



Organic Farming in Morocco:

An Investigation of Agricultural Extension Centers

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Chapter 1: Introduction

Morocco relies on its agricultural sector for 15% of the country's gross domestic product (GDP) (International Trade Administration, 2017). However, due to climate change, Morocco faces challenges such as an increase in water shortages and droughts that hinder agricultural productivity. Since the economy's agricultural GDP fluctuates with respect to water scarcity, many farmers face pressure to plant genetically modified crops, and use pesticides or chemicals in an effort to decrease their reliance on water (World Bank, 2013, p. 35).

Due to these environmental and man-made factors, Morocco's agricultural sector needs to adapt and evolve. The government has implemented strategies and initiatives like the Green Morocco Plan to invest in agricultural areas of high productivity and value while also working to counteract rural poverty by increasing investments in social initiatives (Global Forum for Rural Advisory Services, 2013). There have also been efforts on the part of locally-focused agricultural extension centers to spread knowledge of best farming practices to farmers in their respective regions. Although there are many agricultural extension centers in Morocco, the services they provide are often insufficient to meet farmers' needs. Finding strategies for agricultural extension centers to work more directly with farmers to assess the challenges they face and develop accessible resources is essential to increasing the stability of the agricultural sector, especially in the face of climate change.

An agricultural extension center is being established near Rabat in an effort to support Moroccan farmers. The goal of this agricultural extension center is to provide education through services and resources to local farmers to improve farming efficiency. Our sponsor, Ribat al-Fath, is a Moroccan non-governmental organization (NGO), that is working to enhance the overall quality of life for Moroccan farmers. They believe that the application of organic farming practices may be able to reduce the impacts of global warming and environmental shifts because organic practices promote a more natural relationship with the land.

The goal of our project is to assist Ribat al-Fath in researching and promoting organic farming practices to showcase in the proposed agricultural extension center. The project aims to gain insight into the economic, technological, and environmental difficulties that farmers are

facing, and how those challenges can be influenced by local residents and tourists. Based on our findings, we will recommend to our sponsor, Ribat al-Fath, which resources and services the field office could offer to best aid farmers in adapting to climate change.

Chapter 2: Literature Review

This chapter provides necessary information to understand the current constraints of the agricultural sector in Morocco. We detail the external factors influencing this project, as well as the potential implications for working within the political and economic climate of the Kingdom of Morocco. The chapter concludes with an analysis of three case studies to determine potential services the agricultural extension center can offer and the impacts that the center can have on the local population.

2.1: Agency Profile and Site Description

Ribat al-Fath is a non-profit, NGO located in Rabat, Morocco (“Ribat al-Fath,” 2014). In 1986, Ribat-al Fath was founded with a mission to make Morocco a more sustainable environment and to bring positive change to the residents of not only Rabat, but to all of Morocco. Moroccan citizens volunteer to work with Ribat al-Fath to improve their community’s sustainability for future generations.

Our team will work with Ribat al-Fath to gather information regarding the services that will be most beneficial for the agricultural extension center to offer to farmers near Rabat. A major challenge for this task is Morocco’s vulnerability to drought and climate change despite its rich history of farming. Figure 1 illustrates Morocco’s particular challenge of having minimal average rainfall throughout its different regions.

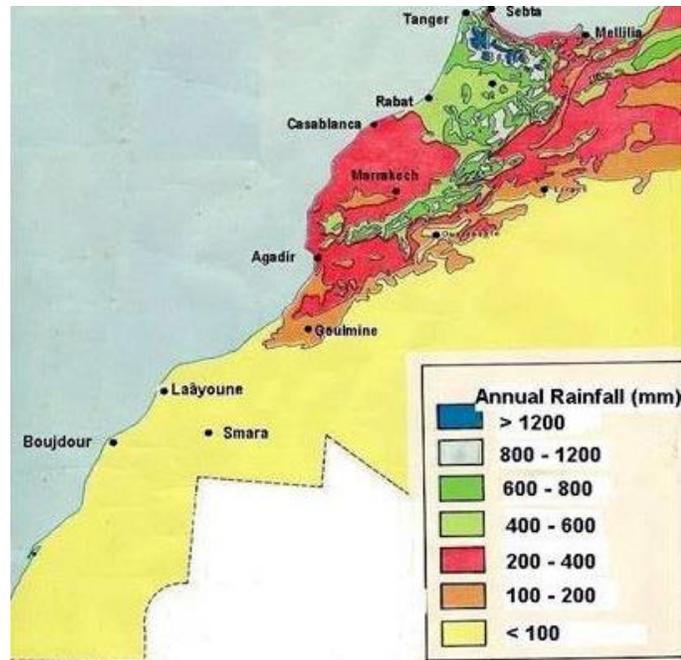


Figure 1: Average annual rainfall in Morocco (Food and Agriculture Organization, 2004, p. 9).

The rural area surrounding the city of Rabat includes land contained within the Central Plateau and Mammora Plateau of Morocco. These plateaus vary in texture and humidity but on average receive about 400-600mm of rainfall per year (Food and Agriculture Organization, 2004). On these plateaus, cultivated land where cereal crops, such as wheat and barley, are dominant is broken up by sections of forest with varying depths of sand. The rural area closely surrounding Marrakech is part of a region referred to as the coastal plains and plateau north of the Atlas Mountains. This region receives about 200-400mm of rainfall per year and is slightly harder to farm due to less rainfall and shallow soil; however, cereal is still the dominant crop (Food and Agriculture Organization, 2004).

As part of their mission to engage communities with the environment, Ribat al-Fath is helping in the planning and execution of an agricultural extension center. A field office that interfaces with farmers can further the education of Moroccan farmers and consumers on organic farming best practices and benefits. Given the challenges faced by farmers with regard to water scarcity and climate change, opportunities to build capacity in this sector will benefit more than the landowners themselves. Agricultural extension centers can provide a variety of services to the community including but not limited to- training courses, a model farm with new technologies, and organic certifications.

