



Practicum Team Final Report:

Sustainability and Business Recommendations for Agriculture for Africa

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Sustainability Recommendations for Agriculture for Africa

Over 2.6 million Cameroonians, or nine percent of the nation's population, experience acute food insecurity due to socio-political unrest affecting the North and Southwest regions (Food and Agriculture Organization [FAO], 2021). Without reliable access to sustenance or steady employment, many Cameroonian youths may resort to petty crimes to sustain themselves. The combined instabilities in the country have created a concerning trend of high incarceration rates among the young adult population. As these youths are released back into a world with limited access to education and employment opportunities, they experience high rates of re-imprisonment and become trapped in the prison system. A survey of prison populations in Cameroon found that 47% of incarcerated people had already been imprisoned at least once before (Besin-Mengla, 2020). Cameroon does not have systems in place to prevent incarceration or recidivism, leaving young people without the resources to become self-sufficient or overcome challenges borne from the stigma surrounding imprisonment.

Agriculture for Africa (A4A) draws on the values and mission of the National FFA Organization to create a pathway for leadership and careers in agriculture. In November 2020, A4A launched a pilot implementing agricultural education curriculum with one of Africa's most marginalized groups—incarcerated youth. This pilot program works to address food insecurity and high rates of re-incarceration by creating stable sources of food and providing educational opportunities to imprisoned populations in Nkongsamba, Cameroon. A4A's curriculum teaches incarcerated youth technical and interpersonal skills, supporting the participants in developing confidence through teamwork, hands-on activities, and mentorship. At the end of the program, participants will have gained the knowledge to become agricultural entrepreneurs, or agripreneurs. A4A aims to become a replicable and sustainable model for prisons across the country to maximize the program's social, economic, and environmental impact. A collaborative partnership has been established between A4A and the UCLA Institute of the Environment and Sustainability (IoES) practicum team to advise the organization on sustainable best practices to adopt.

The IoES research project aims to address the environmental impact of A4A's agricultural program by recommending the implementation of sustainable practices suited to the program's needs. To achieve this goal, research was conducted to identify global best practices of sustainable agriculture and agribusiness programs in prisons. In addition to sustainable best practices, the project investigated the expansion of A4A's curriculum through an introduction of agribusiness concepts as well as improvements to the program's operational efficiency. For each area of research, the project examined how to tailor recommendations to the circumstances of A4A and Nkongsamba as a whole. The project discusses the adoption of some best practices into A4A's program: biochar and fungal spray, the production of homemade fish feed, composting, crop rotation, GPS surveying, plastics upcycling, natural pest management, and business education. Recommendations have been compiled into a comprehensive report including educational workbooks, lesson plans, and posters that can be incorporated into A4A's program and curriculum.

Methods

Research was first conducted by assessing primary and secondary sources available on online databases and websites. In particular, recent scientific studies, data released by relevant organizations, websites, and other publications pertaining to areas of focus were examined. Notes were compiled on documents and spreadsheets in a shared Google Drive, allowing data to be organized in a collaborative manner.

In addition to online research, collaborative exchanges with experts in Cameroon were carried out to better understand how to apply research findings to Cameroon's geographic and cultural context while building upon pre-existing knowledge from our literature reviews. Additionally, experts from the International Institute of Tropical Agriculture (IITA), including Dr. Adalbert Onana and Dr. Samuel Nanga, provided valuable feedback on the content of the composting manuals, ensuring that recommendations for compost pile construction and maintenance were relevant to the climate of Cameroon. The Moungo Divisional Delegate of Cameroon's Ministry of the Environment and Sustainable Development, Mr. Paul Mbeng Mbog, was also contacted for guidance in his areas of environmental expertise.

Lastly, a site visit was conducted to collect primary data about A4A's curriculum, participants, and current practices. The team visited the prison and farm sites in Nkongsamba, Cameroon, from March 21 through 24, 2022. All information gathered was documented in notebooks that were updated regularly throughout the trip. While in Nkongsamba, the team met with government officials and stakeholders in the program, including the agripreneurs, A4A staff, and prison staff, to learn about their existing partnerships with A4A. Informal interviews/discussions were conducted with the agripreneurs to gauge their opinions about the program. Furthermore, assessments of the farm plots allowed the team to understand the state of the land and the program's plan for its use. The information gained from the trip allowed for an adaptation of key findings and recommendations from previous research to fit the circumstances and needs of the program.

Alternatives to Slash-and-Burn Practices

Slash-and-burn agriculture is widely used in this region where the land is clear cut and any remaining vegetation burned to provide a nutrient-rich layer of ash to help fertilize crops (Figure 1). This method has been shown to be highly unsustainable as its impact is particularly destructive, exacerbating destructive impacts on already-fragile ecosystems and contributes to climate change.(Tang, 2020). Crop burning is also known to cause significant air pollution from greenhouse gas emissions (Thiagarajan, 2022). Fortunately, there are many potential alternatives to this practice including the creation of biochar (see below) and the use of fungal sprays.

Rather than allowing mounds of vegetation to dissipate into the atmosphere, the char from burning plants can be used as a fertilizer. Slash-and-char is a simple system that produces biochar, a high-pH material rich in nutrients and microbial diversity. While there are more complicated methods of producing biochar involving pyrolysis, a less intensive procedure can be implemented on smallholder farms. In the traditional system, earthen pits are filled with above-ground biomass to then be mixed into the soil. This method allows for higher carbon sequestration rates and less harm to the environment while improving soil health (Liang, 2018). Utilizing biochar in place of fertilizer saves money and avoids other issues such as eutrophication from stormwater runoff and human cancer risk. Biochar also increases water retention in soil and promotes plant growth (Nkengafac, 2020). While biochar is effective in mitigating pollution, the land is only fertile for a limited time before nutrients are no longer available.

A more involved alternative to slash-and-burn is the use of a microbial spray to reach rapid rates of decomposition. First developed in Northern India, this concoction includes seven fungal species that are naturally occurring in soil and quickly turn plant residue into compost with their digestive enzymes. To make the spray, a single fungal capsule is combined with five liters of water, 150 grams of cane sugar, and 15 grams of chickpeas as a source of protein (Md biocoals Pusa Decomposer Capsule). The mixture is then fermented for three days, and 25 liters of the solution are to be sprayed over one hectare for a two-week period (Tang, 2020). These fungal capsules may be bought from Pusa Decomposer in a pack of four for less than 2500 CFA total.

Figure 1



Slash and Burn in Agripreneur Field Site in Nkongsamba, Cameroon.

Note: IoES students and A4A intern stand behind burned area on farm property in March 2022.

In addition to incorporating fungal spray and biochar into soils, farmers are also recommended to intercrop a variety of plants to prevent the invasion of weeds such as elephant grass to minimize the initial need for slash-and-burn. It is also critical to allow land to fallow at certain points in the year to regenerate soil. By incorporating biodiversity and cover crops during this period of fallow land, the space will be utilized to prevent weeds from dominating (Thiagarajan, 2022). Further, planting perennial crops will help to reduce dead plant matter to be removed. Combining all of these methods will ensure a productive farm that is healthy for people and the local environment.

Production of Homemade Catfish Feed

Catfish farming has become the most popular aquaculture business in Cameroon due to the growing demand for catfish in local markets (Kouam, 2022). While catfish farming can be a profitable business endeavor, farmers with limited financial capital struggle to afford the large cost of catfish feed. Creating homemade feed provides a solution to this expense and gives farmers the freedom to curate feed based on available resources and the specific needs of their catfish populations (Siregar & Dewi, 2019). When making feed, it is important to meet all nutritional requirements to promote fish growth, fish quality, and processed yield (Li & Robinson, 2013). Other factors to consider when making homemade feed are its digestibility, the ability to withstand the manufacturing process, and the consistent availability of resources (Robinson & Li, 2015).

Catfish feed should contain a minimum amount of protein, carbohydrates, and fats (Robinson & Li, 2015). While carbohydrate and fat minimums are typically easier to reach when crafting feed, it takes careful planning to meet adequate concentrations of protein because it is essential for providing energy, replacing damaged cells, and helping the fish grow (Armen, 2019). Catfish protein needs vary based on lifecycle stage: Frys (<4 cm in length) require 50% of their feed to be protein, fingerlings (4-6 cm in length) require 32-36% of their feed to be protein, and adult catfish require 28-32% of their feed to be protein (Chapman, 2018).

Protein for catfish feed can be derived from both animals and plants. While plant protein is often cheaper than animal protein, it can lack essential amino acids and nutrients. Certain plant proteins thus require supplemental additives like lysine and phosphate (Wilson, 1981). Soybean meal has high-quality protein content and amino acid abundance and therefore does not need any supplements (Towers, 2013). Cottonseed meal is another great protein source that can be used with or instead of soybean meal with lysine supplements (Towers, 2013). Similarly, corn gluten feed, wheat middlings, peanut meal, and distilled dried grains with solubles can provide protein (Armen, 2019). However, no more than 30% and 25% of the catfish diet can consist of corn gluten feed and wheat middlings, respectively (Wilson, 1981).

In regard to animal protein, fish meal provides ample digestible protein and an abundance of available energy, fatty acids, and minerals. Porcine meat and bone also have a high protein content but would require additional lysine supplements and should not exceed 15% of the total

diet (FAO, 2002). Finally, poultry by-product meal can be expensive but has a high protein concentration and is a great option when resources are available (FAO, 2002).

Maggot meal is another viable protein option for fish feed when used as the sole animal protein in a nutritionally balanced diet (Fasakin, 2003). Studies show that maggot meal has a crude protein value of 43-62% and an amino acid profile comparable to fish meal (Aniebo et al., 2009). Various African catfish farmers have begun incorporating maggot meal into their catfish feed due to its low cost, easy production, and decreased waste (Aniebo et al., 2009). There are multiple ways to produce the maggots required for maggot meal. Maggots grow on multiple organic wastes including pig dung, cattle gut and rumen content, cattle blood and wheat bran, and poultry manure (Hezron et al., 2019). To attract flies, a mixture of 100 kg of cattle blood and 20 kg of fish or rotten food should be spread on a floor space so that the mixture is 3 cm thick. Another method of attraction is to collect poultry droppings in shaded concrete tanks and sprinkle them with water twice a day (Fasakin, 2003). The odor of either method will attract flies to lay their eggs, which take one to two days to hatch into larvae and another two to four days to mature and then be harvested (Aniebo et al., 2009). A study using poultry manure found that putting a cup of water in the middle of the concrete tank and dampening the surrounding of the cup causes maggots to crawl towards the wet area after about 30 minutes, simplifying the maggot harvesting process (Fasakin, 2003). Mature maggots should be sun-dried and then milled before incorporating into the feed mixture (Aniebo et al., 2009). Once milled, the maggot meal can be incorporated into a nutritionally balanced catfish feed mixture. See Table 1 for an example recipe of catfish feed with maggot meal.

Table 1

Sample of Fish Feed Contents Utilizing Maggot Meal, Fishmeal, and Soybean Meal as the Main Protein Source

Ingredients	Reference diet	Dietary treatment			
		ODM"	SDM 1	DODM ‡	DSDM 6
Fishmeal (65.0%)	25	÷	ē.	iec -	÷.
Oven-dried maggot meal (47.7%)	-	33.5	-	-	~
Sun-dried maggot meal (45.3%)	-	-	35	27	
Defatted oven-dried maggot meal (58.4%)	-	-	-	-	32
Soybean meal (45.0%)	36	36	36	36	36
Bloodmeal (80.0%)	9	9	9	9	9
Maize	22	14.5	13	25	15
Vegetable oll	2.5	2	2	2.5	2.5
Cod liver oil	1.5	Ť	1	1.5	1.5
Vit-Min Premix¶	2	2	2	2	2
Starch	2	2	2	2	2

In addition to protein sources, corn is an essential ingredient in catfish feed. At least 15% of the diet of catfish should consist of corn because it ensures that feed pellets expand and float (Wilson, 1981).

Once the ingredient composition of catfish feed has been determined, the pellets can then be manufactured. While the manufacturing process can be carried out with little to no technology use, it is quicker and more efficient when it incorporates dynamic technologies. First, all raw materials should be crushed using everyday dense objects or with hammer mills. Once crushed, the raw materials should be mixed thoroughly either by hand or with a grain power mixer (Femi, 2018). Next, the mixture should pass through an extruder to form pellets of similar lengths (Femi, 2018). Pellets can then either be dried out by spreading them on a sheet outside in the sun or with a feed pellet dryer (Femi, 2018). Finally, spray the pellets with oil or animal fat to help bind the pellets and reduce pellet dust (Femi, 2018).

A4A should experiment with different feed compositions consisting of adequate protein, amino acids, corn, and fats. It is recommended that A4A focus on locally sourcing soybean meal, cottonseed meal, corn gluten feed, wheat middlings, and peanut meal as a source of plant protein when available and affordable. Additionally, any surplus crops cultivated by A4A that are not sold or consumed can go towards the production of catfish feed. To produce a reliable and inexpensive source of protein, A4A should experiment with maggot meal production using pig dung and poultry manure as growth mediums because these materials are readily available at Nkongsamba prison. The catfish feed recipe books, located in Appendix A, serve as a guide to creating different catfish feeds. In short, A4A should focus on a feed composition that includes available and affordable ingredients to save money and create a more profitable catfish business.

The Benefits of Composting

Compost is a natural form of fertilizer made from plant waste and manure that can be applied to farms in place of conventional chemical fertilizers (Diaz et al., 2007). While the chemical composition of compost may vary slightly from store-bought fertilizers, it is a rich amendment that can help with soil health and benefit crop production at a very low cost (Martínez-Blanco et al., 2014). Integrated soil fertility management is another method that can be implemented to complement the compost additions with mineral fertilizers containing any nutrients that may be lacking (Sanginga & Woomer, 2009). In this method, soil nutrient levels are measured so that only the missing nutrients are applied, eliminating the waste involved in applying nutrients that are already present (Sanginga & Woomer, 2009).

A typical compost pile is a minimum of one cubic meter in size in order for the proper decomposition processes to occur and for the pile to reach temperatures high enough to kill any harmful pathogens (Misra et al., 2003). Optimal decomposition occurs with a combination of one part carbon-rich materials (eg. branches, dry corn cobs and stalks, and ash) and one part nitrogen-rich materials (eg. leaves from leguminous plants and manures) (Misra et al., 2003). To speed up compost production, the implementation of a thermophilic composting system is recommended. This system allows the pile to reach temperatures of 50°C three times throughout the process, killing any harmful microbes while increasing the decomposition rate.

Some useful equipment for generating the compost includes shovels and pitchforks to turn the pile, a thermometer to measure the internal temperature of the pile, and watering cans to ensure the pile maintains an optimal level of moisture. Additionally, plastic sheets can be used to cover the pile during the rainy season to prevent it from getting too wet. When the compost is finished, sieves (see Figure 3) are helpful for separating any larger, undecomposed contents of the pile from the finished product, which resembles dark soil.

Figure 3

Compost Sieve being used to Separate Finished Compost



Using dead plant materials readily available on farm plots after harvest and organic household wastes produced in Nkongsamba, the agripreneurs can create their own compost to serve as nutrient-rich fertilizer for their own farms. This process is inexpensive, straightforward, and produces a finished product rich in nutrients that supports crop growth and soil health. Local materials that can be composted to generate fertilizer include manure, dried corn stalks and cobs, diluted urine, ash, fruit and vegetable scraps, which can be collected from local waste disposal sites, and the residues of leguminous plants such as *Gliricidia sepium*, *Crotalaria*, *Leucaena*, *Sesbania sesban*, *Lantana*, and *Tithonia diversifolia* (Onana, 2022). Given the benefits of compost and integrated soil fertility management, these practices should be integrated on the A4A farm sites as a local fertilizer solution. To support the implementation of composting on A4A farms, a composting manual has been prepared for both the A4A staff and the agripreneurs along with a workbook and posters to further their understanding of the topic (see Appendix B).

Crop Rotation, Intercropping, and Push-Pull Technology

Cultivating high-value crops is a good way to maximize profits on a farm. However, monocropping can lead to increased pest prevalence and decreased soil fertility (Hailu, 2015). Some potential solutions to these issues are push-pull technology, crop rotation, and intercropping, all of which involve planting different plant species to prevent pests from persisting in the soil and replenish soil health. These methods can be used to increase crop yields, though some may be more beneficial to Agriculture for Africa than others depending on whether the main objective is increased soil fertility or pest management.

Push-pull technology uses plant species that repel pests within crop fields and plants that attract them along the borders of fields to guide pests away from valuable crops. Push-pull technology can be used to address pests such as the fall armyworm by disincentivizing them from feeding on the main crop. For example, *Desmodium uncinatum* or *Desmodium intortum* (Figure 4) can be planted between maize crops to repel fall armyworm, while Elephant grass, *Pennisetum purpureum* (Figure 5), which grows naturally in these areas, can be left along the border of the plot when clearing fields to draw the pests away from the maize (Hailu et al., 2018; Midega et al., 2018; Khan et al., 2011). This method has resulted in a significant reduction in armyworm infestations on farms in Uganda and Ethiopia (Hailu et al., 2018; Haftay et al., 2020).

Figure 4

Desmodium intortum, a Plant that can Repel Fall Armyworm



(Gardiner, n.d.) Figure 5 Elephant Grass, a Plant that can Attract Fall Armyworm



Crop rotation is the cultivation of different plant varieties in a sequence. For example, one form of crop rotation is the cultivation of one crop in the dry season and a different one in

the wet season. Studies have found that yields are higher in fields using crop rotation than in fields only planting maize (Chabi-Olaye et al., 2005; Acevedo-Siaca et al., 2020). However, increased nutrient levels in the soil lead to higher plant nutrient uptake, which may attract more pests in the early stages of growth. This may not affect yields though, as plants mature and fight off the pests (Chabi-Olaye et al., 2005). It is important to be aware of this potential consequence of crop rotation before implementing this practice.

