requirements of small ruminants is the most urgent need for livestock smallholders in the agro-pastoral systems of Mali."*
>
> Cibils et al. 2015, *Challenges and Opportunities for Agro-pastoral Livestock Smallholders in Mali*. Outlook on Agriculture 44: 69-80).

**Feed supplementation with a crop byproduct that is usually wasted** (no urea added). Cassava is a starch tuber raised by smallholder farmers for human consumption. It grows well in poor soils and on marginal and degraded land. It survives drought, intense tropical sunlight and heat, so provides a stable source of food and income when other crops fail. The foliage part of the plant is highly prolific but toxic to livestock when fresh due to the hydrocyanic acid in the plant.

Cassava dry hay and silage is safe to feed to animals but needs drying or simple processing so it will be digested efficiently. The silo bag curing method was used to convert the waste byproduct to a safe feed for livestock with resultant crude protein (CP) at approximately 13%. This compares to cassava hay at approximately 8% CP and the desired cowpea hay at 12% CP. **With over 4,000 hectares of cassava grown in the area** we work, silage would be an important product for milking herds and could be a profitable small business for an entrepreneur.

Information on cassava production, management and its importance in both human and animal nutrition was demonstrated to two farmer cooperatives, in addition to students at the University of Segou, and two Agro Pastoral schools.

The role of hydrocyanic acid in cassava plants and how to manage it was explained to farmers to lessen their fears of livestock poisoning. Cassava hay and silage preservation techniques were demonstrated and product produced and consumed successfully. Ration formulation with specific examples for fattening lambs for Tabaski was included using cassava and other feeds.

# Molasses Blocks from Local Ingredients

Above: Production of Urea-Molasses Blocks with volunteer Terry Gipson.

**Recommendation:** Produce urea-molasses blocks for supplemental feeding during the dry season and as an income generating small enterprise. If molasses is not available, substitute a suitable replacement such as honey or a fruit syrup, such as from mangos when they are plentiful.

Sheep and goat diets in Mali are based on fibrous, low nutrient feeds like mature pastures and crop residues. These feeds are deficient in protein, minerals and vitamins and are poorly digested keeping intake low. Supplementation with urea molasses blocks can increase digestibility of fibrous feeds by up to 20%, and increase nutrient and feed intake by up to 30%. During the process vitamins, minerals, and protein can be added.

The taste-testers give their approval

# Upgrading Flock Genetics

**Breeding support provided:**

1. "*Upgrading Breeding Stock: selection, crossbreeding and purchasing replacements"* by Harouna Maiga, Ph.D. University of MN, Crookston

2. "*Upgrading Breeding Stock: selection, and cross-breeding part 2"* by Terry Gipson, Ph.D, Langston University, Oklahoma.

Left and below: Seven goats and thirteen sheep were provided to six farmer cooperatives that met flock upgrading goals. The cooperative members received ongoing support from the University of Segou agriculture intern students as part of their field work. Private donations help support this project. Bali Bali and Moor sheep breeds and Sahelian goat breeds were chosen for improved genetics (see details page 16).

Regardless of breed, the choice of a breeding male is usually based upon:

- Age: Younger breeding males have a longer service expectancy than older.
- Health: Check ocular membranes and overall appearance.
- Confirmation: Males selected for breeding should be taller in stature, longer in length, and with depth of chest cavity than cohorts, and two well-formed testicles

## Recommendations

Castrating all inferior males and controlling the breeding of goats and sheep is critical or there will be no genetic improvement. Intact males currently run with the flock and breed freely.

An understanding of inbreeding and its negative consequences is lacking and will be important follow up training for flock improvement.

# Flock Healthcare and Surveillance

*Improved Small Ruminant Health and Management"* by Scott Haskell, DVM;

Veterinarian supply centers and animal health trainings were established at six farmer cooperatives. The supply centers provide basic medication and tools to be purchased and replenished by the farmers as used.

Participants developed skills and experience in the diagnosis and treatment of common livestock diseases not generally requiring treatment by veterinarians (e.g., internal and external parasite, poor nutrition, lameness) through the use of: hands-on field training, and the "See one, do one, teach one" method. **Flock surveillance** included noticing behaviors such as: standing alone, poor appetite, abnormal walking or other muscular movements, hunched back, diarrhea, abnormal respiration, or grinding teeth. The farmer's flock or a market animal considered for purchase can be screened in a few minutes for common issues.

