BEAN
THRESHING

IDDS
TANZANIA
2014

1

PROJECT ABSTRACT

CONTEXT

BACKGROUND

COMMUNITY DESCRIPTION

PROBLEM FRAMING STATEMENT

PROJECT ABSTRACT

The main objective of this project is to improve bean-threshing difficulties in the Mbulumbulu community in Tanzania. This project started with a four-day visit to the community where we identified different issues concerning bean threshing. During our visit we observed how bean threshing is done in the area, we tried threshing beans to know how it feels to do it and we asked them for reasons of threshing the way they do. We also conducted several interviews with members of the community and since they rely mainly on agriculture and beans are one the most profitable crops, there were a lot of identified issues concerning the bean threshing process, which include: back pain, expensive transportation, costly labour, production losses and difficult / time-consuming selection; all of which affects small-scale farmers' profit. Due to these findings we decided to provide a solution that will help small-scale farmers increase their yield's profit through a more efficient process. Therefore, we made different paper prototypes of a portable threshing machine and presented them to the community during our first visit. In our second visit, we went back with an incomplete prototype of a thresher and worked together with the community to finish it, which helped us get feedback necessary improvements that lead to the final prototypes.

CONTEXT

BACKGROUND

Kambi ya Simba community in Mbulumbulu relies mostly on agriculture for both food and income. Throughout generations beans have been threshed using a log, usually the threshing is done in a flat surface or on top of a tarp. The beans are usually put in sacks during the threshing. The threshing is usually done by women for small scale farmers and it usually costs them a lot of money and results in losses. The higher costs are usually due to hiring labourers to thresh the beans at 3000 shillings for three labourers. The cost of transportation is also very high which cost at about 15000 per load of beans. The separation process of the beans usually take a long time which leads to most of the beans being lost thus the farmers do not get to make profit from the beans that they sell. Only the large scale farmers can afford to hire tractors for their field thus they tend to make profit from their sale, since they are usually the ones who manage to sell their beans before other people in the community.

Lina Owino engaging with locals during the corn sheller build-it

COMMUNITY DESCRIPTION

Within the hilly area to the west of Arusha, Tanzania lying within sight of the spectacular Lake Manyara, Mbulumbulu is a rural community deeply attached to the land. The 10 000 strong population comprises mainly of farmers and the sprinkling of other trades. They have a very fertile land, yielding a bounty of maize, beans, pigeon peas, millet, barley, wheat, sunflower and a variety of vegetables. Some of their produce is sold in Karatu or Arusha. The locals in Mbulumbulu primarily communicate in Busu, their indigenous language and the majority of villagers speak Kiswahili, Tanzania's local language. And every last one of them is vested with the universal language of hospitality, making it a warm and welcoming community. The idyllic views by day and a night sky crowded with stars makes it a beautiful place worth exploring.

PROBLEM FRAMING STATEMENT

Hand threshing and separation of beans is labour intensive and time consuming. Transporting before threshing is costly, time consuming and causes loss of beans during the process.

A portable threshing and separation machine operated by a piki-piki (motorcycle) or bicycle will reduce processing time and costs, while improving ergonomics for small scale farmers.

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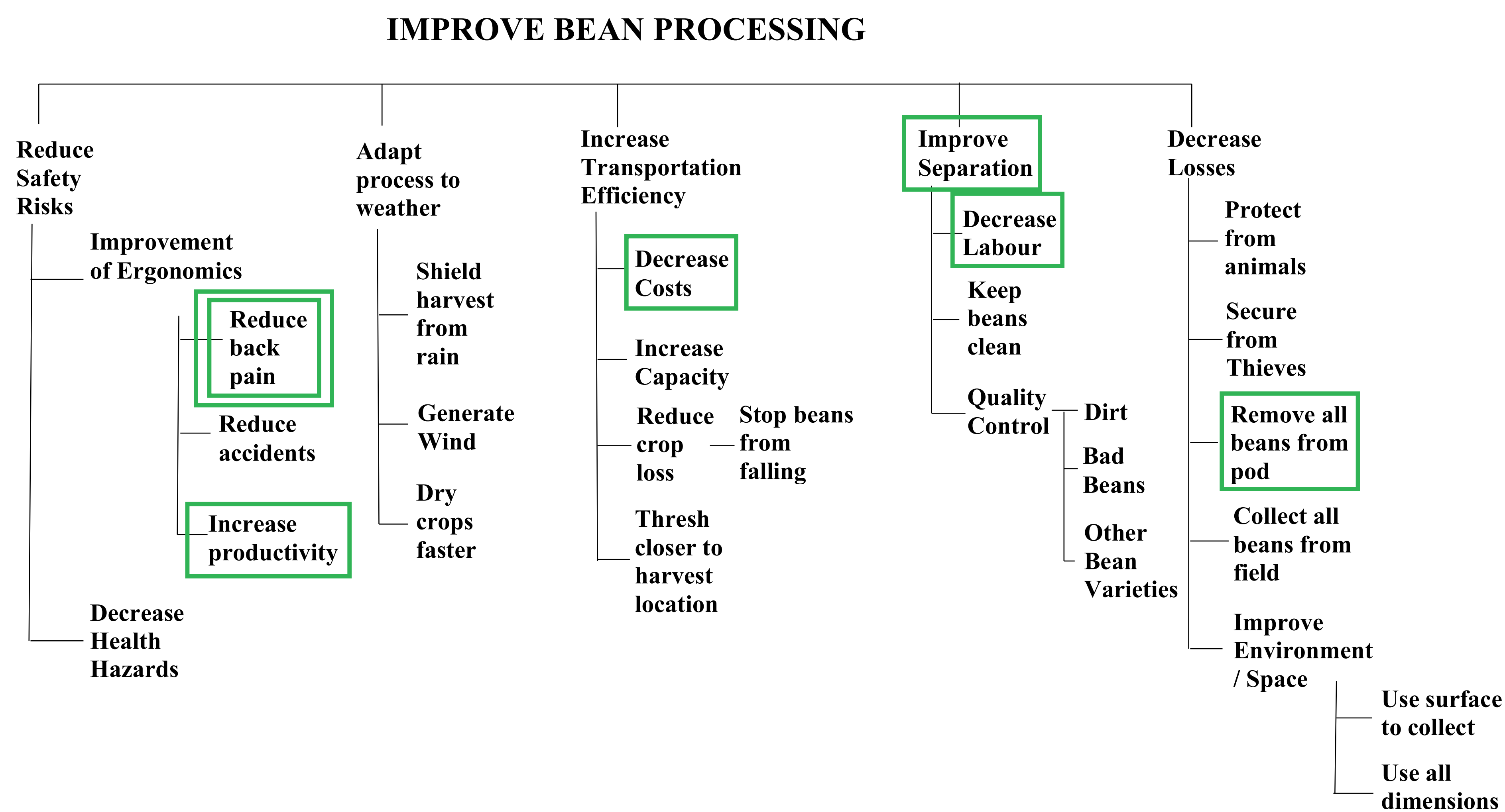
DESIGN PROCESS

