University of California, Santa Cruz

Seed Saving Strategies in San Ramon, Nicaragua

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BACHELOR OF ARTS

In

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by

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Abstract: In Nicaragua, farmer seed systems continue to remain poorly understood yet could provide food security at the local level while national agricultural production continues to experience harvest loss. At the local level, farmers are struggling to find successful basic grain varieties that are drought tolerant and adaptable to local environments. The purpose of this investigation is to both document and identify seed production of basic grains and seed loss experienced by rural farmers affiliated in a food security and food sovereignty partnership between the Community Agroecology Network (CAN) and the UCA San Ramon. I will conduct a qualitative survey with 1 seed bank manager and 30 households. The objective of this study is to continue capacity building of successful seed saving practices in order to strengthen food security projects with beneficiary households with the UCA San Ramon.

Keywords: Nicaragua, rural farmers, seed preservation, seed loss.

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Background: Seeds are an integral component to agricultural production throughout the developing world, with farmer -produced seeds as the primary source for subsistence farming. In Latin America, governments have established genetic improvements seed programs with the support of multilateral institutions for the development of agriculture sector in their countries ("Seed Policy and Programmes"). Nationally bred seeds and certified varieties from formal seed markets are promoted amongst rural farmers promising to improve yield outcomes and to create an export led economy. Despite the dissemination of formal seed varieties, agricultural systems continue to be driven by informal seeds systems (Almekinders, C. Louwaas, N. 2008). Informal seed sector and farmer seed production will be used alternatively to describe the flow of seeds used by farmers from local landraces.

Farmer seed systems are difficult to understand because "seeds are deeply embedded in in social relations and institutions that constitute the economic, political and cultural fabric of rural life" (Coomes et al. 2014). The production of seed by rural farmers in Central America has been limited to the adoption of agricultural technologies and the dissemination of seeds from formal seed markets. This present study examines farmer conservation strategies in the Central American country of Nicaragua and seeks to answer the following questions:

1. How are seeds being lost?
2. What is being done to conserve seed quality?
3. What could be improved?

Literature: Farmer seed production is based on a experiences and experimentation practices accumulated over time (Almenkinders, 2000). To maintain seed quality farmers implement both traditional preservation practices and disseminated agricultural technologies to maintain seed viability for the next harvest cycle. Preservation consists of the application of natural treatments, preventing seed loss from biological occurrences. Literature on seed production in Central America is limited in contrast to its counterparts in sub saharan Africa where development projects and government policies promoting green revolution technologies have had a mixed impact. In this paper, I first review the literature on seed storage, preservation of seed quality, agricultural technologies, and conclude with experienced seed damage.

Seed Storage: In Central America, metal silos have been the primary method to store seeds and maintain seed quality. Silos in Central America were introduced in by the Swiss Development Agency because farmers in the tropics experience great post harvest loss due to excess moisture and specialized insects in the region. Studies on the adoption of metal silos in Central America demonstrate that farmers store greater amounts of grain and have grain available for the next harvest. They are also able to take advantage of volatile grain prices (Coulter et al.1995).

The adoption of storage technologies is examined by Maonga et al. (2013) by analyzing how the adoption of metal silos affects the livelihood of small farmers in Malawi. Descriptive statistics and focus groups were conducted to understand farmers' perceptions to the adoption of silos. Farmer identified metal silos as effective for protection of grain against pests, as well as for moisture and potential theft (1542). Metal silos in Malawi also demonstrated to offer long-term storage of grain along with allowing farmers to sell their grains at higher prices. To date, no existing research has demonstrated a relationship between food security ands the use of silos. The overall effectiveness of metal silos is undetermined and additional seed storage methods should be investigated. Additionally, costs remain a barrier for small farmers to adopt silos despite being perceived as a great long-term investment.

