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Refugee Camps as Microcosm: Restoration & Sustainability in an Accidental City

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[Editor's Note: This article seeks to address the broader challenges of food security in refugee camp environments, of which there are many within our Asia region, while offering individual practical options that may be implemented to address the need for nutritional diversity in these challenging settings. For further questions or feedback please feel free to contact the author at etf26@cornell.edu]



Figure 1: Za'atari Refugee Camp in Jordon. (UNHCR Photo Unit, Creative Commons Attribution License)

Refugees, Asylum Seekers, and Internally Displaced People

Forces causing dislocation and flight from danger are on the increase worldwide. On an average day, 44,000 people are displaced and seek refuge within their own country, neighboring countries, or other continents. In 2017 alone, 1.2 million refugees fled Myanmar, 6.3 million fled Syria, and 2.6 million fled Afghanistan. The total number of people displaced due to civil conflicts exceeded 68 million at the end of 2017. This total included 25.4 million refugees (i.e., those crossing national borders), 3 million people seeking official asylum in other countries (also called political refugees), and 40 million internally displaced people Eighty-five percent of these refugees fleeing violence relocate to developing countries or regions with populations struggling with food insecurity and poverty. Over half of the refugees are under 18 years old as well (UNHCR, 2018).

The severity of the migration crisis goes far beyond the 68 million people classified as refugees, asylum seekers, and internally displaced people (IDPs) since this number does not include regional and international migration due to hunger, poverty, and lack of opportunity. It excludes people fleeing crime and gang violence in their home coun-

tries, drought and famine, land seizures and forced relocation, and natural and environmental disasters (FAO et al., 2018). Hundreds of millions of people are on the move seeking safety, food, and opportunity. According to the International Organization for Migration, the total number of international migrants was over 257 million by the end of 2017 (International Organization of Migration).

Accidental Cities on the Margin

Refugee camps are almost always located on sparsely populated "waste" land, so the host country does not need to displace a large population. For example, reports suggest that the government of Bangladesh may plan to settle 400,000 Rohingya refugees on Hatiya Island—an uninhabited river island prone to flooding and typhoons (bdnews24.com). This wasteland is usually hot, dry, and dusty, and the addition of thousands of families in high-density housing with inadequate waste disposal creates a harsh environment. The camp environment, or "Accidental City," is a microcosm of the conditions that exist in urban slum areas where non-refugee migrants settle in their own countries and other countries (Figure 1).

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Places of refuge and resettlement are usually plaqued by their own set of difficulties including inadequate food supplies, poor water quality and quantity, a harsh environment, and resentments and fears within the host population. Emotional and psychological issues from trauma plague many, if not most, refugees. Not only are people suffering needs of food and shelter, but they have lost kinship networks, cultural ties, and geographical familiarity. Deforestation due to firewood collection and rangeland damage due to livestock creates conflict with host communities. (Adam-Bradford et al., 2009). All of these factors make a refugee feel they do not belong.

This article demonstrates ways in which gardening, agriculture, and land restoration can be integrated into refugee camps to provide resources, utilize resident expertise, build skills and livelihoods, and address many of the physical and psychological difficulties faced by these communities of necessity.

Current Policies & Limitations

Food rations for refugees in camps have changed since the 1970s to protect against caloric deficit and reduce the high refugee mortality rates of that decade. Rations were changed from "survival" levels of 1200-1800 kcal/person/day to "minimum" rations of 1900 kcal/person/day to the present level of at least 2100 kcal (Mason, 2002). The rations consist of wheat or maize, vegetable oil, salt, and sugar. They are sometimes supplemented with pulses, fortified corn-soya blend, peanut butter, and tomato paste. All are non-perishable items. Unfortunately, these starch heavy diets remain micronutrient deficient and result in epidemics of scurvy and pellagra (WHO and UNHCR 1999; 2000).

UNHCR and the World Food Programme (WFP) recognize the need for more diverse and nutritious diets but are hampered by budget deficits and food shortages. Prolonged conflicts and frequent environmental disasters, with subsequent increases in refugees, have been acknowledged by donors and funding is at a record high. But the 2018 budget shortfall is 25% below projected needs (Columbus, 2018).

UNHCR decided to promote vegetables in diets in 2007 and started some gardening pilot projects (Adam-Bradford et al., 2009). The intent was to include home gardening into its nutrition and livelihoods strategy. budgetary constraints and the increasing demands of new camp establishment have slowed implementation. Exacerbating the problem are land policies of most host countries that do not allow refugees to farm outside camp bound-

aries. The intensifying refugee and migrant crisis keeps relief agencies focused on providing the basic needs of shelter, water, medical care, and basic food rations, and unable to transition to the recovery or rehabilitation phases that usually follow disasters such as earthquakes or tsunamis. More permanent construction for housing and clinics needed for prolonged crises are being delayed as well.