DESIGN PROCESS

PROBLEM FRAMING TREE

Several issues in nowaday's tradicional process were taken in consideration in order to provide a new solution:



VALUE PROPOSITION

Bean-threshing machine	**Threshing by hand**
2 workers x 3,000 TSh = 6,000 TSh 2 workers x 4 hours = 8 hours *Dependency on bicycle. *Investment: +/- 250,000 TSh *High chance of offering threshing-service to near by farms and have an alternative source of income. *Better posture while working / ergonomics	4 workers x 3,000 TSh = 12,000 TSh 4 workers x 4 hours = 16 hours *Dependency on others especially if women have beans that need to be threshed. They will usually wait for their husbands, sons, grandsons or hire someone.

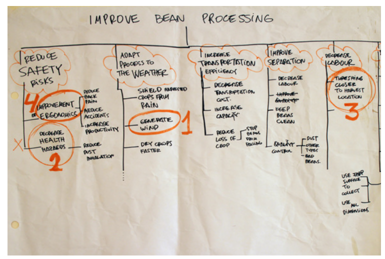
SUMMARY OF DESIGN PROCESS

1.
First community visit
to Mbulumbulu:
build-it to engage, diagnosis and
evaluation of needs in Kambi ya Simba

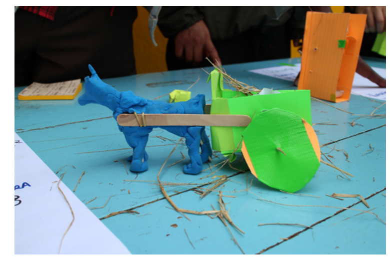
2.
Information gathering:
about beans, threshing,
existing solutions.

3.
Observe.Ask.Try - OAT:
after defining bean threshing as a
project, OAT was conducted to
better understand the problem

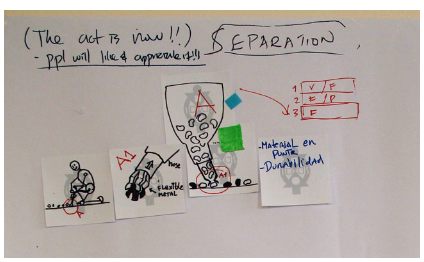
4.
Interviews &
focus groups:
specific questions were made
to individuals and stakeholders



5.
Problem framing tree:
the whole process was mapped
and main issues were identified
in order to address them



6.
Rapid prototyping:
paper models were
presented to the community



7.
Sketching:
after presenting rapid prototypes
to the community, the best ideas
were developed further

8.
First feedback:
the community agreed with
the identified issues and provided
more information about threshing problems

9.
Research:
specific information was
investigated to improve
sketches and design proposals

10.
Existing technology:
research about existing threshing machines for beans and other crops

11.
Group brainstorming & sketching:
exploration of concepts and development of new ideas

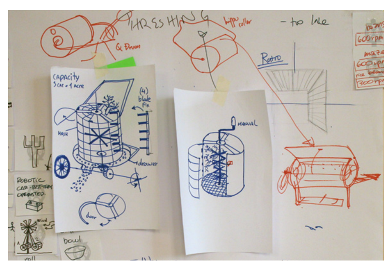
12.
Modeling / testing:
mock-ups of mechanisms and testing at a smaller scale

