University of British Columbia

Faculty of Land and Food Systems

LFS 350

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Community Based Experiential Learning Project Report

LET'S: Low-Tech Food Storage

Introduction

Background

LET'S is a non-profit organization designed to promote education and socio-economic advancement in developing countries (LET'S, 2017a). The acronym stands for Learn, Empower, Transform, and Solve and they look to employ sustainable and inclusive solutions in providing tools needed to make differences in community development (LET'S, 2015a).

A standalone server created by LET'S, Takhti, will provide educational resources and network connectivity to regions without internet (LET'S, 2015b). In cultivating assets to include in this device, we can deliver solutions to assist increasing food security in Punjab, Pakistan.

Significance

The FAO defines food security as "a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (World Food Summit, 1996). 77 million people in Pakistan, half the population, suffer from food insecurity with caloric intakes below standard (Government of Pakistan, 2009). This project addresses food justice as we work to provide Pakistani farming communities resources to gain control over production and access of good food to eat regardless of social factors such as gender or class (Institute for Agriculture and Trade Policy, 2012). Our project aims to provide innovative low-cost, low-tech solutions for storage to address these issues.

Agriculture plays an important role for Punjab's GDP. In an agricultural production census for 2013-2014, shown in Table 1, the Punjab region showed production of over 50% of all crops in Pakistan, with the exception of barley (Government of the Punjab, 2015). This high level of agriculture is why we are focusing on this region.

Table 1. (Government of Punjab, 2015).

Item		Year/Period	Unit	Pakistan	Punjab	% Share of Punjab
Production of Principal Crops						
i)	Wheat	**2013-14**	**Thousand Tonnes**	25979	19739	76.0
ii)	Rice	-do-	-do-	6798	3481	51.2
iii)	Cotton	-do-	**`000' Bales**	12769	9145	71.6
iv)	Jowar	-do-	**Thousand Tonnes**	119	94	79.0
v)	Maize	-do-	-do-	4944	4021	81.3
vi)	Bajra	-do-	-do-	301	274	91.0
vii)	Gram	-do-	-do-	399	331	83.0
viii)	Sugarcane	-do-	-do-	67460	43704	64.8
ix)	Barley	-do-	-do-	67	22	32.8
x)	Rape & Mustard	-do-	-do-	203	147	72.4

This project focuses on grain storage since as they are the main subsistence crop and provides the majority of calories consumed by rural populations (FAO, 2013). Substandard training, knowledge, and obsolete storage leads to 25-30% loss of seasonal harvest, prior to reaching consumers (USAID, 2009). In 2011, poor storage of wheat contributed $248-259 million USD in economic loss (FAO, 2013).

Insufficient storage solutions have been identified by the FAO and the government as a key factor in need of improvement (FAO, 2013). The gross income per capita for Pakistan in 2015 was only $1,440 USD (World Bank, 2017). Therefore, solutions must be meaningful and easily implemented, in addition to low-cost and low-tech. Focusing on adjusting existing methods and supplying potential alternative solutions that are economical and easily constructed by local farmers, is our attempt to tackle food security in this region through our partnership with LET'S.

Objectives

1. Understand the storage problems farmers face in the Punjab province in Pakistan.
2. Develop an understanding of how cultural differences within Pakistan play a role in figuring out sustainable solutions to specific problems for remote communities.
3. Provide LET'S with storage options in the form of a report that can be incorporated in their Takhti network.

Inquiry Question

1. What resources does the Punjab province have to implement user-friendly food storage solutions?
2. What is considered a low-cost storage solution with regards to the economic status of the people in Punjab?
3. What aspects of current food storage methods are effective?

Research Methods

Data Collection

Data will be collected through primary and secondary research. Firstly, data will be acquired from peer-reviewed literature, academic papers and government reports through online sources. More specifically, searching for several keywords, such as "Pakistan," "food storage," "cost-effective," "low-cost," or "low-tech", on the search engines Google scholar, CAB direct, and UBC library. These sources provide general insight into Punjab's current and historical storage methods, climate, agriculture and socioeconomic conditions. We will hold two consultations in total, with Saadan Sulehri, LET'S community partner, and the LET'S Punjab team, respectively, via email for more community-based information. This will provide specific information related to inquiry questions.