Cultivating one crop species on an entire farm will decrease biodiversity and increase the susceptibility of crops to pests, disease, and soil degradation, whereas intercropping high-value crops with nitrogen-fixing plants increases soil fertility to improve maize production. The type of beans cultivated alongside maize may be chosen based on optimal productivity and cost-effectiveness, while neem is advised as a living fence around the crop space to fix nitrogen and reduce pests.

Intercropping involves planting different crops at the same time and results in the highest yields when different crops are planted in the same row. If different crops are separated into different rows, intercropping will produce lower yields (Kermah et al., 2017; Rusinamhodzi et al., 2012). Intercropping can be especially beneficial when practiced in fields with poor soil fertility because there is lower competition for light and the impact of nitrogen fixation by leguminous plants is greater (Kermah et al., 2017). While this method is more labor-intensive than monocropping, the potential benefits of increased soil fertility and reduced pest prevalence outweigh the costs in the long-term.

Intercropping and crop rotation can be used to address the nutrient demands of maize, a crop favored by the agripreneurs and the A4A program. If fields are consistently planted with maize, chemical fertilizers will be necessary to maintain high yields. Planting leguminous, nitrogen-fixing plants in between maize plants can increase nitrogen levels in the soil, reducing chemical fertilizer demands (Chabi-Olaye et al., 2005). Leguminous plants that may be grown in Sub-Saharan Africa include cowpea, groundnut, soybean, pigeon pea, and beans. Soybeans may be less successful when used in crop rotation in Sub-Saharan Africa, given that native populations do not directly consume it and it has a high nutrient demand (Acevedo-Siaca et al., 2020). See Appendix D for a guidebook on nitrogen fixing plants.

A4A should consider using push-pull technology to address armyworm infestations rather than using chemical pesticides. The A4A program should test out crop rotation and intercropping on its farm sites to assess its benefits because these techniques can reduce the need for synthetic fertilizers, thus lowering crop production costs and increasing profits. For example, one of the agripreneurs, Elvine, planted her entire plot with corn. In order to implement intercropping, she could plant one row of groundnuts, or another leguminous plant, for every two rows of corn. Alternatively, crop rotation could be used by dividing the field into four sections (A, B, C, and D), sowing sections A and C with corn, and planting sections B and D with another leguminous plant, then rotating these crops. This way, in the next season, the nitrogen content of sections A and C will be replenished while the corn benefits from the nitrogen fixed in the soil in sections B and D.

Geographic Information Systems (GIS) Plot

Figure 6 represents a map of the farm of a graduated agripreneur, Elvine, in Nkongsamba, Cameroon, with recommended cropping choices. The map emphasizes an avoidance of monocropping by suggesting intercropping maize with beans to build soil health. In addition to recommended crop selections, the map identifies the farm's perimeter and area, which were calculated by a GPS device used to survey the plot. The IoES practicum team hosted an instructional session with A4A's interns about how to use a geographic positioning systems (GPS) device to survey farm plots, allowing the program to pass down the knowledge to other staff members and improve upon its surveying techniques. If desired, staff can also learn how to convert the data from GPS surveys into maps for the program. Digital mapping is a highly valuable skill which A4A staff can use to neatly design and display farm properties.

This map is based off of a shapefile of the farm plot created from the GPS device given by the team to A4A. A survey of the site with the device produced a digital representation of the plot shape as well as its associated perimeter and distance. The shapefile on the GPS device comes with a set of longitude and latitude coordinates that were virtually displayed using geographic information systems (GIS) software.

Figure 6

GIS Map of the Farm Managed by Elvine, a Graduated Agripreneur



Note: This map shows an example crop arrangement for Elvine's farming space, including intercropped corn and beans with a living fence of neem to fix nitrogen.

The Consequences of Plastics in Soil

600,000 tonnes of plastic are disposed of each year in Cameroon (Sondo, 2021). Because of poor waste management and a lack of recycling programs, this plastic is often disposed of in unauthorized dumping sites and often ends up on agricultural lands (Nkwachukwu, 2013). Plastic can remain in agricultural soil for hundreds to thousands of years, where it breaks down and becomes harmful to crops and human health. Although Cameroon made great strides when the Ministry of the Environment, Nature Protection and Sustainable Development banned the use of non-biodegradable plastic packaging of fewer than 60 microns in 2014, plastic is still found

littered throughout Cameroon's valuable farmland (Magoum, 2021). Agriculture for Africa's program should encourage the agripreneurs to remove, and either reuse or recycle, plastics from the lands they plan to cultivate.

The presence of plastic waste in farm soil poses a risk to both crop and human health. Plastic debris littering the soil will gradually decay to minute fragments (<5mm) and become classified as microplastics (Sajjad, 2022). The presence of microplastics is associated with a decrease in nutrients and water uptake in crops as well as lower species biodiversity within the soil, including species that help promote soil fertility (i.e. mites and larvae). These consequences adversely affect crop growth, development, and production (Sajjad, 2022). In particular, multiple studies have found evidence of the negative consequences of microplastics on specific crops including lettuce, corn, and tomato (Sajjad, 2022). Additionally, microplastics in the soil create significant changes in plant biomass, tissue elemental composition, root traits, and soil microbial activities (de Souza Machado et al., 2019). Microplastics can also create biogeochemical changes when toxins like polyvinyl chloride leach into the soil (de Souza Machado et al., 2019).

As plastics decompose, additives like phthalates and bisphenol leach into the soil and cause harm to organisms. Additives can disrupt hormone systems, while nano-sized particles can cause inflammation, traverse cellular barriers, pass through membranes like the blood-brain barrier, and even enter placentas (UNEP, 2021). The harmful chemicals released by degrading plastics can also seep into groundwater and other water sources, creating potential negative health effects for those that consume this water (UNEP, 2021).

A popular form of plastic waste management in Cameroon is incineration. However, incineration is not a recommended waste management practice because it releases harmful toxins and vapors into the atmosphere (Nkwachukwu, 2013). The best way to manage plastic waste is to reuse it, thereby extending its lifecycle and avoiding the use of new plastics. Agripreneurs should remove plastics from agricultural land and collect them in secure containers. Collected plastic can be reused as a material in upcycled products as shown in the attached upcycled plastic project guide (Appendix F). Any plastics that cannot be upcycled should be collected in large bins onsite (bins can be made from upcycling bottles) and recycled by arranging for a pickup through recycling centers in Douala.

Areas of Future Research

Considerably more men have participated as agripreneurs in the A4A program, with only two female agripreneurs graduating from the agricultural program between two cohorts of agripreneurs. Determining causes for the significantly disproportionate ratio of male to female participants is worth a closer examination. Increasing rates of female participation in A4A's program can help incarcerated women gain independence post-release and learn important skills to apply to support their families. In rural Cameroon, three-quarters of farmers are women and therefore should be better represented within the A4A program (Molua, 2011). With women responsible for most crop production activities, they would benefit most from learning how to establish sustainable and successful farm businesses. A4A should continue leveraging

Cameroon's Ministry of Women's Empowerment and the Family, to explore ways to increase female participation in the agriculture program. Collaboration with local female prisons should be considered as well to identify ways to accommodate more women in the program.

A4A's transition to sustainable agriculture will take time due to financial limitations and other constraints. In order to achieve a fully regenerative system, recommendations must be tailored to A4A's circumstances and be presented as discrete goals. Certain recommendations included in this report are not feasible to incorporate at this point in time, therefore it would be of great use to create a timeline for the incremental implementation of recommended sustainable practices. The timeline should detail the costs, materials, labor, and time commitment associated with the implementation of each recommended practice that A4A seeks to adopt. Additionally, it is important to take into account cultural factors that could deter the program from implementing certain recommendations. A deeper analysis of how these cultural factors affect A4A's willingness and ability to adopt more sustainable practices would benefit the design of the timeline.

Conclusion

Sustainable recommendations founded upon a comprehensive investigation into A4A's farming practices and teaching curriculum have been presented to A4A. The following represent the UCLA IoES team's recommended best practices for A4A to adopt over time: the application of biochar or fungal spray, the production of homemade catfish feed, plastics collection and upcycling, composting, crop rotation, intercropping, push-pull technology, GPS surveying, natural pest management, and the integration of business concepts into the program curriculum. See the appendix for all detailed explanations of the recommendations included in this report. The recommendations emphasize the importance of sustainability for the organization as well as the environment. Should a partnership with UCLA continue, it is our hope that A4A is paired with a new round of students to build upon the work that has been done thus far. This could include our proposed future research and will be determined by the progress of A4A at the time. The IoES practicum team wants to ensure the long-term prosperity of A4A to maximize the program's impact on incarcerated youth and local food availability.

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Appendix A: Catfish Feed

Fry Fish Food

Ingredients

- 230 grams of soybean meal
- 150 grams of groundnut cake
- 5 grams of catfish feed premix
- 430 grams of fishmeal
- 160 grams of corn grain
- 20 grams of animal fat/oil

Directions

- Crush the raw materials (everything but animal fat/oil)
 a. Use a hammer mill for better efficiency
- 2. Mix the raw materials
 - a. Mix powder ingredients first, then mix in all other ingredients besides animal fat/oil
 - b. Add water in small increments and mix until the mixture is a 'mash' consistency
 - i. Use a power mixer for greatest efficiency
- 3. Extrude the pellets
 - a. Set the extruder to desired diameter
 - b. Pass the mixture through the pellet extruder
- 4. Dry the pellets
 - a. Spread the pellets on flat surface in direct sunlight and allow moisture to evaporate
 - b. Make sure the pellets are spread in a single layer
- 5. Spray the pellets with fat/oil
 - a. Spray evenly with animal fat or oil to help bind pellets







Fingerling Fish Food - 36% Protein

Ingredients

- 501.5 grams of soybean meal
- 100 grams of cottonseed meal
- 100 grams of porcine meat & bone meal
- 200 grams of corn grain
- 55 grams of wheat middlings
- 2.5 grams of dicalcium phosphate
- 30 grams of animal fat/oil

Directions

- 1. Crush the raw materials (everything but animal fat/oil)
 - a. Use a hammer mill for better efficiency
- 2. Mix the raw materials
 - a. Mix powder ingredients first, then mix in all other ingredients besides animal fat/oil
 - b. Add water in small increments and mix until the mixture is a 'mash' consistency
 - i. Use a power mixer for greatest efficiency
- 3. Extrude the pellets
 - a. Set the extruder to desired diameter
 - b. Pass the mixture through the pellet extruder
- 4. Dry the pellets
 - a. Spread the pellets on flat surface in direct sunlight and allow moisture to evaporate
 - b. Make sure the pellets are spread in a single layer
- 5. Spray the pellets with fat/oil
 - a. Spray evenly with animal fat or oil to help bind pellets







Adult Cat Fish Food A - 32% Protein

Ingredients

- 410 grams of soybean meal
- 100 grams of cottonseed meal
- 50 grams of porcine meat & bone meal
- 200 grams of corn grain
- 182 grams of wheat middlings
- 5 grams of dicalcium phosphate
- 20 grams of animal fat/oil

Directions

- 1. Crush the raw materials (everything but animal fat/oil)
 - a. Use a hammer mill for better efficiency
- 2. Mix the raw materials
 - a. Mix powder ingredients first, then mix in all other ingredients besides animal fat/oil
 - b. Add water in small increments and mix until the mixture is a 'mash' consistency
 - i. Use a power mixer for greatest efficiency
- 3. Extrude the pellets
 - a. Set the extruder to desired diameter
 - b. Pass the mixture through the pellet extruder
- 4. Dry the pellets
 - a. Spread the pellets on flat surface in direct sunlight and allow moisture to evaporate
 - b. Make sure the pellets are spread in a single layer
- 5. Spray the pellets with fat/oil
 - a. Spray evenly with animal fat or oil to help bind pellets







Adult Cat Fish Food B - 32% Protein

Ingredients

- 332.5 grams of soybean meal
- 250 grams of cottonseed meal
- 182.1 grams of corn grain
- 200 grams of corn gluten feed
- 10 grams of dicalcium phosphate
- 3.4 grams of lysine HCl
- 20 grams of animal fat/oil

Directions

- 1. Crush the raw materials (everything but animal fat/oil)
 - a. Use a hammer mill for better efficiency
- 2. Mix the raw materials
 - a. Mix powder ingredients first, then mix in all other ingredients besides animal fat/oil
 - b. Add water in small increments and mix until the mixture is a 'mash' consistency
 - i. Use a power mixer for greatest efficiency
- 3. Extrude the pellets
 - a. Set the extruder to desired diameter
 - b. Pass the mixture through the pellet extruder
- 4. Dry the pellets
 - a. Spread the pellets on flat surface in direct sunlight and allow moisture to evaporate
 - b. Make sure the pellets are spread in a single layer
- 5. Spray the pellets with fat/oil
 - a. Spray evenly with animal fat or oil to help bind pellets







Adult Cat Fish Food C - 32% Protein

Ingredients

- 306 grams of soybean meal
- 250 grams of cottonseed meal
- 150 grams of corn grain
- 108.2 grams of wheat middlings
- 150 grams of distiller's dried grains with solubles (27%)
- 10 grams of dicalcium phosphate
- 3.8 grams of lysine HCI
- 20 grams of animal fat/oil

Directions

- 1. Crush the raw materials (everything but animal fat/oil)
 - a. Use a hammer mill for better efficiency
- 2. Mix the raw materials
 - a. Mix powder ingredients first, then mix in all other ingredients besides animal fat/oil
 - b. Add water in small increments and mix until the mixture is a 'mash' consistency
 - i. Use a power mixer for greatest efficiency
- 3. Extrude the pellets
 - a. Set the extruder to desired diameter
 - b. Pass the mixture through the pellet extruder
- 4. Dry the pellets
 - a. Spread the pellets on flat surface in direct sunlight and allow moisture to evaporate
 - b. Make sure the pellets are spread in a single layer
- 5. Spray the pellets with fat/oil
 - a. Spray evenly with animal fat or oil to help bind pellets







Adult Cat Fish Food D - 28% Protein

Ingredients

- 329 grams of soybean meal
- 100 grams of cottonseed meal
- 50 grams of porcine meat & bone meal
- 250 grams of corn grain
- 243.2 grams of wheat middlings
- 5 grams of dicalcium phosphate
- 0.8 grams of lysine HCl
- 20 grams of animal fat/oil

Directions

- 1. Crush the raw materials (everything but animal fat/oil)
 - a. Use a hammer mill for better efficiency
- 2. Mix the raw materials
 - a. Mix powder ingredients first, then mix in all other ingredients besides animal fat/oil
 - b. Add water in small increments and mix until the mixture is a 'mash' consistency
 - i. Use a power mixer for greatest efficiency
- 3. Extrude the pellets
 - a. Set the extruder to desired diameter
 - b. Pass the mixture through the pellet extruder
- 4. Dry the pellets
 - a. Spread the pellets on flat surface in direct sunlight and allow moisture to evaporate
 - b. Make sure the pellets are spread in a single layer
- 5. Spray the pellets with fat/oil
 - a. Spray evenly with animal fat or oil to help bind pellets







Adult Cat Fish Food E - 28% Protein

Ingredients

- 253.5 grams of soybean meal
- 200 grams of cottonseed meal
- 200 grams of corn grain
- 110.8 grams of wheat middlings
- 200 grams of corn gluten feed
- 10 grams of dicalcium phosphate
- 3.7 grams of lysine HCI
- 20 grams of animal fat/oil

Directions

- 1. Crush the raw materials (everything but animal fat/oil)
 - a. Use a hammer mill for better efficiency
- 2. Mix the raw materials
 - a. Mix powder ingredients first, then mix in all other ingredients besides animal fat/oil
 - b. Add water in small increments and mix until the mixture is a 'mash' consistency
 - i. Use a power mixer for greatest efficiency
- 3. Extrude the pellets
 - a. Set the extruder to desired diameter
 - b. Pass the mixture through the pellet extruder
- 4. Dry the pellets
 - a. Spread the pellets on flat surface in direct sunlight and allow moisture to evaporate
 - b. Make sure the pellets are spread in a single layer
- 5. Spray the pellets with fat/oil
 - a. Spray evenly with animal fat or oil to help bind pellets







Adult Cat Fish Food F - 28% Protein

Ingredients

- 223 grams of soybean meal
- 200 grams of cottonseed meal
- 150 grams of corn grain
- 241 grams of wheat middlings
- 150 grams of distiller's dried grains with solubles (27%)
- 10 grams of dicalcium phosphate
- 4 grams of lysine HCl
- 20 grams of animal fat/oil

Directions

- 1. Crush the raw materials (everything but animal fat/oil)
 - a. Use a hammer mill for better efficiency
- 2. Mix the raw materials
 - a. Mix powder ingredients first, then mix in all other ingredients besides animal fat/oil
 - b. Add water in small increments and mix until the mixture is a 'mash' consistency
 - i. Use a power mixer for greatest efficiency
- 3. Extrude the pellets
 - a. Set the extruder to desired diameter
 - b. Pass the mixture through the pellet extruder
- 4. Dry the pellets
 - a. Spread the pellets on flat surface in direct sunlight and allow moisture to evaporate
 - b. Make sure the pellets are spread in a single layer
- 5. Spray the pellets with fat/oil
 - a. Spray evenly with animal fat or oil to help bind pellets







Appendix B: Composting Manuals and Posters

Composting Manual for A4A Staff







Agriculture for Africa Environmental Science Practicum Team 2022

Purpose:

This manual is intended to introduce the A4A staff to the concept and practice of composting. After reviewing the content in this manual, the A4A staff should be able to teach the agripreneurs how to create their own compost, referring to local resources if there are any issues that need to be addressed before instructing the agripreneurs. The A4A staff can decide if they would like to directly reference this manual when teaching the agripreneurs.