13.
Prototype no.1:
finished with the community at a local workshop in order to present the machine's principle

14.
Engagement:
build-it and Kuku-picker used to engage with locals through a laughing/learning process

15.
Storyboards / scenarios:
tools that complemented the partially-functioning prototype

16.
Second feedback:
stakeholders at the community shared their impressions about the first prototype and concept



17.
Sketching and blueprints:
final designs were selected and the team decided to manufacture two prototypes

18.
Prototypes no.2 & 3:
no.2 using a mechanism similar to the one used in maize grinders and no.3 using the rotor combine concept

ANALYSIS AND EXPERIMENTATION

The testing of the performance of the bean thresher prototypes involved initial dry running of the machines, followed by tests involving unthreshed beans.

The initial model ran smoothly during the initial dry runs. The fixed and moving blades exhibited good clearance, and the bearings were well mounted, such that the drive shaft moved smoothly. Rotation of the blades was initially by hand, and it was noted that for best performance, it was necessary to feed the thresher once the blades were running. Feeding it with static blades resulted in jamming of the blades, and no threshing could be done.

The next iteration of the initial design involved using bicycle power. The bicycle tyre was placed in contact with a heavy plough wheel, and when the bicycle was pedalled, the thresher blades rotated smoothly. The pedalling speed required to operate the thresher was found to be quite low- about 60 rpm. As pedalling speed increased, the bicycle tire showed signs of heating and began to leave a black residue on the thresher wheel. An attempt was made to increase friction between the bicycle tire and the thresher wheel by wrapping the thresher wheel in a strip of rubber cut from tire tubing, but the incorporation of the rubber wrapping only served for a few rotations, after which the slip between the thresher wheel and the bicycle tubing was too great to allow motion.

The spinning blade type prototype was put through a dry run to observe the performance of the bearings and the movement of the drive shaft. Initial running resulted in a tightening of the closed end of the drum around the reinforcing flat bar as the threaded rod was rotated by hand. Closer examination showed that the clearance between the drive shaft and the edges of the hole in the drum was too small to allow smooth motion. The assembly was dismantled to allow for enlargement of the hole. Further running of the prototype after this yielded very smooth motion, with the peripheral blades rotating uniformly even when driven by hand.

When the prototype was connected to a bicycle tire, pedalling resulted in rotational speeds that were high enough to thresh beans. An attempt was made to shell corn using the same system, and initial attempts resulted in the corn cob being hurled out of the drum. This was found to be due to the absence of the feed hopper, and once it was attached, the corn cob was shelled in about 5 seconds with no visible damage to either the grains or the cob.

The welded prototype was inspected for strength, and several welds had to be redone. Upon dry running, the shaft showed some resistance to motion, and this was determined to be an issue with the mounting of the bearings. Adjustments in the bearing positioning on the shaft resulted in a slight improvement in the motion.

During the Nane Nane exhibition, both machines were tested using millet. The rotor combine type prototype proved capable of beating the grains out of the millet stalk, but due to the mesh size and the spacing between the rotor and the mesh, the grains were unable to be collected. The blade-type machine performed admirably, and threshed the millet without damaging the grains. However, it was noted that if the millet was fed into the machine at low speeds, there were chances of the head getting entangled on the threaded rods.

The bean picker prototype was tested within the community. The initial design was capable of picking 10-15 beans at a rate slightly slower than hand picking, depending on the dexterity of the user. The picking tip had a tendency to sink into the bottle, requiring constant fixing. The beans that were picked were found to be clean, free of dirt or grass blades, and the users hands were kept protected from dirt under the fingernails as well as thorn pricks.

The final bean picker prototype had a tip that stayed in place throughout the picking process, and the picker was found to be capable of picking 40 or more beans before requiring emptying.

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TECHNOLOGY / FINAL PROTOTYPE