In addressing seed loss by suboptimal storage materials, development agencies have introduced hermetic storage to improve seed loss without the use of pesticides (Bern et al. 2013). The purpose of hermetic storage systems is to limit gas exchange, increasing insect mortality due to low availability of oxygen. Hermetic storage is a viable alternative for preserving seed quality without using insecticides. Commercial insecticides are not cost effective, and can lead to health problems if misused.

In understanding the effectiveness of hermetic systems Groote et al. 2013 examined the implementation of hermetic storage containers and its ability to control insect pests. A total of six treatments: 3 different containers and 2 treatments were applied. Results demonstrated that metals silos were the most effective in controlling common insect pests like the maize weevil and the grain borer. In contrast, the researchers underlined that hermetic plastic bags (superbag) were not recommended for areas encountering grain borers. Trials of polypropylene bags without insecticide experienced the most damage from grain weevils.

Preserving Seed Quality: Nelson (2013) documented seed preservation methods carried out by farmers in Malawi and examined the efficacy of seed quality by testing germination rates. Practices for seed preservation used by farmers in Malawi consisted of grinding local leaves for allelopathic properties, natural insecticide of cow dung ashes and ashes of bean shells. Materials for seed storage included sacks, granaries, clay pots and smoking seeds on rooftops. The most inefficient methods were using sacks to store grain, granaries and smoking seeds. Sacks and granaries provided air circulation but did not provide moisture protection. Although smoking seed on the rooftop prevented insects, the seed were of low quality because of exposure to sunlight. Although there are drawbacks to each of the methods use, the author concluded that farmers mitigation practices were successful because they provided adequate, short term storage.

In examining seed germination, seeds that were saved in grinded leaves and insecticide surpassed the minimal germination rates. Ground leaves were primarily used because their were readily available and because farmers believe it to be the most effective method. The seeds saving in dung ash were just as successful as the seeds stored with insecticides. Traditional seed saving methods can also contribute to enhanced seed saving and food security. Even though insecticide provided quality seed preservation, there was no significant difference in seed viability.

Experienced Seed Damage: Once stored, seeds are susceptible to a series of damage from pests and disease. While many farmers take the precautions to prevent seed loss, some will experience grain loss while others may encounter no loss at all. In Central America, insects cause a 20-30% of grain loss in Central America with the most common pests to stored grains being: maize weevil, the large grain borer, and the Angoumois grain moth (Santos n.d.)

Farmers take a series of precautions to insure seed viability for their next harvest. Preventive practices require reducing moisture content in the grain by drying, limiting the amount of oxygen available in stored container and the usage of chemical control. Basic grains are stored in airtight containers that minimize the availability of oxygen. Any availability of oxygen will support the vitality of insects pests amongst the grains. Fungi is the most significant biological occurrence that causes crop deterioration ("FAO Action Programme"). Moisture content has been identified as the most important factor to grain storage. The most common practice to measuring grain moisture is a salt test, grains are placed into a glass container and is shaken. If salt particles remain on the glass, then grains have a humidity percent greater than 15%, and are not suitable for storage. Grain for storage is dried down to 13-12% moisture to prevent the metabolic activity of fungi. Rodents although less frequent, consume grains and cause damage to sacks.

Introduction of Study: In Nicaragua, farmer seed systems continue to remain poorly understood yet could provide food security at the local level while national agricultural production continues to lack economic planning to combat drought. Nicaragua is currently experiencing post harvests loss from drought driven conditions that are bringing challenges to food security of staple foods throughout the country. In encountering low bean harvests, the government of Nicaragua is importing bean reserves from the United States (La Prensa).

At the local level, farmers are struggling to find successful basic grain varieties that are drought tolerant and adaptable to local environments. The introduction of improved grain varieties are limiting the amount of local and creolized seed varieties farmers are saving. As a result, farmers are facing increasing challenges in identifying basic grain varieties that provide both subsistence and environmental resiliency.