Overview:

Composting is a relatively simple process that turns plant waste into a soil amendment rich in nutrients. Using plant materials found on the A4A farm sites and food scraps generated by the prison and the local community, waste can be diverted from trash heaps and repurposed into an important asset for the farms. Compost can be used to improve crop yields and improve soil quality. Additionally, composting reduces and recycles large quantities of waste. A final advantage of using compost is that it will save the agripreneurs money as they significantly decrease their fertilizer demand. The prepared manuals and worksheets teach the agripreneurs the fundamentals of composting, and a list of materials needed to begin the process. The only materials that are truly essential for building a compost pile are a space to house the pile with room to mix the ingredients, the organic matter (both fresh and dry), and water. A pitchfork or shovel, cutlass, watering can, plastic sheets, thermometer, adapted sieves 1-2 m² in size, and an enclosure for the pile are additional tools helpful for composting (Onana, 2022).







Organic materials (Image: Yesaya et al., 2021) *Watering can* (Image: Burkybile, 2013) Compost sieve (Image: Albabtain, 2011)

Why Compost?

A4A currently buys compost from the market, which is more sustainable than purchasing synthetic fertilizers. However, purchasing compost may not be feasible for the agripreneurs upon release given the cost and transportation constraints. Compost is expensive and heavy, therefore it is best transported via motor vehicle, which may not be accessible to the agripreneurs. Making

compost is a low-cost process that requires minimal equipment and can produce rich fertilizer in relatively short time periods depending on the size of the pile, type of compost, and climatic conditions (Onana, 2022). Additionally, composting food scraps and plant waste diverts these materials from garbage heaps, contributing to a more pleasant environment. Making compost allows for control over what ingredients go into the compost and promotes the presence of beneficial microbes and bacteria in soil, which supports healthy plant growth, better yields, and higher profits.

How Does Compost Compare to NPK Fertilizer?

Compost from plant residues and animal manures contains the nutrients essential for crop production. While exact quantities of nitrogen, phosphorus, and potassium (nutrients typically applied via NPK fertilizer) may vary depending on the specific ingredients added to the compost pile, most compost should contain enough of these nutrients to benefit crop growth (Soumaré et al., 2002). Additionally, compost may contain small amounts of copper, zinc, iron, and magnesium, other minerals that support plant growth (Soumaré et al., 2002). Most of these nutrients are released slowly over longer time periods when applied through compost, which is preferable to chemical fertilizers that have readily available nutrients that may be washed away with rain (Herai et al., 2006). Measuring the nutrient concentration of finished compost using basic soil testing kits allows for an analysis of any potential deficiencies, which can be addressed with mineral fertilizers if deemed appropriate.

Ingredients:

A compost pile needs three things: carbon-rich materials, nitrogen-rich materials, and water to aid with the decomposition process. Carbon-rich materials are typically brown things like branches, sawdust, and corn stalks, whereas nitrogen-rich materials are typically green things like fruit and vegetable scraps, animal manures, leguminous crop residues (soybeans, beans, peas, etc.), and leguminous tree leaves such as *Gliricidia sepium*, *Crotalaria*, *Leucaena*, *Sesbania sesban*, *Lantana*, and *Tithonia diversifolia* (Onana, 2022). Diluted urine also contains high quantities of nitrogen, phosphorus, and potassium, and can be added to the compost pile as an additional nitrogen source (Shingiro et al., 2020). This could be collected from the prison and mixed in a 1:3 ratio with water before being added to the compost. The materials should be combined in the following ratio: two parts of carbon-rich materials to one part animal manure and one part green materials (Onana, 2022). With too many browns, the pile will take a long time to decompose. With too many greens, the pile will be too wet and will start to smell bad. Enough water should be added to the materials so that the compost is about as wet as a wrung-out sponge.







Gliricidia sepium (Image: Meike Piepenbring, 2017) **Things to Avoid**:

Crotalaria (Image: Daniela Zappi) *Leucaena* (Image: Paul Latham, 2005)

Avoid adding plastics, metal, and glass to the compost pile because they won't break down in the pile and can pose safety hazards. These materials should be sorted and kept separately for recycling. For ideas on how to use these materials, refer to the recycling documents. Meat, bones, and dairy can be added in small quantities as the pile reaches high enough temperatures, but they should not be added in large quantities because they can attract pests. Excessive quantities of oils should also be avoided because they have a more complex chemical structure and take much longer to break down than plant material. Finally, plant materials that have been treated with chemical fungicides and pesticides should not be added as they will kill some of the beneficial microbes that naturally grow in the pile. Some fungicides or pesticides may break down faster than others, but natural pest management techniques can be used to avoid chemicals that are long-lasting in the environment altogether.

Building the Pile:

Before starting a compost pile, collect two separate piles of brown and green materials that can be used to build the pile all at once in layers. Organic materials can be gathered from the local community by visiting the sites where household waste is disposed of, including municipal waste sites. Establishing structures for community members to sort their waste by separating biodegradable materials from non-biodegradable materials can reduce the time spent collecting organic waste. These materials could be transported via bike or scooter back to the farm sites for processing. Reduce the size of the materials using a cutlass (the pieces should be no larger than **20 cm**) for the composting process to occur as quickly as possible.

A clear, flat location is an ideal site to choose for the compost pile to minimize nutrient runoff (Onana, 2022). To begin, spread out a layer of brown materials approximately **1 meter long by 1 meter wide**, and then add a layer of green materials on top. Continue this process until the pile is about **1 meter tall**. The pile can be built straight in the field or within a simple structure made of

wooden sticks to contain the materials (see the image below). The structure will help keep the pile contained and prevent pests from disturbing it, but is not necessary for compost production.





Wooden structure (Image: J.A.C.K., 2013) *Free-standing pile* (Image: Burkybile, 2013) As the concept of composting is introduced to the agripreneurs, a **demonstration pile** should be started on the farm site outside of the prison to test out the methods before expanding to multiple piles or making compost at further sites such as Melong II. Assigning several agripreneurs to act as compost leads could help them stay engaged if they are interested in helping to monitor the progress of the compost pile (similar to the agripreneurs specializing in chicken and pig care).

Note: One factor to consider is the weather patterns. During the rainy season, it is best to shelter the compost pile from the rain using a plastic sheet so that it does not get too wet (Onana, 2022). The microorganisms living in the soil need some air to breathe, and an overly saturated compost pile can become anaerobic (lacking oxygen).

Types of Composting:

There are two main types of composting: hot composting and cold composting. Hot composting is recommended as it generates a finished product much faster and will reach temperatures high enough to kill most diseases and pathogens. Hot composting requires more labor through the frequent turning of the pile and for best results, a thermometer so that the temperature can be monitored. Alternatively, a large stick can be inserted into the center of the pile to gauge the temperature. Whether or not the stick heats up will indicate whether the hot composting process is taking place. Once the finished product has been created, the nutrient content can be measured using simple soil testing kits to decide whether or not to supplement the compost with fertilizer or alter the production process to correct for any deficiencies. Cold composting simply requires the building of a pile and occasional turning. However, it can take as long as **several years** for the compost to finish decomposing (contrasted with the **1-2 months** for hot composting).



Measuring temperature with a stick (Image: One Acre Fund.org)

Monitoring the Pile:

If using a thermometer to monitor the temperature, insert a thermometer with a long metal tip (24 **cm** or longer) into the middle of the compost heap to measure how hot it gets. Once the pile has reached temperatures above 40°C for five days (and 55°C for at least 4 hours in that time period), mix up the compost. If using a stick inserted into the pile to measure temperature, leave the pile standing while the stick remains warm to the touch, and turn the pile when it cools (One Acre Fund, n.d.). Frequently turning the pile will bring air into the compost and help it break down faster (Misra et al., 2003). Turn the compost by using a shovel to bring materials from the bottom to the top. Another strategy is to move the entire compost pile from one area to another, mixing up the materials as you transfer the pile.

Repeat this process of leaving the pile to heat up and then turning it three times. After it has gone through three rounds of heating, the compost should start to look like rich, dark soil. The finished compost can be sifted using a metal sieve to remove materials that are too big, or that have not yet finished breaking down. Crops applied with finer composts have been shown to have higher nutrient uptake due to the increased surface area to volume ratio, so this sifting is an important step in achieving the best results from compost application (Duong et al., 2011). Sieving will leave behind a finished product that can be applied directly to your crops. If not applied immediately, it is advisable to store the finished compost in bags to prevent contamination (Onana, 2022).
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Composting Manual

Overview & Purpose

This manual contains step-by-step information about the process of composting for the agripreneurs to reference. This manual should be supplemented with instruction from the A4A staff and guided sessions where the agripreneurs can fill out the accompanying worksheets.



Composting

Definition:

Composting is the conversion of food and plant waste into soil. In a forest, leaves naturally break down and replenish the soil, but on a farm, planting and harvesting prevent the build-up of organic matter. Dead organic materials contain nutrients that can be found in fertilizers. Creating your own compost will **save money** because you will no longer have to purchase fertilizers from the market. You can make compost for free using food scraps and plant waste from your farm. Additionally, compost brings beneficial bacteria and fungi into your soil. These soil organisms will help your plants grow healthy and strong, **increasing yields and profits**.







Food scraps and plant waste

(Image: Yesaya et al., 2021)

Finished compost

(Image: Kolping International, 2022)

Components of Compost:

To build a successful compost pile, you must add both carbon-rich materials (browns) and nitrogen-rich materials (greens). Balancing these two ingredients allows the materials to break down and prevents the pile from smelling bad. Below are some examples of browns and greens that you may use in your compost pile.

Browns (carbon rich materials)

Straw



Sawdust



Ash



Dry Corn Stalks



Dry Leaves



Corn Cobs



Greens (nitrogen-rich materials)

Grass Clippings



Fruit and Vegetable Scraps



Manure



Green Plant Trimmings



Leguminous Plants



Diluted Urine



Things to Avoid Composting

Meat and Bones



Diseased Plants



Chemically Treated Plants



Dairy and Oil



Plastic and Glass



Metal





Avoid adding lots of meat, bones, and dairy:

Meat, bones, and dairy attract pests, such as rodents and flies, that may dig in the pile. Small quantities can be placed at the center of the pile, but larger quantities should be avoided as they will not break down if the pile doesn't reach high enough temperatures.

Avoid adding oils:

Oils take much longer to break down than plant material, so adding too much of it to your compost pile will slow the decomposition process.

Avoid adding diseased plants:

Although plants will break down in the compost, if the pile does not reach high enough temperatures, any diseases or pathogens may remain in the finished compost.

Avoid adding plastics, metal, and glass:

While plastics, metal, and glass are all made from organic materials, they take a very long time to break down. Additionally, plastics may contain chemicals that will leach into your soil while glass and sharp metals can pose safety hazards if left in your compost.

How to Build a Compost Pile

Beginning:

Prepare separate piles of brown and green materials so that you can layer them on top of one another in your pile. Your pile should be approximately **1m x 1m x 1m**, as this size will allow your pile to get hot enough to kill pathogens or diseases that may be present in the materials. The materials you add should be **small** (no larger than **20 cm**) for the composting process to occur as quickly as possible. You can cut the materials into smaller pieces using a cutlass. While it is possible to build a free-standing compost pile, building a simple enclosure for it can be helpful to keep it contained and prevent pests from disturbing it. During the rainy season, cover your compost with a plastic sheet to prevent it from getting too wet.



Wooden structure (Image: J.A.C.K., 2013)

Turning the Pile:



Free-standing pile (Image: Burkybile, 2013)

You can measure the temperature of the compost pile using a thermometer, or by inserting a large stick into the middle of the pile. After the thermometer has reached 40°C for five days, the pile should be turned. If using a stick to measure the temperature, turn the pile once the stick is no longer warmer than the surrounding air temperatures. Frequently turning the pile will bring air into the compost and help it break down faster.

Turn the compost by using a shovel or pitchfork to bring materials from the sides to the center. Another strategy is to move your entire compost pile from one area to another, mixing up the materials as you transfer the pile.





Measuring temperature with a stick (Image: One Acre Fund.org)

Turning the pile (Image: City of Davis)

Finished Compost:

The finished compost should look like rich, dark brown soil. It will be finished after **three rounds** of reaching temperatures of at least 55°C and turning. Once the compost starts to look like soil, you can sift it to remove any larger pieces that have yet to decompose. You can apply the finished compost directly to the soil, as you would a fertilizer, or store it in bags for future use to avoid contamination.



Compost Sieve (Image: Berea College Farm)

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Composting Workbook Guide

This workbook guide aims to help the A4A staff understand how to teach the agripreneurs about composting by using the worksheets created on various aspects of composting. After each agripreneur is supplied with a composting manual, a short lesson should be led on each worksheet topic. Ideally, each lesson would be taught on a separate day so that the content is broken up. Then, the agripreneurs should be provided with a worksheet to work through in teams after the topic has been introduced by a member of the A4A staff. The workbook consists of four worksheets: (1) Defining Composting, (2) How to Start a Compost Pile, (3) Compost Maintenance, and (4) How to Use Compost. Within each worksheet are a few exercises that prompt the agripreneurs to apply what they have learned from the composting lessons provided by staff members. When the agripreneurs graduate from the program, they will be able to take this information with them and apply it in future projects. Below is guidance on how to fill out the worksheets with the agripreneurs. The information needed to fill out each worksheet is available in this manual and the manual for the agripreneurs.

While teaching each module, engage the agripreneurs in the lessons rather than exclusively lecturing. Encourage participation by asking the agripreneurs questions before and while introducing the materials. For example, "Does anyone know what composting is?" or "Does anyone know what things can be composted?" Furthermore, check in on the agripreneurs throughout the lesson to answer any questions they may have.

Limit the class lessons to approximately 10 minutes, and explain some of the details in the field. This should maximize their engagement and keep them interested. Additionally, delegating responsibility by assigning some of the agripreneurs as compost leaders will help them feel more motivated to continue.

Worksheet 1: Defining Composting

This worksheet introduces agripreneurs to the concept of composting as a way to make their own natural fertilizer.

Lesson Plan:

Though the agripreneurs will have their own manuals for reference, verbally present the definition of compost and its benefits to reinforce these concepts. Additionally, highlight which materials belong in the compost.

Potential Answers:

Why should you compost?

Creating compost will save money because it reduces the need to purchase fertilizers from the

market. This compost can be made at a low cost using food scraps and plant waste from the

farm and local community and can produce rich fertilizer in 1-2 months.

What are browns and greens? List some examples.

Browns are carbon-rich materials such as dry corn cobs and stalks, ash, straw, and sawdust.

Greens are nitrogen-rich materials such as leguminous plant residues, manure, and food scraps.

What things should you avoid composting? Why?

Plastic, metal, and glass can not be composted because they are not biodegradable.

Chemically-treated plants can kill the beneficial microbes in the compost.

Meat, bones, and dairy should be added in limited quantities because they attract pests.

Worksheet 2: How to Start a Compost Pile

Lesson Plan:

The following worksheet helps the agripreneurs identify the materials needed to start composting. Understanding the cost of these materials allows the agripreneurs to make budgets for the necessary supplies. The cost of a bag of compost or fertilizer should also be included for their reference. *Please identify the market cost of the items below to share with the agripreneurs*.

Farming Tool	Cost
Shovel	
Pitchfork	
Cutlass	
Watering Can	

Composting Tool	Cost
Organic materials	Free
Enclosure made of branches	Free
Large stick	Free
Thermometer	
Sifter (1-2m ²)	
Plastic sheets	
50 kg bag of NPK fertilizer	35,000 CFA

Potential Answers:

Do you plan to build an enclosed pile or a free-standing one? Why?

I plan to build a free-standing pile because it is cheaper.

Materials needed to start:

Organic materials, water, shovel, cutlass, sifter. Use costs identified above for budget.

Worksheet 3: Compost Maintenance

This worksheet helps the agripreneurs make a schedule for maintaining their compost.

Potential Answers:

Preparation:

Collect food scraps and plant materials. Collect organic material from community trash

disposal sites using bikes or buckets to maximize the quantity of material.

Daily Tasks:

Record the temperature of the pile and check to make sure pests aren't disturbing the pile.

Day 1:

Build the pile 1 meter x 1 meter x 1 meter using an equal ratio of greens and browns and

layering these materials. Add water until the pile is as moist as a wrung-out sponge.

Day 7:

Once the pile has reached 40°C for 5 days, turn the pile, mixing up all of the materials

Day 14:

Turn the pile again once it has reached 50°C for 5 days after the first time you turn it.

Day 21:

Turn the pile again once it has reached 50°C for 5 days after the second time you turn it

Day 28:

Now the pile should start to look like finished compost. Sift the compost using the sieves to

remove any large debris or non-biodegradable materials. Apply the compost to the field when it is finished, or store it in bags until it is ready to be applied.

Worksheet 4: How to Use Compost

Lesson Plan:

In this worksheet, the agripreneurs will plan how much compost they will produce based on the quantity of materials that they input. This will allow them to decide if they want to keep all of the finished compost on their farm or sell some of it to other farmers. Group the agripreneurs in teams, with at least one agripreneur who is strong in math per team, to collaborate on the worksheet.