2.2 Opportunities for Agricultural Resilience and Food Security

An agricultural extension center (AEC) is a service that provides guidance and resources to farmers and other agricultural producers. These resources can be in the form of training sessions, workshops, outreach programs, model farms, or other similar programs. Centers can be controlled by universities or research institutions but are sometimes completely independent entities. A proposed new agricultural extension center will be located near the Sidi Muhammad-Ben-Abdallah Dam, shown in Figure 2, approximately 10 km outside of Rabat. The location will provide an ideal site for any agricultural irrigation testing and model farm plots at the proposed AEC.



Figure 2: Sidi Muhammed-Ben-Abdallah Barrage Dam (Directorate Atlantic Coast, 2004)

Morocco already has a significant network of agricultural extension services available through local-level AECs, Centers of Agricultural Development, NGOs, and farmer cooperatives that focus on specific crops. There are currently many agricultural extension services offered throughout Morocco with the Provincial Directorate of Agriculture (DPA) overseeing 122 AECs in rain-fed agricultural areas throughout Morocco and the Global Forum for Rural Advisory Services identifying about 185 similar centers in irrigated agricultural areas in Morocco (Global Forum for Rural Advisory Services, 2013). These sites are responsible for implementing agricultural advancement plans put forth by the Moroccan Government's Ministry of Agriculture, Rural Development, and Maritime Fisheries.

The purpose for these centers in Morocco are twofold. They serve to disseminate information on sustainable practices to rural farmers, to coordinate activities centered on new technologies and to funnel the knowledge gained from their activities back to the Ministry of Agriculture. Despite aiming to extend new methods and best practices to rural areas, many extension centers in Morocco do not have strong relationships with research institutions. Other factors such as poor administrative communication and consistency, poor physical condition of the centers, insufficient budgets and irregular resources inhibit the progress of the majority of AEC's in Morocco (Global Forum for Rural Advisory Services, 2013). Since top-level government officials determine the operations of the AECs, they often do not spend enough time trying to improve farmers' conditions (Gatzweiler, Braun, 1970). Consequently, the Green Morocco Plan (a Moroccan public policy program, explained further in Section 2.4.4) encourages investment in better extension services.

In 2014, the Economic Cooperation Program of the German Ministry of Food, Agriculture and Consumer Protection (BMELV) inaugurated a center for agricultural excellence in Morocco where producers could obtain information on the value of their products and the newest farming technologies. The services successfully offered by this German-Moroccan Centre of Excellence for Agriculture (CECAMA) in partnership with several public and private partners include assessments of training needs for farmers, training programs and courses, consulting of agricultural specialists from schools, associations and cooperatives, field demonstrations, and farming method trials. In addition, CECAMA provides written material such as brochures and manuals to interested parties, and organizes annual events such as press conferences, tours, workshops, fairs and field days.

2.3 Stakeholders and Beneficiaries

With 40% of employed Moroccans working in the agricultural sector, the development of an agricultural extension center could have a substantial positive impact on all those it serves (Canli, 2016). Table 1, below, charts this project's key stakeholders and their position with regard to agricultural development in Morocco.

Stakeholders	Interest and Impact	Perspective	Assets and Resources
Small farmers (Less than 6 hectares)	Monetary profit, sustainable practices, job security and stability	<ul style="list-style-type: none"> ● Capacity building ● Resilience ● Food security ● biodiversity protection ● occupational stability ● Economic Value Chain: making profit from planting to harvesting and selling the produce 	<ul style="list-style-type: none"> ● Property ownership ● Local knowledge of farming practices ● Potential ability to apply best practices in organic farming ● Value of Morocco's biodiversity
Local Consumers	Sustenance and food security, natural and healthy produce	<ul style="list-style-type: none"> ● Food security ● Support of local commerce ● Personal well-being and health 	<ul style="list-style-type: none"> ● Value of Morocco's biodiversity ● Economic Value Chain: choosing what to buy and where to buy it
Moroccan Government Officials	Economic growth and sustainability	<ul style="list-style-type: none"> ● Food security ● Economic growth for the country ● Ensuring job security ● Biodiversity protection 	<ul style="list-style-type: none"> ● Laws and policies to protect the environment, improve infrastructure, and provide resources
Plants and Animals	Well-being and more effective resistance to climate change	<ul style="list-style-type: none"> ● Biodiversity protection and sustained life 	<ul style="list-style-type: none"> ● Value of Morocco's biodiversity

Table 1: Summary of Project Stakeholders

Small farmers in Morocco, like the ones in Figure 3 below, account for 74% of all agricultural land with the majority of agricultural workers being rural residents. In Morocco, 19% of rural residents live in poverty with the majority of those citizens working in the agricultural sector (Canli, 2016). Literature suggests that many rural citizens working in agriculture are living in poverty due to the lack of new technologies, susceptibility to drought, and vulnerability to other environmental factors (Baccar, Bouaziz, Dugué, and Le Gal, 2016).



Figure 3: Small farmers in Morocco (“Moroccan Parliament”, 2014)

Farmers waste a large portion of their profit buying fertilizers, chemical treatments, and pesticides for crops that often barely bring sufficient revenue to cover their expenses (Benaziz, 2014). These harsh chemicals are a severe detriment to soil quality and increase environmental contamination (Bendra et al., 2012). The introduction of more information on organic farming can potentially help small scale farmers save money and naturally put crucial nutrients back into the soil.

Due to irregular production from small farms because of varied climate and soil degradation, local consumers will see less locally grown foods if changes are not made. The food consumers do buy may be contaminated from the harsh chemicals and have lower nutritional value compared with produce grown on naturally rich soil (Canli, 2016). The implementation of organic farming practices allows plants and animals to face less biological damage from environmental contamination and will support a reversal of damage done from harsh farming practices. Crops could more naturally adapt to climate change, and specifically drought, if the soil is replenished with more of its natural nutrients.