Current/Proposed Project: The purpose of this investigation is to both document and identify seed production of basic grains and seed loss experienced by rural farmers affiliated in a food security and food sovereignty partnership between the Community Agroecology Network (CAN) and the UCA San Ramon (Union de Cooperativas Agropecarias de Augusto Cesar Sandino). The UCA San Ramon is a coffee based cooperative in Nicaragua that has been conducting food security based projects to reduce food insecurity amongst coffee farmers. I will conduct a qualitative survey with 1 seed bank manager and 30 households. The objective of the project is to continue capacity building of successful seed saving practices in order to strengthen food security projects with beneficiary households with the UCA San Ramon.

Study Site: The UCA San Ramon, is a union formed by multiple rural cooperatives surrounding the municipality of San Ramon, Nicaragua. It initially formed with the purpose of protecting the threatened land rights of cooperative members. Today, their mission is to build capacity among its associated cooperatives and commercialize their coffee. To meet this challenge and others related to agricultural production and food security, the UCA San Ramon began working with the Community Agroecology Network (CAN) at University of California, Santa Cruz in a food security project.

Through its partnership with (CAN) the UCA San Ramon has focused on relieving food insecurity and seasonal hunger amongst coffee farmers through food security based projects in six rural cooperatives. One of their goals for year four of their projects is to increase capacity building for seed saving in order to strengthen food security projects amongst project beneficiaries. Six associated cooperatives of the UCA San Ramon were selected because they have been piloting food security initiatives.

Methods: A pre-test was conducted with 8 project leaders from the UCA San Ramon, to pilot the interview questionnaire. Twenty-eight semi structured interviews of project beneficiaries were conducted in six cooperatives associated with the UCA San Ramon and CAN Food Sovereignty and Food Security Project. Individuals selected to be interviewed were identified by cooperative leaders based on their active practice of seed saving. Cooperatives interviewed were: Danilo Gonzalez, Ramon Garcia, Simon Bolivar, Denis Gutierrez, Silvio Mayorga and Sixto Sanchez. Interviews were conducted in the month of august in arrival of the first harvest cycle of basic grains. Interviews were conducted in participant households and in the fields. Information collected consisted of: types and varieties of seeds and basic grains, seed selection, methods of storage, and types of damage experienced. Interviews were conducted during the month of August during the first cycle of basic grain production.

Results and Discussion: Problems to seed saving consisted of 1) difficulty identifying adaptable varieties, few available creolized seed varieties and 2) damage by Curculionidae. Farmers saved between 1 to 3 varieties of both maize and beans, responding that few varieties successfully germinated, and provide adequate yields. Having a limited amount of varieties available makes it difficult for farmers to identify which varieties are most adaptable and ecologically resilient in their fields. In the more active coffee cooperatives, farmers complained about humid soils that would not allow for the adaption and growth of maize.

Farmers rely on hermetic plastic bags, silos and other airtight containers. Although the majority of farmers practicing hermetic storage experienced no damage (14 of 28 total responses), a significant amount of farmers (10 of 28 total responses) identified seed damage by Curulionidae. Weevils lay their eggs inside grains making it difficult for farmers to prevent insect larvae when storing seeds. Lesser damage experienced occurred from humidity and damage from rats. Humidity only occurred when farmers rushed the drying process or failed to do a humidity test with a sample of grains. Humidity was a primary problem at the seed bank level when farmer´s contributed seed.

Seed Preservation Treatments: To maintain seed quality while stored, farmers apply a treatment to maintain seed quality and to protect seeds from maize and bean weevils. Practices implemented consisted of:

- Secado/Drying- seeds selected from the middle of the best corn stalk were dried down to 12-14 % moisture prior to storage. Reducing the humidity prevents fungus and rot while in storage.
- Bolsa de Plastico/Hermetic Plastic Bags: hermetic bags have are used to eliminate oxygen that could keep weevils alive. Plastic bags are maintained inside a sac (usually a rice sac) in order to protect the plastic.
- Brosa de frijol/Fragments of Bean shells: the bits and pieces of bean shells are collected and stored amongst beans because it makes it difficult for weevils to move around after hatching from its larvae.
- Pastillas de Fasfomina /commercial Insecticides- insecticide in the form of pills are used to kill off weevil larvae amongst the stored seeds.
- Ajo/Garlic: Cloves of garlic are either wrapped in a cloth or placed in a container along the center of the sac. The garlic perforates becoming an irritant to the weevil.