Answer Key:

If you have a nursery that is $2 \text{ m x } 1 \text{ m } (2 \text{ m}^2)$ and want to apply a layer of compost 10 cm (.1 m) thick, how much compost will you need to make?

 $2 \text{ m}^2 \text{ x } 0.1 \text{ m} = 0.2 \text{ m}^3$

How many nurseries of this size could you cover with a pile of 1m x 1m x 1m?

 $1 \text{ m}^3 / 0.2 \text{ m}^3 = 5 \text{ nurseries}$

Based on this information, do you think you will be able to produce surplus compost for sale? Why?

Yes. I plan to build multiple piles, but only have 5 nurseries, so I should produce surplus

compost for sale.

Composting Workbook







Agriculture for Africa Environmental Science Practicum Team 2022

Introduction

This workbook is meant to help you identify the essential information in the composting manual. By filling in this workbook, and building a compost pile in the field, you will be able to start a compost pile on your own farm.

The goals of the first module are to introduce you to the concept of composting and help you identify what can and cannot be composted.

The second module helps you plan how you would compost on your future farm, including a consideration of potential costs and inputs.

The third module is a space for you to make a schedule for maintaining your compost. Based on the information in the manual, you should be able to design a manageable schedule that you can use on a future farm.

The final module allows you to consider the potential for creating excess compost to be sold to other farms. Using some simple calculations, you can determine how much compost you would need to fertilize a nursery.

Exercise 1: What I Know About Composting

Fill out this worksheet to test your knowledge of composting basics.

Why should you compost?

What are browns and greens? List some examples.

What things should you avoid composting? Why?

Additional notes:

Exercise 2: How I will Build my Compost Pile

Fill out this worksheet to begin planning the steps for building your own compost pile.

Do you plan to build an enclosed pile or a free-standing one? Why?

Materials needed to start:

Budget for materials:

Additional notes:

Exercise 3: How I Will Monitor My Compost

Fill out this worksheet to make a schedule for how you will maintain your compost.

Daily Tasks:

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Day:			
Day:			
Day:			
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<i>Duy</i> <u> </u> .			

Exercise 4: How I Plan to Use my Compost

Fill out this worksheet to plan how much compost you will produce based on the quantity of materials you input. This will allow you to decide if you want to keep all of your finished compost on your farm, or sell some of it to other farmers.

If you have a nursery that is 2 m x 1 m (2 m²) and you want to apply a layer of compost 10 cm (0.1 m) thick, how much compost will you need to make?

How many nurseries of this size could you cover with a pile of 1m x 1m x 1m?

Based on this information, do you think you will be able to produce surplus compost for sale? Why?

Composting Educational Posters



Agriculture for Africa UCLA Environmental Science Practicum Spring 2022

Composting: Dos and Don'ts

Composting is the conversion of **food and plant waste** into **soil**. Dead plant materials contain nutrients that can be found in fertilizers. Making your own compost saves money and is better for the environment. A healthy compost pile will have approximately equal quantities of brown and green materials to support optimal decomposition.



Browns (carbon-rich materials)

- Dry leaves, corn stalks, and corn cobs
- Straw
- Dry branches
- Sawdust
- Ash

Greens (nitrogen-rich materials)

- Fruit and vegetable scraps
- Grass clippings
- Leguminous plant leaves such as Leucaena
- Manure
- Diluted urine





Do NOT Compost

- Meat, bones, or dairy
- Diseased plants
- Plastics, metal, or glass
- Oils and fats
 - Plants treated with pesticides and herbicides

How to Build a Compost Pile

Having a balance of brown and green materials is very important. If you have too many green materials, your pile will start to smell bad. If you have too many brown materials, your pile will take a very long time to turn into compost. Every time you add fresh materials, make sure that you balance them (with browns or greens).



Getting Started

- Layer brown and green materials on top of each other, forming a pile measuring about 1m x 1m x 1m
- Cover the top of the pile with brown materials to disincentivize pests from disturbing it

Turning the Pile

- Measure the temperature of the pile using a thermometer
- Turn the pile once it has reached 55°C for 5 days
- It is okay to mix up the layers
- Repeat this process 3 times to kill any pathogens





Finished Product

- Once the compost starts to look like soil (after 1-2 months, or 3 rounds of mixing the pile), it is done
- Apply the compost to your farm as you would with compost from the store

Appendix C: Natural Pest Management Booklets









Maize

Natural Pest Management

Overview & Purpose

This workbook contains images of common pests on crops grown by A4A participants and outlines alternatives to synthetic pesticides.



Fall Armyworm (Spodoptera frugiperda)



Source: PinalCentral.com

Crop Damage

- Leaves with holes and pitting caused by larvae
- Extensive leaf defoliation with fresh droppings

Preventative

Solutions

- Place earth or ash at the arrow of the attacked plant to prevent the movement of larvae inside the arrow
- Conserve natural enemies found in the field such as earwigs, ants, parasitoids
- Plant *Desmodium uncinatum* between maize crops and Napier grass along the plot border to draw the pests away from maize

Retroactive Solutions

• Spray PYRETHRUM 5% EW solution in small doses (1480 ml p.c./ha)



Corn Stalk Borer (Busseola fusca)



Source: GardenKnowHow.com

Crop Damage

- Destruction of stems and seeds
- Presence of holes and caterpillar droppings on the stem
- Withering of the inflorescence



Preventative Solutions

- Destroy plant residues after harvest
- Associate corn with legumes (peanuts, beans)
- Conserve natural enemies found in the field such as earwigs

Retroactive Solutions

- Spray BATIK WG solution in small doses (0.5 kg p.c./ha)
- Introduce ladybugs to eat pests (approximately 4 ladybugs/square meter)

Corn Weevil (Sitophilus zeamais)



Source: OnTheFlyPestSolutions.com

Crop Damage

- Presence of holes in the grains
- In a severe attack, the grains are reduced to powder



Solutions (Post-Planting)

- Disinfect storage areas; monitor stock
- Sort and remove suspicious ears; winnowing or sifting if stored as grains
- Use ash, flour from the dried and ground seeds of neem and chili to coat the grains before bagging









Maïs Gestion Naturelle des Ravageurs

L'aperçu et l'objet

Ce cahier d'exercices contient des images de ravageurs typiques sur les cultures cultivées par des participants d'A4A et expose les grandes lignes des stratagèmes de gestion naturelle des ravageurs.



Les Chenilles Légionnaires D'Automne (Spodoptera frugiperda)



Source: PinalCentral.com

Dommages aux Cultures

- Feuilles trouées et piquées par les larves
- Défoliation étendue des feuilles avec des déjections fraîches

Solutions Préventives

- Placer de la terre ou de la cendre à la flèche de la plante attaquée pour empêcher le movement des larves à l'intérieur de la flèche
- Conservation des ennemis naturels trouvés sur le terrain comme les perce-oreilles, les fourmis, et les parasitoïdes
- Plantez du *Desmodium uncinatum* entre les cultures de maïs et l'herbe Napier le long de la bordure de la parcelle pour éloigner les ravageurs du maïs

Solutions Rétroactives

• Pulvérisez PYRETHRUM 5% EW à petites doses (0.5 kg p.c./ha)



Foreur de Tige de Maïs (Busseola fusca)



Source: GardenKnowHow.com

Dommages aux Cultures

- Destruction des tiges et des graines
- Présence de trous et de déjections de chenilles sur la tige
- Flétrissement de l'inflorescence

Solutions Préventives

- Destruction des résidus végétaux après récolte
- Association du maïs avec des légumineuses (cacahuètes, haricots)
- Conservation des ennemis naturels trouvés sur le terrain, comme les perce-oreilles)

Solutions Rétroactives

- Pulvérisez BATIK WG à petites doses (0.5 kg p.c./ha)
- Introduire des coccinelles pour manger des nuisibles (environ 4 coccinelles/mètre carré)

Le Charançon de Maïs (Sitophilus zeamais)



Source: OnTheFlyPestSolutions.com

Dommages aux Cultures

- Presence of holes in the grains
- In a severe attack, the grains are reduced to powder



Solutions (Après la Plantation)

- Désinfecter les zones de stockage; suivi des stocks
- Trier et enlever les oreilles suspectes; vannage ou tamisage si stocké sous forme de grains
- Utiliser de la cendre ou de la farine des graines séchées et moulues de neem et de piment pour enrober les graines avant l'ensachage









Tomato

Natural Pest Management

Overview & Purpose

This workbook contains images of common pests on crops grown by A4A participants and outlines alternatives to synthetic pesticides.


Late Blight (Phytophthora infestans)



Late Blight comes from bacteria (Source: IDTools.org)

Crop Damage

- Leaf burns
- Root and crown rot



Preventative Solutions

- Abundant watering
- Use resistant varieties of tomato (Fantasio, Ferline, Golden Sweet, Old Brooks)

Retroactive Solutions

• Cover threatened area in baking soda

Bacterial Wilt (Ralstonia solanacearum)



Crop Damage

• Sudden wilting without yellowing of plant leaves



Preventative Solutions

- Favor cultivation of resistant varieties of tomato (Fantasio, Ferline, Golden Sweet, Old Brooks)
- Plant Salix tree species in the area to decontaminate the soil
- Avoid successions of nightshades in crop rotation

Apical Necrosis (Pseudomonas syringae)



Source: IDTools.org

Crop Damage

• At the immature stage, rotting and blackening of the end of the fruit



Preventative

Solutions

- Sanitary harvest
- Raise the rows on the ridge
- Have a regular and sufficient supply of water, favoring the assimilation of calcium
- Apply lime mineral to the soil to increase calcium intake (9-23 kg of ground limestone per 93 square meters)

White Fly (Bemisia spp.)



Source: JOMO Studio

Crop Damage

- Desiccation of attacked leaves
- Plant growth stunting
- Leaf curling

Preventative Solutions

• Perform fairly regular irrigation on the foliage

Retroactive Solutions

• Spray a well-mixed solution of 1 tablespoon of liquid soap and 4 liters of water



Tomato Leaf Miners (Tuta absoluta)



Crop Damage

- Whitish galleries dug by the larvae on the leaves, petioles, and fruits
- Mined spots appear as translucent spots
- Larvae droppings are lumpy, black, and scattered in disorder outside the mines.
- Larvae can also colonize stems and fruits



Source: JOMO Studio

Retroactive Solutions

- Eliminate and destroy parts of plants attacked to effectively reduce pest populations
- Spray a solution of 2 cups of vegetable oil and ½ cup of liquid soap onto the affected areas

Tomato Cutworm (Helicoverpa armigera)



Source: Purdue Extension Entomology

Crop Damage

• Small caterpillars dig small holes while large caterpillars make large entry points which facilitate access to pathogens thus causing fruit rot



Retroactive Solutions

- Collect infested fruits
- Seal caterpillars in a plastic bag and place in the sun to kill pests
- Spray BATIK WG in small doses (0.5 kg p.c./ha)









Tomate Gestion Naturelle des Ravageurs

L'aperçu et L'objet

Ce cahier d'exercices contient des images de ravageurs typiques sur les cultures cultivées par des participants d'A4A et expose les grandes lignes des stratagèmes de gestion naturelle des ravageurs.



Mildiou de la Tomate (Phytophthora infestans)



Le mildiou provient de bactéries (Source: IDTools.org)

Dommages aux Cultures

- Brûlures des feuilles
- Pourriture des racines et du collet

Solutions Préventives

- Arrosage abondant
- Utilisation des variétés résistantes (Fantasio, Ferline, Golden Sweet, Old Brooks)

Solutions Rétroactives

• Courrez la zone menacée de bicarbonate de soude



Flétrissement Bactérien

(Ralstonia solanacearum)



Dommages aux Cultures

• Le Flétrissement soudain sans jaunissement des feuilles des plants



Solutions Préventives

- Utilisation des variétés résistantes (Fantasio, Ferline, Golden Sweet, Old Brooks)
- Planter des espèces de Salix pour décontaminer le sol
- Réaliser des rotations en évitant les successions de solanacées

Nécrose Apicale (Pseudomonas syringae)



Source: IDTools.org

Dommages aux Cultures

 Au stade immature, pourriture et noircissement de l'extrémité du fruit

Solutions Préventives

- Récolte sanitaire
- Surélever les rangs sur billon
- Avoir un approvisionnement en eau régulier et suffisant, favorisant l'assimilation du calcium
- Appliquer de la chaux minérale sur le sol pour augmenter l'apport en calcium (9-23 kg de calcaire broyé par 93 square m)

La Mouche Blanche (Bemisia spp.)



Source: JOMO Studio

Dommages aux Cultures

- Dessèchement des feuilles attaquées
- Blocage de la croissance des plantes et enroulement des feuilles

Solutions Préventives

• Réaliser une irrigation assez régulière sur le feuillage

Solutions Rétroactives

• Vaporiser une solution bien mélangée d'une cuillère à soupe de savon liquide et de quatre litre d'eau



Mineuse de la Tomate et ses Dégâts (Tuta absoluta)



Dommages aux Cultures

- Galeries blanchâtres creusées par les larves sur les feuilles, les pétioles et les fruits
- Les endroits minés apparaissent comme des taches translucides
- Les déjections des larves sont grumeleuses, noires et disséminées en désordre à l'extérieur des mines



Source: JOMO Studio

Solutions Rétroactives

- Éliminer et détruire les parties des plantes attaquées pour diminuer efficacement les populations de ravageurs
- Vaporiser une solution de deux tasdes d'huile végétale et ½ tasse de savon liquide sur les zones touchés

La Noctuelle de la Tomate et ses Dégâts (*Helicoverpa armigera*)



Source: Purdue Extension Entomology

Dommages aux Cultures

 Les petites chenilles creusent des petits trous tandis que les grosses chenilles font des grands points d'entrées qui facilitent l'accès aux pathogènes causant ainsi la pourriture des fruits

Solutions Rétroactives

- Collectez les fruits infestés dans un sac de plastique, sceller et placez le sac au soleil
- Pulvérisez BATIK WG à petites doses (0.5 kg p.c./ha)

Appendix D: Nitrogen-Fixing Plant Identification Booklet



Image: Permaculture Research Institute

Nitrogen-Fixing Plant ID Booklet

Overview & Purpose

This booklet contains photographs and descriptions of various nitrogen-fixing plants that can be found in Cameroon. These plants can either be used as a nitrogen source for composting or as options for intercropping and living fences.

Gliricidia (*Gliricidia sepium*)

Uses:

- Add leaves to compost as a nitrogen source
- Use for living fence posts

Characteristics:

- Small tree
- Grows 2-14 meters tall
- Compound leaves



Image: Meike Piepenbring, 2017



Image: Paul Latham, 2008

Rattlepods (*Crotalaria ledermannii* or *Crotalaria bamendae*)

Uses:

- Add leaves to compost as a nitrogen source

Characteristics:

- Yellow flowers and pod formations
- Native



Image: Daniela Zappi



Image: Daniela Zappi

Lead Trees (*Leucaena leucocephala*)

Uses:

- Add leaves to compost as a nitrogen source

Characteristics:

- Pinnately compound leaves
- Brown pods



Image: Paul Latham, 2005



Image: Paul Latham, 2005

Egyptian Riverhemp (Sesbania sesban)

Uses:

- Add the leaves to compost as a nitrogen source
- Intercrop with maize and beans for increased nitrogen availability in the soil

Characteristics:

- Can grow up to 8 meters tall
- Pinnately compound leaves
- Yellow flowers



Image: Bùi Thụy Đào Nguyên



Image: Penny Wang

Lantana

Uses:

- Add leaves to compost as a nitrogen source

Characteristics:

- Perennial shrub
- Grows 2-5 m tall
- Yellow, white, pale pink, orange, or red flowers
- Yellow-green leaves

Note: may be invasive, so only use if already present (do not introduce)



Image: UCANR

Mexican Sunflower (*Tithonia diversifolia*)

Uses:

- Add leaves to compost as a nitrogen source

Characteristics:

- Perennial shrub
- Grows 2m tall or more
- Yellow flowers

Note: may be invasive, so only use if already present (do not introduce)



Image: Pedro Tenorio Lezama



Image: Pedro Tenorio Lezama

Silverleaf Desmodium (*Desmodium uncinatum*)

Uses:

- Repels fall armyworm use as push factor in push-pull technique
- Nitrogen-fixing plant

Characteristics:

- Green leaves with silver stripe
- Pink or purple flowers
- Sticky pods that turn brown when dry



Image: Mc Cleay Grass Man



Image: Mc Cleay Grass Man

Greenleaf Desmodium (Desmodium intortum)

Uses:

- Repels fall armyworm, can be used as push factor in push-pull technique
- Nitrogen-fixing plant

Characteristics:

- Purple or pink flowers and sticky seed pods
- More heat and drought tolerant than Silverleaf desmodium



(Image: Kim Starr)



(Image: Russel Cummings)

Appendix E: Pesticide Posters

Pesticide Educational Posters



Agriculture for Africa UCLA Environmental Science Practicum Spring 2022

Insecticides: Impacts and Alternatives

Insecticides are substances used to control pest populations. A4A uses the insecticide **beta-cypermethrin** to kill pests that threaten crops. Beta-cypermethrin is **not approved for use in the E.U.**, suggesting that it does not meet legal standards for human and/or environmental health.