Analysis

All primary sources will be collected through email. Data will then be analyzed to identify constraints and possibilities for food storage in Punjab. Such analysis will be done based on establishing feasibility criteria from both sources. The detailed criteria being analyzed include cost to implement, positive features of methods, challenges associated with implementation and examples of successful implementation. Answers will be gathered and aligned with project

objectives to eliminate inconsistencies. Finally, data will be collected into tabular form thus creating straightforward comparisons between differing storage methods.

Ethical Considerations:

All of our information will be gathered from reliable websites to reduce bias. Additionally, all resources provided by community partner will be kept confidential and for academic use only.

Results

Based on various sources obtained through data collection, a table has been created showing various proposed and in-use storage methods. Description outlines the appearance of the storage mediums. The second column examines cost associated with the storage method and its viability. Positive aspects examine successful components of each method, including prevalence of crop spoilage. Challenges addresses the constraints of each method with regards to Punjabi farmers. Successful cases demonstrate where cases are proven effective. Finally, feasibility rank categorizes each method based on affordability and ease of construction, with 1 being the most feasible and 7 being the least. The ranking is additionally effected by judging benefits and challenges associated with each method in Punjab's environment. Our results are presented in Table 2.

Table 2. Results

	Storage Methods	Description	Cost	Positive Aspects	Challenges	Current Cases	Fea F
Current Storage Methods	*Earthen Bin*	Normally circular in shape.[8] Made of clay and sometimes strengthened with straw.[8] (Fig.1)	Jars can be made by local potters for at approximately $4.37 USD.[3]	The jar is not in direct contact with soil.[2] This reduces potential risk of pest infestation.[2]	Cracked clay encourages moisture accumulation leading to crop spoilage.[2]	Pakistan[2]	
	Bulk covered	Grain is piled on the ground and covered with straw and mud covering.[8] (Fig.2)	As long as the farmers have land to use, it is free.[8]	Can store large amount of grains.[8]	Only suitable if weather conditions are dry.[8] More susceptible to pest infestation and climate fluctuations.[8]	Pakistan[8]	
	Khurrum	A circular ditch covered by cloths or plastic sheets during rain and storms.[1] (Fig.3)	Workers can be hired at $4.56 USD/day to dig out the ditch.[3]	Requires minimal maintenance.[1]	Requires specific location conditions to construct.[1] Crops can ferment if left for a length of time.[1]	South Africa[1]	
Potential Storage Methods	*Straw-clay, concrete block and ferrocement bins*	Bins built with straw, clay, concrete and/or cement, with roofs made of straw or tin.[4] (Fig.4)	Materials are inexpensive and easily acquired.[4]	Easy to construct.[4] Materials are readily accessible.[4]	Material not immune to elements.[5] Is not hermetic.[5]	Pakistan[4]	
	Mud storage	Mud storage using larger, polyethylene bags.[2] (Fig. 5)	Mud structure is inexpensive and easily erected.[2] Polyethylene bags for grain are $10USD per unit.[2]	Large polyethylene bags can hold 2000kg of grain.[2] These bags reduce crop spoilage.[7]	Bags are costly.[7] Short lifespan.[7]	Pakistan[1]	
	Metal silos	Cylindrical storage structure made of metal.[7] (Fig 6)	Cost depends on volume of silo (see appendix II).[7]	Hermetic and minimizes crop spoilage (see appendix II).[8]	Materials are not easily accessible.[7]	Kenya[8], developed countries.[7]	

(1) Food and Agriculture Organization of the United Nations. (1994). Grain storage techniques. Retrieved from http://www.fao.org/docrep/T1838E/T1838E12.htm
(2) Nawaz, K. (2010). Improving local grain storage. *Spate Irrigation Network, 10*, 3. Retrieved from: http://www.spate-irrigation.org/wordpress/wp-content/uploads/2011/08/PN10_improving-local-grain-storage-LO.pdf

Discussion

Post-harvest losses from inadequate storage presents ongoing challenges fo farmers. Inadequate methods are primarily affected by high temperatures and humidity (and Kalita, 2017). High moisture levels often lead to mold growth which is the first indic spoilage due to lowering nutritional quality and the germination rate of grains (Chattha 2015a). Moreover, pest infestations are prevalent due to Pakistan's being characterized wi humidity and temperature, further reducing nutritional quality of stored wheat (Chattha 2015a). As a result, farmers tend to sell grain early and at diminished prices to av damaging effects of fungal growth and pest infestation (Chattha, S.H. et al, 2016). Addit farmers in Punjab are incapable of affording more suitable methods that can overcome cr and rely on food processing companies to take care of storage (LET's Punjab team, 201 emphasizes the equity problem within the global food system as traders, manufa processors, and retailers control 70% of decision-making (Bailey, 2011). Such authority food processing companies to determine market prices and results in farmers under m (Bailey, 2011).