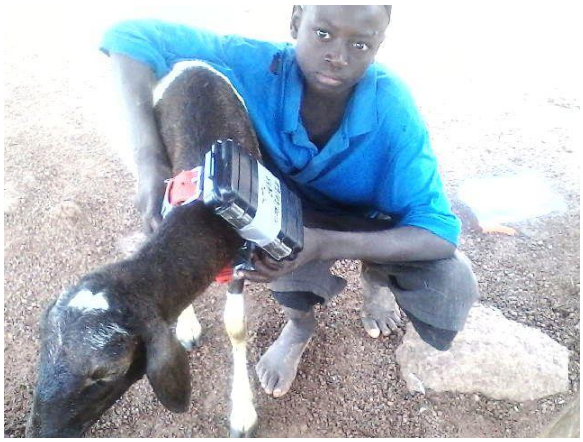
A treatment rubric was developed for the cooperative members utilizing simple Body Condition Scoring, respiration and temperature. A veterinary medical treatment and diagnosis 'kit' was provided to the cooperatives to sustainably manage their resources. Each medicament was price structured so that members could purchase items on a 'per pill' or' per ml' basis as needed and thereby maintaining a stable inventory.

Veterinarian supervision was provided to the cooperative members and the University of Segou Animal Science students during their field internship by **MEDIVET**, Bougouni, and the **Private Veterinary Unit,** Koulikoro**.**

During their internship, the students examined and vaccinated **10,639 ruminants;** and conducted follow-up trainings to **158 farmers** on nutrition, health and breeding. They also attended and assisted at all the volunteer trainings.

# TECHNOLOGY:

GPS was used to better understand grazing patterns, dry matter intake potential and to educate farmers on overgrazing, inadequate grazing, and erosion threats.



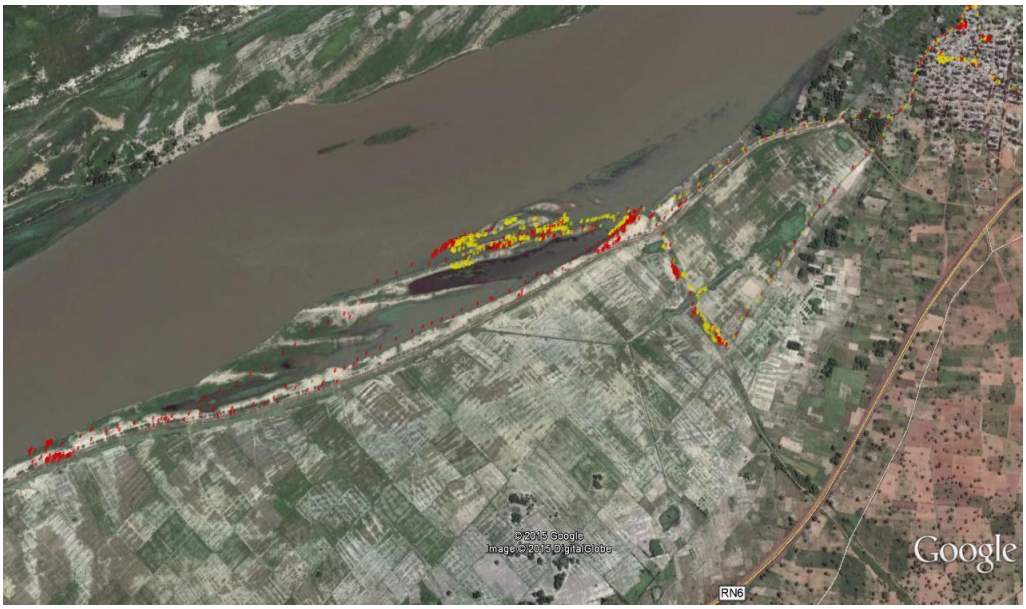

*"Develop improved rangeland-based small ruminant production and nutrition systems"* in Bougouni and Segou by Andres Cibils, Ph.D.