Treatments were added to grain stored hermetically to further prevent seed loss by insect pests. Drying seeds was the most common method of treating seeds for storage. Although farmers recommended drying maize grains as an efficient treatment, results are inconclusive, requiring more research. In adopting silos for seed storage, many farmers demonstrated a fear in the toxicity of using fumigants, replying that they only use 1 pill or half a pill in their grain.

Placing cloves of garlic in hermetic bags was a less common treatment because it is a variable practice. Some farmer's perforated the garlic by placing it in a small plastic container with holes or in a cloth. Other would switch out the clove every 3 months. The most effective treatment for bean storage was using fragments of bean shells to prevent grain weevils. Farmers using this practice alongside hermetic bags escaped seed damage. During the interviews, a few farmers interviewed demonstrated an interest in having access to neem trees and using ashes from cow dung as a protection against insects.

Storage Materials Adopted: Hermetic plastic bags and sacs were the most common materials used by farmers to store their grains. This could be because hermetic bags provide the most fundamental prevention of weevils by depleting oxygen that would encourage their survival. Plastic bags are also easier to use for storing small quantities and more economically viable than silos. The plastic bags were maintained in plastic rice sacs from the purchase of rice for meals. Drawbacks to using plastic bags and was that they would experience damage from mice.

Farmers that reported having silos stored both maize and bean grains for the following harvest. Many farmers interviewed described their silos of being in poor condition, experiencing some damage from weevils due to damage on their silo. All farmers that used silos described using *ule de bicicleta,* plastic from bicycle wheels to hermetically seal their silo containers. Although silos have been widely distributed in Central America, for the farmers of San Ramon their adoption depended on the amount of kilos harvested. In order to benefit from a silo, farmers commented that they needed to produce a greater amount of kilos to fill silo containers. Silos also require maintenance of which many farmers may not be familiar with. In order to be effective, silos need to remain partially full of grain.

Other materials reported but used at a minimum were barrels and wooden granaries. Granaries are wooden structures with wired walls to dry whole corn stalks. Barrels of both plastic and metal from petroleum containers can serve as hermetic containers. Even though barrels could appear to be a more inexpensive alternative to silos, they are not designed to store grains and have a lower storage capacity. For this reason they are not commonly adopted as an alternative to silos. Drawbacks to using granaries are inconclusive since farmers did not describe any difficulties to using granaries.

Seed Bank Management: One community seed bank interview was conducted in the cooperative Ramon Garcia. Seeds from this community seed bank have been distributed to project beneficiaries of the UCA San Ramon. Seed bank managers have been experimenting with treatments of bean shells, and garlic cloves. The seed bank managers previously experiencing spoiled seeds and humidity from a treatment of garlic cloves. They are currently experimenting by placing garlic cloves in an enclosed container with holes. Beans have been treated with bean shell fragments and has proven to be highly successful. To prevent further seed loss, beans are maintained by community members who clean out the damaged seeds one month after it has been stored.

Challenges to maintaining seed quality in the seed bank has been humidity because community members may donate seeds that are not completely dry, and then those humid seeds get mixed with the already stored seeds. Other damage previously experienced is caused by insect pests which they have intervened by cleaning out the seed while stored.

Additional Seed Studies in San Ramon, Nicaragua: In 2008, a study by the organization Campesino a Campesino (Farmer to Farmer network) documented the amount of localized seed varieties conserved in the highlands of Matagalpa, Nicaragua.The investigation began when farmers protested the extensionists desire for farmers to adopt improved seed varieties in effort to improve their food security circumstances ("Bancos communitarios"). Farmer's underlined that there needed to be a greater emphasis in understanding of local seeds. In conclusion, the researchers found that localized varieties became indirectly displaced with the adoption of improved seed varieties.