Finally, the Moroccan Government may see a growth in the economy if the quality and stability of the agricultural center increases. Although the impact on the economy from the development of the agricultural center will take time, local communities could see progress and improvement harvest-to-harvest with the implementation of more sustainable farming practices.

2.4 Policy Implications for Improved Farm Practices

Small changes in how agricultural extension centers support farmers will increase the value that government officials see in making stronger policies with regard to agricultural practices. The next sections provide more information with regards to current farming practices, economic factors, and public policy.

2.4.1 Organic Farming Practices Specific to Morocco

Morocco is a country with great variety in its agriculture. Many farms in Morocco use organic techniques such as avoiding fertilizer and pesticide use, however, due to lack of awareness, money, and accessibility, farms are not recognized or certified by the National Commission for Organic Production (CNPBio) for this sustainable practice (Azim, 2017). The labeling of organic products is relatively new for the country. In the mid-nineties, organic farming became important for economic revenue. Morocco wanted to compete in the global economy that profited from organic farming. Labeling organic produce aims to lessen the divide between the rich and the poor by improving the farmers' income and quality of living (Alaoui, 2009). Not only was it economically necessary for the country to transition from conventional farming to organic farming, but Moroccans also wanted to conserve the chemically untouched land they had and turn it into a rich biodiversity of agriculture. Certified organic farmland greatly increased from 200 hectares in 1997 to 5,995 hectares in 2007 (Alaoui, 2009). Organic agricultural farmland has seen an overall increase with 8,660 hectares in 2013 and 9,330 hectares in 2015 (The Research Institute of Organic Agriculture, 2017). Morocco also has a large area of land strictly designated for agricultural production with 164,965 hectares in 2015 (The Research Institute of Organic Agriculture, 2017). Figure 4, below, illustrates agricultural farmland and natural biodiversity patterns within Morocco.



Figure 4: Geographical distribution of agricultural, irrigated, and desert land (Fanack, 2017).

It is a challenge to accurately estimate the number of organic farms currently in Morocco. Many farmers run their farms with organic practices- they rotate their crops, use manure for fertilizer, and avoid pesticides or insecticides. Most of these farmers are not going organic by choice; they do not have the resources to afford supplies such as insecticides, pesticides, herbicides, and fertilizers. Without even knowing it, Moroccan farmers are protecting their population from the harmful effects of these chemicals. According to the World Health Organization, three million people worldwide experience pesticide poisoning each year (Lah, 2011). While farmers that do not use pesticides are technically organic, the certification to become an organic farm is still a tedious process for small-scale Moroccan farmers and expensive depending on the level of certification.

2.4.2 Sustainable Irrigation

In Morocco, farmers use approximately 85% of all available water resources to irrigate land. Despite this immense water consumption, only about 15% of the country’s lands receive the benefits of irrigation (The UN Department of Economic and Social Affairs, 2015). Fresh harvested crops such as vegetables require more water than dry harvested crops such as grains, so accessibility to water dictates which crops farmers are able to cultivate on specific farms (Brouwer & Heibloem, n.d.). As surface water shortages become more common around Morocco, many farmers are turning to the use of groundwater wells and drip irrigation systems which are “considered as the most water saving method of irrigation for areas with limited water

resources” to irrigate their farms (Bhuiyan et al., 2013). Since drip irrigation systems use as little as one third of the water as traditional sprinkler-like irrigation systems by applying water directly to the roots of plants instead of spraying water over entire fields at a time, they are ideal for locations with water scarcity issues (Legrouri et al., 2012).

Farms with little-to-no access to water often practice low-risk agriculture, such as growing cereal crops and olives because these crops do well even without access to water (Kuper et al., 2012). The farms with slightly more access to groundwater have a tendency to diversify their horticulture to include crops such as onions, chili peppers and carrots because their irrigation systems are able to moisturize crops without significantly depleting water reserves (Kuper et al., 2012). Additionally, the farms with an ease of access to groundwater typically cultivate citrus crops due to their high exportation value (Kuper et al., 2012). The economic returns of producing more water intensive crops are so significant that the disparity between annual revenues is nearly twenty times higher for farms with access to groundwater compared to farms without access to groundwater (Kuper et al., 2012).

Access to water can drastically improve the revenue, diversity, and productivity of farms. One option might be to increase the number of drip irrigation systems in Morocco, which reduces water usage. The World Bank Board of Executive Directors approves using drip irrigation and noted successes in 2015 (World Bank, 2015). This approval allows for a 150-million-dollar project to improve the irrigation infrastructure in Morocco by providing 9,300 farmers with access to drip irrigation systems that enable them to increase their diversification and annual revenues. Although irrigation systems, in any form, are currently only accessible to approximately 15% of the arable lands, this percentage is on the rise as farmers seek to reap the benefits of irrigation.

2.4.3 Economic Stability for Moroccan Agriculture

The agricultural sector in Morocco accounted for about 27% of the nation’s Gross Domestic Product (GDP) in 2016 (Morocco GDP from agriculture, 2017). Half of that GDP was from small farms, with the other half from larger, fully irrigated farms. Larger farms exported about 75% of their produce, contributing to the GDP from added external revenue (Canli, 2016). The majority of the exports come from these larger farms since they have more monetary resources and more advanced technology than small farms to properly regulate their products to

meet the qualifications required for exports. Small farms lack the potential for profit from exportation as they often do not produce a sufficient volume of product, or meet agricultural export standards (Canli, 2016). Conversely, there is an opportunity to increase the value of local crops sold by local vendors if the market for more natural or organic produce continues to develop since organic crops can be sold at a higher price (Maine Organic Farmers and Gardeners Association., 2011). In Morocco, vendors are selling organic products like argan oil, which accounts for a large portion of certified organic items (Azim, 2017). Since 81% of small farmers are illiterate, their finding resources online or through printed documents about organic certification may be difficult. Farmers cannot all simply read about standards, new technologies, or other techniques to improve crops, and thereby increase their profit. One possibility for an agricultural extension center to be a resource for farmers is to offer in-person training about equipment and verbal information to illiterate farmers (Canli, 2016).