Signs of Hope

The biggest challenge to overcome when initiating programs is the idea that planting food crops means giving up hope on returning home or being resettled more permanently. One way to overcome apprehension of putting down roots is to use gardens as learning tools in adult education classes or extension projects that focus on how new techniques can be used back home. Acquiring these skills at a camp is like going to school and then applying the techniques in other situations, including urban gardening and cityscapes.

An important step in normalizing gardening for residents is to recruit refugees with farming experience and enthusiasm to be trainers of other refugees. Learning from others of one's own culture and shared hardships is often easier. These "mobilizers" are analogous to lead farmers in mainstream agriculture development projects (Figure 2). Mobilizers are hired as teachers but also demonstrate gardening with their families and act as mini demonstration farms in various areas of the camps. These



Figure 2: Ayesha Khatun is an outreach worker in Balukhali camp in Bangladesh serving Rohingya women for the Multi-Purpose Women's Centre. Source: UN Women/Allison Joyce, Creative Commons Attribution License

dedicated community members also act as resident liaisons and distributors of tools and seeds (Adam-Bradford et al., 2009).

Land Planning

The most obvious need in planning for agriculture in camps is to allow land to be set aside for the purpose, and buildings and tents to be sited to allow for garden space. Equally important are considerations of how and where wastewater will be created and locating growing areas near these sources. Food scraps and human and livestock wastes can be utilized as fertilizer if waste treatment and composting facilities are designed and located to transform them into a valuable resource. Energy supplies for cooking and heat must also be planned for and space made available and accessible for fuelwood collection and production (Figure 3). Camps need to plant firewood tree species quickly to prevent conflicts with neighboring farmers and charcoal producers. Space for nurseries to grow seedlings for demonstration areas and training purposes will need to be made available (Corbett, 2009). Nursery caretakers are often children and the elderly since they can raise seedlings in schools and activity centers with infrastructure already in place for their needs.

NGOs can take a role in addressing these land issues. The Border Consortium, an NGO in Thailand, aims to increase land tenure of both local and displaced peoples (TBC Strategy, 2017). The Catholic Office for Emergency Relief and Refugees, another NGO in Thailand, trains commu-

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Figure 3: Rohingya children collect firewood outside Balukhali camp, Bangladesh. Source: UN Women/Allison Joyce, Creative Commons Attribution License



Figure 4: Tent entrance in Kurdistan. Source: Mustafa Kyayat, Creative Commons Attribution License

nity members to manage their own waste management systems, including planting trees to prevent soil erosion (COERR).

Practical Agricultural Options for the Camp Setting

Doorstep Gardening

Personal gardens that supplement a refugee family's meals can be adapted from many designs. The types of gardening suitable for situations with limited space, soil, water, and labor fall under several terms including urban, rooftop, container, or doorstep gardening (Price, 1996). Figure 5 illustrates the typical "doorstep" of a refugee family. These styles and methods draw on long histories of urban agriculture that evolved around the world wherever cities developed (Price, 2018). Metropolitan areas that develop favelas, slums, or shantytowns around their outskirts often invent new practices to deal with harsher conditions and fewer resources. These forms of micro-agriculture incorporate recycled materials for pens for raising small animals, for planting containers, and for raised bed construction. Resourceful water collection systems are created from recycled scrap to save and channel rainwater and grey water to gardens.

Other innovative methods have evolved in response to meeting the needs of the elderly, the chronically ill, those with physical disabilities, and orphans. These include keyhole gardens and homestead gardens that help people with limited mobility or who must stay at home to be caregivers (Merrey and Langan, 2014). Keyhole gardens use a raised bed system to produce vegetables

near waist height for those who cannot bend over, need support to stand, or are visually impaired but can feel their way around the bed. These "doorstep" gardens make adding fresh vegetables and herbs to meals far easier.

Multi-Story Gardens

These old and new garden strategies suit the constraints faced by refugees who live in rows of tents or shack/shelters with only the space directly outside their cooking and sleeping space available for production. The unique recycling streams of refugee camps have contributed to more innovations. Grain sacks and cooking oil cans are the waste products of bulk food distribution in camps and have been used to create multi-story gardens (Global Service Corps). Sacks and cans are filled with rocks, soil, and compost that can be planted and watered easily. These are arranged in many ways to use space efficiently and are easily rearranged to fit the family's changing needs (Figure 5).