## GPS Data Points Plotted on Google Earth

Helps to improve current feeding practices by understanding:

1) The kinds and amounts of feed that small ruminants in agro pastoral villages are likely harvesting while grazing; and
2) The amount of energy that they expend in doing so.

The visual display of information was helpful to demonstrate to farmers the distance their animals' travel per day to graze. The yellow and red points (upper right corner and mid area) on the map show the movement during one day of the collared livestock as they were herded from the villages to the Niger River riparian area walking 8 to 13 km daily for food and water.



# Sun Cookers to Help Save Browse & Trees

Six cooperatives were trained to build and use solar stoves. *"Capacity Building for Women"* by Bonnie Loghry above. Materials were sourced locally and plans provided.

**Deforestation** and soil erosion is an increasing problem that affects both human and animal feed availability. Discussions on decreasing the need for wood as fuel helped to make the connection between solar cooking and small ruminant production

Fabrication of solar cookers was used as a potential means to reduce deforestation and to improve available small ruminant fodder, lessen lung and eye diseases, and stimulate small-holder business income. Demonstrations of sun movement, angles, cloud, and wind conditions provided the students with concrete examples of factors influencing the success or failure of solar cooking. Creation of a small business model for production, marketing and sales of solar cookers for potential future use was included. Farmers with disabilities were actively sought and welcomed to all trainings, but especially this one.

## Farmers with Disabilities

All assignments were open and welcoming to farmers with disabilities. Over 30 individuals with disabilities, including physical, vision and hearing issues, participated.

Physical disabilities were common due to a polio epidemic many years ago and recent military upheaval. Farmers own land, and actively tend fields and livestock with the support of children and extended families.

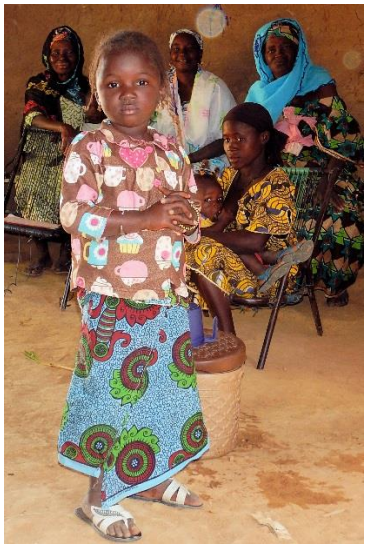
# Farm Management & Marketing: **Agro Pastoral Schools**


Four assignments were focused on farm management and marketing. These assignments had classroom trainings for agro-pastoral school students in addition to the village trainings for farmers.

Assignments included:

- "*Profit or Loss: Business side of supplementing small ruminants grazing on common lands"* by Otto Wiegand, Ph.D.;
- *"Capacity Building in Start-up Business Implementation and Management"* by Michael Lowry;
- "*Marketing Assessment from Grass to Table"* by Ashton McGinnis; and
- *"Viability of Dual Goat Breeds for Meat and or Milk Production"* by Judith Moses.

# Training and Trust Building in Remote Villages



***"When my country was suffering you brought us…oxygen."*** Host.

*"As we post photos and stories to outlets like Facebook and Instagram, people I haven't seen in years have come calling with questions, asking for stories. Very few of the people we've told these stories to have known anything about Mali, even down to its location on a map. Even more unknown is the state of the country, and the people.*

*It is unfathomable to many just how important this work is,* ***to think of sustainability not in the sense of 'eco-friendly', but rather in the capacity to endure."*** *Volunteer Ashton McGinnis*