A correlation between the growth of Morocco’s GDP and the GDP of the agricultural sector is apparent throughout the last decade (“Morocco GDP from agriculture”, 2017). Although environmental factors often cause the GDP from the agricultural sector to fluctuate, there has been a steady increase in Morocco, about 7.7% between 2008 and 2014, with projections for continued growth through 2018, as seen in Figure 5 below.

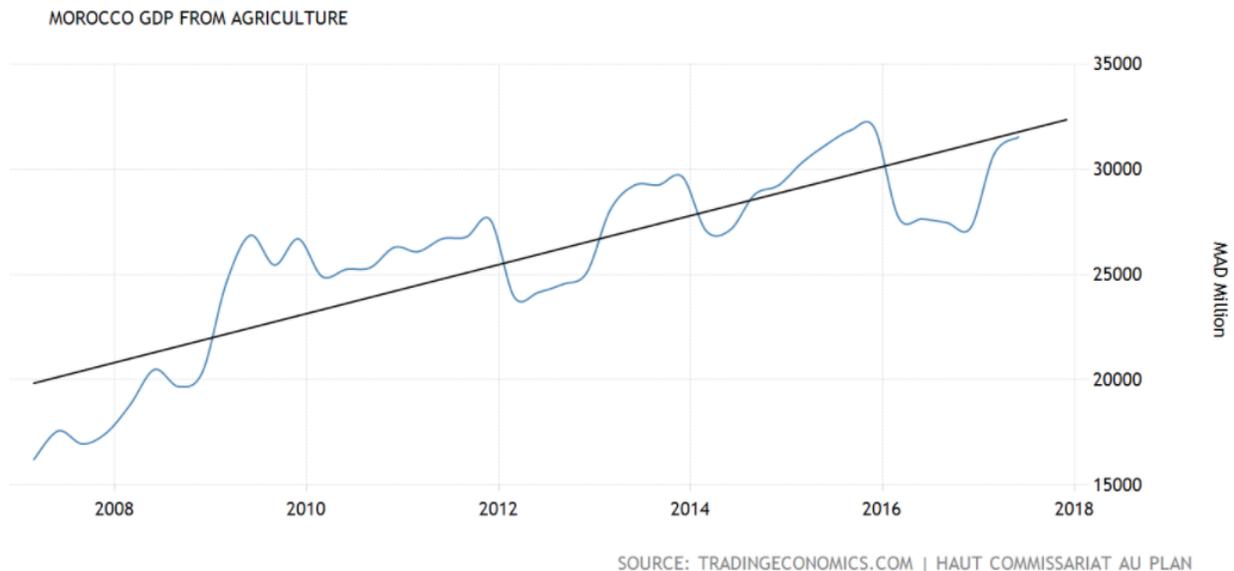


Figure 5: Morocco’s GDP from agriculture from 2008 through predictions for 2018 with a trend line (“Morocco GDP from agriculture”, 2017).

Part of the reason for this increase is the implementation of reforms and an increase in government investment in the sector (International Monetary Fund, 2015). Specifically, the growth occurred after the implementation of the Green Morocco Plan in 2008, which helped increase investment by 1.7 times the amount invested into the sector previously (Canli, 2016). Plans and policies like the Green Morocco Plan have the potential to have lasting and vital effects on the agricultural sector if policy makers can continue to provide accurate information. Morocco cannot sustain its economic growth by policy and funding alone. It is imperative that both farmers and educators take farming practices into consideration in combination with awareness towards the increased negative impact on agriculture due to climate change.

2.4.4 Public Policy Support for the Agricultural Sector

Since agriculture is important to Morocco's economy, the government aims to target the industry with a plan for improved sustainability and success in the form of the Green Morocco Plan. The Green Morocco Plan works hand-in-hand with Ribat al-Fath's initiative to make Morocco a more sustainable country. While the Plan's main goal is to increase food safety and reduce the harmful effects of climate change, it also aims to better the economic and political power of Morocco. The Green Morocco Plan contains two main pillars that directly benefit agriculture or farmers. Pillar II focuses on "Investment in social initiatives to combat rural poverty" (Badraoui and Dahan, 2011, p. 61) and with the majority of rural farmers living in poverty, the agricultural sector is intertwined with the initiatives of this pillar. Pillar I more explicitly pertains to how ministry officials want to invest in agriculture in order to increase its productivity and value (Badraoui and Dahan, 2011, p. 61). These pillars manifest themselves in initiatives covering topics such as irrigation improvement and solutions, extension resources, redesigning and overhauling ministry structures, and agricultural labeling.

The Moroccan government has identified improvements in the Plan that are necessary for the remainder of its implementation. In the coming years, from 2018 to 2020, government officials and policy makers will pursue a stronger innovation system in the agriculture industry as well as better financial services for those systems. The Moroccan government promotes this improvement with the goal of strengthening professional associations and organizations that are related to agricultural extension services. A second major improvement proposed in the Green Morocco Plan is to encourage farmers and their resources to move towards being a "Climate-

Smart Agriculture Sector” (Canila, 2016). This is an attempt by the Moroccan government to create a more resilient infrastructure as a hedge against the current climate change effects occurring in Morocco.

2.5 Case Studies

To explore specific aspects of our project topic in greater depth, this section considers three case studies that analyze suggestions for agricultural extension center programs. These case studies shed light on the negative impacts of overusing pesticides and the techniques that farmers use to deal with water scarcity. By analyzing these case studies, we can qualify the resources offered by the proposed agricultural extension center as either being useful or falling short of their intended purpose.