DESIGN REQUIREMENTS

HOW IT WORKS

PERFORMANCE

BILL OF MATERIALS

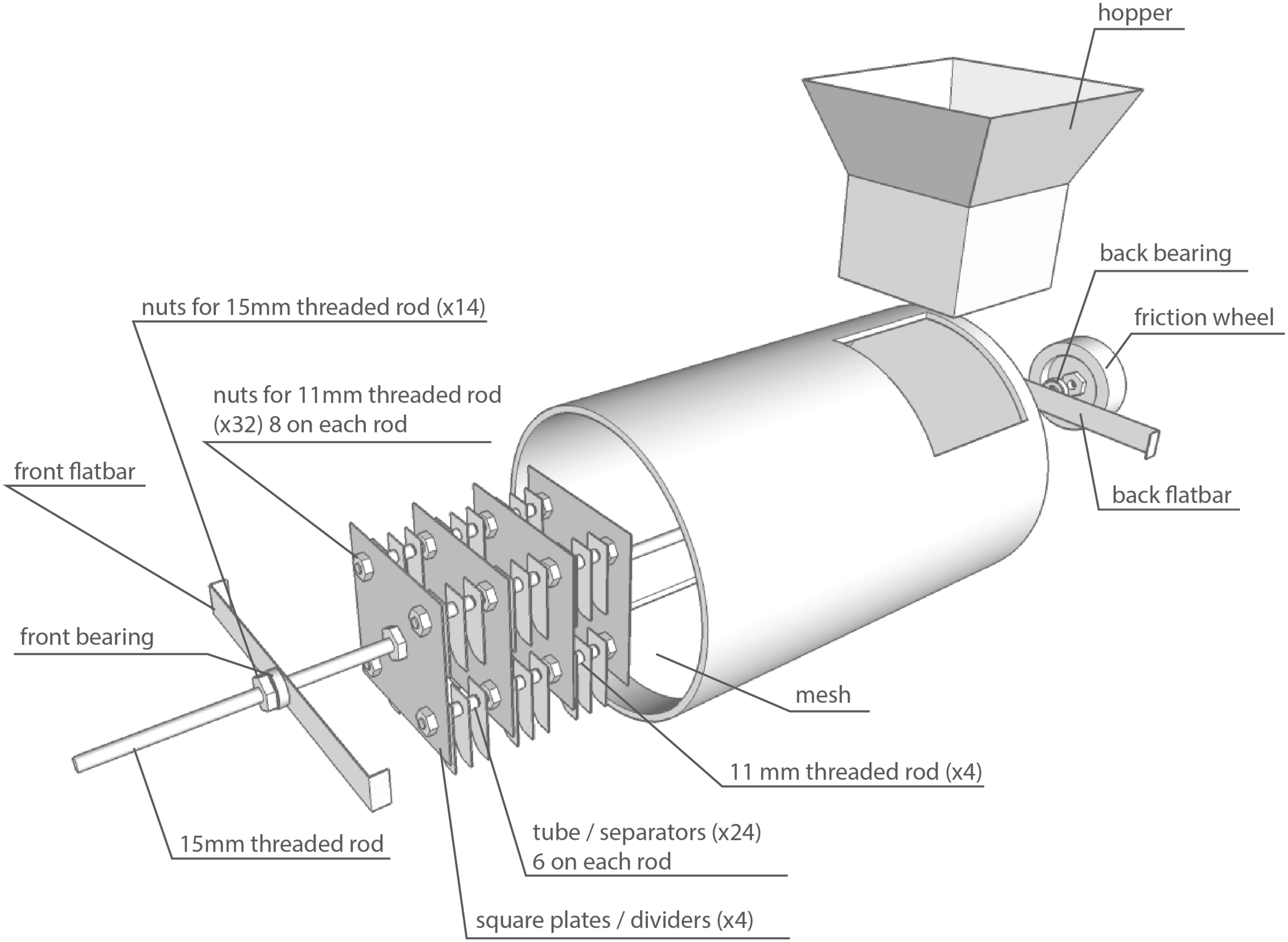
SELF-ASSESS USING FOUR LENSES

DESIGN REQUIREMENTS

Before manufacturing our prototype, the following requirements were established: Affordability, Use of local available materials, User friendly, Portable, Light weight, Durable, Fast / efficient, Fewer parts for easier dismantling, Ergonomic, Large capacity

Customer need	**What are you going to measure**	**How to measure it (units)**	**Good value**	**Better value**
Local materials	Stock availability	%	>80%	>90%
	Few parts	# parts	<10	<5
Affordable	Cost (price)	Shillings	<200,000	<120,000
	Operating expenses	T Shillings / kg	<1000	<500
Ergonomic	Accidents	# accidents	<1 / year	0
	Increase productivity	Kilos / hour	30 kg/h	60 kg/h
	Posture	Back pain (other) complaints	5 / year	0
User friendly	Portable (light weight)	Kilos	<50kg	<20kg
	Easy to use	Error/time	<1 / min	0
	Speed	Time/50 kg sack	<10 min	<5 min
Capacity	Production farm	Kg/hrs	>300	<?
	Volume of unthreshed product held	50 kg sacks	>0.5	<1200 /600

HOW IT WORKS


hopper
back bearing
friction wheel
nuts for 15mm threaded rod (x14)
nuts for 11mm threaded rod
(x32) 8 on each rod
front flatbar
back flatbar
front bearing
mesh
11 mm threaded rod (x4)
15mm threaded rod
tube / separators (x24)
6 on each rod
square plates / dividers (x4)