Multi-story gardens projects offer dietary diversification, nutritional education, and self-sufficiency. The empty 50 kg cereal sacks and 18-liter metal or plastic "jerry" cans allow adequate space for root systems of most common vegetables. Smaller cans are also used as water channels inside bags to allow easy watering with grey water. The cans are filled with rocks and placed on top of each other in the center of upright bags with holes drilled in the sides and bottoms to allow for slow water movement. The soil surrounding the cans receives moisture throughout the day.

Seeds are planted in the soil around the top of the bag or nursery seedlings are transplanted into them. Holes are cut into the sides of the bags, and some of the seedlings from the top of the bag are transplanted along the sides to create a vertical plant tower (Adam-Bradford et al., 2009). The proximity of the MSGs provides ease of maintenance, reduces the risk of theft, and water needs can be closely monitored. They can also be decorative and help to demarcate outdoor living space or animal pens. MSGs have been a proven success in camps in Kenya, Ethiopia, and Aceh Indonesia. Commonly grown vegetables in MSGs are sweet potato, carrots, beets, green beans, tomato, cabbage, leafy greens, okra, peppers, eggplant, onions, cooking spices, medicinal plants, and ornamentals (Tsadik, 2009).



Figure 5: Watering a multi-story sack garden in Haiti. Source: Colleen Taugher, Creative Commons Attribution License

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Figure 6: Community Garden at Oure Cassoni camp, Chad. Source: UNHCR/F. Noy, Creative Commons Attribution License

Community Gardens for Families

Community gardens that are used for family production assign growing areas according to the allotment system used in many European cities (Surls, 2001). Allotment style gardening results in immense diversity from bed to bed and facilitates learning between residents and sharing seeds of diverse varieties. Establishment of beds, compost piles, fencing, and shed construction are often group activities that build cohesion. This type of garden promotes the sharing of tools, potting materials, and animal husbandry responsibilities.

Family gardens are good teaching and demonstration sites for sustainable farming techniques such as crop rotation, green manure crops, mulching, drip irrigation, natural soil fertility, and pest control techniques (FAO, 2005). These methods can be introduced as supplies and materials are brought in or produced. Allotment gardening has health and therapeutic benefits in addition to those of doorstep gardening since it offers a social activity with opportunities for sharing and connecting (Figure 6) (Hawkins et al., 2013). Schools or community centers make great locations or land must be set aside in the camp design.

Broad-Scale Agriculture

Budget shortfalls and larger refugee populations make large-scale crop production an increasing necessity for camps, and not just an afterthought or extra. This will require farm planning and design in new camps and introducing farm programs into existing camps. UNHCR, Red Cross, Red

Crescent, and WFP do not have the mandate, personnel, or funding to create an agrarian sector within camps. Multilateral Agencies and NGOs should be encouraged to initiate or increase programs with the necessary expertise and funding to promote refugee innovation and self-sufficiency (FAO et al., 2018).

Resource limitations and health concerns that apply to gardening

also apply to farming in camps. Non-toxic, low-resource, and inexpensive methods must be used whether or not they are called sustainable, organic, ecological, or conservation agriculture. Techniques include intercropping, crop rotation, composting, green manure cover crops, mulching, Zai holes, and various watering strategies. The most commonly grown cereal crops grown in UNHCR camps are maize, wheat, millet, and sorghum. Common vegetables include kale, spinach, squash, okra, peppers, tomato, onion, and cabbage. Pulses and seeds include peanuts, cowpeas, lentils, sesame, and sunflower (Weimer, 2008).

Green & Sustainable Landscapes

Establishing refugee camps in response to civil conflicts and disasters involves clearing land, fencing the perimeter, erecting tents, and building roads as fast as possible without consideration for aesthetics. The attractiveness of camps can be altered over the years, and sometimes decades, of a camp's life. Improving how the environment looks has other equally valid outcomes. Shade trees reduce temperatures, lower wind speeds, and reduce airborne dust. Trees also provide fruits, nuts, medicines. and bee forage. One NGO working in refugee camps takes its name, the Lemon Tree Trust, from its efforts to promote lemon production in camps, in addition to home gardens (Lemon Tree Trust). Olive and banana trees thrive in very different growing conditions, but there are many camps in these environments.

Bushes and living fences are good replacements for ugly wire fences and cement walls. Hedges can also provide food, flowers, and dust reduction. Herbs and flowers in containers, along borders, and surrounding buildings add beauty and can supply cooking herbs and tea ingredients.

Beyond the Camp – Agroforestry

Many camps cannot provide charcoal or propane for cooking, and residents must go outside the camp to collect fuel. Camps are often located in areas already experiencing deforestation, fuelwood shortages, and overgrazing. Competition for fuel and pasture sometimes leads to confrontation and violence, causing the host country to withdraw support or increase security to keep refugees within the camp enclosure (Adam-Bradford et al., 2009).