Case 1. Family Farming in the Saïs Plain, Morocco

Family farming varies greatly depending on economic, political, and social factors that break the farms into different categories. While the Saïs Plain is a region with minimal rainfall, promising agricultural outputs are made possible by fertile soils and ground aquifers (Baccar, Bouaziz, Dugué, Le Gal, 2016). This study shows the diversity of forty family farms in terms of size of the farm (in hectares), production output, and the farm’s access to water for irrigation. The authors found that, regardless of farm size, the farmers used numerous irrigation methods such as rainfed, drip, surface, and sprinkler irrigation.

The small-scale farmers experienced difficulty with the production of their crops, striving to overcome environmental factors to economically supporting their families. Their farms are typically around 7 hectares of land that farmers use to grow crops such as fava beans, chickpeas, lentils, oats, and barley in order to feed their families (Baccar, Bouaziz, Dugué, Le Gal, 2016). Since many small-scale farmers cannot adapt to weather conditions such as droughts, they are incapable of cultivating adequate produce to both feed their family and sell for income. Small-scale farmers suffer from receiving little or no profit from selling their produce, which makes it challenging for them to access new technologies that would improve their productivity.

On the other hand, large-scale farmers are able to use their income to obtain access to modern technologies. These technologies improve the productivity of their farms and therefore, they continue to receive a higher income than small-scale farmers. Large-scale farmers transition

from using rainwater for irrigation to using drip irrigation systems in order to cope with water scarcity. The large-scale farmer's ability to access efficient and sustainable irrigation systems allows them to reduce the amount of water needed for production, while increasing their crop yield. This access to resources such as chemicals and irrigation systems allows farmers to increase their productivity. The case study concludes that small-scale farmers should have access to modern technologies in order to improve their overall productivity and financial stability to compete with large-scale farmers.

Case 2. The Kenyan Agricultural Extension Center

Agricultural extension centers focus on spreading new technologies and knowledge to farmers, though the specific methods vary based on location. In 1999, the Operations Evaluation Department (OED) of Kenya conducted a study to evaluate the effectiveness of an agricultural extension center in Kenya. The extension center used a method, known as the Training and Visit System, which trained workers visited farms to educate the farmers on new technological innovations in the field. These innovations and methods, if implemented correctly, could vastly improve a farm's productivity. The OED specifically analyzed farmers visited by the agricultural extension for improvements in production, as well as the quality and quantity of disseminated information. The OED gathered this information through surveys of extension staff and farmers visited by extension staff members, staff members visiting farmers, and through using existing statistics, reports, and assessments (World Bank, 1999). The OED discovered that the agricultural extension center's approach was riddled with deficiencies, such as an ineffective system for the selection of farms to visit, a failure to incorporate the farmers' opinions, and low staff motivation, which hindered the agricultural extension center's ability to drastically increase most farms' productivity levels (World Bank, 1999).

The OED discovered that Kenya's center workers "generally target[ed] the better-off and those who can afford the new technologies" and then designed their programs based upon the needs of those select few (World Bank, 1999). This meant that the center primarily focused on big farms with significant financial backing despite 81% of farmers in Kenya being smallholders (World Bank, 1999). This approach left the majority of the farmers' needs unaddressed. After analysis of the benefits of focusing on big farms, the OED determined that better-off farmers could quickly implement new technologies, but eventually the farm's new technology and

information would be insufficient to drastically boost their productivity. Once the increase in productivity stagnated, any further focus on farmers by extension workers would yield negligible results (World Bank, 1999). To combat this waste of resources, the OED concluded that overall focus of on-site extension center visits should be on less-productive farms, as they have the highest growth potential. This allows the centers to address the majority of farmers' problems by providing techniques and cheap technologies that they can implement. These OED solutions to rectify the Kenyan agricultural extension center's deficiencies are highly applicable to the new center near Rabat because the majority of farmers in both Kenya and Morocco are smallholders who need improvement. As the case study of the Kenyan agricultural extension center shows, the center in Rabat would likely be more effective by focusing its services on smallholder farmers rather than concentrating on the larger and often better-off farms.

Case 3. Soil Quality of Triffa Plain, Morocco

The nutrient composition of soil is an important factor in agricultural diversity and productivity. In Morocco, the agricultural sector has grown drastically over the past several decades. This rapid growth increased the total area of agricultural land use by 34% between 1974 and 2001 alone, and also raised fertilizer consumption by 78% in the last 20 years (Bendra et al., 2012, p. 508). In 2012, Brahim Bendra conducted a case study with the assistance of the Franche-Comté University to analyze the effects of farming practices on the soil of the Triffa Plain. The Triffa Plain is a 750 km area that has both warm and cold semi-arid climates and varying soil composition. It also possesses access to several water sources; two above-ground reservoirs, and one groundwater reservoir (Bendra et al., 2012, p. 507). Accessibility to these conditions allowed for the cultivation of a diverse selection of crops, making it "the most productive agricultural zone in north-eastern Morocco" (Bendra et al., 2012, p. 507). The researchers used grid sampling to collect soil samples from forty-eight randomly selected locations within the plain. Their research ran samples through a variety of tests to determine the composition of the soil. Based on the poor test results, specifically in regards to salinity and soil organic matter, Bendra concluded that the practices of the current agricultural sector depleted the soil of vital nutrients required for plant growth (Bendra et al., 2012, p. 512).

In addition to the soil depletion, the tests determined that 37.5% of the examined soil had salinity levels that could negatively affect sensitive crops and reduce both the quality and

quantity of non-sensitive crops (Bendra et al., 2012, p. 512). These high salinity levels are likely the byproduct of continuous surface irrigation and high drainage ability, resulting in an accumulation of salt in the soil. The researchers tested soil organic matter because plants require nutrients in order to grow and soil organic matter improves the soil's ability to retain nutrients (Bendra et al., 2012, p. 512). After analysis, Bendra reported that 52.06% of the soils tested for quality showed a less-than-average ability to hold nutrients, creating a lower soil fertility (Bendra et al., 2012, p. 512). These low levels lead many farmers to overuse fertilizers to try and fix the problem, causing more damage to the land.