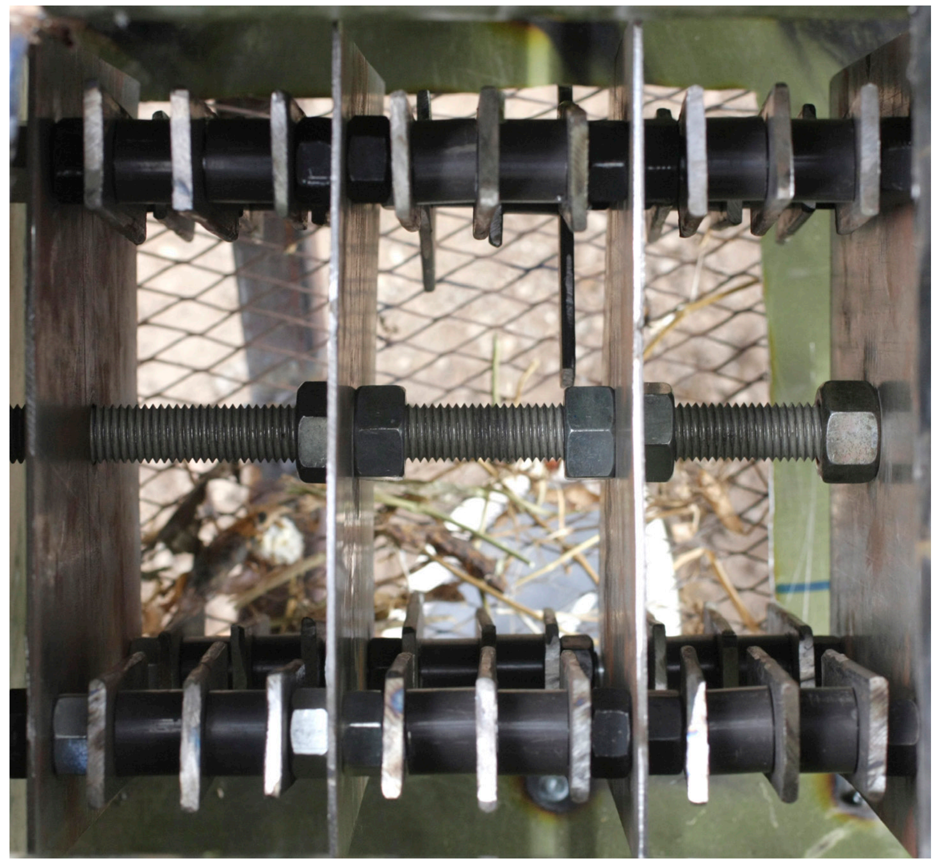
HOW IT WORKS

Prototype 2 uses blades similar to the maize grinding machines

Detail of rotating mechanism inside the drum

One of the requirements was to manufacture the threshing machine using no welding. This prototype almost accomplished this requirement since the only welded parts are the bearings' housings. Threaded rods and nuts were used to secure the parts instead of using metal tubes. Sets of blades rotate on four different axes, while they all together rotate around a central rod. Further testing is suggested since the bean plants might entangle on the exposed rods. Quick tests with sorghum and corn showed perfect results.

Cost: ≈ 196,00 Tanzanian Shillings



Upper view: detal of blades, separating pipes, nuts and separating plates

HOW IT WORKS

Prototype 3 based on the rotor combine concept

In order to avoid bean plants to entangle, another concept was protyped based on rotor combines used in big farming machines. Even if the prototype consists of welded angle bars, it addresses the possibility of plants getting entangled in a better way. The pods are threshed while being pressed between the rotor and the mesh located on the lower part of the drum. Testing must be carried to define if the rotor's size is correct or if two rotors need to operate simultaneously.

Cost: ≈ 98,00 Tanzanian Shillings

Detail of rotating mechanism inside the drum

Is suggested to operate both prototypes with a bicycle

PERFORMANCE

Sorghum plant threshed with prototype using blades

Sorghum seeds after threshing

Due to a shortage of un-threshed beans in July and August, tests were performed with other crops like sorghum and maize; both showing perfect results. Testing was conducted using mainly Prototype no. 2 using rotating blades powered by a bicycle's tire that contacts a small metal wheel attached to the main rod.

Other components like a fan might facilitate winnowing.

Prototype no. 3 needs to be tested with different crops while being operated by a bicycle.

SELF ASSESSMENT USING FOUR LENSES

Financial Sustainability

The overall cost of the raw materials required to make the bean threshing machine is low, and parts used are standard parts that are locally available. There are local community members with the skills necessary to fabricate the machine, thus labour would not have to be outsourced.

The machine itself is capable of being modified to suit a variety of grains, thus it will not be restricted to the bean harvesting season, but will be in use over a large fraction of the year, allowing it to recoup purchase costs. Another financial aspect involves possible leasing out or charging for services, thus it will allow the purchaser of the machine to make an income, as well as saving on costs associated with manual threshing.

Technical Sustainability

The construction of the threshing machine makes use of simple skills available at Kambi ya Simba- one prototype requires welding, which would at present require travelling to Karatu town, but only for purposes of getting workshop space, since community members have the required welding skills. The other assembly can be made entirely without welding, and all the necessary skills and tools are available within the community.

The design of the machine itself is also simple, making it easy to reverse-engineer and possibly make improvements. Within the community itself, there are individuals capable of constructing the machine without requiring further training on how to put everything together.

Social / Cultural Sustainability

In the Kambi ya Simba setting, threshing of beans is primarily done by women, thus the model that has a handle for manual turning would find applicability. However, children are also involved in handling activities at home, thus the bicycle version could also be used, with older children helping in the pedalling.

Another aspect in favour of the bicycle type threshing machine is the availability of many bicycles within the community. Most of the homes have at least one bicycle mainly used by the man of the house to get about, particularly when long distances are involved. Several families also own motorcycles. Thus, the design as it stands would not burden the community with purchase of bicycles.