Considering these difficulties, we ranked various storage methods in Table 2 ba affordability, ease of implementation and overall storage security. A yearly income ($144 was also taken into consideration (World Bank, 2017). Our results found that stra ferrocement and concrete block bins were the most practical among potential methods a materials are locally available and affordable. Generally, these bins possessed roofs cons from straw, thatch and asbestos which gave structures the ability to maintain cool tempe overnight and reduce moisture buildup (Chattha, et al., 2016). The conical roof w characterized by a 30° slope and overhang, protecting contents from the elements (Chattha 2016). The bin floors were aboveground preventing moisture uptake from soil surface (Chattha, et al., 2016). Though these structures were not completely resistant, the design r in diminished fungal growth and pest infestations compared to traditional structures (Cha al., 2016).

The earthen bin method was ranked second. This structure is currently employed a be acquired through local potters for approximately $4.37 USD (Paycheck.in, 2016). In a to being cost-effective, they reported lower risk of pest infestation as the jar is not in

contact with soil (Chattha, et al., 2015a). Improving the current construction would reduce the risk of cracking and allow for a longer shelf life (Chattha, et al., 2015a).

The third practical method is the mud storage structure. This structure is user-friendly and can be modified but contains relatively expensive polyethylene bags, Binda, costing up to $10USD/unit (Nawaz, 2010). Furthermore, these large bags possess a short lifespan due to their easily penetrable surface (Likhayo, 2016).

Bulk covered structures was the fourth most viable method. This system is advantageous as it can be void of most cost so long as farmers own land to place it (Chattha, 2015b). However, this structure beneficial only in dryer conditions thus reducing versatility (Chattha, 2015b). Furthermore, Pakistan's climate variability and extreme weather events make this method unfavourable (Muhammad, et al., 2016).

The storage method ranked fifth was metal silos. In terms of structural security, this method is the most suitable since its hermetically sealed and constructed with galvanized iron or tin sheets (Tefera, et al., 2011). Unfortunately, most Punjab farmers cannot afford it since constructing materials are costly and local availability is limited. They cost $35USD - $375USD depending on volume, thus not economical (Tefera, et al., 2011). Implementation of metal silos, furthermore, could demand frequent collaboration with government organizations, farmers and manufacturers (Tefera, et al., 2011).

Lastly, Khurrum's were the least practical among methods. This current strategy placed grain inside ditches covered by cloths or plastic sheets during periods of precipitation (FAO, 1994). The Khurrum is affordable as workers to dig the ditch for $4.56 USD/day. However, this method is extremely vulnerable to climate and may lead to fermentation during lengthened periods (FAO, 1994).

In conclusion, limitations in methods would be that most suggestions are based on secondary sources. It is challenging to provide realistic alternatives when observation of current food storage and insecurity in Pakistan was incapable of happening. Furthermore, academic sources utilized did not analyze all of storage methods in Table 2 together. Instead, conclusions and assumptions on feasibility were made based on multiple studies of various storage methods. If the community project was given further primary sources and community feedback, improved storage methods to prevent post-harvest losses could be presented.

Conclusion

Our goal for this project was to supply storage methods that can be utilized by Punjabi people to reduce crop loss while considering accessibility to materials and ease of construction. Our project has demonstrated the practicability of certain storage methods that can be utilized by farmers in this region. In the Punjab region, comparing storage methods allows farmers to make judgement calls on where their resources are better laid. Future research could look into community resources rather than individual-based strategies. Moving forward, we would like to see more community participation and insight. With current storage methods contributing sizably to crop loss, the populace's voices are integral in the execution of more sustainable storage methods.