A leading conclusion of the study was the need for controlled fertilization. The proper rotation of the crops ensures higher fertility and crop growth if the farmers monitor the fertilization by time and dosage. Soils that are overly salinized reduce the potential for crop growth since the amount of soil organic matter is limited. To combat soil salinization, farmers should employ irrigation systems such as drip irrigation because applying water directly to the plants reduces the volume of water needed to irrigate the land and thus reduces salt accumulation in the soil (Bendra et al., 2012, p. 517). These modifications will greatly improve the sustainability of agricultural practices in the Triffa Plain region.

2.6 Summary

Important takeaways that the team found from the case studies identified that large-scale farmers are able to handle environmental changes on their own. It would be more beneficial for agricultural extension centers to focus on small-scale farmers who can benefit more from the resources provided to them since they have more opportunity for growth. Additionally, the Kenya case study showed that agricultural extension centers can only work as effectively as possible if they address the needs of farmers and if the workers are motivated and willing to aid the less well-off farmers. These services should also focus on addressing farmers' use of poor agricultural techniques such as the overuse of irrigation and fertilizers due to their environmental damage on the land. Organic farming methods present an opportunity for alternative ways to preserve the environment from harmful man-made problems, and reduce the farmers' reliance on chemicals. As an appropriate addition to the proposed agricultural extension center, a field office for organic farming could promote accessible services and resources that make farmers aware of the new farming techniques available to them.

Chapter 3: Methodology

The goal of this project is to assist with the establishment of a field office promoting organic farming within a new proposed agricultural extension center near Rabat, Morocco. We identified the following objectives in order to reach this goal:

1. Gain an understanding of the challenges organic farmers and non-organic farmers in Morocco face.
2. Investigate successful mechanisms for promoting organic farming in an effort to increase the value of farmers' produce.
3. Identify and examine services and resources that the agricultural extension center can offer to farmers around Rabat.

3.1: Understanding challenges of organic farmers and non-organic farmers

We will visit farms selected by Ribat al-Fath located in the rural areas outside of Rabat and Marrakech. Through this objective we aim to gain a holistic understanding of each farm we visit. We will focus on the challenges that these farmers encounter and the practices that they utilize to overcome these challenges in order to propose programs and resources most beneficial to meeting the farmers' needs.

3.1.1: On-Site Documentation and Profile

Our sponsor will choose the initial set of farms for interviews, and the project team will expand the set of farm interviews using snowball sampling. Working with our sponsor and the farms we visit, we will employ the appropriate precautions and procedures to meet confidentiality needs. We will also ask permission to profile each farm that we visit before conducting a site assessment. This assessment will include a careful documentation of the farm through photography and videography to capture its geophysical and biological characteristics as well as its size and operation (Garrett, 2014). For our own information and clarifications, we will record each farm's location and proximity to other establishments. A detailed checklist of information collected for each site visit can be found in Appendix A.

We will research public records to determine the laws, policies, and subsidies that apply to the farms outside of Rabat and Marrakech (Ward, 2014). We plan to use this information to gain a thorough understanding of the economic, social, political and environmental constraints of Moroccan farmers.

3.1.2: Interviews with the Farmers

The team will conduct structured interviews of farmers and our sponsor, Rabat al-Fath, will provide us with translators to aid in these interviews (Cochrane, 2014). Each interview will begin with an introductory statement to explain our project and ask permission not only to interview them, but to record the interview. The next step will be to read a statement of confidentiality to ensure privacy and make known to the interviewee that they do not need to answer questions that are uncomfortable for them. The interview questions will start with demographic information and will identify the practices that the farmers employ. The goal of the interview is to collect information about farmers' demographics, to determine the types of methods farmers use to cultivate crops, and to ascertain ways in which global warming has altered farmers' crop production and ways in which farmers prefer to receive additional resources about new techniques.

Through the information we gather, we aim to classify the farms as organic or non-organic without asking the farmers outright if their farms are organic or not. If the farm uses organic techniques, we will gather information on the substitutions used for pesticides and fertilizer, the use or nonuse of crop rotation, and the origin of their seeds. The interview will ask why the farmers use their specific cultivation techniques, what types of certifications, if any, the farmer possesses, and what resources and services they feel could aid in the improvement of their crops. If the farm uses non-organic techniques, we will gather information on the types of chemicals, pesticides, herbicides, and fertilizers used, as well as the use or nonuse of crop rotation and the origin of their seeds. Interview questions 10-24 found in Appendix B will determine why the farmer uses these non-organic techniques, if they would consider using more organic techniques and what could aid in that decision. If the interviewee does not know what organic means, we will take time to define the term based upon its definition learned later in the comparative case studies within the methods for objective 3. The final portion of the interview

will focus on the crops' post-harvest usage and possible exportation of the produce to local or international distributors.

3.2: Investigation of successful mechanisms for promoting organic farming

In an effort to increase the value of farmers' produce, we will conduct an investigation into the consumers' and vendors' interests and awareness of organic produce. To achieve this objective, we will identify potential ways that vendors and farmers increase the marketability of their produce. This study will also investigate if people are willing to pay a higher price for pesticide-free or chemical-free crops in order to support a more sustainable environment in Morocco. We will collect this information by surveying and interviewing residents, tourists, and vendors in order to gain an understanding of the factors that influence consumer choices of produce.