Environmental Sustainability

The body of the thresher is a recycled metal drum, and the blades of the blade-type thresher are made of small strips of metal that can be made from scraps left over from other jobs within the workshop that require flat bars. In case the blade-type thresher fails, it is possible to reuse various components, such as the threaded rods, the nuts, the metal plates and the blades, as well as the mesh. This would reduce the generation of waste from the machine once its useful life is over.

4

LESSONS LEARNED

COMMUNITY ENGAGEMENT

USER FEEDBACK

TROUBLESHOOTING

LESSONS LEARNED

COMMUNITY ENGAGEMENT

During our two visits to the community, we made sure that we engaged both males and females to make a product that the community will love and will actually use. We were more interested in creating with the community, thus we welcomed suggestions from everyone and worked using the opinions, comments and suggestions that we got from the community to make the final product. The community was so interested in our project that we also were offered a workshop to finish our prototype from where we had different people coming to see our prototype as we were designing, and we got a lot of help with cutting metals, drilling and we even got a bicycle that we used to test our product. We were also interested in continuity of the project thus we spotted different people that we thought could be useful in continuing the project in our absence.

USER FEEDBACK

We got a lot of different suggestions, opinions and comments that we have to incorporate in our final prototype. These were both from men and women. But we were mostly interested in getting feedback from women because they are the ones who do most of the threshing. Some of the suggestions we got include;

First focus group: MEN AT THE WORKSHOP

Suggestions

•Use stronger material (For drum, rods, bearings; Use material similar to that used in maize milling machine)
•Incorporate hand operation (not all women have bicycles and motorcycles)
•Use sharper threshing blades
•Have a wire mesh at the opening for feeding to prevent beans flying out as they are being threshed.
•Incorporation of mesh may result in blockage of mesh openings. Have something to remove chaff from mesh openings.

Comments

•Few women own motorbikes and bicycles, so they would be dependent on men to accomplish the threshing.
•Have continuous operation so that the machine can be continuously fed with unthreshed beans as they are fetched.

Second focus group: WOMEN AT THE THRESHING PLACE

Suggestions

•Make machine larger (To accommodate 1 sack; To have length of about 1.2 metres)
•Ensure beans can be separated from chaff
•Have a larger opening for feeding in beans- some varieties tangle up at harvest
•Make sure the machine works well, and is faster than hand-threshing
•The machine should be in pieces that can be dismantled and reassembled
•Incorporate winnowing mechanism (fan?)
•Have wheels on machine for movement to and from the field
•Make it possible to modify thresher for use in processing pigeon peas

Comments

•The use of the thresher may result in double transportation work-transporting the beans from the field, then transporting the chaff for use as cattle feed
•Thresher is likely to save time

•Many women own motorbikes and bicycles, and would be willing to use them for threshing.
•Concern about the tyre heating up during operation
•About 20 large scale farmers currently use tractors for threshing.

Third focus group: Community gathering

Suggestions

•Use chain or belt to connect bicycle or motorbike rather than a direct connection
•Make machine larger (To accommodate 1.5 to 2 sacks; Length of one full drum)
•Incorporate hand operation
•Make sure the machine works well, and is faster than hand-threshing
•Use a tractor or diesel generator for operation- Hand and bicycle operation still laborious
•Educate the farmers properly on the use of the thresher

Comments

•Chaff gets cut by the machine, so the cattle feed is better processed for feeding to the animals.
•Farmers with larger farms may be willing to buy 2 threshers on their farms
•Users willing to buy as long as it works efficiently. Price range of Tsh 200,000 to 300,000 considered okay.
•Thresher is likely to save time

KUKU PICKER (tool for replacing hand-picking, manufactured with used PET bottles)

Women at the threshing place

Suggestions

•Should be made from a bigger bottle
•Bottom of bottle should be totally open
•Should be modified to pick different bean varieties and sizes, such as longer beans (Nyayo type)
•Should be able to pick more than 10-15 beans

Comments

•Very useful
•Prevents dirt from getting under nails
•Allows to pick beans where there are thorns
•Quicker to use
•No blades of grass picked up along with the beans
•They would be willing to do it as a build it.
•Each family would need about 3 kuku pickers. There are about 1,000 families in Kambi ya Simba, so about 3,000 pickers would need to be made.

Community gathering

Suggestions

•Should be made from a bigger bottle
•Should be made from a smaller bottle

Comments

•Can be easily used when seated
•Very useful

General Comments

•Hand separation of beans very difficult work. It takes between 2 weeks to one month and is usually spread out over the period. If hired hands are used, it takes 3-5 people a full day to complete a 90 kg sack.
•Beans are usually harvested and stored till around December to fetch higher prices at market. For emergencies immediate sale after harvest.
•Beans sold in Arusha. During harvest time, vehicle picks up produce daily from village.
•Price of beans dependent on variety, with yellow Soy beans fetching highest price. Black beans grown for own consumption.
•Challenge in storage of harvested, threshed beans- insect damage. Beans usually mixed with insecticide powder for preservation.

TROUBLESHOOTING

The first prototype/system will probably get stuck since the whole bean plant is harvested and likely to be threshed all at once. The machine is likely to have no problem threshing only the pods but when feeding the machine with whole plants there is a high probability that they will get entangled in the exposed rods. Some quick tests with the threshed bean plants proved that.