Traditional reforestation efforts are ineffective in such situations since commonly planted timber species do not provide the multiple benefits needed by camp residents and locals. Also, tree plantations are planted and protected from use to allow for long time periods until economic maturity. Agroforestry systems can provide the multiple products and services required including livestock forage, wildlife habitat, fuelwood, construction poles, fruits and nuts, erosion control, as well as space for crops interplanted among woody species (UNHCR, 2005).

An agroforestry strategy for managing the natural resources around camps also provides opportunities for refugee employment in nurseries to produce seedlings of various species, tree planting, tree thinning, controlled fuelwood and pole harvesting, and cut and carry forage systems for livestock (Martin and Scott, 1992). Intensive penned livestock production can also create jobs for milking, food processing, and compost production. The manufacture of fuel-efficient cook stoves in camp workshops can create jobs and reduce total fuel demand (UNHCR, 2005).

Protracted refugee situations need not inevitably lead to environmental degradation and can be a stimulus to landscape restoration and multiple use agriculture that contributes to host communities (Adam-Bradford et al., 2009). Agrofor-

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estry can decrease soil erosion, lessen flooding a nd d rought c ycles, a nd provide wildlife habitat for game meat. Refugees flee instability and need a secure environment in which to rebuild their lives. Host communities also face many challenges, and resources mobilized by international efforts can provide benefits to them as well through land restoration.

A Model for Agricultural Extension and Community Development

There are unique challenges and conditions in camps pertinent to agricultural education not found in communities of origin, but many issues are the same. All agricultural

REFERENCES

Adam-Bradford, A., F. Hoekstra, and R. van Veenhuizen. 2009. Linking Relief, Rehabilitation and Development: A Role for Urban Agriculture? Urban Agriculture Magazine. 21:3–10. Available: https://pdfs.semanticscholar.org/6c-b1/29990e382f98b054c0892b76fe727a59ad86. pdf

BDNews24.com. Published 28 November, 2017. Tk 23.12 Billion for Rohingya Housing Project on Island in Hatia. *Available*: https://bdnews24.com/bangladesh/2017/11/28/tk-23.12-billion-for-rohingya-housing-project-on-island-in-hatia

Beck, C. 2017. Gardens of Hope. The Lemon Tree Trust. *Available*: https://lemontreetrust.org/wp-content/uploads/2018/02/GI_257_p080-083_LemonTree.pdf

COERR. Catholic Office for Emergency Relief and Refugees. Thai-Burmese Border Refugee Project. Accessed April 9, 2019.

Columbus, C. 2018. The UN's Terrible Dilemma: Who Gets to Eat? National Public Radio. Accessed March 27, 2019. *Available*: https://www.npr.org/sections/goatsand-soda/2018/01/10/574597536/the-u-n-s-terrible-dilemma-who-gets-to-eat.

Corbett, M. 2009. Multi-Storey Gardens to Support Food Security. Urban Agriculture Magazine. 21: 34–35. *Available*: http://www.indiaenvironmentportal.org.in/files/Multi%20storey%20 Gardens%20to%20Support.pdf

FAO. 2005. Setting Up and Running a School Garden: A Manual for Teachers, Parents, and Communities. *Available*: http://www.fao.org/3/a0218e/A0218E00.htm

FAO, IFAD, IOM, and WFP. 2018. The Linkages Between Migration, Agriculture, Food Security and Rural Development. *Available*: http://www.fao.org/3/CA0922EN/CA0922EN.pdf

Global Service Corps. Making a Sack Garden. Accessed from echocommunity.org. *Available*:

extension should be inclusive, participatory, and culturally respectful. The lessons learned from decades of community-based and farmer-to-farmer extension services can be applied to working with migrant and refugee populations.

A sustainable livelihood and resilience strategy integrates agricultural, vocational, and extension education into camps, since, unfortunately, many migrants face recurring disaster and hostility situations, or at best must prepare for multi-step resettlement journeys (Adam-Bradford et al., 2009). Camps are staging areas to prepare families for future challenges, not just minimal crisis intervention. Camps can also func-

https://www.echocommunity.org/en/resources/69ec0db4-d544-4c9d-aeed-0e8fbe92075e

Hawkins J. L., J. Mercer, K. J. Thirlaway, and D. A. Clayton. 2013. "Doing" Gardening and "Being" at the Allotment Site: Exploring the Benefits of Allotment. Ecophysiology. 5:110–125. Available: http://orca.cf.ac.uk/53177/1/Ecopsychology%20 Paper%20-%20JHawkins%20et%20al.%20 June%202013.pdf

