International Development Design Summit
Documentation

LIVESTOCK FODDER

A project in Orkolili, Tanzania

OVERVIEW

Fig. 1. Team Fodder © Bianca J Anderson

01. ABSTRACT

At IDDS 2014 in Arusha, Tanzania five participants were selected to develop an appropriate technology related to the theme of “Livestock Fodder Production” in Orkolili. After two community visits to the Maasai village of Orkolili, the team developed two prototypes: a hand-powered maize stem chopper and a manual hay baler. After the second community visits, the team decided to further develop the hay baler due to its potential to challenge the Maasai community’s assumptions about agriculture. The hay baler puts fodder into specific amounts and encourages farmers to cut grass, which is not currently a universal practice.

02. CONTEXT

Background

The Maasai from East Africa practice pastoralism as their major economic activity. They keep various types of livestock such as cows, goats, sheep and some also keep pigs. They keep both indigenous and hybrid livestock. It's a patriarchal community where men take charge of most issues in the villages. Up until recently, they have started to practice agriculture and they grow maize, sorghum and beans.

An interesting fact that was discovered during the community visit was the culture behind keeping cows and the evolving trends. The Maasai would rather sell their land and not their cows. They would rather they have their large herds of cattle and migrate to feed them than have to sell the cows to ensure the few they have live in better conditions.

Fig. 2. Gathering feedback in a community meeting

Community Description

Most of the community members depend on rainfall to grow their produce. The rainy season starts from mid-February to end of July. During this period, they let their cows feed on grass, which grows wildly around their areas. There is enough food for both the family and the livestock. The livestock feed on the grass in an uncontrolled manner hence there is no planning for future food stock.

The dry period normally begins in August and ends in January. Because of the poor fodder production methods, they lack food for their livestock during this period. They have to migrate to other wet areas to enable their cattle to eat and survive. This has led to the Maasai migration that happens every dry season around East Africa.

During the wet season, the indigenous cows produce an average of two liters while the exotic cows produce approximately ten liters per day. As for the dry season, the indigenous cows produce half a liter while the exotic cows produce five liters per day.

Moreover, the Maasai do not have proper storage facilities for their fodder. Some families store all the cut grass, maize leaves and bean stalks in a heap at a specified corner in their compounds. Such a system is prone to rotting when it rains and the total space used is more than required for little amounts of fodder.

External factors leading to the Maasai migration include urbanization, desertification, capitalism and lack of the proper agricultural knowledge. Urbanization of small towns has led to more land being developed forcing the Maasai to move further away for them to take care of their large herds of livestock.

This has also led to capitalism in the form of land acquisition and hence fencing of private land.

Problem Framing Statement

Due to their nomadic origin, agricultural practices are a recent introduction in the Maasai community. Historically, grazing has been the predominant way of feeding livestock. There is a shortage of land for grazing livestock caused by urbanization, desertification and the new trend of acquiring private land. The need to feed livestock in different ways is a major concern in this community so as to stop the migration habits commonly associated with the Maasai.

03. DESIGN PROCESS

Together with our community, we explored various opportunities for the project. One of the main challenges in Orkolili is the lack of knowledge about agricultural practices within the Maasai community. Therefore, a considerable amount of opportunities we uncovered lies in long-term educational programs.

We arranged the topics of interest on a scale, illustrating a range from projects that can be done within a short amount of time up to long-term implementation. In this way, we sought to discover the most promising aspect to work on for our project.

Currently, the community practices hay making and storage of fodder for the dry season. However, we discovered little systems established for conducting these practices. Therefore, appropriate storage presents a challenge and crop residues that could be used as fodder, such as maize stalks and straw, are often wasted.

We therefore identified this topic as the most relevant to work on during our time at IDDS.