After receiving feedback from Carl Jensen, we analysed rotor combine technology, used in many farms in U.S and Europe. We simplified the concept and came with a new system for the second prototype that needs to be tested many times in order to obtain the right weight of the rotor, a cost-efficient system and the precise calibration of space between the rotor and the inner wall of the drum.

Bean harvest seasons occur in February and June so our prototypes have only been tested with threshed bean plants and chaff. The behaviour of pods opening, beans falling through the mesh and the percentage of beans damaged by the blades still need to be tested.

Another situation that might cause the project to pivot is the machine's adjustability to other crops like pigeon peas and millet. The community mentioned that they have similar difficulties when threshing these crops, so our machine's aim is to be efficient when threshing at least 3 different crops, with only minor adaptations.

Pigeon peas season will be in September and our community partners are willing to test the machines at that moment. They are also willing to build on top of our prototypes in order to modify and make them better.

The initial prototype of the threshing machine was tested in the village. It was noticed that unthreshed beans had a tendency to accumulate around the central shaft. This resulted in a redesign of the threshing system to allow for rotating blades both on the periphery of the main shaft and around a set of secondary shafts to prevent entanglement.

Upon assembly, the main shaft advanced on its threads and tightened the bottom of the enclosure, resulting in uneven motion and noise in operation. The cause was the tight clearance between the threaded rod and the metal drum. The solution was to enlarge the hole through which the threaded rod was mounted to ensure minimum interference between the drum and the threaded rod. Upon further testing, the machine was found to operate smoothly, without noise.

The initial bean picker prototype had the tendency to pop back into the bottle during use as pressure was applied on individual beans to pick them up. Another problem was that since the bottle was held vertically above the picking tip, the limit of number of beans that could be picked before emptying the bottle was 10 to 15. Finally, the tip also had a tendency to unravel during use, since the opening was not firmly in place.

A redesign of the tip involved having a set of secondary flaps running underneath the primary flaps of plastic used to make the picking tip. The secondary flaps were used to lock the picking tip in shape, as well as to fix the tip firmly to the bottle cap, which prevented it from sinking into the bottle.

Further troubleshooting will be carried out on the threshing machines once they are field tested.

5

NEXT STEPS / PROJECT'S FUTURE

REFLECTION ON PROJECT'S VIABILITY
AND OTHER DESIGN OPPORTUNITIES

CONTINUITY OR DISSEMINATION MODEL

6-MONTH PLAN AND TEAM MANAGEMENT

ANTICIPATED RISKS AND CHALLENGES

STAKEHOLDERS

~~LEAN BUSINESS CANVAS~~

~~VALUE CHAIN~~

REFLECTION ON PROJECT'S VIABILITY AND OTHER DESIGN OPPORTUNITIES

Beans are a major source of protein on many continents, and many small scale farmers will usually have a crop of beans as part of their products. The problem of bean threshing for small scale farmers is therefore one that is not restricted to Tanzania. As such, it is possible to export the technology used in the design of the bean threshing prototypes to several countries. For instance, just within the team, all countries represented have similar conditions faced by small scale farmers growing beans. Small scale farmers in Kenya, Guatemala, Peru, Botswana and Tanzania all thresh beans by beating with clubs, which means this is a global problem.

Given the simplicity of the prototypes designed, and the availability of two variants which can be implemented directly as designed, or have features borrowed between one and the other, the possibility of bringing a commercial bean thresher based on the prototypes made is very high. Particularly taking into account the blade type prototype, which was designed to minimize welding, and given that many small scale farming communities in the developing world are found in rural areas with minimal access to electricity, building of the prototype in local workshops would not be difficult.

Another factor that would influence project viability is the availability of materials and parts for fabrication of the prototypes. Of the parts used, the one likely to be most challenging to obtain would be meshes of the appropriate sizes to separate the threshed grains from the chaff. The prototypes made use of locally available chicken wire, which was good enough for locally produced bean varieties, but for the range of bean varieties available in different countries, it would be prudent to consider availability of meshes or sieves capable of accommodating the grain sizes available.

The use of a bicycle or hand power for the threshing is yet another design feature that improves the adaptability of the prototypes. Bicycles are readily available in many rural communities as a mode of transport, and the fact that the bicycle does not need to be specially attached to the thresher in order to perform the threshing makes it more likely that the prototypes would be readily accepted in communities where the bicycle is frequently used.

Design opportunities that arise from the bean threshing project include design of a separation mechanism for removal of the chaff. In the course of the project, several alternatives were proposed, such as use of vibratory mechanisms, fans and use of wire meshes/sieves. The mesh was incorporated into the existing design, though, since the prototypes were yet to be tested fully, it was not possible to evaluate the efficiency of separation using wire mesh.

Another aspect arising from the separation part of the design would be removal of the chaff from the thresher body. With the current design, the chaff requires to be removed by hand, thus the need for the blade mechanisms (and the rotor mechanism for the other prototype) to be restricted to one end of the metal drum. Suggestions given for removal of chaff included a screw type mechanism to push the chaff out as threshing is done, and having a slight inclination of the thresher as it operates to make use of gravity. Neither was attempted during the prototype design.