3.2.1: Surveys for Moroccan Residents and Tourists

We plan to distribute brief in-person surveys in English, French, and Darija designed to analyze both locals' and tourists' perceptions of the way produce is marketed in order to determine how they selected their produce (Theodore, 2014). A translator will administer the survey verbally or the individual can choose to read it themselves. We will conduct these surveys near locations that sell local produce such as grocery stores, smaller convenience stores, and in the medina in order to gain insight from the consumer's point of view. The survey will contain questions to determine their interest in labeled produce, their willingness to find vendors to purchase these labeled foods, and their general knowledge about the origins of the produce that they choose to consume. See Appendix C and Appendix E for the survey questions and label recognition handout.

3.2.2: Interviews with Marketplace Vendors

We will conduct semi-structured interviews with vendors in marketplaces with the assistance of a translator provided by Ribat-al Fath (Cochrane, 2014). These interviews will be brief since we plan to approach vendors in the marketplace at the beginning of their work days. The reason that these interviews will be semi-structured is that this approach has the "advantage of providing framework that helps to ensure that all important issues are covered in the [given]

time” (Cochrane, 2014, p. 44). Our questions focus on where vendors buy their produce, if the price of their produce is a key factor in sales, the types of produce in high demand, and if they would sell produce for more if it had a specialty label. We will present images of common organic labels to see which, if any, they recognize. The information gathered on produce will inform the choice of recommended services and resources for those types of crops and their respective farms. A team member will record general observations on the time of the interview, the number of people shopping at the vendor and the types of food seen. This is to make the interview answers as consistent as possible to reduce the amount of bias within the data analysis. See Appendix D for the interview guide and Appendix E for label recognition handout.

3.3: Identify services and resources that the agricultural extension center can offer to farmers around Rabat

Agricultural extension centers can provide valuable resources to benefit farmers. In order to optimize the effect that this center can have, we plan to identify the needs of the farmers. Through the analysis of comparative case studies as well as utilizing the knowledge gained while completing our previous objectives, we aim to obtain a holistic perspective on which agricultural services and resources should be provided by the extension center.

3.3.1: Comparative Case Study

We plan to utilize Ribat al-Fath as a means to connect us with two or more extension service providers out of the approximately 120 in Morocco that operate in a manner similar to how the proposed agricultural extension center will operate (Global Forum for Rural Advisory Services, 2013). Depending on the resources of our sponsor, we plan to either visit these centers and document our findings and interactions, or conduct our own remote comparative case study through phone and email communication. We will pose questions to these centers to determine which resources they offer and how their activities impact nearby farmers. We will then compare and contrast these programs to one another based on their effectiveness in improving farmers’ productivity, sustainability, and income. By conducting this comparative case study, we hope to determine which extension services will be the most valuable for Moroccan farms near Rabat. See Appendix F for the comparative case study questions.

3.3.2: Interviews with Farmers

Many farmers in Morocco do not depend on written materials to receive and pass along information, so we intend to discern which alternative methods would be the most useful for the dissemination of resources and information about extension services (Canli, 2016). During the structured interviews with farmers, we hope to find a useful method of communication, whether that be through written materials, websites, SMS, visual representation, or in-person interaction (Cochrane, 2014). We will communicate these methods to the agricultural extension center so the services that they provide will address the farmers' needs. See interview questions 25-32 in Appendix B.

3.4 Data Management and Translation

We will work with translators provided to us by Ribat al-Fath to bridge the language barrier encountered when interviewing farmers, vendors, locals, and other stakeholders. We intend to convey our project goals and collaborate with them before meeting with our stakeholders to adjust the appropriateness and interpretation of our surveys and interview questions. Since we plan to organize questions for our stakeholders, we want the translator to provide translations of responses after specified sections of questions. Before we conduct the interviews, we will request that the translator inform us on conventional norms and courtesies in Morocco so that we do not offend the interviewees. The translator will bridge the language barrier between us and the farmers, since reliable and accurate translations are crucial for our data collection. We plan to audio record our interviews, if given permission by the translator and the stakeholders in order to lessen the burden on our translator.

3.5 Gantt Chart

The following Gantt Chart details our predicted timeline for completing our project and its tasks. Lighter shades indicate the possibility of a task beginning earlier or continuing on to later weeks depending on availability of our stakeholders.

ID	Objective(s)	Task Name	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
1		On-Site Profile and Documentation								
2	1 & 3	Interviews with Farmers								
		Prepare surveys for locals and tourists								
3	2	Surveys for locals and tourists								
4	2	Interviews with Marketplace Vendors								
5	3	Comparative Case Study								
7	n/a	Data analysis								
8	n/a	Project writing								
9	n/a	Project editing								

Chapter 4: Conclusion

This project will contribute to Ribat al-Fath's ongoing work with farmers and the challenges that they experience. Ribat al-Fath hopes to establish programs that the agricultural extension center can offer to rural farmers seeking new innovational farming techniques for their farms. In particular, the NGO plans to use the agricultural extension center as an outlet to promote organic farming practices to remedy Morocco's diminishing resources.

Our analysis of both producer and consumer feedback will allow us to develop a better understanding of how people in Morocco perceive organic farming. We will use this knowledge to collaborate with Ribat al-Fath in an effort to learn which organic farming resources will be the most useful for farmers to increase the value of their crops, and for the preservation of Morocco's natural land. By the conclusion of our project we hope to present a set of recommendations to Ribat al-Fath on the resources and services that we believe the center should provide.

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Appendices

Appendix A: On-Site Documentation

- The purpose of this checklist is to ensure consistent documentation of each farm we visit and to potentially identify trends.
- Confidentiality Statement: This information will be kept for our own use and your farm will not be directly associated with this information unless we are granted permission. Photos and videos will only be taken if we are allowed; we will work with our sponsor and the farms to determine appropriate confidentiality methods (which may be dependent on a case-by-case basis).

Irrigation Type: Do you have an irrigation system?