International Organization of Migration. Accessed March 27, 2019. *Available*: https://migrationdataportal.org/?i=stock abs &t=2017

Lemon Tree Trust. Accessed March 27, 2019. *Available*: https://lemontreetrust.org

Martin, F. and S, Scott. 1992. Agroforestry Principles. ECHO Technical Notes. 25: 1-10. *Available*: https://www.echocommunity.org/ en/resources/06c870a1-3fbb-47ec-9951e8c0cb134582

Mason, J. B. 2002. Lessons on Nutrition of Displaced People. Journal of Nutrition. 132:2096–2103. *Available*: https://academic.oup.com/jn/article/132/7/2096S/4687321

Merrey, D. J., and S. Langan. 2014. Review Paper on "Garden Kits" in Africa: Lessons Learned and the Potential of Improved Water Management. International Water Management Institute Working Papers. 162. *Available*: https://ilssi.tamu.edu/media/1078/review-paper-on-garden-kits-in-africa.pdf

Price, M. L. 2018. Gardening on Rooftops: The Last Agricultural Frontier. *Available*: https://www.echocommunity.org/en/resources/13e3e04a-d10f-4c96-8438-f7686f431882

Price, M. L. 1996. Rooftop and Urban Gardening. ECHO Technical Notes. 31: 1-20. *Available*: https://www.echocommunity.org/en/resources/0940276d-a2a2-431e-8778-2d81c8260548

Surls, R. 2001. Community Garden Start up Guide. RUAF Foundation. Available: https://

tion as focal points for extension services for surrounding communities, many without prior access to extension.

To plant, grow, and harvest food is a restorative therapy, an enriching activity, and a practical pastime. Empowering and equipping refugees to care for the land and make a livelihood from it not only helps the refugees themselves to recover from their loss, but improves lives in the local community as well. To quote Nohad Kalash, a Syrian refugee in the Domiz Refugee Camp in

Kurdistan, "Without green the world is meaningless. Where there's green, there's happiness" (Beck, 2017).

www.ruaf.org/sites/default/files/Community%20 garden%20startup%20guide.pdf

The Border Consortium. 2017. TBC Strategy 2017-2019. *Available*: https://www.theborderconsortium.org/media/84542/Strategic-Plan-2017-2019-En.pdf

Tsadik, M. 2009. Enhancing Household Food Security in Refugee Camps in Ethiopia. Urban Agriculture Magazine. 20:16–17. *Available*: http://re.indiaenvironmentportal.org.in/files/Enhancing%20Household%20Food%20Security.pdf

UNHCR. 2005. Forest Management in Refugee and Returnee Situations: A Handbook of Sound Practices. United Nations High Comissioner for Refugees. *Available*: https://www.unhcr.org/438724c42.pdf

UNHCR. 2018. Global Trends: Forced Displacement in 2017. United Nations High Comissioner for Refugees. *Available*: https://www.unhcr.org/5b27be547.pdf

Weimer, A. 2008. Homestead Gardening: A Manual for Program Managers, Implementers, and Practitioners. Catholic Relief Services. *Available*: https://www.ruaf.org/sites/default/files/Homestead%20gardening%20manual.pdf

WHO and UNHCR. 1999. Scurvy and Its Prevention and Control in Major Emergencies. World Health Organization and United Nations High Comissioner for Refugees. *Available*: https://www.who.int/nutrition/publications/emergencies/WHO NHD 99.11/en/

WHO and UNHCR. 2000. Pellagra and Its Prevention and Control in Major Emergencies. World Health Organization and United Nations High Comissioner for Refugees. *Available*: https://www.who.int/nutrition/publications/emergencies/WHO_NHD_00.10/en/

Low-Cost Natural Building Options for Storing Seed in Tropical Southeast Asia

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[Editor's Note: ECHO's Network of Community Level Seed Banks across Asia leads not only to the sharing of more seeds, but to the sharing of information as well. In 2018 ECHO Asia partnered with the Kahelu Small Farm Resource Center in Myanmar's Irrawaddy Delta to research the practicality of storing seeds in various low-cost earthen structures, with and without vacuum-sealing. We are pleased to engage with partners in the field to test and verify better the practices and technologies we promote, with the goal of sharing this information with the wider ECHO network.]