Human Health Impacts

- Acute exposure can cause irritation to the eyes and respiratory tract
- Chronic exposure may cause disruption to the endocrine system

Environmental Impacts

- Highly toxic to honeybees lower pollination and crop yields
- Toxic to aquatic life, mammals, and birds
- Non-persistent in the soil





Alternatives to Insecticide Use

- Physical trapping and removal of insects
- Enhancement of natural pest enemies
- Crop rotation
- Timing planting and harvesting to avoid pests
- Use of natural remedies like neem oil

Herbicides: Impacts and Alternatives

Herbicides are chemical substances used to control undesirable vegetation. On farms, they are used to inhibit the growth of weeds and increase crop production. Despite their convenience, many herbicides like glyphosate cause damage to human health and surrounding ecosystems. Always consider non-chemical alternatives (see pest management workbooks) to herbicides before committing to the use of herbicides.



Human Health Impacts

- Acute effects: skin and eye irritation, respiratory issues, allergies, vomiting
- Chronic effects: DNA damage, disruption of the endocrine system, cancer

Environmental Impacts

- Groundwater contamination
- Toxic to plants, small animals, and aquatic life
- Increased susceptibility of plants to disease
- Reduced seed quality
- Declines in soil fertility





Alternatives to Herbicide Use

- Crop rotation
- Planting cover crops
- Hand weeding
- Mulching
- Natural chemicals like vinegar or essential oils

Pesticide Safety Guidelines

Follow these recommendations to minimize common environmental and human health risks associated with the use of pesticides.



General Safety Practices

- Always read the label and follow the instructions on the container before use
- Consider non-chemical alternatives
- Don't spray pesticides on windy or rainy days
- Don't use more than directed by the label

Personal Protective Equipment (PPE)

- Always wear a long shirt, long pants, closed-toe shoes, and gloves
- Wear goggles to avoid contact with eyes
- Wear a mask to reduce inhalation of vapors





Post-Use Actions

- Wash hands after handling pesticides
- Wash protective clothing separate from other laundry after pesticide use
- Store pesticides in a well-ventilated shed away from food and medical supplies

Affiches Éducatives sur les Pesticides



Agriculture for Africa UCLA Environmental Science Practicum Printemps 2022

Insecticides: Impacts et Alternatives

Les insecticides sont des substances utilisées pour contrôler les populations de ravageurs. A4A utilise l'insecticide **beta-cypermethrine**pour tuer les ravagers qui menacent les cultures. Le beta-cypermethrine **n'est pas autorisé pour être utilisé dans l'Union Européenne**. Cela suggère qu'il ne respecte pas les normes légales en matière de santé humaine et/ou environnementale.



Les Impacts sur la Santé Humaine

- Exposition aiguë peut provoquer une irritation des yeux et des voies respiratoires
- Exposition chronique peut perturber le système endocrinien

Les Impacts sur l'Environnement

- Hautement toxique pour les abeilles baisse de la pollinisation et des rendements de cultures
- Toxique pour la vie aquatique, les mammifères, et les oiseaux



• Non persistant dans le sol



Alternatives à l'Utilisation d'Insecticides

- Utilisation de pièges physiques et élimination des insectes
- Renforcement des ennemis naturels des ravageurs
- Rotation des cultures
- Calendrier de plantation et de récoltes pour éviter les ravageurs
- Utilisation de remèdes naturels (eg. l'huile de neem)

Herbicides: Impacts et Alternatives

Les herbicides sont des substances chimiques utilisées pour contrôler la végétation indésirable. Dans les fermes, ils sont utilisés pour empêcher la croissance des mauvaises herbes et augmenter la production agricole. Malgré leurs inconvénients, de nombreux herbicides sont nocifs pour la santé et endommagent les écosystèmes environnants. Envisagez toujours des alternatives non chimiques aux herbicides avant d'engager dans leur utilisation.



Les Impacts sur la Santé Humaine

- Effets aigus: irritation de la peau et des yeux, problèmes respiratoires, allergies, vomissements
- Effets chroniques: détérioration del'ADN, perturbation du système endocrinien, cancer

Les Impacts sur l'Environnement

- Contamination des eaux souterraines
- Toxique pour les plantes, les petits animaux, et la vie aquatique
- Sensibilité accrue des plantes aux maladies
- Qualité de semence réduite
- Baisse de la fertilité des sols





Alternatives à l'Utilisation d'Herbicides

- Rotation des cultures
- Plantation de cultures de couverture
- Désherbage à main
- Le paillage
- L'utilisation de produits chimiques naturels

Consignes de Sécurité sur les Pesticides

Suivez ces recommandations pour minimiser les riques communs pour l'environnement et la santé humaine associés à l'utilisation de pesticides.



Practiques Générales de Sécurité

- Lisez toujours l'étiquette et suivez les instructions sur le récipient avant l'utilisation
- Envisagez l'utilisation d'alternatives non chimiques
- Ne pulvérisez pas de pesticides les jours de vent ou de pluie
- N'utilisez pas plus que ce qui est indiqué sur l'étiquette

Équipement de Protection Individuelle (EPI)

- Portez toujours une chemis longue, un pantalon long, des chaussures fermés, et des gants
- Portez des lunettes de protection pour éviter tout contact avec les yeux
- Portez un masque pour réduire l'inhalation de vapeurs





Actions Post-Utilisation

- Lavez-vous les mains après avoir manipulé des pesticides
- Lavez les vêtements de protection séparément du reste du linge après l'utilisation de pesticides
- Entreposez les pesticides dans un hangar bien ventilé à l'écart des aliments

Appendix F: Plastics Posters

Remove Plastic For Healthier Soil

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Have you thought of how long it takes your plastic trash to decompose?



When plastic remains in soil for many years, there are negative impacts on your crops, your health, and the planet.



To help this problem you can: Avoid disposing plastic waste on your farmland, remove plastic before planting, recycle or reuse plastic waste.







Retirez le Plastique pour 107 un Sol plus sain

Avez-vous pensé au temps qu'il faut pour que vos déchets plastiques se décomposent?



Lorsque le plastique reste dans le sol pendant de nombreuses années, il y a des impacts négatifs sur vos cultures, votre santé et la planète.



utiles

Pour résoudre ce problème, vous pouvez : Éviter de jeter des déchets plastiques sur vos terres agricoles, retirer le plastique avant de planter, recycler ou réutiliser les déchets plastiques.





suppression du système immunitaire



Upcycled Plastic Project Guide







Agriculture for Africa Environmental Science Practicum Team

2022
Ecobricks

Ecobricks are PET bottles made by hand with clean and dry used plastic. Each bottle is densely packed with plastic to form viable building blocks. Once several Ecobricks are created, they can be used for short-term or long-term structural products. Ecobrick products can be sold at local markets or kept for personal use. Ecobricks are simple, require little technology, and promote a healthy environment.



Ecobrick Uses

- Benches
- Planters
- Furniture
- Landscape Architecture
- Raised Beds
- Buildings (Schools, Homes, etc.)

Making Ecobricks

- 1. Wash and dry flexible plastic bottles
- Stuff plastic waste tightly into plastic bottles using a stick or similar object.
- **3.** Once the bottle is as solid as a brick, screw the bottle cap back on.





A4A Recommendation

- Start with small projects like planters and note the amount of plastic waste used.
- When enough ecobricks are created, build benches or small structures.
- Sell ecobrick creations in local markets.

Upcycled Hydroponics

Hydroponic systems are a method to cultivate crops without soil. While there are many different ways to set up a hydroponic system to deliver required water and nutrients to the plant, widespread hydroponic cultivation can be expensive. inexpensive hydroponic systems can be created by upcycling old plastic water bottles. The links below detail a few different ways to create your upcycled system.



Making Upcycled Hydroponic Systems

- Grow seeds in egg cartons.
- Cut bottles in half and cut a hole in the cap.
- Apply mesh (from old shower scrunchies or citrus bags) over the bottle mouth to support the plant.
- Transplant organic mediums and sprouts into the bottle cap.
- Fill half of the water bottle base with water and nutrient mix.
- Place the top half of the bottle into the base half so that the bottle cap side is just above the waterline.

Hydroponic Tips

- Use coconut husks or similar organic growing mediums instead of buying sponges, rock wool, soil, or LECA balls (the best option).
- Use recycled water bottles instead of buying new ones.
- Paint over the bottle to reduce algae growth that could consume nutrients needed for plant growth.
- Cover the bottles from the sun to prevent plastic toxins from leaching into the nutrient solution.
- Start seed growth in recycled egg cartons.





A4A Recommendation

- Large-scale hydroponics is not profitable at this point in time due to large monetary investments.
- Agripreneurs should make small-scale hydroponics to learn new techniques and help eliminate plastic waste.

Miscellaneous Upcycled Plastic Projects



Baskets and Bags

Plastic waste can be cut into strips and used to build baskets and bags as an alternative to typical threads and fabrics.

Greenhouses

Plastic bottles can be threaded onto sturdy sticks that can then be fixed to a frame and utilized as walls in a greenhouse. The bottles help insulate the greenhouse.





Plant Holders

Plastic bottles can be turned into plant holders. Cut the sides of the bottom half of the bottle into an even number of strips. Interweave yarn, string, or recycled plastic between the strips.

A4A Recommendation

Agripreneurs should experiment with different upcycled plastic projects. Upcycled plastic creations can be used in the prison and on farms or sold in local markets for profit.

Links to Additional Resources

EcoBrick Resources:

- https://www.ecobricks.org/welcome.php
- <u>https://redaccion.lamula.pe/2012/10/05/comunidad-indigena-cons</u> <u>truye-el-primer-asiento-con-eco-ladrillos/admin/</u>
- <u>https://www.youtube.com/watch?app=desktop&feature=youtu.be&</u>
 <u>v=8TUTWdRc3OU</u>
- <u>https://hugitforward.org/what-we-build/</u>
- https://www.youtube.com/watch?v=QYcPK_EKNtw

Upcycled Hydroponic Resources:

- https://www.youtube.com/watch?v=I9WrbohU1L4
- https://www.youtube.com/watch?v=Yx5fLrmj8v4
- https://www.youtube.com/watch?v=xIrENki4WW4
- <u>https://www.instructables.com/hydroponic-lettuce-garden-from-plastic-bottles-Gr/</u>
- https://red-dot-geek.com/easy-diy-hydroponics-beginners/
- <u>https://www.instructables.com/Hydroponic-Soda-Bottle-System/</u>

Plastic Bags and Baskets Resources:

- <u>https://m.ok.ru/group/52913086070870/album/52913096818774/8</u> 87956642646
- <u>https://icreativeideas.com/how-to-weave-plastic-baskets-from-plas</u> <u>tic-bottles/</u>
- <u>https://www.amazinginteriordesign.com/plastic-bottles-got-recycled</u> <u>-amazing-woven-baskets/</u>

Plastic Greenhouse Resources:

 <u>https://travelteachtalk.com/a-plastic-bottle-greenhouse-is-where-i</u> <u>ts-at/</u>

Plant Holder Resources:

• <u>http://krokotak.com/2013/04/weave-a-plastic-bottle-basket/</u>

Appendix G: Business Curricula

A4A Business Curriculum







Agriculture for Africa Environmental Science Practicum Team 2022

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Introduction

The business curriculum provides an in-depth set of lessons to teach the agripreneurs essential agribusiness concepts. The curriculum includes twelve lessons, each of which is divided into one of three modules: (1) Assessment of Current State, (2) Marketing, and (3) Financial Management. Every lesson plan lays out key terms, relevant concepts, and learning activities. Furthermore, each lesson is associated with a particular worksheet that the agripreneurs fill out after listening to the lesson. A4A staff should teach the lessons throughout the A4A program for one cohort, giving the agripreneurs time to digest new concepts over a longer period. Overall, the business curriculum provides a general structure for individual lessons about a variety of topics that should be customized and adjusted by the A4A staff as needed. Utilize the following guidelines to maximize engagement and learning retention for each lesson:

- During the Lesson
 - $\circ~$ Keep lessons under 15 to 20 minutes in duration.
 - Encourage participation by asking questions and encouraging the agripreneurs to share their prior knowledge about a particular topic.
 - Incorporate guest speakers (eg. former agripreneurs, local farmers), stories, and visuals (eg. photos) into lessons.
 - Take the agripreneurs on field trips to connect lesson concepts to real-life scenarios.
- After the Lesson Worksheet Completion
 - Assign agripreneurs into different groups for each worksheet to encourage collaboration and create an inclusive environment for people with different educational backgrounds.
 - Check in on the agripreneurs to clarify terms/concepts and answer any questions.
 - Integrate games and friendly competition into the worksheet activities.
 - Encourage agripreneurs to share their work with the class.

Module 1: Assessment of Current State

Overview

Module 1 aims to help agripreneurs assess the current state of A4A's assets, property, and farm as a whole. By taking note of what the program has, the agripreneurs can then assess the needs of the farm and its production capacity. Furthermore, an understanding of the farm's current state is necessary to plan out how the business will grow from this starting point. Agripreneurs will utilize Worksheet 1.1 to create a map of the farm. In Worksheet 1.2, the agripreneurs will create a log of all the working physical assets that they possess and utilize in their daily operations. For each asset, they should take note of its size, capacity, condition, and approximate monetary value. Worksheets 1.3 and 1.4 prompt the agripreneurs to create a schedule of farm operations. Worksheet 1.3 is specific to the operations for crop production systems, while Worksheet 1.4 pertains to livestock production systems. The agripreneurs will learn about cost-sharing in Worksheet 1.5. Finally, Worksheet 1.6 introduces the agripreneurs to the SWOT (strengths, weaknesses, opportunities, threats) analysis. Use the following lesson plans to accompany the worksheets within the module:

Lesson Plan 1.1: Property Map

1. **Lesson** - explain the importance of keeping a property map and what to include Maintaining a property map allows farmers to navigate across their farm. Maps provide the rough location of all physical assets on the property as well as the crops and livestock raised on the farm. Farm maps should include the following things: buildings, machinery and equipment, fields, and natural phenomena (eg. rivers, streams, forests). Farm maps should be drawn approximately to scale to provide a more accurate representation of the property. Lastly, maps should include labels to clarify all drawn phenomena.

2. Activity - complete Worksheet 1.1

Show the agripreneurs a visual of A4A's current farm site - either a sketch, a GIS map, or the map shown on the GIS device. Ask the agripreneurs to make a map of the farm site on the space provided by Worksheet 1.1. After around four minutes, have the agripreneurs share their maps with the people next to them.

Lesson Plan 1.2: Physical Assets

1. Definition - define the different types of physical assets

Physical assets in agriculture fall into the following categories: buildings and structures, machinery and equipment, livestock equipment, and livestock. Equipment includes any tools used to prepare the fields and grow crops, while livestock equipment pertains to the raising of livestock only.

2. **Lesson** - explain the importance of keeping an updated record of farm assets Maintaining an up-to-date, accurate record of physical assets is important for businesses because it allows businesses to...

- Stay organized
- Assess the value of their assets
- Identify assets in need of repair or replacement
- Know the location of each asset
- 3. Activity complete Worksheet 1.2

Ask the agripreneurs to get into groups of four to five people and complete Worksheet 1.2 together. After around eight minutes, go through the worksheet together and ask different groups to share one of their rows in the worksheet. On the board, have a template of the worksheet drawn out and have a representative from each group fill in one row. Ask the class if they agree or disagree with the entry and point out any assets they may have missed once each group has contributed to the shared worksheet on the board.

Lesson Plan 1.3: Current Crop Production Systems

1. Lesson - explain the importance of maintaining a schedule of operations

It is important to keep a schedule of crop production operations because it allows farmers to...

- Organize their work
- Identify the labor and inputs required for each operation
- Compare the costs and benefits of alternative tasks
- Assess how to improve operational efficiency and reduce costs

2. **Example** - share one crop production operation and its associated labor and inputs Potential examples to share:

- Applying insecticide to crops
- Hoeing and other weed suppression activities
- Planting seeds
- Harvesting crops

Provide an estimate of the hours of labor required to complete the task as well as information about any items used in the operation.

3. Activity - complete Worksheet 1.3

Write a template of the first page of Worksheet 1.3 on the board. Group the agripreneurs into teams of four to five people and have each team fill out half of the March, April, or May tables. Tell them which crop to focus on and give them about eight minutes to complete the task. Once all teams are done, ask a representative from each team to share their work on the board and aloud. Encourage class members to comment, ask questions, and participate.

Lesson Plan 1.4: Current Livestock Production Systems

1. **Lesson** - Explain the importance of maintaining a schedule of operations Use the lesson in Lesson Plan 1.3: Current Crop Production Systems.

2. **Example** - share one livestock operation and its associated labor and inputs Potential examples to share:

- Feeding the chickens or pigs
- Administering medication and vaccines
- Collecting eggs

Provide an estimate of the hours of labor required to complete the task as well as information about any items used in the operation.

3. Activity - complete Worksheet 1.4

Write a template of Worksheet 1.4 on the board. Group the agripreneurs into teams of four to five people and assign each group an animal to focus on for the worksheet (pigs, chickens, or

fish). Prompt each team to fill out two rows of the table for their assigned animal. Give them about eight minutes to complete the task. Once all teams are done, ask a representative from each team to share their work on the board and aloud. Go through all teams that worked on the same animal before moving on to the worksheet for a different assigned animal. Encourage class members to comment, ask questions, and participate.

Lesson Plan 1.5: Cost-Sharing

1. Lesson - explain the concept of cost-sharing

Farmers engage in cost-sharing to reduce the amount they must pay for something. Costs can be shared with family members, other farmers, government agencies, or companies.

2. Activity - complete Worksheet 1.5

Aloud and on the board, share costs and quantities of the items and property used by A4A that are eligible for cost-sharing. Put the agripreneurs into groups of three or four and have them fill out two rows of Worksheet 1.5 together. After around five minutes, have one representative from each group go up to the board to write down their group's work and share the numbers out loud. Encourage the agripreneurs to take notes on their peers' contributions and share any comments or questions.