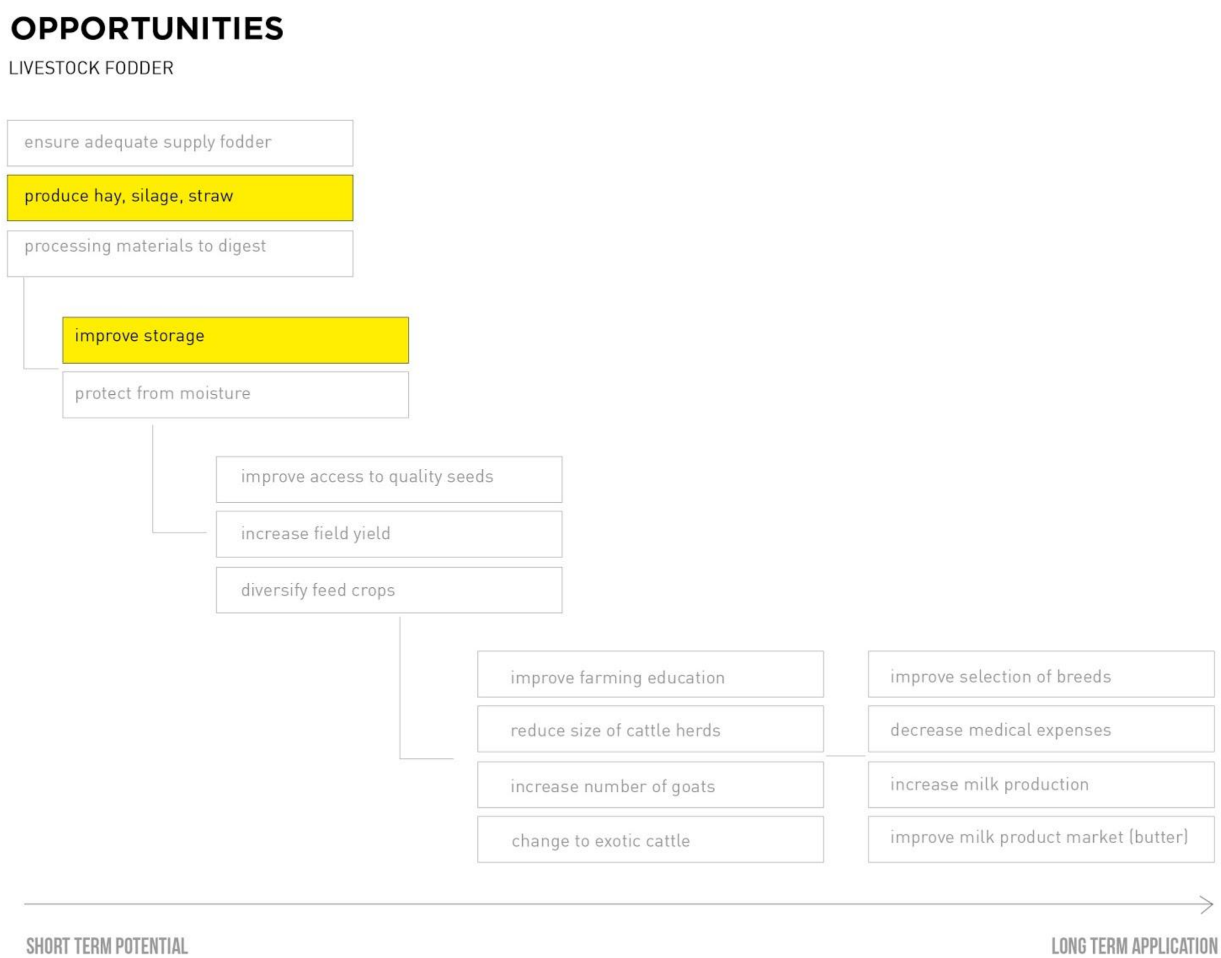

Fig. 3. Diagram to help us to discover opportunities

Value Proposition

Preserving and storing fodder slowly becomes common practice in the Orkolili community. However, there is still a lack of understanding in how to efficiently prepare the fodder for use during the dry season. The Fodder Team has developed a hand-operated baler that helps pressing dried fodder material such as hay, maize or bean straw into packages that can be easily stored and transported. The device supports and educates the farmers to strategically plan the use of fodder throughout the season and reduce the time spent on migration. With every month saved on migration, which usually lasts 5 months, the farmers save 30 000 Tanzanian Shillings per cow, which they could earn from selling the milk.