Figure 1A: Earth Bag Seed Storage Facility



Figure 1B: Hilliside Bunker Seed Storage Facility



Figure 1C: Buried Clay Cistern Seed Storage Facility

Introduction

Given the proper facilities necessary to store seeds long-term, whereby low temperature and low humidity are kept stable over time, it is very possible to store most orthodox seeds for several years at a time in the tropics (Harrington, 1972). Unfortunately, implementation and maintenance of the proper facilities can be very costly and many existing seed bank and gene bank facility examples do not satisfy the needs of many smaller organizations or communities. Thankfully, many diverse options currently exist, with varying levels of investment for a wide range of facilities, from expensive, high-tech facilities down to low-cost, low-maintenance models. At ECHO, we operate our own range of seed storage facilities at our various seed banks around the world, from a high tech, walk-in climate-controlled cold storage room, to a retrofitted refrigerated shipping container, to a low-cost, foam-insulated cold room cooled with a standard split-unit air conditioning system.

While each of these systems has proven to be effective in storing seeds for our needs over time (Motis, 2016), even our lower cost options do not adequately address the very real question of how seed storage facilities may be replicated at a farm or local community level. Though we have learned how to bring down costs considerably to establish low-budget facilities, these options remain out of reach for many communities and smaller organizations,

and each example currently relies on the need for an uninterrupted supply of electricity, among other barriers. In an attempt to address these ongoing questions, much of our recent effort at the ECHO Asia Seed Bank has shifted into improving the practicality and cost-effectiveness of seed storage options for small Community Level Seed Banks, and on down to the individual farm level.

Building on ideas observed in the field, and storage ideas passed onto us by ECHO network members (CRS, 2014), we attempted to verify the effectiveness and practicality of various options using natural earth-building techniques. A small research experiment was implemented over the course of 2018 (Jan – Dec) at the ECHO Asia Seed Bank in Chiang Mai, Thailand, and was replicated by one of ECHO's Community Level Seed Bank Network members in Myanmar.

Comparing Earth Bag Houses, Hillside Bunkers, and Buried Cisterns

It has been suggested for many years now that various natural building facilities such as earth bag and rammed earth houses may serve as ideal sites for storing seeds, while in other places it has been suggested that storing seeds underground may be effective as well. Keeping in mind the insulating qualities and low-cost of construction of natural building techniques (Build Abroad), we began testing different methods at the

Asia Impact. In 2018, ECHO conducted a small experiment in Thailand and Myanmar to test these hypotheses, specifically within the Southeast Asian context, where temperature and humidity are higher than the climates in which these facilities have previously been implemented.

Using lablab - Lablab purpureus (L.) seeds were stored over the course of one year inside of three different natural building facilities, including (1) an Earth Bag House, (2) a Hillside Bunker, and (3) a Buried Clay Cistern (Figure 1). Seeds were placed inside of each facility, with half of the seeds being (A) Sealed in jars using a modified Bicycle Vacuum Pump (Bicksler, 2015; Thompson, 2016), while the other half remained (B) Unsealed in Paper Bags. Four separate batches were placed in each storage facility in order to test seeds for Seed Moisture Content and Germination rates over the course of months 3, 6, 9, and 12, with containers remaining unopened until testing during their respective months.

In addition to testing and monitoring the viability of these seeds stored in these environments, data loggers were placed inside and outside of each of these facilities to track storage conditions over the course of one year, specifically temperature and relative humidity. Data loggers recorded temperature (°C) and relative humidity (%) every hour.

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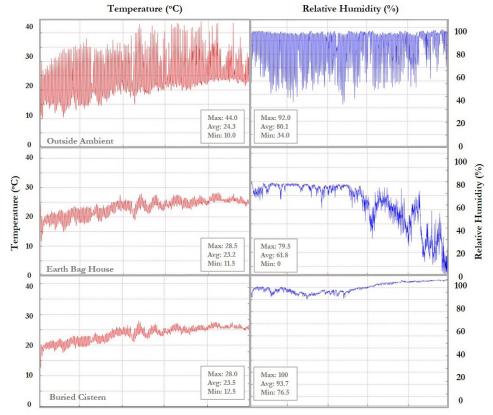


Figure 2: Comparison of Temperature (oC) and Relative Humidity (%) conditions - over a 6 month period - of outdoor ambient conditions and conditions inside of an Earth Bag House and a Buried Ceramic Cistern designed for seed storage in northern Thailand.

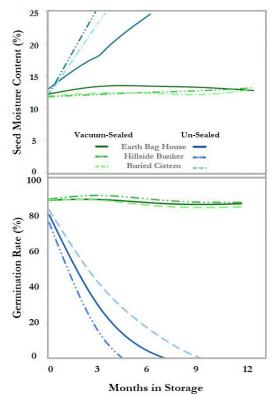


Figure 3: Seed quality of sealed and unseasled see (moisture content and germination rate) after storage inside Earth Bag Houses, Hillside Bunkers, and Buried Cisterns over one year.