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Appendix I:

Images of Storage Solutions from Results Table

Figure 1. Earthen Bins (Nawaz, 2017)

Figure 2. Bulk-Covered (Chattha, S.H., 2015)

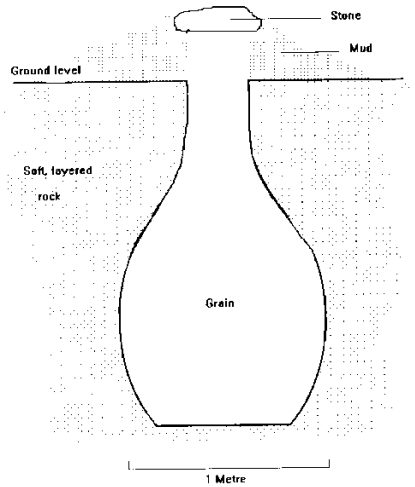
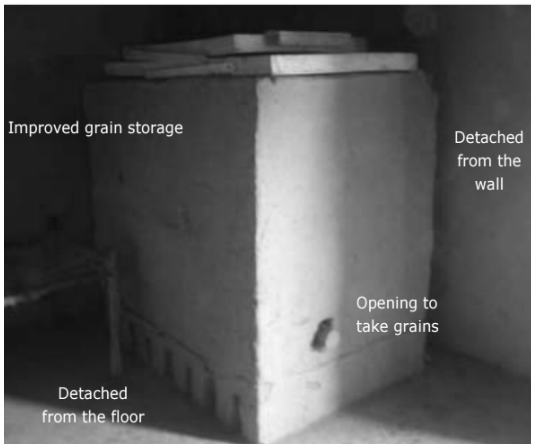


Figure 3. Khurrum (FAO, 1994)



Appendix II:

Table 3. Price of Metal Silo in Malawi in 2010. (Teferea, et al., 2011)

Metal silo capacity (kg)	Unit Price (Malawian Kwacha)	Unit Price (US Dollar)
1000	50,000	320
1500	55,000	350
2000	65,000	420
3000	75,000	480

Table 4. Mean percentage weight loss of the grain samples at Nalvasha (a) and Nakuru (b). (Likhayo, et al., 2016)

Treatment	Storage time (d)		
	90	180	270
a) Naivasha			
Polypropylene bag	2.8 ± 1.1b	10.7 ± 3.3b	32.1 ± 4.2c
Polypropylene bag + Actellic Super dust	0.6 ± 0.4a	10.7 ± 4.1b	16.8 ± 5.3b
Metal silo	0.1 ± 0.0a	0.4 ± 0.1a	1.1 ± 0.4a
SuperGrain IV-R bag	0.2 ± 0.1a	0.5 ± 0.3a	0.5 ± 0.2a
b) Nakuru			
Polypropylene bag	2.6 ± 1.4a	15.4 ± 3.2b	30.0 ± 3.9c
Polypropylene bag + Actellic Super dust	3.4 ± 2.2a	2.1 ± 1.5a	10.5 ± 4.4b
Metal silo	0.2 ± 0.1a	0.8 ± 0.4a	1.5 ± 0.5a
SuperGrain IV-R bag	0.3 ± 0.2a	0.2 ± 0.0a	1.8 ± 1.2a

Means within a column followed by the same letter are not significantly different (SNK test, $P > 0.05$).

Critical Reflections

Student #1

Personally, doing this project had it's ups and downs. As our project is heavily research based, we didn't spend that much time meeting with our community partners face to face. However, we did talk for a length of time using emails to make sure that we were on the same page. Our community partners strife was to make improve the living conditions in third world countries and that was what encouraged our group to participate in this project.

I am grateful for this class, as I had one of the best experiences in a group after coming to UBC. Our group shares similar concern for food security status in third world countries and this project aligned with our beliefs. The members of this group are attentive to details and always aimed to give their best when they can. It has been a pleasure working on this project with my group members and the community partners.

I have heard from my friends that this course is flexible in a lot of ways. I was unsure if learning outside of the classroom was suitable for me. In using other resources from the website and connect, it actually made it easier to learn at my own pace. The flexible learning session also made me realize that we can learn from our peers, not just our instructor or TAs. Submitting our works using online platforms was lot more convenient rather than submitting a physical copy to the class.