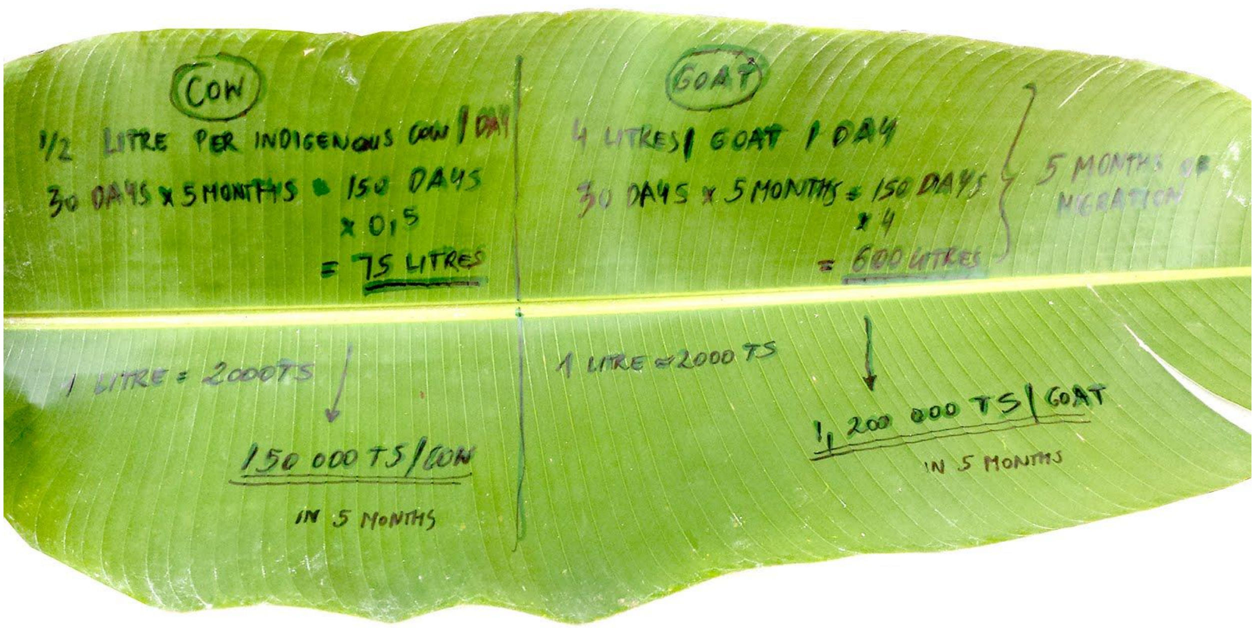

Fig. 4. Value Proposition on a banana leaf

<u>Summary of design process</u>

Our design process was marked by 5 phases: Exploration, Ideation, Physical Application, Concept Selection and Gathering User Feedback on the prototypes.

Exploration

Challenged by the fact that our project scope of Livestock Fodder was rather intangible, we came up with strategies on how to gather information and insight. One of the most productive ways of gathering information was to draw information on big sheets of paper in real time, as the community members were telling us their stories. This attracted a lot of attention, reduced the language barrier and seemed to create trust and understanding in the design process.

Fig. 5. Gathering information visually with community members

Discussing and ideating on the findings in the community on site was another method of gaining ideas and exploring opportunities.