A Story of Stabilized Storage Conditions

Climatic data collected from the Thailand site generally indicate a significant stabilization of temperate and humidity in the Earth Bag House and Buried Cistern compared to Outside Ambient conditions (Figure 2). Temperatures did not drop considerably on average in each of the storage facilities (~23°C), but daily temperature swings were reduced substantially. For reference, our climate-controlled. walk-in seed storage cold room in Florida maintains an average temperature of 6oC, with very little fluctuation, while our spray-foam insulated cold room using a standard split-unit air conditioning system maintains an average temperature of 15°C.

Relative humidity inside of these natural building facilities was very high overall, even during the dry season (Figure 3). The underground facilities, the buried cistern and the hillside bunker, recorded very high rates of humidity, while the freestanding earth bag house appears to have achieved lower overall humidity. Conditions in

the hillside bunker were so humid that our data logger shorted out within days, prohibiting us from recording conditions within.

Good News, if Sealed Properly

On their own, these natural earth-building facilities appear to be poor storage facilities for seeds, due to their high rates of relative humidity, which can quickly deteriorate seed quality. In both Thailand and Myanmar, seed germination rates of unsealed seeds plummeted from 94% to less than 50% within just 3 months of storage (Figure 3). Measuring seed moisture content showed a rapid absorption of moisture in seeds, due to the high moisture content of the air within, rising from 12% seed moisture content to over 20% in just 4 months. Similar results were found when storing seed in vacuum-sealed and unsealed conditions in a refrigerator, where humidity is similarly high (Croft, 2012).

However, in combination with vacuum-sealing, seed germination rates in each of the 3 storage facilities remained steady over the course of one year, maintaining germination rates above 90% at the end of the experiment. Seed moisture content held constant for the most part as well, increasing less than 2% over the course of the year.

This combination of best practices, of sealing seeds with a vacuum and placing them within a stable storage environment, appears to offer an excellent and affordable option for storing seeds in the tropics. Without any use of electricity or external cooling systems, these techniques were successful in terms of storage and adequately maintained seed quality and viability for a full year. Certainly, work in this area needs to continue to seek answers to questions of how much longer seeds can be stored in this manner, and attempted with different seed types as well, but this is good news overall.

Economic Summary of ECHO Seed Storage Facilities

Over the years, ECHO has scaled its various seed banks around the world to the specific needs of the individual seed bank. Each has its appropriate scale and serves different purposes, from distributing thousands of seed packets a year, to serving the needs of a single community or region. Therefore, we deemed it pertinent to share with our network the costs of implementing these different options, to be used as reference points for various levels of seed

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	Facility	Location	Details	Size (m)	Avg. Temp.	Cost (USD)
Long-Term Storage Options	ECHO Global Farm Cold Room (large)	Florida, USA	High-tech, climate- controlled, walk-in cold room	6 x 3 x 2.5	5	35,000
	ECHO Global Farm Shipping Container Cold Room	Florida, USA	Retrofitted refrigerated shipping container, single split-unit A/C system with Cool-Bot sensor	2.5 x 3 x 2.5	<u>-</u>	10,000
	ECHO Asia Cold Room (large)	Chiang Mai, Thailand	Foam insulated, double split-unit A/C system with Cool-Bot sensor	8 x 5 x2 .5	15	5500
	¹ ECHO Asia Cold Room (small)	Mae Ai, Thailand	Foam insulated, single split-unit A/C system with Cool-Bot sensor	5 x 3 x 2	6	3250
Year-to-Year Storage Options	Earth Bag Storage House	Mae Ai, Thailand	Clay and rice hull filled bags, stacked walls with thatched roof	4diam. x 1.7h	23	750
	Hillside Bunker	Mae Ai, Thailand	Dug-out storage nook, in primarily clay-based hillside or sloping land	2 x 2 x 1.5	-	80
	Buried Cistern	Mae Ai, Thailand	Large glazed ceramic cistern designed for water storage, buried up to the rim in the ground	<u>2</u>	23	20

Figure 4: Price and capacity comparison of current ECHO seed storage facility options.

storage facility options (Figure 4). Note that these prices may vary considerably depending on your location and access to materials and/or labor, and existing structures that being retrofitted.

It is important to note that the higher-cost options listed above are designed more for multi-year storage of seeds (such as



Figure 5: Retrofitted shipping container seed storage room located on the ECHO Global Farm, Florida. Photo credit: Elizabeth Casey/Holly Sobetski).