Lesson Plan 1.6: SWOT Analysis

1. Definition - define the SWOT analysis and its purpose

A SWOT analysis is an assessment of a business's strengths, weaknesses, opportunities, and threats, hence the acronym 'SWOT.' Strengths and weaknesses are internal factors that pertain directly to the business, whereas opportunities and threats arise from external factors like the market and competitors.

Businesses use SWOT analysis to inform strategic plans and actions they may want to take in the future.

2. **Example** - share a strength, weakness, opportunity, and threat for A4A's business A4A staff should feel free to choose their own example, but a potential SWOT analysis has

been provided below for convenience:

Strength	Weakness
Location - the Melong II site is across from a market, making it easy for A4A to sell its products	Limited public attention - A4A's growth is limited by a lack of public awareness; more awareness could bring more funding
Opportunity	Threat
Government partnerships - A4A's newest partnership with the Delegate of Environment could result in operational improvements	Pests - potential for pest outbreaks to reduce crop yields and thus profits

3. Activity - complete Worksheet 1.6

Put the agripreneurs into groups of five to six people. Each group will work on one box in the SWOT analysis. Pose the following questions to the agripreneurs before they begin collaborating on the worksheet:

Strengths

- What does A4A do well?
- What is unique about A4A's business and products?
- What do partners and other third parties see as A4A's strengths?
- What assets does A4A own?

Weaknesses

- What can A4A improve?
- What are customers or partners dissatisfied with?
- What do competitors do better?
- What does A4A lack in knowledge and resources?

Opportunities

- What goals can A4A achieve this year?
- How can A4A make use of its strengths?
- What trends can A4A take advantage of?

Threats

• What economic or political issues could affect A4A's business?

• What environmental conditions could impact crop yields?

Write down the questions on the board and share them out loud. Prompt the groups to fill out their particular section of the SWOT analysis in Worksheet 1.6. After five minutes, ask one person in each group to share what their team put for their assigned section of the SWOT analysis.

Module 2: Marketing

Overview

In this module, the agripreneurs will determine how to market A4A's products. The worksheets within this module outline a few key components of a business marketing strategy: production capacity, pricing strategy, and distribution plan. First, the agripreneurs will establish an estimate of the program's potential sales volume in Worksheet 2.1. This estimate depends on their approximation of the number of expected customers and the number of products they expect each customer to purchase. Next, Worksheet 2.2 prompts the agripreneurs to define potential pricing strategies to set prices for A4A's products. Lastly, the agripreneurs will use Worksheet 2.3 to decide how A4A should package and distribute its products. Use the following lesson plans to accompany the worksheets within the module:

Lesson Plan 2.1: Potential Sales Volume

1. Lesson - explain how to calculate sales volume

Sales volume represents the amount of product sold over a particular period. There are two ways of calculating the potential sales volume of a business:

Sales Volume = Number of Customers * Number of Items Sold per Customer Sales Volume over Time Period = Items Sold per Unit Time * Time Period

For example, if a cabbage farmer estimates 15 customers will purchase an average of two cabbages each in one day, the potential sales volume for one week would be calculated as follows:

Potential Sales Volume = 15 customers * 2 cabbages per customer Potential Sales Volume = 30 cabbages per day * 7 days per week Potential Sales Volume = 210 cabbages per week

The same potential sales volume can be derived with different starting information about the cabbage farmer's sales. If the cabbage farmer expects to sell 30 cabbages every day, her potential sales volume for one week of sales would be calculated as follows:

Potential Sales Volume = 30 cabbages per day * 7 days per week

Potential Sales Volume = 210 cabbages per week

Estimating the potential sales volume for a particular product sold by a business helps the business set targets for their sales over a particular period. Businesses can also make adjustments based on how they perform compared to their estimated potential.

2. Activity - complete Worksheet 2.1

Aloud and on the board, share sales data about two products sold by A4A last year. Ask the agripreneurs to get into groups of two or three and fill out Worksheet 2.1 together. After around ten minutes, ask representatives from a few groups to share their potential sales volume calculations and explain their logic and reasoning. Suggest any improvements to their thought process.

Lesson Plan 2.2: Pricing

1. Lesson - explain how to gauge industry and competitor prices

Government agencies that govern regional agriculture and farming industries can provide estimates of industry prices for certain products. Consulting with the delegate of agriculture or livestock in the region is a good first step toward understanding the average price of a good in the market. Competitor prices can be gauged by simply going to the market and seeing what prices competitors have set for the same products.

2. Definition - define three common pricing strategies and unit cost.

Cost-plus pricing: A pricing strategy in which price is determined by adding a fixed percentage to the product's unit cost.

Unit cost: the cost to produce one unit of a product.

Dynamic pricing: a pricing strategy in which product prices change with product demand. *Competitive pricing*: A pricing strategy in which prices are set based on those set by competitors.

3. **Lesson** - explain the pros and cons of each pricing strategy and which is best for A4A Farmers should use cost-plus pricing as their default pricing strategy because the strategy guarantees that a business will cover all of its production costs and make a profit. Cost-plus pricing is calculated as follows:

Price = unit cost * fixed percentage

Businesses determine this fixed percentage based on their desired profit margin. To find unit costs, businesses must divide their total operating expenses by the number of products they expect to sell.

Competitive pricing allows businesses to outcompete rival businesses by pricing their products relative to the costs of other products on the market. The downfall of this strategy is that it does not account for initial costs and any differences in operating costs between competitors. A4A should assess how its prices compare to that of other vendors in the market; however, it should not base the prices of its products solely on its competitors' prices.

Dynamic pricing is recommended for businesses that sell products with varying demand throughout the year. As demand increases, businesses increase the price of their products to make more revenue. This pricing strategy is not common in the food industry and thus is not recommended for A4A, although it is important to understand the opportunity for increased revenues when product demand increases.

4. Activity - fill out Worksheet 2.2

Prompt the agripreneurs to fill out Worksheet 2.2 as they listen to the lesson. Share industry prices for a particular product chosen by A4A staff. Take the agripreneurs on the optional field trip* to collect information about prices set by vendors with competing products. If not, give the agripreneurs a range of potential competitor prices or skip the section.

* OPTIONAL FIELD TRIP: take the agripreneurs to the market to ask other vendors about the prices of their products.

Lesson Plan 2.3: Packaging and Distribution

1. Definition - define different distribution channels

Distribution channel: The network by which a business delivers its products or services to consumers.

Direct-to-consumer: a distribution channel whereby a business sells its products directly to its end consumers.

Retailer: An entity that buys products from a producer and sells them to consumers. **Wholesaler**: An entity that purchases products in bulk from a variety of producers and sells them in smaller amounts to various retailers.

A4A uses a direct-to-consumer distribution channel because sales are made in person at markets. Grocery stores and supermarkets are considered retailers.

2. Lesson - explain how to package A4A's different products

Most crops do not require any individual packaging, although they should be stored in sacks, baskets, or bags when stored in bulk. However, animal products like eggs, fish, and meat require packaging to protect them from contamination or damage. Farms should follow industry-wide hygiene standards and best practices for food packaging and storage.

A4A staff should supplement this lesson with any additional guidelines provided by government partners.

3. Definition - define processing and handling

Processing: The transformation of agricultural raw materials into new food products. *Handling*: The process of preparing and packaging items before they are sold.

Processing is an optional step in the supply chain of a product that changes its form and often increases its value.

Handling is an essential step for products that require prior preparation or packaging before they are sold. Handling includes the following actions: sorting, trimming, packing, storing, and washing.

4. Activity - complete Worksheet 2.3

Prompt the agripreneurs to get into groups of three to four people. Assign a different product to each group and give them around seven minutes to complete Worksheet 2.3 for their assigned product. Once all teams are done, ask one representative from each team to share their work aloud and on the board. Encourage other agripreneurs to participate by asking questions or giving feedback.

Module 3: Financial Management

Overview

In this module, the agripreneurs will learn how to keep track of financial data and use the data to estimate A4A's net income. With a record of revenues and expenses, businesses can assess the financial success of their operations and plan for future growth. Worksheet 3.1 prompts the agripreneurs to quantify A4A's expenses over the course of one year of business. Agripreneurs will learn about income statements in Worksheet 3.2. Lastly, Worksheet 3.3 teaches the agripreneurs how to project sales. Use the following lesson plans to accompany the worksheets within the module:

Lesson Plan 3.1: Annual Expenses

Definition - explain the difference between direct and overhead (indirect)expenses
 Direct expense: Money spent directly on producing goods or services.

Overhead (indirect) expense: Money spent on work-related costs aside from materials and labor (ie. rent).

Definition - explain the difference between variable and fixed costs
 Variable costs: Costs that change based on production (ie. cost of seeds).
 Fixed costs: Costs that remain the same regardless of production (ie. taxes, rent).

3. **Lesson** - explain the importance of maintaining a record of expenses Businesses need to keep a record of the expenses they incur to maintain control of their finances, track progress, and budget accordingly. Businesses can identify any problems with their financials by comparing their expenses to their revenues and take action to remediate the issue.

4. Activity - complete Worksheet 3.1

Provide the agripreneurs with A4A's expenses over one year by writing them on the board and sharing them aloud. Group the agripreneurs into teams of two or three and fill out Worksheet 3.1 together. After around seven minutes, ask a representative from each group to share their answers.

Lesson Plan 3.2: Income Statement

1. Lesson - describe the purpose and structure of an income statement

Income statement: A financial statement that reports the income and expenses of a business. Income statements provide information about annual expenses, annual revenues, and net income for one year of business. Businesses use income statements to understand their profitability during one year of operations.

2. Definition - Distinguish between revenue and income

Revenue: Money generated from ongoing business operations.

Income: Revenue minus expenses; the money earned by a business after expenses have been deducted

3. Activity - Complete Worksheet 3.2

Out loud and on the board, share information about A4A's revenue and expenses from last year. Group the agripreneurs into teams of three to four people and prompt them to complete Worksheet 3.2 together. After around eight minutes, go through the worksheet together and call on representatives from each group to provide their values for total revenue (a), total expenses (b), and net farm income (a-b).

Lesson Plan 3.3: Projected Sales

1. Lesson - explain how to calculate projected sales

Projected sales represent the revenue that a business expects to earn in the future. Use the following equation to calculate projected sales:

Projected Sales = Units of Product Sold * Selling Price

Take the sum of projected sales for each month over one year to find the annual projected sales. If a business sells 30 cabbages in one month for a price of CFA 5, the projected sales would be determined as follows:

Projected Sales = 30 cabbages per month * CFA 5 / cabbage

Projected Sales = CFA 150 per month

2. Activity - complete Worksheet 3.3

Out loud and on the board, share monthly sales volume and price information for the products sold by A4A last year. Group the agripreneurs into teams based on their crop or livestock project focus and prompt them to fill out Worksheet 3.3 to calculate projected sales of their particular product for one year. After around ten minutes, ask a representative from each team to share their results for one of the products.

Glossary

Marketing Terms and Concepts		
Term	Definition	
Competitive Pricing	A pricing strategy in which prices are set based on those set by competitors.	
Consumer	A person or group who purchases goods or services for personal use.	
Cost-Plus Pricing	A pricing strategy in which price is determined by adding a fixed percentage to the product's unit cost.	
Distribution Channel	The network by which a business delivers its products or services to consumers.	
Dynamic Pricing	A pricing strategy in which product prices change with product demand.	
Handling	The process of preparing and packaging items before they are sold.	
Market	The systems, institutions, procedures, and social relations in which buyers and sellers exchange goods and services.	
Processing	The transformation of agricultural raw materials into new food products.	
Retailer	An entity that buys products from a producer and sells them to consumers.	
Sales Volume	The number of units of product sold over a particular period of time.	
Unit Cost	The cost to make one unit of a product.	
Wholesaler	An entity that purchases products in bulk from a variety of producers and sells them in smaller amounts to various retailers.	

Financial Management Terms and Concepts				
Term	Definition			
Direct Expense	Money that is spent directly on producing goods or services.			
Expense	Money spent during business operations.			
Fixed Costs	Costs that remain the same regardless of production (ie. taxes, rent).			
Income Statement	A financial statement that reports the income and expenses of a business.			
Net Income	Revenues minus expenses.			
Overhead (Indirect) Expense	Money spent on work-related costs aside from materials and labor (ie. rent).			
Revenue	Money that is generated from ongoing business operations.			
Variable Costs	Costs that change based on production (ie. cost of seeds).			

Post-Release Business Curriculum







Agriculture for Africa Environmental Science Practicum Team 2022

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Introduction

The business curriculum provides an in-depth set of lessons about essential agribusiness concepts. The curriculum includes fifteen lessons, each of which is divided into one of four modules: (1) Assessment of Current State, (2) Identifying Goals and Values, (3) Marketing, and (4) Financial Management. Every lesson plan lays out key terms, relevant business concepts, and learning activities. Furthermore, each lesson is associated with a particular worksheet to fill out after listening to the lesson. Pace the lessons over a month-long period to give yourself time to digest new concepts. Overall, the business curriculum provides a general structure for individual lessons about a variety of topics that should be customized and adjusted as needed. Utilize the following guidelines to maximize engagement and learning retention for each lesson:

- Think about how the lesson concepts apply to your prior experiences and knowledge.
- Take field trips to local markets and farms to connect the concepts to real-world scenarios.
- Make connections with local farmers, other former agripreneurs, government officials, and any other experts. These people will serve as resources and guides as you begin your own business.

Module 1: Assessment of Current State

Overview

Module 1 shows you how to assess the current state of your assets, property, and farm as a whole. By taking note of what the program has, you can then assess the needs of the farm and its production capacity. Furthermore, an understanding of the farm's current state is necessary to plan out how the business will grow from this starting point. You will utilize Worksheet 1.1 to create a map of your farm. In Worksheet 1.2, you will create a log of all the working physical assets that they possess and utilize in their daily operations. For each asset, they should take note of its size, capacity, condition, and approximate monetary value. Worksheets 1.3 and 1.4 prompt you to create a schedule of farm operations. Worksheet 1.3 is specific to the operations for crop production systems, while Worksheet 1.4 pertains to livestock production systems. You will learn about cost-sharing in Worksheet 1.5. Finally, Worksheet 1.6 introduces the SWOT (strengths, weaknesses, opportunities, threats) analysis. Use the following lesson plans to accompany the worksheets within the module:

Lesson Plan 1.1: Property Map

1. **Lesson** - explain the importance of keeping a property map and what to include Maintaining a property map allows farmers to navigate across their farm. Maps provide the rough location of all physical assets on the property as well as the crops and livestock raised on the farm. Farm maps should include the following things: buildings, machinery and equipment, fields, and natural phenomena (eg. rivers, streams, forests). Farm maps should be drawn approximately to scale to provide a more accurate representation of the property. Lastly, maps should include labels to clarify all drawn phenomena.

Activity - draw a map of the farm site on Worksheet 1.1
 Make a map of your farm property on the space provided by Worksheet 1.1.

Lesson Plan 1.2: Physical Assets

1. **Definition** - define the different types of physical assets Physical assets in agriculture fall into the following categories: buildings and structures, machinery and equipment, livestock equipment, and livestock. Equipment includes any tools used to prepare the fields and grow crops, while livestock equipment pertains to the raising of livestock only.

2. **Lesson** - explain the importance of keeping an updated record of farm assets Maintaining an up-to-date, accurate record of physical assets is important for businesses because it allows them to...

- Stay organized
- Assess the value of their assets
- Identify assets in need of repair or replacement
- Know the location of each asset
- 3. Activity fill out Worksheet 1.2: Physical Assets

Complete Worksheet 1.2.

Lesson Plan 1.3: Current Crop Production Systems

1. Lesson - explain the importance of maintaining a schedule of operations

It is important to keep a schedule of crop production operations because it allows farmers to...

- Organize their work
- Identify the labor and inputs required for each operation
- Compare the costs and benefits of alternative tasks
- Assess how to improve operational efficiency and reduce costs
- 2. Activity complete Worksheet 1.3

Fill out Worksheet 1.3 if applicable.

Lesson Plan 1.4: Current Livestock Production Systems

1. Lesson - Explain the importance of maintaining a schedule of operations

Use the lesson in Lesson Plan 1.3: Current Crop Production Systems.

2. Activity - complete Worksheet 1.4

Fill out Worksheet 1.4 if applicable.

Lesson Plan 1.5: Cost-Sharing

1. **Lesson** - explain the concept of cost-sharing

Farmers engage in cost-sharing to reduce the amount they must pay for something. Costs can be shared with family members, other farmers, government agencies, or companies.

Activity - complete Worksheet 1.5
 Fill out Worksheet 1.5.

Lesson Plan 1.6: SWOT Analysis

1. Definition - define the SWOT analysis and its purpose

A SWOT analysis is an assessment of a business's strengths, weaknesses, opportunities, and threats, hence the acronym 'SWOT.' Strengths and weaknesses are internal factors that pertain directly to the business, whereas opportunities and threats arise from external factors like the market and competitors.

Businesses use SWOT analysis to inform strategic plans and actions they may want to take in the future.

2. Example - a strength, weakness, opportunity, and threat for A4A's business

Here is an example of a SOT analysis for A4A's business:

Strength	Weakness
Location - the Melong II site is across from a market, making it easy for A4A to sell its products	Limited public attention - A4A's growth is limited by a lack of public awareness; more awareness could bring more funding
Opportunity	Threat
Government partnerships - A4A's newest partnership with the Delegate of Environment could result in operational improvements	Pests - potential for pest outbreaks to reduce crop yields and thus profits

3. Activity - complete Worksheet 1.6

Think about the following questions as you fill out Worksheet 1.6:

Strengths

- What does your business do well?
- What is unique about your business and products?
- What do partners and other third parties see as your strengths?
- What assets do you own?