Fig. 6. Brainstorming at night in the community homestead

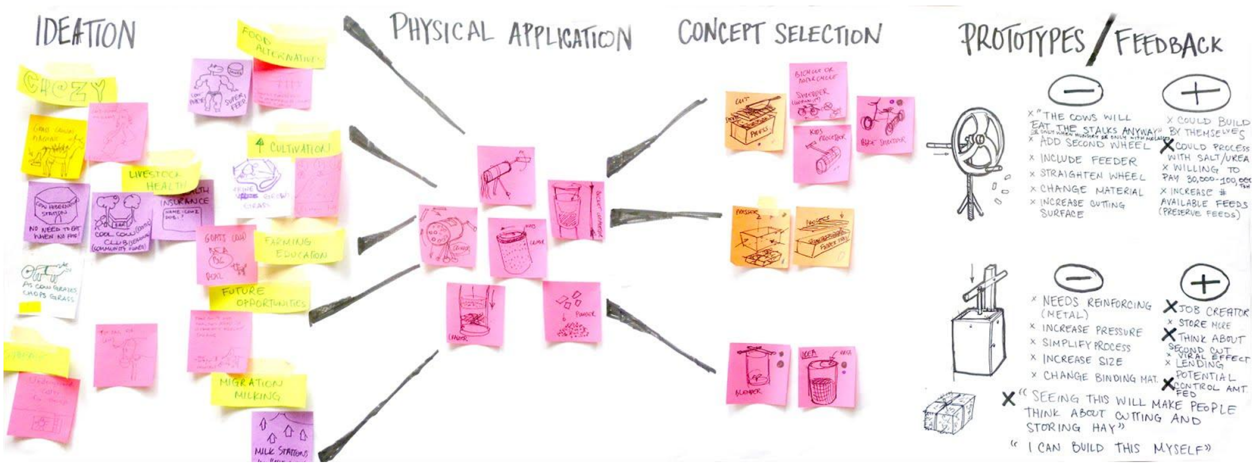

Fig. 7. Overview of Design Process

Ideation

We tried to keep our focus as wide as possible in the beginning, creating a large amount of ideas. These ideas ranged from blue sky ideas, high-tech solution over to long-term projects. We later on narrowed down our ideas with appropriate technology as well as the potential for physical application.

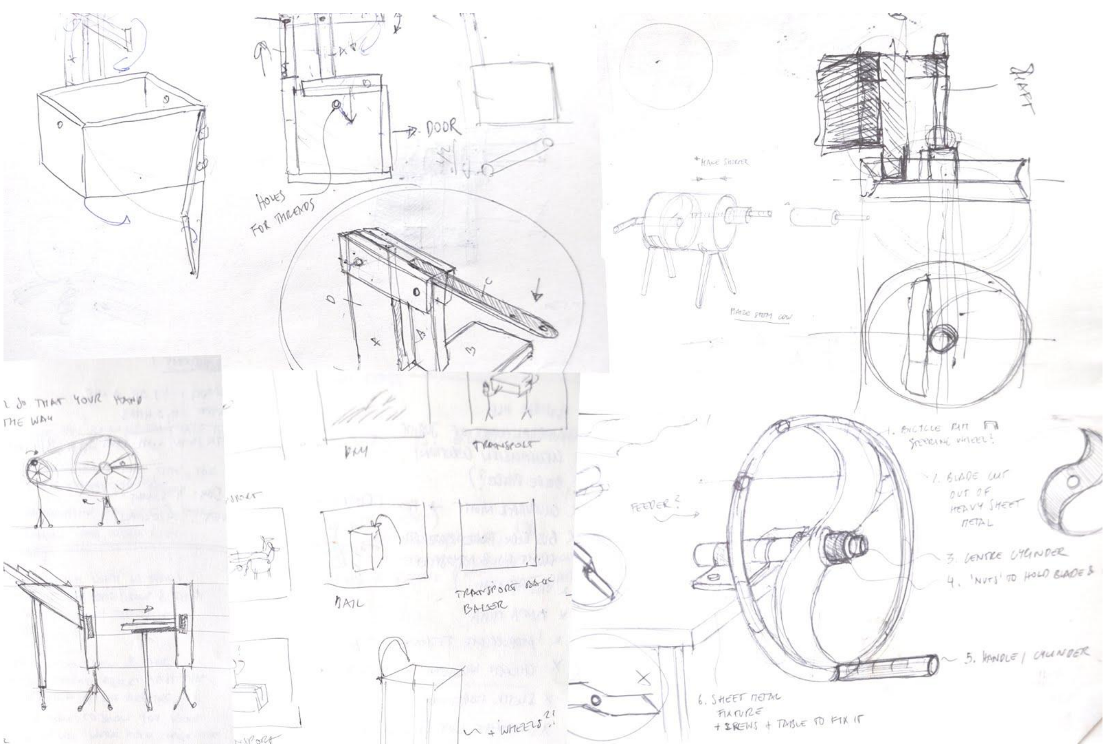

Fig. 9. Explorative Sketches

Physical Application

We understood very soon that cutting crop residues and storing dried materials could be the most appropriate implementations for this project. We drew and experimented with a variety of mechanisms and technologies serving this purpose.