REFERENCES

Bicksler, A.J. 2015. Bicycle Vacuum Sealer for Seed Storage. ECHO Development Notes. 126: 1-4. *Available*: https://www.echocommunity.org/en/resources/12321cde-1e32-4aa4-8bb7-56c63be726a8

Build Abroad. "Realizing the Full Potential of Earthbag Construction." *Available*: https://buildabroad.org/2017/02/03/earthbag-construction/

Catholic Relief Services. 2014. Improved Seed Storage Briefs. Nairobi: Catholic Relief Services. *Available*:https://www.crs.org/sites/ default/files/tools-research/seed-storage-briefs. pdf in a seed bank or gene bank setting), while the lower-cost options are designed more for community or farm-level settings where seeds only need to be stored year to year, or 2 years at most.



Figure 6: Climate-contolled walk-in cold storage room located on the ECHO Global Farm, Florida. Photo credit: (Tim Watkins)

Croft, M., A.J. Bicksler, J. Manson, R. Burnette. 2012. Vacuum Sealing vs. Refrigeration: Which is the Most Effective Way to Store Seeds. ECHO Asia Notes.14: 1-6. *Available*: https://www.echocommunity.org/en/resources/5262cfab-ddcf-42ec-843a-82f8468f0829

Harrington, J.F. 1972. Seed Storage and Longevity. Edited by Kozlowski, T.T. in: Seed Biology. 3:145-245.

Kennedy, Joseph F. 1997. Building with Earthbags. Retrieved from Earthbagbuilding.com. *Available*: http://www.earthbagbuilding.com/articles/buildingwithearthbags.html

Motis, T.N. 2016. Seed Storage in the Tropics. ECHO Best Practice Notes. *Available*: https://www.echocommunity.org/en/resources/6fa5029a-b130-4561-aa58-b2bf117de358

Conclusions

While this data may speak more to the necessity of vacuum-sealing than to the efficacy of natural earth-building techniques for seed storage, it is important to note that in a recent ECHO seed storage experiment we found that vacuum-sealing on its own was not enough to maintain adequate seed viability over the course of one year in Thailand's tropical conditions (unpublished work). Vacuum-sealed seeds stored on a hot outdoor porch did perform well compared to unsealed seeds, but germination rates still declined considerably. The ability to maintain high germination rates over the course of the entire year in this experiment leads us to believe that the combination of vacuum-sealing AND storage in a stabilized environment are what led to extremely effective seed storage practices in this experiment. ECHO will continue to build on this work to find low-cost, practical options for storing seeds in Community Level Seed bank settings, using practices that are simple and replicable.

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Motis, T.N. 2019. Vacuum Sealing Options for Storing Seeds: Tehnologies for Small-Scale Seed Banks. ECHO Technical Notes. 93: 1-16. *Available*: https://www.echocommunity.org/en/resources/690545ac-4de7-4cc2-9654-70953d2c21bc

Price, Z. 2016. Constructing an Improved Cold Room for Seed Storage. ECHO Asia Notes. 27: 1-5. *Available*: https://www.echocommunity.org/en/resources/3171bfa2-b742-40d2-9ae1-5dc4da827628

Thompson, K. 2016. Seed Saving in the Tropics: Lessons Learned from the Network. ECHO Asia Notes. 28: 1-5. *Available*: https://www.echocommunity.org/en/resources/c2b5d0e2-8bd1-48f5-898e-1e5d0b993211

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Community Driven Development (CDD) is a weeklong training for development practitioners and others interested in strengthening their knowledge, tools and understanding of supporting community development across a wide-range of sectors through community based organisations (CBOs). The course is offered by HelpAge International, Vietnam country office (HAIV) with over 10 years experience in community driven development and capacity building of development practitioners.

For more information, please contact:

- Ms Tran Bich Thuy Email: thuytb@helpagevn.org
- Ms Chu Viet Nga Email: ngacv@helpagevn.org



Deadline for application: 13 September 2019

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- 1. Please do remember that a "Development Worker" membership entitles you to 10 free trial packets of seed per year! If you would like more seed packets or larger quantities of some seeds (especially green manure/cover crops), we do have additional seed packets and bulk seeds for sale, and our seed bank catalog is available online.
- 2. Please also know that besides being written in English, our ECHO Asia Notes are translated and available for free download in Thai, Khmer, Burmese, Mandarin, Bahasa Indonesia, Vietnamese, and Hindi languages.

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Additionally, if you have any ideas or would like to write an article for an upcoming ECHO Asia Note, we invite you to do so! Thank you for reading, and please do stay in touch!

Sincerely,

Patrick Trail, M.S., CCA Research Coordinator & Agricultural Trainer

Daniela K. Riley, MBA

Office Manager