Weaknesses

- What can you improve?
- What are customers or partners dissatisfied with?
- What do competitors do better?
- What do you lack in knowledge and resources?

Opportunities

- What goals can you achieve this year?
- How can you make use of your strengths?
- What trends can you take advantage of?

Threats

- What economic or political issues could affect your business?
- What environmental conditions could impact crop yields?

Module 2: Identifying Goals and Values

Overview

The following module aims to establish a business roadmap founded upon your values and goals. Business roadmaps communicate the vision of the business, segment business growth into a few key phases, and establish a timeline for achieving goals. In Worksheet 2.1, you will identify your short-term, intermediate, and long-term goals for your farm and business. It is important to keep these goals in mind because they provide you with the motivation and direction to improve the business. Worksheet 2.2 prompts you to outline your most important values. Understanding your values will help you decide your vision for your business and the direction you want it to take. Once you have identified your goals and values, you can proceed to create a business roadmap. Worksheet 2.3 provides a template for a business roadmap, which you can use to plan the growth of your business over a short period. Use the following lesson plans to accompany the worksheets within the module:

Lesson Plan 2.1: Business Goals

1. Lesson - the importance of setting business goals

Goals give businesses a direction to take and allow them to measure their progress. Setting goals helps businesses organize their time and gives employees motivation to work towards these objectives. Goals should be specific, clearly defined, and achievable.

2. Activity - complete Worksheet 2.1

Fill out Worksheet 2.1.

Lesson Plan 2.2: Values

Lesson - the importance of understanding your values
 Identifying personal values helps people make decisions and inform any actions they take.
 Knowing one's values allows people to align their business with what is most important to them.

Activity - fill out Worksheet 2.2
 Complete Worksheet 2.2.

Lesson Plan 2.3: Business Roadmap

1. **Lesson** - how to use a business roadmap and why it is important Business roadmaps allow farmers to plan strategic actions and execute them according to a specific timeline. They provide an organized structure for businesses to plan out what goals they want to achieve within a certain time frame, how to achieve those goals, and what outcomes they expect. Use the following guidelines to build a business roadmap:

- Identify a business goal you would like to achieve in the short term
 - What would the business like to achieve?
 - Tip set goals that are specific, measurable, attainable, relevant, and time-bound
- Establish a plan to achieve your goal with key phases of advancement over a certain timeframe
 - How will the goal be achieved?
 - What main steps must be taken to make progress towards your goal?
 - How long will it take to achieve the goal?
 - Tip the following key phases are crucial to the successful execution of a plan: preparation, implementation, evaluation, and modification.
- Identify any activities required to carry out each phase of progress
 - What actions must be taken to complete each phase?
 - How can each phase be broken down into several smaller action items?
 - Tip create a step-by-step action plan that breaks down the necessary activities into small tasks that are easy to accomplish
- Identify the outcome(s) of achieving goals
 - What will change and/or improve as a result of this achievement?
 - What is the value derived from completing these activities?
- 2. Activity complete Worksheet 2.3

Complete Worksheet 2.3.

Module 3: Marketing

Overview

In this module, you will determine how to market your products. The worksheets within this module outline a few key components of a business marketing strategy: production capacity, pricing strategy, packaging, and distribution. First, you will establish an estimate of the program's potential sales volume in Worksheet 3.1. This estimate depends on their approximation of the number of expected customers and the number of products they expect each customer to purchase. Next, Worksheet 3.2 prompts you to define potential pricing strategies to set prices for your products. Lastly, use Worksheet 3.3 to decide how you should package and distribute your products. Use the following lesson plans to accompany the worksheets within the module:

Lesson Plan 3.1: Potential Sales Volume

1. Lesson - explain how to calculate sales volume

Sales volume represents the amount of product sold over a particular period. There are two ways of calculating the potential sales volume of a business:

Sales Volume = Number of Customers * Number of Items Sold per Customer Sales Volume over Time Period = Items Sold per Unit of Time * Time Period

For example, if a cabbage farmer estimates 15 customers will purchase an average of two cabbages each in one day, the potential sales volume for one week would be calculated as follows:

Potential Sales Volume = 15 customers * 2 cabbages per customer Potential Sales Volume = 30 cabbages per day * 7 days per week Potential Sales Volume = 210 cabbages per week

The same potential sales volume can be derived with different starting information about the cabbage farmer's sales. If the cabbage farmer expects to sell 30 cabbages every day, her potential sales volume for one week of sales would be calculated as follows:

Potential Sales Volume = 30 cabbages per day * 7 days per week

Potential Sales Volume = 210 cabbages per week

Estimating the potential sales volume for a particular product sold by a business helps the business set targets for their sales over a particular period. Businesses can also make adjustments based on how they perform compared to their estimated potential.

2. Activity - complete Worksheet 3.1

Fill out Worksheet 3.1 using sales data about one or more products you sell.

Lesson Plan 3.2: Pricing

1. Lesson - explain how to gauge industry and competitor prices

Government agencies that govern regional agriculture and farming industries can provide estimates of industry prices for certain products. Consulting with the delegate of agriculture or livestock in the region is a good first step toward understanding the average price of a good in the market. Competitor prices can be gauged by simply going to the market and seeing what prices competitors have set for the same products.

2. Definition - define three common pricing strategies and unit cost.

Cost-plus pricing: A pricing strategy in which price is determined by adding a fixed percentage to the product's unit cost.

Unit cost: the cost to produce one unit of a product.

Dynamic pricing: a pricing strategy in which product prices change with product demand. *Competitive pricing*: A pricing strategy in which prices are set based on those set by competitors.

3. **Lesson** - the pros and cons of each pricing strategy and which is best Farmers should use cost-plus pricing as their default pricing strategy because the strategy guarantees that a business will cover all of its production costs and make a profit. Cost-plus pricing is calculated as follows:

Price = unit cost * fixed percentage

Businesses determine this fixed percentage based on their desired profit margin. To find the unit cost of a product, businesses must divide their total operating expenses by the number of products they expect to sell.

Competitive pricing allows businesses to outcompete rival businesses by pricing their products relative to the costs of other products on the market. The downfall of this strategy is that it does not account for initial costs and any differences in operating costs between competitors. Assess how your prices compare to that of other vendors in the market; however, do not base the prices of your products solely on your competitors' prices.

Dynamic pricing is recommended for businesses that sell products with varying demand throughout the year. As demand increases, businesses increase the price of their products to make more revenue. This pricing strategy is not common in the food industry and thus is not recommended, although it is important to understand the opportunity for increased revenues when product demand increases.

4. Activity - complete Worksheet 3.2

Research industry prices for the products you plan to sell via informational interviews with government officials or other experts. If possible, collect information about prices set by vendors with competing products at a local market. Based on the information collected, fill out Worksheet 3.2.

Lesson Plan 3.3: Packaging and Distribution

1. Definition - define different distribution channels

Distribution channel: The network by which a business delivers its products or services to consumers.

Direct-to-consumer: a distribution channel whereby a business sells its products directly to its end consumers.

Retailer: An entity that buys products from a producer and sells them to consumers.

Wholesaler: An entity that purchases products in bulk from a variety of producers and sells them in smaller amounts to various retailers.

Farmers selling at local markets utilize a direct-to-consumer distribution channel. Grocery stores and supermarkets are considered retailers.

2. Lesson - how to package different products

Most crops do not require any individual packaging, although they should be stored in sacks, baskets, or bags when stored in bulk. However, animal products like eggs, fish, and meat require packaging to protect them from contamination or damage. Farms should follow industry-wide hygiene standards and best practices for food packaging and storage.

Speak to government officials and other experts to learn about any additional guidelines.

3. Definition - define processing and handling

Processing: The transformation of agricultural raw materials into new food products.

Handling: The process of preparing and packaging items before they are sold.

Processing is an optional step in the supply chain of a product that changes its form and often increases its value.

Handling is an essential step for products that require prior preparation or packaging before sale. Handling includes the following actions: sorting, trimming, packing, storing, and washing.

Activity - complete Worksheet 3.3
 Fill out Worksheet 3.3 for a particular product.
Module 4: Financial Management

Overview

In this module, you will learn how to keep track of financial data and use the data to estimate your net income. With a record of revenues and expenses, businesses can assess the financial success of their operations and plan for future growth. Worksheet 4.1 prompts you to quantify your expenses over one year of business. You will learn about income statements in Worksheet 4.2. Lastly, Worksheet 4.3 teaches you how to project sales. Use the following guidelines as a lesson plan to accompany the worksheets within the module:

Lesson Plan 4.1: Annual Expenses

Definition - the difference between direct and overhead (indirect) expenses
Direct expense: Money spent directly on producing goods or services.

Overhead (indirect) expense: Money spent on work-related costs aside from materials and labor (ie. rent).

Definition - the difference between variable and fixed costs
Variable costs: Costs that change based on production (ie. cost of seeds).
Fixed costs: Costs that remain the same regardless of production (ie. taxes, rent).

3. **Lesson** - the importance of maintaining a record of expenses Businesses need to keep a record of expenses they incur to maintain control of their finances, track progress, and budget accordingly. Businesses can identify any problems with their financials by comparing their expenses to their revenues and take action to remediate the issue.

4. Activity - complete Worksheet 4.1

Fill out Worksheet 4.1 with expense data over a year (or a shorter time frame if not possible) of business.

Lesson Plan 4.2: Income Statement

1. Lesson - the purpose and structure of an income statement

Income statement: A financial statement that reports the income and expenses of a business. Income statements provide information about annual expenses, annual revenues, and net income for one year of business. Businesses use income statements to understand their profitability during one year of operations.

2. Definition - Distinguish between revenue and income

Revenue: Money generated from ongoing business operations.

Income: Revenue minus expenses; the money earned by a business after expenses have been deducted

3. Activity - fill out Worksheet 4.2

Complete Worksheet 4.2 with information about your revenue and expenses after one year of business.

Lesson Plan 4.3: Projected Sales

1. Lesson - explain how to calculate projected sales

Projected sales represent the revenue that a business expects to earn in the future. Use the following equation to calculate projected sales:

Projected Sales = Units of Product Sold * Selling Price

Take the sum of projected sales for each month over one year to find the annual projected sales. If a business sells 30 cabbages in one month for a price of CFA 5, the projected sales would be determined as follows:

Projected Sales = 30 cabbages per month * CFA 5 / cabbage

Projected Sales = CFA 150 per month

2. Activity - complete Worksheet 4.3

Fill out Worksheet 4.3 to calculate projected sales of a particular product you plan to sell over the course of six months.

Glossary

Marketing Terms and Concepts				
Term	Definition			
Competitive Pricing	A pricing strategy in which prices are set based on those set by competitors.			
Consumer	A person or group who purchases goods or services for personal use.			
Cost-Plus Pricing	A pricing strategy in which price is determined by adding a fixed percentage to the product's unit cost.			
Distribution Channel	The network by which a business delivers its products or services to consumers.			
Dynamic Pricing	A pricing strategy in which product prices change with product demand.			
Handling	The process of preparing and packaging items before they are sold.			
Market	The systems, institutions, procedures, and social relations in which buyers and sellers exchange goods and services.			
Processing	The transformation of agricultural raw materials into new food products.			
Retailer	An entity that buys products from a producer and sells them to consumers.			
Sales Volume	The number of units of product sold over a particular period.			
Unit Cost	The cost to make one unit of a product.			
Wholesaler	An entity that purchases products in bulk from a variety of producers and sells them in smaller amounts to various retailers.			

Financial Management Terms and Concepts				
Term	Definition			
Direct Expense	Money that is spent directly on producing goods or services.			
Expense	Money spent during business operations.			
Fixed Costs	Costs that remain the same regardless of production (ie. taxes, rent).			
Income Statement	A financial statement that reports the income and expenses of a business.			
Net Income	Revenues minus expenses.			
Overhead (Indirect) Expense	Money spent on work-related costs aside from materials and labor (ie. rent).			
Revenue	Money that is generated from ongoing business operations.			
Variable Costs	Costs that change based on production (ie. cost of seeds).			

Agripreneur Business Workbook







Agriculture for Africa Environmental Science Practicum Team 2022

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Introduction

The business workbook is a booklet of exercises intended for the agripreneurs to complete to reinforce their understanding of important agribusiness concepts. The workbook consists of twelve worksheets, each of which falls under one of three main modules: (1) Assessment of Current State, (2) Marketing, and (3) Financial Management. Each module of worksheets should be completed in order to build upon fundamental concepts taught in earlier worksheets. At the end of the workbook, there is a glossary with the definitions of important terms and concepts.

Each worksheet within the workbook is associated with a lesson taught by the A4A staff. Lessons will take place over the duration of the A4A program, allowing for the completion of the workbook by the end of the program. The business lessons define key terms, explain important concepts, and include activities to facilitate learning comprehension. After listening to the lesson, please follow staff instructions and complete the accompanying worksheet. Raise your hand if you have a question and/or need assistance with completing the worksheet. Refer to the glossary if you are unsure of what a particular term means in the worksheets.

Keep the workbook after completion as a resource to support your potential agribusiness after release from prison. The concepts taught in the workbook are essential to any farming business.

Worksheet 1.1: Property Map

Use this worksheet to draw the farm property and associated structures approximately to scale.

Worksheet 1.2: Physical Assets

Fill out this worksheet to maintain a log of all working, physical assets used to operate the farm.

Buildings &	
Structures	
Machinery &	
Equipment	
Equipment	
Breeding	
LIVESTOCK	

Worksheet 1.3: Current Crop Production Systems

Fill out the following tables to establish a spring schedule of crop production activities and their associated physical and human resource requirements.

March Production of						
Labor			Operating Input			
Operation	Hours/Hectare	ltem	Quantity	Price/Unit	Total Cost	

April Production of					
La	bor		Operatin	g Input	
Operation	Hours/Hectare	ltem	Quantity	Price/Unit	Total Cost

May Production of					
La	bor	Operating Input			
Operation	Hours/Hectare	ltem	Quantity	Price/Unit	Total Cost

Worksheet 1.4: Current Livestock Production Systems

Fill out this table to establish your monthly schedule of livestock production activities and their associated physical and human resources requirements.

Livestock Production System for					
Labo	r	Operating Input			
Operation	Hours	Machinery & Equipment	Feed	Vet & Medication Costs	

Worksheet 1.5: Cost-Sharing

Use this worksheet to maintain a log of cost-sharing for A4A's land and inputs.

	Quantity	Price per Unit	Cost for A4A	Cost for Others	Total Cost
Land Rent					
Field Prep					
Cutlass					
Ное					
Pickax					
Rake					
Buckets					
Watering Can					
Dipple					
Planting					
File					
Shovel					
Knapsack					
Sprayer					
Rope					
Measuring					
Таре					
Total					

Worksheet 1.6: SWOT Analysis

Fill out the following table to assess the market environment and your position within the market.

	Helpful	Harmful
Internal	Strengths:	Weaknesses:
External	Opportunities:	Threats:

Worksheet 2.1: Potential Sales Volume

Fill out this table to project the sales from each market segment for a particular product.

Product:

	1 Day	1 Week	1 Month	6 Months
Potential # of Customers (a)				
Estimated Units Sold per Customer (b)				
Potential Sales Volume (a*b)				

Product:

	1 Day	1 Week	1 Month	6 Months
Potential # of Customers (a)				
Estimated Units Sold per Customer (b)				
Potential Sales Volume (a*b)				

Worksheet 2.2: Pricing

Use this worksheet to learn about different strategies for pricing products.
Product:
Competitor's Price Range:
Industry Price Range:
Define Cost-Plus Pricing:
Define Competitive Pricing:
Define Dynamic Pricing:

Worksheet 2.3: Packaging and Distribution

Fill out this worksheet to determine a system for packaging and distributing A4A's products.

Product:	
Processing & Handling:	
Packaging:	
Distribution Channel:	
Market Location(s):	

Worksheet 3.1: Annual Expenses

Fill out this worksheet to estimate A4A's annual operating expenses.

Direct Expenses	
Seeds	
Fertilizer	
Livestock Feed	
Pesticides	
Other Direct Crop Expenses	
Breeding Fees	
Veterinary Costs	
Other Direct Livestock	
Expenses	
Fuel and Oil	
Total Variable Costs	
Overhead Expenses	
Rent	
Repairs and Maintenance	
Taxes	
Interest on Debt	
Total Fixed Costs	

Worksheet 3.2: Income Statement

Use this worksheet to record A4A's income and expenses during one year of business.

Revenues:

Gross product sales	Lettuce sales
	Tomato sales
	Cabbage sales
Breeding livestock	Pig sales
	Chicken sales
Other income	
Total revenue (a)	
Expenses:	
Annual variable	Seeds
expenses	Fertilizer
	Pesticides
	Tools
	Feed
	Livestock supplies
	Veterinary costs
	Fuel and oil
	Other expenses
Annual fixed expenses	
	Rent
	Staff wages
	Telephone & internet
Total expenses (b)	
Net farm income (a-b)	

Worksheet 3.3: Projected Sales

Use this worksheet to estimate A4A's future sales for one or more products over six months.