Concept Selection

We identified 3 concepts as valuable to the community:

- Cutting of crop residues into edible portions
- Pressing dried materials
- Further processing crop waste

Prototypes

We resulted in creating 2 different prototypes, which we tested in the community: A crop residue chopping wheel and a hand operated baler.

After analyzing the feedback gathered we decided to pursue the most promising technology: the baler.

Experimentation and Analysis

After a lot of experimentation, both in sketches and sketch models, we arrived at a design to test and gather feedback from in the community. Both technologies that we created provoked great interest, however, the hay baler showed greater potential. The overall feedback on it was more positive and precise and the community immediately felt ownership over the technology. Also, ideas around business and job creation evolved.

Fig. 10. Gathering feedback on chopping wheel and baler

04. TECHNOLOGY

Design Requirement

Priority	**Parameter**	**Requirement**
1	Cost to build	< 70,000 TSh
2	Manufacturing	Easy to build
3	Capacity	35cm *45 cm* 90 cm square bale per unit operation
4	Components	Made out of a material available locally and cheap.
5	Operation	Ease of use
6	Repair	Easy to repair with cost of < 10,000 TSh
7	Energy/Fuel Consumption	Physical energy
8	Transportation	Easy to transport from home to grazing area.
9	Lifespan	5 to 9 seasons
10	Speed	20 bale per hour
11	Aesthetics	Proper wooden Finish

How it works

Fig. 11 Important baler components

The construct of the baler can be seen in above image. The dry hay used for this is seen next to the baler. The tags indicate the main parts of baler used during operation.

The baler is a parallelogram with inner dimension of 35cm*45 cm* 100cm and with no top. Bottom rectangle and three walls of rectangular prism forms a fixed structure with the fourth wall used as door with help of three hinges attached at equal distances. A doorknob is used. A column is attached to wall opposite to the door from outside having a gap so as to house another column (smaller in terms of cross sectional area) with pressing square plane (that apply required pressure on the hay) at one end and lever at the other (lever at which physical pressure is exerted). The two columns are connected via a 1" diameter screw acting as rotary part. Also, the wooden cylinder (1") provides arrangement to attach sisal spool. The wedge provides an inclined surface so that pressing plane is directed towards inner part of prism. Four equally spaced hooks are attached at the bottom to provide knot mechanism. Small wedges are present on the upper side of door.

Principal of Operation:

An individual pressed down on a mechanism, which compressed hay. Before this process begins, the user arranges the string in such a way that it is binds a square shaped bale.

Operation:

1. Close the door and the lock the door using knob.
2. Pull the either sisal rope attaches them on the successive hooks on the bottom and move the thread through tiny wedges on the upper side of door.
3. Repeat the above step for the other rope.
4. Pulling the lever all the way down towards extreme (say rest position), insert the dry hay in the baler. Fill till the hay overwhelms the baler.
5. Pull the lever inwards, which will result in pressure plane applying pressure on the hay after passing over inclined wedge.
6. Pull back the lever to rest position, cut the sisal rope from spool side tie knot by removing rope from the door wedge.
7. Open the door, remove the bale.
8. Close the door and repeat the process.

Fig. 12 Presenting Operation Instruction

Performance

Fig. 13 The square bale output of the baler

The product is successful in providing 35cm *45 cm* 90 cm square bale per unit operation. The average time required to produce a bale and tie the knot takes about ~4 minutes. But with iterations the time required converges. The sisal ropes provides necessary support so that it makes up a solid and sound bale. The hinged doors provide easy pull out mechanism.

Bill of materials

Wooden board 6 m X 3m X 3 cm = 40,000 Tsh
Wooden column 8 cm X 5 cm X 8 m = 10,000 Tsh

20 X screws = 3,000 Tsh

3 X Hinges = 3,000 Tsh

Door Knob = 1,500 Tsh

2 x spool of string = 6,000 Tsh

Tools used (In this scenario the workshop tools were available at no cost.):

Handsaw

Brace and Bits

Rasps

Claw Hammer

Chisels

Clamp

Try Square

Tape Measure

Marker

Self-assess using four lenses

Financially: People are willing to pay for it but uncertain of its real value to them.

Technological: The technology seems basic and appropriate to us as designers.