# Activities by Country: Mali, West Africa

| Activity | Volunteer | Date | Days |
|---|---|---|---|
| SOW 001: 1) Improved Small Ruminant Health and Management. 68 M / 91 F | Scott Haskell, DVM | Jun 8 - Jun 25 | 18 |
| SOW 002: Capacity Building with Women Groups for a Sustainable Small Ruminant Production. 68 M / 91 F | Bonnie Loghry, MPH | Jun 8 - Jun 25 | 18 |
| SOW 003, a & b: 1) Upgrading Breeding Stock: selection, crossbreeding & purchasing replacements. 184 M / 74 F<br>2) Improving Small Ruminant Nutrition through local forage (cassava). 91 M / 29 F | Harouna Maiga, PhD | Jun 12 - Jul 14:<br>July 20 - Aug 6. | 44 |
| SOW 004: Develop improved rangeland-based small ruminant production and nutrition systems. 59 M / 10 F | Andrés Cibils, PhD | Aug 1 - Aug 19 | 19 |
| SOW 005: 1) Improving Small Ruminant Nutrition through local forage; 2) Develop & conduct 2 Agro-pastoral school trainings at Koulikoro and Sikasso. 91 M / 29 F | Thierno Hady Diallo, MS | July 14 - Aug 2 | 16 |
| SOW 006: Profit or Loss: Business side of supplementing small ruminants grazing on common pastures. 85 M / 79 F | Richard Wiegand, PhD | Aug 1 - Aug 19 | 19 |
| SOW 007: Facilitate the intercropping of legume forage trees on small farms and est a demonstration site. 56 M / 10 F | Margaret Summerfield, PhD | Aug 6 - Sep 4 | 22 |
| SOW 008: Marketing Assessment from “Grass to Table.” 11 M / 2 F | Ashton McGinnis | July 25 - Aug 9 | 16 |
| SOW 009: “Grass to Table” Part 2: Viability of Dual Goat Breeds for Meat and Milk Production. 95 M / 81 F | Judith Moses, MS | Aug 5 - Sep 4 | 25 |
| SOW 0010: Upgrading Breeding Stock: selection, crossbreeding & purchase replacements. 116 M / 19 F / 72 Y | Terry Gipson, PhD | Feb 9 - Mar 1 | 22 |
| SOW 0011 Capacity Building in Start-up Business Management. 24 M / 25 F / 18 Y | Michael Lowry | Nov 20 - Dec 2 | 13 |
| **Total:** | **Volunteers: 11** | | **232** |

# Performance Indicators, Targets, and Impact

| Indicator | Target | Actual |
|---|---|---|
| **Number of Volunteers** | **10** | **11** |
| Number of Hosts Strengthened | 20 | 16** |
| Number of Person Trained | 600 | 1,611 |
| Number of Families Benefited * | 1,800 | 4,833 |
| Agriculture Professionals | 40 | 78 |
| Students and Youth | 60 | 416 |
| Farmers with disabilities | 25 | 32 |
| Total Days | 195 | 232 |

*Average Mali family size estimated as 4.
**Due to heavy rains and unpassable village roads Volunteers was unable to logistically reach hosts.

*Performance: We fielded an **extra volunteer** and exceeded the majority of our targets!*

## Sheep and Goat Donations as of April 1, 2016

**Cooperative members must reach specific goals before receiving breeding stock.**

| Regions | Villages | Improved Breeds | | | | | | Notes |
|---|---|---|---|---|---|---|---|---|
| | | SHEEP | | | GOAT | | | |
| | | Ram | | Ewe | Buck | | Doe | |
| | | Bali-Bali | Moor | Bali-Bali | Sahelian | Moor | Moor | |
| Koulikoro | Dladie | 1 | 0 | 1 | 1 | 0 | 0 | |
| | Mafeya | 2 | 0 | 1 | 1 | 0 | 0 | |
| | Katibougou | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Tanabougou | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Tienfala | 1 | 0 | 1 | 1 | 0 | 0 | |
| **TOTAL** | **3** | **4** | **0** | **3** | **3** | **0** | **0** | |
| Sikasso | Bougouni | 1 | 1 | 2* | 1 | 1 | 2 | * Ewe died |
| | Toula | 1 | 0 | 0 | 0 | 0 | 0 | |
| | Solla-Bougouda | 1 | 0 | 0 | 0 | 0 | 0 | |
| | Mena | 0 | 0 | 0 | 0 | 0 | 0 | |
| **TOTAL** | **3** | **3** | **1** | **2** | **1** | **1** | **2** | |
| **TOTAL** | **6** | **7** | **1** | **5** | **4** | **1** | **2** | |

# Public Outreach

## Publications:

*Farmer to Farmer Project makes Progress in Mali.* Jan 2016. WI Agriculturalist. Circulation 26,000.