In the report "Bancos Communitarios de Semilla" by UNAG the most common storage method were wooden granaries with light and air circulation to dry whole corn stalks. Silos were also a common storage method because it guarantees protection from pests and diseases. Treatments used in silos consisted of conventional fumigants and garlic in proliferating containers. The authors also concluded that silos were not the best solution because of their high costs (1,200-1,500 cordovas) is an inconvenience for farmer households. Storage methods that I did not encounter were corn stalks in the kitchen or hanging from trees. This could be because these strategies are used for very small amounts of seeds, while many of the farmers I interviewed are producing grain for household consumption.

In this study, a great variety of treatments were being applied to store beans. Examples of treatments were: ash from cow dung, ash from firewood, and ash from bean shells. Other less used treatments for beans were garlic cloves and chili peppers. The researchers stated that they found few treatments for maize but could not be listed. Damage experienced according to treatment was not documented. Treatments applied in silos were placing burning candles above the stored grain before sealing off the container. This practice would be a beneficial alternative for farmers in San Ramon who are currently placing fumigants to maintain their seeds. Farmers would need to be instructed on the steps needed to adequately place the candles.

Perforating garlic cloves was the most common treatment for seeds stored in plastic bags and sacs. The cloves are mashed and wrapped in a piece of cloth, then placed in the middle of the sac. Their recommendation is to use 1 clove of garlic per "quintal", every 100 kilos. The success of treatments used was not identified. For the farmers involved in the 2008 baseline study, developing community seed banks became a strategy to prioritize local seeds varieties and to conduct capacity building on seed saving. The cooperatives in the PCAC study have also identified poor quality soils as contributing to the lack of seed viability. Velvet bean cover beans have been used to increase soil quality.

Conclusion and Recommendations: Farmers affiliated with the UCA San Ramon use a myriad of practices to preserve seed quality for the next harvest cycle. This is because farmers adjust their seed production practices according to their experiences and any personal experiments. Farmers in San Ramon have been able to reduce seed loss by using hermetic storage systems but could benefit from experimenting with a greater variety of treatments for seed preservation. Silos could be made more available to farmers that experience seed loss by insect pests.

Experimental trials with additional seed treatments at the seed bank level could influence farmer's interest to experiment with different treatments and exchange information. Seed bank managers at Ramon Garcia could experiment with ash treatments and share their results. Establishing seed banks could improve the availability of seed varieties in the most marginal cooperatives along with improving genetic diversity and capacity building (Almenkinders, 2000).

Seed viability for seed saving depends on many factors. For the cooperatives of the UCA San Ramon, poor soils and the lack of rain made it difficult to prepare seed for the next cycle. Seed relief, the dissemination of improved varieties indirectly For highly impoverished thus increasing the use of improved seed varieties from formal seed sectors. The adoption of formal seed varieties, in particular INTA bean varieties that have been genetically bred and certified by the National Institute of Nicaraguan Agriculture (INTA) was significantly adopted by farmers associated with the UCA San Ramon. This could result because of farmer experiences with seed loss following crop failure and the inability to save seeds due to low yields (Almenkinders 2001).

In conclusion, farmers are highly proficient in conserving seeds. Their practices could benefit from being better understood by government agencies that are distributing formal seeds for adoption rather than helping farmers overcoming changing climate conditions. For farmers, local seeds are considered a more stable source of seed than the formal seed sector (Almenkinders, 2000). Support in connecting the work of farmer seed systems can be done by way of NGO's and extentionists. Although Almenkinders critiques the work of NGO's to be short term and extention service as short term and unreliable, there is a great deal of extention networks like campesino-a-campesino and CAN's work in food sovereignty and food security projects that could leverage the contribution of farmers in producing seeds. The farmers of San Ramon have a pool of resources and support to demonstrate the "formal" ability of farmer seed management.

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