Social/cultural: The technology seems adaptable to Maasai traditional culture, which acts as a stress test for future cultural contexts.

Environmental & sustainability: The technology could further deplete the soil by having Maasai collect organic material, which currently acts as mulch and baling it.

05. LESSONS LEARNED

Community Engagement

Design practices should respect social hierarchy. For instance, dot voting was not an appropriate way to lead our first community meeting in Orkolili. It may have been perceived as undermining or disrespecting the local leaders such as the Ward Executive or Mtendaji.

Our project team was frustrated by the community meetings. Attendees (users) were out of context. Our team could only practice "ask" techniques of gathering information. It was difficult to practice observing and trying. For instance, the first community meeting was held on a market day. Only men attended and answered our questions. However, we were not able to see their current sources of fodder and methods of preserving and storing.

By engaging unobvious stakeholders, our project team was able to connect with other interesting users. For instance, my team reluctantly decided to share our final presentation with a local secondary school principal, Mama Mche, during the first community. After our presentation (only a few minutes before our bus arrived) she introduced our project team to a farmer with stellar agricultural practices. Meeting this farmer named Zachariah was a real breakthrough for our team. The visits helped us to better the disparities of understanding of modern agricultural practices.

User Feedback

Generating a discussion can be a real challenge with a hierarchical social structure. For instance, when we tried to create a discussion among community members at a meeting during our first community visit, most community members deferred to the Mtendaji. It is reasonable to assume that many community members may have felt uncomfortable disagreeing with the Mtendaji's approving nods.

Think creatively about ways to make your users feel empowered to give you feedback. For instance, our project team sat on the ground to show our respect for the community meeting attendees. We noticed a considerable increase in participation from community members after we sat down and shared with them our problem tree and visuals.

Participatory design is not easy. Co-design implies equality. In the developing world, the users see you as a highly educated outsider. The community members may not be accustomed to co-designing. Community members may expect a presentation, which requires no active participation.

Troubleshooting

Designers are stakeholders in the development of a new product. For instance, despite feedback from our key stakeholders, Maasai farmers from Orkolili, that they preferred a metal hand-powered bailer, our team selected wood as a material to use. While still in the prototype development stages, our interest as designers was to use a material that was easy to work with.

06. NEXT STEPS

Reflection on project viability and other design opportunities

Our project is a viable design because community members from Orkolili (and the greater Nane Nane attendees) expressed interested in purchasing or building the project on their own. Judith also has the knowledge to continue working on the design.

We identified design opportunities such as those brought about by transportation. For instance, the design may need to change completely or partially because of a need for an easily transportable product (that might be used to share between families).

Also the design may need to change based on future prototypes: in metal, the engineering of the mechanical pressure may need to be increased or changed, if the design needs to be even further pushed towards the educational agricultural aspect. We could include descriptions or depictions of cattle marking the amount that one bail feeds. Exterior visuals are certainly a design opportunity.

Continuity/dissemination model

In the discussions with the community members, we developed a plan to pilot the prototypes near the Mtendaji's house. The community members present at VETA agreed that it would be difficult to determine an actual price for the technology without letting the farmers test it first.

From the internal conversations of the team, it seemed that X number of members were interested in pursuing the project further. Katharina, David, and Bianca expressed interest in continuing the project.

Drawing inspiration from a past IDDS project in Zambia, we created a model of dissemination:

1. Prototype development – support in teaching the community how to build 5 prototypes suitable for a trial between farms
2. Implementation – Implementing the prototypes in the four communities of Orkolili ward.
3. Demonstration and Dissemination – Teaching the communities about the technology and providing training on how to use it. This was recommended by the community.
4. Technology trial and activities
    a. February - June > grass cutting, storage and community organization
    b. Dry Season: July – August > Prototype trial and feedback
    c. August – November > Development of best practice fodder management and planning for dissemination.

A community trial would take place in Orkolili ward comprising of the villages of Orkolili and Ormilili.

The community identified the achievement of four objectives for a 12-month continuity plan:

1. To see famers bailing and cutting grass
2. To see farmers with good storage facilities
3. To receive feedback from farmers of how the prototype can be improved
4. More holistic education on how to do things better (i.e. education and technology)