Product		Month 1	Month 2	Month 3	Month 4	Month 5	Month 6
	Units Sold						
	Selling Price						
	Revenue						
	Units Sold						
	Selling Price						
	Revenue						
	Units Sold						
	Selling Price						
	Revenue						
	Units Sold						
	Selling Price						
	Revenue						
	Units Sold						
	Selling Price						
	Revenue						
Total Pro	ojected Sales						

Glossary

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Net Income	Revenues minus expenses.				
Overhead (Indirect) Expense	Money spent on work-related costs aside from materials and labor (ie. rent).				
Revenue	Money that is generated from ongoing business operations.				
Variable Costs	Costs that change based on production (ie. cost of seeds).				

References

The Minnesota Institute for Sustainable Agriculture. (2003). Building a Sustainable Business: A Guide to Developing a Business Plan for Farms and Rural Businesses. College Park; Sustainable Agriculture Research and Education.

Rodale Institute. (n.d.). Transition to Organic Course.

Cahier d'Affaires pour les Agripreneurs







Agriculture for Africa Environmental Science Practicum Team 2022

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Introduction

Ce cahier d'exercises est un livret destiné aux agripreneurs pour renforcer leur compréhension des concepts importants de l'agro-industrie. Le livret ce compose de douze feuilles de travail, chacune relevant de l'un des trois modules principaux: (1) l'évaluation de l'état actuel, (2) le marketing, et (3) la gestion des finances. Chaque module de feuilles de travail doit être rempli de manière séquentielle pour s'appuyer sur les concept fondamentaux enseignés dans les feuilles de travail précédentes. À la fin du manuel, il y a un glossaire avec les définitions des termes et concepts importants.

Chaque feuille de travail dans le livret est associée à una leçon enseigné par le personnel A4A. Les leçons se dérouleront pendant toute la durée du programme A4A, premettant l'achèveement du cahier d'exercises à la fin du programme. Les leçons de commerce définissent les termes clés, expliquent les concepts importants et incluent des activités pour faciliter la compréhension de l'apprentissage. Après avoir écoutée la leçon, veuillez suivre les instructions du personnel et remplir la feuille de travail qui l'accompagne. Levez la main si vous avez une question et/ou avez besoin d'aide pour remplir la feuille de travail. Reportez-vous au glossaire si vous n'êtes pas sûr de la signification d'un terme particulier dans les feuilles de travail.

Conservez le cahier de travail une fois terminé comme ressource pour soutenir votre entreprise agroalimentaire potentielle après votre sortie de prison.

Feuille de Travail 1.1: Carte de la Propriété

Utilisez cette feuille pour dessiner la propriété agricole et les structures associées approximativement à l'échelle.

Feuille de Travail 1.2: Actifs Physiques

Remplissez cette feuille de travail pour tenir un registre de tous les actifs physiques en état de marche utilisés pour exploiter la ferme.

	ltem	Size/Capacity	Location	Condition	Value
Buildings & Structures					
Machinery & Equipment					
Livestock Equipment					
Breeding Livestock					

Feuille de Travail 1.3: Système Actuel de Production Agricole

Remplissez ce tableau pour établir votre calendrier mensuel des activités de production agricole et leurs besoins de resources.

Production de en Mars					
Main	D'Oeuvre		Entrée de For	nctionnement	
Opération	Heures par Hectare	Objet	Objet Quantité Unité		

Production de en Avril					
Mair	n D'Oeuvre	Entrée de Fonctionnement			
Opération	Heures par Hectare	Objet	Quantité	Unité	Prix Total

Production de en Mai						
Mair	D'Oeuvre		Entrée de For	nctionnement		
Opération	Heures par Hectare	Objet Quantité Unité Prix			Prix Total	

Feuille de Travail 1.4: Système Actuel de Production Animale

Remplissez ce tableau pour établir votre calendrier mensuel des activités de production animale et leurs besoins en resources.

Système de Production de					
Main D'Oeuvre		Entrée de Fonctionnement			
Opération	pération Heures		Aliments pour Les Animaux	Coûts Vétérinaires et des Médicaments	

Feuille de Travail 1.5: Partage des Coûts

Utilisez cette feuille pour tenir un registre du partage des coûts cost-sharing de la propriété et des intrants.

	Quantité	Prix par Unité	Coût pour A4A	Coût pour les Autres	Coût Total
Loyer					
Préparation du Terrain					
Coutelas					
Houe					
Pioche					
Râteau					
Seaux					
Arrosoir					
Matériel de Plantation					
File					
Pelle					
Pulvérisateur à Dos					
Corde					
Ruban à Mesurer					
Total					

Feuille de Travail 1.6: Matrice SWOT

Remplissez le tableau suivant pour évaluer l'environnement du marché et votre position sur le marché.

	Utile pour atteindre l'objectif	Néfaste pour atteindre l'objectif
Origine Interne	Forces:	Faiblesses:
Origine Externe	Opportunités:	Menaces:

Feuille de Travail 2.1: Volume Potentiel des Ventes

Remplissez ce tableau pour projeter les ventes de chaque segment de marché pour un produit

Produit:

	1 Jour	1 Semaine	1 Mois	6 Mois
# Potentiel de Clients (a)				
Volume Estimé de Produits par Client (b)				
Volume Potentiel des Ventes (a*b)				

Produit:

	1 Jour	1 Semaine	1 Mois	6 Mois
# Potentiel de Clients (a)				
Volume Estimé de Produits par Client (b)				
Volume Potentiel des Ventes (a*b)				
Feuille de Travail 2.2: Prix

Utilisez cette feuille de calcul pour découvrir les différentes strategies de tarification.
Produit:
Gamme de Prix du Concurrent:
Gamme de Prix de l'Industrie:
Définissez La Tarification au Coût Majoré:
Définissez La Tarification Compétitive:
Définissez La Tarification Dynamique:

Feuille de Travail 2.3: Emballage et Distribution

Remplissez cette feuille de travail pour déterminer un système d'emballage et de distribution des produits.	
Produit:	
Traitement & Manipulation:	

Emballage et Stockage:

Canal de Distribution:

Emplacement(s) du Marché:

Feuille de Travail 3.1: Dépenses Annuelles

Remplissez cette feuille pour estimer les dépenses d'opération annuelles d'A4A.

Dépenses Directes	
Les Semences	
L'Engrais	
L'Alimentation du Bétail	
Les Pesticides	
Autres Frais Directs de Culture	
Le Frais d'Élevage	
Les Frais Vétérinaires	
Autres Frais Directs d'Élevage	
Le Carburant et le Pétrole	
Coûts Variables Totaux	
Overhead Expenses	
Le Loyer	
Les Réparations et Entretien	
Les Taxes	
Les Intérêts	
Coûts Fixes Totaux	

Worksheet 3.2: Le Compte de Résultat

Utilisez cette feuille pour enregistrer les revenus et les dépenses d'A4A pendant un an.

Revenus:

Ventes de produits bruts	Ventes de laitues			
	Ventes de tomates			
	Ventes de choux			
Bétail d'élevage	Ventes de porcs			
	Ventes de poulets			
Autres revenus				
Total des revenus (a)				
Dépenses:				
Dépenses variables	Les semences			
annuelles	L'engrais			
	Les pesticides			
	Les outils			
	L'alimentation			
	Fournitures pour bétail			
	Frais vétérinaires			
	Carburant et pétrole			
	Autres dépenses			
Dépenses fixes				
annuenes	Le loyer			
	Salaires du personnel			
	Téléphone & internet			
Dépenses totales (b)				
Revenu agricole net (a	-b)			

Feuille de Travail 3.3: Ventes Projetées

Utilisez cette feuille pour estimer les ventes futures d'un ou plusiers produits vendus par A4A.

Produit		Mois 1	Mois 2	Mois 3	Mois 4	Mois 5	Mois 6
	Unités Vendues						
	Prix de Vente						
	Revenus						
	Unités Vendues						
	Prix de Vente						
	Revenus						
	Unités Vendues						
	Prix de Vente						
	Revenus						
	Unités Vendues						
	Prix de Vente						
	Revenus						
	Unités Vendues						
	Prix de Vente						
	Revenus						
Ventes To	otales Prévues						

Glossaire

Les Termes et Concepts du Marketing					
Terme	Définition				
Les Prix Compétitifs	Une stratégie de tarification dans laquelle les prix sont fixés en fonction de ceux fixés par les concurrents.				
Le Consommateur	Une personne ou un groupe qui achète des biens ou des services pour son usage personnel.				
Le Prix de Revient Majoré	Une stratégie de tarification dans laquelle le prix est déterminé en ajoutant un pourcentage fixe au coût unitaire du produit.				
Le Canal de Distribution	Le réseau par lequel une entreprise fournit ses produits ou services aux consommateurs.				
La Tarification Dynamique	Une stratégie de prix dans laquelle les prix des produits changent avec la demande des produits.				
La Manutention	The process of preparing and packaging items before they are sold.				
Le Marché	Le lieu où les acheteurs et les vendeurs échangent des biens et des services.				
Le Traitement	La transformation des matières premières agricoles en nouveaux produits alimentaires.				
Le Détaillant	Une entité qui achète des produits à un producteur et les vend aux consommateurs; commerçant qui pratique la vente au détail.				
Le Volume des Ventes	Le nombre d'unités de produit vendues sur une période donnée.				
Le Grossiste	Une entité qui achète des produits en vrac auprès de divers producteurs et les vend à divers détaillants; l'intermédiaire entre le détaillant et le producteur ou le fabricant.				

	Les Termes et Concepts de la Gestion Financière
Terme	Définition
La Dépense Directe	L'argent dépensé directement pour produire des biens ou des services.
Les Frais	L'argent dépensé pendant les opérations commerciales.
Les Coûts Fixes	Des coûts qui restent les mêmes quelle que soit la production.
Le Compte de Résultat	Un état financier qui rend compte des revenus et des dépenses d'une enterprise.
Le Revenu Net	Les revenus moins les dépenses.
Les Frais Généreaux (Indirects)	L'argent dépensé pour les coûts liés au travail en dehors des matériaux et de la main-d'oeuvre.
Le Revenu	L'argent généré par les opérations commerciales en cours.
Les Coûts Variables	Les coûts qui changent en fonction de la production

Références

The Minnesota Institute for Sustainable Agriculture. (2003). Building a Sustainable Business: A Guide to Developing a Business Plan for Farms and Rural Businesses. College Park; Sustainable Agriculture Research and Education.

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Post-Release Business Workbook







Agriculture for Africa Environmental Science Practicum Team 2022

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Introduction

The business workbook is a booklet of exercises intended for young farmers to complete to reinforce their understanding of important agribusiness concepts. The workbook consists of fifteen worksheets, each of which falls under one of four main modules: (1) Assessment of Current State, (2) Identifying Goals and Values, (3) Marketing, and (4) Financial Management. Each module of worksheets should be completed to build upon fundamental concepts taught in earlier worksheets. At the end of the workbook, there is a glossary with the definitions of important terms and concepts.

Each worksheet within the workbook is associated with a lesson in the Business Curriculum. The business lessons define key terms, explain important concepts, and include activities to facilitate learning comprehension. After learning the lesson, please complete the accompanying worksheet. Reach out to local experts if you have a question and/or need assistance with learning the business concepts applied in the worksheets. Refer to the glossary if you are unsure of what a particular term means in the worksheets.

Keep the workbook after completion as a resource to support your business. The concepts taught in the workbook are essential to any farming business.

Worksheet 1.1: Property Map

Use this worksheet to draw your farm property and associated structures approximately to scale.

Worksheet 1.2: Physical Assets

Fill out this worksheet to maintain a log of all working, physical assets used to operate the farm.

Buildings &	
Structures	
Machinery &	
Equipment	
Equipment	
Breeding	
LIVESTOCK	

Worksheet 1.3: Current Crop Production Systems

Fill out the following tables to establish a spring schedule of crop production activities and their associated physical and human resource requirements.

March Production of						
La	bor	Operating Input				
Operation	Hours/Hectare	ltem	Quantity	Price/Unit	Total Cost	

April Production of					
La	bor	Operating Input			
Operation	Hours/Hectare	ltem	Quantity	Price/Unit	Total Cost

May Production of					
La	bor	Operating Input			
Operation	Hours/Hectare	ltem	Quantity	Price/Unit	Total Cost

Worksheet 1.4: Current Livestock Production Systems

Fill out this table to establish your monthly schedule of livestock production activities and their associated physical and human resources requirements.

Livestock Production System for					
Labo	r	Operating Input			
Operation	Hours	Machinery & Equipment	Feed	Vet & Medication Costs	

Worksheet 1.5: Cost-Sharing

Use this worksheet to maintain a log of cost-sharing for your land and inputs.

	Quantity	Price per Unit	Cost for You	Cost for Others	Total Cost
Land Rent					
Field Prep					
Cutlass					
Ное					
Pickax					
Rake					
Buckets					
Watering Can					
Dipple					
Planting Equipment					
File					
Shovel					
Knapsack					
Sprayer					
Rope					
Measuring					
Таре					
Total					

Worksheet 1.6: SWOT Analysis

Fill out the following table to assess the market environment and your position within the market.

	Helpful	Harmful
Internal	Strengths:	Weaknesses:
External	Opportunities:	Threats:

Worksheet 2.1: Business Goals

Fill out this worksheet to establish your goals for your farm and agribusiness.

Short-term goals (0-1 years):

Intermediate goals (1-5 years):

Long-term goals (5+ years):

Worksheet 2.2: Values

Use this worksheet to list your most important values.

Personal Values:

Community Values:

Economic Values:

Environmental Values:

Worksheet 2.3: Business Roadmap

Fill out this table to outline your business roadmap to achieve a particular goal. For each month, list the strategic phase, associated activities, and expected outcomes.

Month	Phase	Activity	Outcome

Worksheet 3.1: Potential Sales Volume

Fill out this table to project the sales from each market segment for a particular product.

Product:

	1 Day	1 Week	1 Month	6 Months
Potential # of Customers (a)				
Estimated Units Sold per Customer (b)				
Potential Sales Volume (a*b)				

Product:

	1 Day	1 Week	1 Month	6 Months
Potential # of Customers (a)				
Estimated Units Sold per Customer (b)				
Potential Sales Volume (a*b)				

Worksheet 3.2: Pricing

Use this worksheet to learn about different strategies for pricing products.
Product:
Competitor's Price Range:
Industry Price Range:
Define Cost-Plus Pricing:
Define Competitive Pricing:
Define Dynamic Pricing:
Your Overall Pricing Strategy:

Worksheet 3.3: Packaging and Distribution

Fill out this worksheet to determine a system for packaging and distributing your products.

Product:	
Processing & Handling:	
Packaging:	
Distribution Channel:	
Market Location(s):	

Worksheet 4.1: Annual Expenses

Fill out this worksheet to estimate your annual operating expenses.

Direct Expenses

Seeds	
Fertilizer	
Livestock Feed	
Pesticides	
Other Direct Crop Expenses	
Breeding Fees	
Veterinary Costs	
Other Direct Livestock	
Expenses	
Fuel and Oil	
Total Variable Costs	
Overhead Expenses	
Rent	
Repairs and Maintenance	
Taxes	
Interest on Debt	
Total Fixed Costs	

Worksheet 4.2: Income Statement

Use this worksheet to record your income and expenses during one year of business.

Revenues:

Gross product sales	Lettuce sales
	Tomato sales
	Cabbage sales
Breeding livestock	Pig sales
	Chicken sales
Other income	
Total revenue (a)	
Expenses:	
Annual variable	Seeds
expenses	Fertilizer
	Pesticides
	Tools
	Feed
	Livestock supplies
	Veterinary costs
	Fuel and oil
	Other expenses
Annual fixed expenses	
	Rent
	Staff wages
	Telephone & internet
Total expenses (b)	
Net farm income (a-b)	

Worksheet 4.3: Projected Sales

Use this worksheet to estimate your future sales for one or more products over six months.

Product		Month 1	Month 2	Month 3	Month 4	Month 5	Month 6
	Units Sold						
	Selling Price						
	Revenue						
	Units Sold						
	Selling Price						
	Revenue						
	Units Sold						
	Selling Price						
	Revenue						
	Units Sold						
	Selling Price						
	Revenue						
	Units Sold						
	Selling Price						
	Revenue						
Total Pro	ojected Sales						

Glossary

	Marketing Terms and Concepts
Term	Definition
Competitive Pricing	A pricing strategy in which prices are set based on those set by competitors.
Consumer	A person or group who purchases goods or services for personal use.
Cost-Plus Pricing	A pricing strategy in which price is determined by adding a fixed percentage to the product's unit cost.
Distribution Channel	The network by which a business delivers its products or services to consumers.
Dynamic Pricing	A pricing strategy in which product prices change with product demand.
Handling	The process of preparing and packaging items before they are sold.
Market	The systems, institutions, procedures, and social relations in which buyers and sellers exchange goods and services.
Processing	The transformation of agricultural raw materials into new food products.
Retailer	An entity that buys products from a producer and sells them to consumers.
Sales Volume	The number of units of product sold over a particular period of time.
Wholesaler	An entity that purchases products in bulk from a variety of producers and sells them in smaller amounts to various retailers.

Financial Management Terms and Concepts	
Term	Definition
Direct Expense	Money spent directly on producing goods or services.
Expense	Money spent during business operations.
Fixed Costs	Costs that remain the same regardless of production (ie. taxes, rent).
Income Statement	A financial statement that reports the income and expenses of a business.
Net Income	Revenues minus expenses.
Overhead (Indirect) Expense	Money spent on work-related costs aside from materials and labor (ie. rent).
Revenue	Money generated from ongoing business operations.
Variable Costs	Costs that change based on production (ie. cost of seeds).

References

The Minnesota Institute for Sustainable Agriculture. (2003). Building a Sustainable Business: A Guide to Developing a Business Plan for Farms and Rural Businesses. College Park; Sustainable Agriculture Research and Education.

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