Winrock International Interventions, circulation 3,000 March 2016 http://us1.campaign-archive2.com/?u=cee7d573e6c3474e9cf3922c4&id=c34eae2eaf&e=da2f1563a9

*Dladie Village Shepherds in Mali, West Africa (2012),* Handout on volunteering in Mali.

*Rainy season herding patterns of agro-pastoral livestock smallholders in southwestern Mali: A preliminary GPS-based assessment*, accepted for a poster session and publication in the 2016 International Rangeland Congress Proceedings.

## Workshops, Conferences, and Classroom:


- NW Graziers Fall Conference in Spooner, Nov 2015, presentation on forage trees including Mali. 35 attended.
- Presentation and display on F2F in Mozambique, Kenya and Mali at NW Regional Extension Conference, Eau Claire, Feb 2016. 20 people.
- Introductory Range Science course. Sep 2015. 97 students.
- Range Ecology course. Sep 2015. 30 students.
- Graduate students and colleagues. Ongoing updates as project progresses to 15.
- *Small Ruminant Clinic*, University WI Extension, Baldwin, WI. April 20th. The presentation included slides showing small ruminant production and marketing. 36 attended.
- Vega Anniversary, Panel. Dec 3, 2015. 100 attended
- Church groups (2). 83 attended.
- Synagogue presentation. 102 attended.

## Outreach:

- Over 100 soccer balls donated from a soccer ball organization.

- Discussed with over 120 members of the community face-to-face and an additional 60 emails for donations towards the legume tree project. Individuals and small groups of five to 10 people were contacted in Maine, Texas, California, Wisconsin, and Minnesota.
- Volunteer talked about the project to approximately 80 ex-students.
- Social media on volunteers' Facebook pages, three Youtube channels, Vimeo, two websites, LinkedIn pages, Twitter, Google+, Instagram.
- 20 flash drives and two CDs with video and PowerPoint information summary.
- Email news list four times to 90.

## Technology:

The Common Pasture's project successfully used and will expand the use of drones and GPS tracking collars and remote sensing tools to understand grazing patterns. Freeware developed by the Minnesota Department of Natural Resources was used to download GPS data. Social media blogs on this activity has resulted in inquiries from India, and Botswana researchers and NGOs.

Video and digital cameras, Skype, social media, and messaging were commonly used both by volunteers and participants. Many trainings were partially videoed on cell phones by participants. The trainings provided at the four Agro-pastoral schools and the University of Segou were all fully video- and audio-taped for classroom use.

Demonstrating drone used by volunteer McGinnis and friend for videoing grazing patterns and surrounding area.

## Expected Impact:

- The workshop participants will successfully treat crop residues with urea, ensile, and feed to ruminants, thereby increasing the nutritional status of livestock.
- One or two cooperatives or individual members will manufacture urea-molasses blocks for supplementation of small ruminants, thereby increasing efficiency of production and resulting in improved nutrition during the dry season. Making them available for sale in the surrounding villages could potentially be a source of income for a small group.
- The farmer cooperatives that received improved Bali-Bali, and Moor breeding rams and Sahelian bucks will see offspring on the ground and the economic returns of improved selection. The basis for sustainable sheep and goat improvement is nutrition and basic herd health and this takes time.

- Legume trees will be grown, protected, and utilized as a feed source. Leaf fodder will be dried and stored for supplementation during the dry season. Protein is generally around 25 percent so no more than 20-30% leaf fodder is needed.
- Rations will be balanced to the extent possible and recipes shared with fellow cooperative members and the project team. Pregnant, lactating, and growing animals will receive the most attention and be separated for feeding if necessary.
- Methods of alternative feed supplementation will be explored, such as dried ground nut foliage, ensilaged cassava, and urea treated rice straw. Results will be shared with fellow cooperative members and the project team.
- Health surveillance by the livestock owners will be initiated and basic health care provided. Consultation with local veterinarians sought as appropriate.

***"This boy said he was coming to Africa to plant trees. And he came. When he returns he doesn't knock, but enters, as my son."***

Village elder

***"I learned….I will always have a home in Africa,"***

Asher Plants Trees

Organizing legume saplings for distribution at Bougouni