Harvested beans, even from the same variety, are of different sizes, and grading the beans according to size results in higher prices at the market. The grading is, however, tedious and time consuming. An adaptation of the thresher that would allow grading of the beans once they have been threshed and separated from the chaff would make the machine a one-stop processing centre, such that when a farmer arrives with their unthreshed beans, they leave with clean, graded beans, packaged separately according to grain sizes.

CONTINUITY OR DISSEMINATION MODEL

The current dissemination model involves use of the local community representatives from Kambi ya Simba, Mbulumbulu to take over the testing and further development of the prototypes to come up with a final design. Since all materials used for fabrication of the prototype are locally available, there exists workshop space and all the required tools to modify the prototypes should need arise, then it is feasible to continue the development of the prototype on site.

The initial group of 5 community members identified as partners on the project will be the first to test the prototypes and any future modifications. Since Kambi ya Simba is a close knit community, the other villagers will also get the opportunity to use the prototypes for processing their own grains once they have been confirmed to function satisfactorily. Possible dissemination to other communities in the area may involve establishment of threshing businesses or having individuals take up the job of travelling between farms and offering threshing services to farmers. Given the current size of the prototypes, an individual could strap it onto a bicycle to travel to the threshing site, and on arrival, use the same bicycle to power the thresher.

There are possible opportunities of further working on the prototypes in Botswana, Guatemala and Kenya. These opportunities are under investigation, and the form of partnership that would take place between those in the team involved in continuing with the design process is also being worked out.

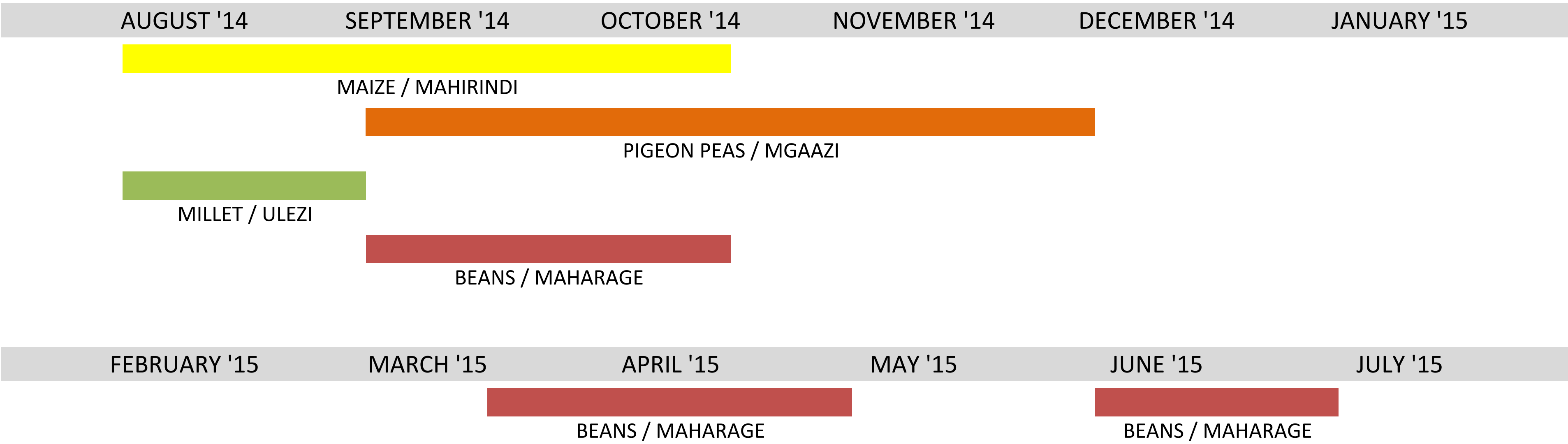
ANTICIPATED RISKS AND CHALLENGES

- Lack of continuity due to some parts or materials not being accessible to the community
- Community or local preference for traditional methods
- It might be too costly to make

STAKEHOLDERS (community members, organizations, partners)

- Small scale farmers
- Workshop owners
- Hired labour
- Village committee
- Farmers’ representative for sales
- SACCOS
- Large scale farmers
- Farmers’ families
- Community
- Suppliers

6 MONTHS PLAN AND TEAM MANAGEMENT



While developing the bean-threshing machine, the design team realized the mechanisms have potential to thresh other crops too.

The calendar above shows the harvesting seasons for different crops raised in Kambi ya Simba, Mbulumbulu. The design team agreed with Reginald Sule and community stakeholders to conduct several tests with different crops.

During the last months of 2014, locals will test the machines with maize, millet, pigeon peas and beans (there is a good chance that beans will be harvested in a plot off-season). At the end of October, the design team will receive the results and feedback from the community for improving the mechanisms.

A better experimentation phase with beans will have to wait until 2015, unless team members from other countries test the mechanisms first.

A new team will be responsible locally to conduct the experimentations:

Alex Mrosso will keep the prototypes and coordinate the necessary tests.

Leokadia Gazbar will provide beans during an off season and will participate in further testing.

Reginald Sulle will provide crops for threshing and send feedback to the design team.