Student #2

At first, I felt nervous working with a randomly assigned group where we did not know one another. However, after working with my group member for a while, I felt that it is a meaningful engagement in the community and for building relationships. Not only did we gather information from online resource together, we were able to delegate tasks by explaining our thoughts on how each of us want to perform our task and on how we can do in order to improve our project.

During flexible learning time, we were able to discuss our weekly goals, meet with our community partner and modify time to fit everyone's schedule. I feel grateful meeting and working with my group members this terms because they are easy-going, understanding and helpful. The same goal, improving food justice, makes us united and we are all trying our best to help really find a practical, feasible and applicable method to help the community needed help.

This project is a nice connection between what we learnt in lecture – food justice and the situation in real life. After doing this project, I have a deeper understanding of food justice and how it connected with our daily life.

Student #3

I think this community project was rewarding because it gave me the opportunity to study a real food insecurity issue from the other side of the world. Furthermore, I'm glad that this assignment isn't just for academic purposes but could be potentially used as a starting point for

the LET's organization to find a solution for Punjab farmers. This is why LFS 350 could possibly be one of the most unique courses I've taken because it grants me a learning experience that goes beyond the classroom.

My assigned team was also another highlight for me. This project was fairly independent and research-based so it was extremely helpful that we had a proactive, organized group.We were all on top of time management because we got our tasks done ahead of time and reminded each other of upcoming deadlines. Our team was also helpful to each other if anyone had trouble with their part. This strong support system has made me more appreciative of group projects at UBC.

Apart from the community project, I think the lecture component of LFS 350 was interesting and eye-opening. I've always appreciated the focus on food justice and security issues in LFS courses and I believe that 350 further deepened my understanding. Furthermore, the flexible learning sessions gave me time to reflect and work closely with my teammates. I would say it's one of the best aspects of the course because we used this time to share ideas and work effectively on our community project.

Student #4

This community project experience was very new and interesting to me. Before LFS 350, I have never had a class where we have mostly community project based assignments and flexible learning lectures. My project was research based and I think it has some pros and cons. The pro is that I don't have to physically construct something, and the con is that our proposed storage methods are very idealized and we don't know how it will work in real life.

At first, I was very uncertain about my project because it was so virtualized, but my group members helped me work through it. We were always keeping others on track and letting everyone know what we should do so no one was left out. I think I got a great team, without them the project would have been a lot harder than it is now.

I think the flexible learning days allocated for group members to work together was a very crucial part of our project. During those meeting times, we were always able to get more things done than we ever would online. It pushed the project forward and allowed more bonding time for group members. The online reports and blog posts were clever because it allows group members to contribute online and share our project with others. E-lectures were interesting and new for me, I enjoyed it except the quizzes were a bit difficult.

Student #5

The LFS 350 class was a unique experience. This was my first time experiencing a course that was entirely focused on one community project and had flexible learning. I found the lectures had lots of interesting information and covered a wide range of topics. However, I found there to be a large disconnect between the material and perspective offered in class and our community project. The class focused on the importance of working closely with the community and using

asset based development. Since our project was based in Pakistan we were unable to be involved in the community and have no cultural understanding of the areas we were are focusing on. This lack of firsthand experience lead to some problems as it is hard to rely on research when aiming to build upon community assets and supply solutions that fit with the local lifestyles. This fundamental separation from the project lead to issues as we were unsure if any of the work we did had any value for the people, or if we were just further perpetuating the ideology of the West knows best, rather than actually helping the community.

The community project was challenging but although we struggled we really worked well as a group and did the best we could with the available resources. I am thankful I had such a hardworking and dedicated group to work with, and I believe that we all grew due to the uncertainty presented by the project and improved in our group work and communication skills.

Student #6

This LFS 350 class was much like the online one that I participated in for LFS 250. A lot of experience was derived from actual experience versus what we can learn in a classroom, a matter that I find particularly insightful. As a student that find the food security issues an interesting topic, I believe this course aligned greatly with the beliefs that I have. I believe the flexible learning sessions were important throughout this course, as it allowed more growth among my group as well as a time to catch up with what we all did. We maintained clear communication, were efficient in completing the assigned deadlines. I learned that working with community partners isn't as easy as it can seem and that as students, preparing for community partner meetings was necessary. In a more research-based community based experiential learning project, having more guidelines and information to go off of would've been more desirable but this experience was rewarding in finding out prevalent issues associated with post-harvest loss.