- No: (Rainfed)
- Yes: _____

How long does it take you to get to:

- Fresh water sources: _____
- Roads: _____
- Oases: _____
- Mountains: _____
- Deserts: _____
- Vendors: _____
- Notable Observations: _____

Appendix B: Interview Questions with Farmers

- Introductory Statement: Thank you for agreeing to be interviewed by us. We are a team of students from an American university that is researching different farming techniques in Morocco. In this interview we hope to learn about your farming techniques and the challenges that you experience as a farmer. We will ask a series of questions and if any of these questions make you uncomfortable, you do not have to answer that question.
- Confidentiality Statement: We would like to use your name and the name of your farm to give you credit for aiding in this data collection. If you do not wish for us to share this information we will omit your name and only use it as a reference for ourselves.
- Do we have your permission to use an audio and/or video recording of this interview?

Demographic questions:

1. Job title and role at the farm
2. Gender
3. Age
 - a. Under 18
 - b. 18-24
 - c. 25-34
 - d. 35-44
 - e. 45-54
 - f. 55-64
 - g. 65 or older
4. Size of farm
 1. Less than 6 hectares
 2. 6-10 hectares
 3. Greater than 10 hectares
5. Years working in agriculture

Farming Methods:

6. What types of crops do you currently grow?
7. How long have you been growing these crops?
8. Who makes the decisions on what crops to grow?
9. How is that decision made? What factors influence this choice? Please explain.
10. How do you deal with pests, insects, weeds, and diseases?
11. Do you use fertilizers and/or chemicals? What is each used for? Do you have information on what kind of chemicals are in them? (Ask to see labels if they have them)
12. Where did you learn your farming techniques?
13. Where do you get seeds for your crops? From previously self-harvested crops, a distributor, or a mix of both? Another place?
14. Do you know if your seeds are genetically modified organisms (GMOs)?

Farming Challenges:

16. As a farmer, do you face challenges due to:
 - Global warming
 - Droughts/ rainfall in region
 - Pests and Insects

- Crop Rotation
 - Farming equipment
 - Other: _____
17. What solutions do you employ to combat these challenges?
18. Have you had to change your farming practices due to weather or climate change? Please explain.

Marketing

19. Does your farm sell produce to local vendors? If yes, to whom, in what quantity and for how much money?
20. Are you aware of any cooperatives for selling the specific crops you are growing?
21. Do you export your crops? If so, what percentage of your farm's crops do you export?
- 0-10%
 - 11-20%
 - 21-30%
 - 31-40%
 - 41-50%
 - Greater than 51%
22. Do you have any types of organic certifications or specialty labels for your produce?
23. Would you be willing to not use GMOs, fertilizers, pesticides, insecticides, herbicides, or other chemicals in order to work towards organic farming practices?
24. If organic produce could sell for more than nonorganic produce, would it influence you to switch to organic practices?

Resources and educational opportunities

25. What resources and services do you wish you had at your disposal to make your farm more efficient or sustainable?
26. Which of these could benefit you:
- Model farms to learn how to use new equipment
 - In-person training sessions from qualified Moroccan farmers or individuals that take place at your farm
 - Product marketing training from Moroccan experts
 - Videos of best farming practices
 - Pamphlets
 - Websites
 - Other: _____
27. Would you be willing to utilize resources to advance your farming?
28. Would you be willing to attend training experiences led by Moroccans working with an agricultural extension center?
29. How far would you be willing to travel for this training?
- Less than 10 kilometers
 - 10-50 kilometers
 - Greater than 50 kilometers
30. Do you have anyone working at this farm who would want to collaborate or partner with an agricultural extension center?
31. Would you find written documents, visual representations, or in-person meetings to be the most effective means of conveying information about resources and services?
32. Do you have internet access?

Appendix C: Survey Questions for Moroccan Residents and Tourists

- Introductory Statement: Thank you so much for agreeing to answer some questions for us. We are a team of students from an American university that are researching the agricultural industry in Morocco and how produce is marketed. In this interview we hope to learn about the produce you buy. We will ask you a series of questions and if any of these questions make you uncomfortable, you do not have to answer them.
- Confidentiality Statement: Your identity and name will be kept only as reference for ourselves unless you agree to allow us to disclose that information.
- Do we have permission to use your name in our research?

Interview Code:

Date: _____

Time: _____

Location: _____

Interviewer: _____

Translator: _____

Interviewee: _____

Demographics:

1. Gender
2. Age
 - Under 18
 - 18-24
 - 25-34
 - 35-44
 - 45-54
 - 55-64
 - 65-74
 - 75 and older
3. Where are you from?
 - City in Morocco: _____
 - Other country: _____
 - Why do you shop here?

Main Survey Questions:

4. Who primarily buys food for you?
 - Yourself
 - Sibling
 - Mother
 - Father
 - Other: _____
5. How does that person select where to buy it? (Select all that apply)
 - Proximity to home
 - Always shop at the same vendor
 - By available of desired produce
6. Refer to Appendix E about labeling

7. Do these labels influence your decision of what to buy?
 - Not at all
 - Somewhat
 - Neutral
 - A lot
 - Extremely
8. When going to a restaurant, do you consider where the food you eat is from?
 - Yes
 - No
 - Information is unavailable
9. Would you be more inclined to visit a restaurant if the food was labeled as organically-grown or chemical-free?
 - Yes
 - No
10. Would you be willing to pay more in order to buy and consume produce that has these specialty labels?
 - 0-10%
 - 11-20%
 - 21-30%
 - 31-40%
 - 41-50%
 - Above 50%

Appendix D: Interview Questions with Marketplace Vendors

- Introductory Statement: Thank you for agreeing to answer some questions for us. We are a team of students from an American university researching local produce marketing in Morocco.
- Confidentiality Statement: Your identity and store or stand name will be kept only as reference for ourselves unless you agree to allow us to share that information.
- Do we have permission to use your name in our research?
- Do we have your permission to take an audio and/or video recording of this interaction?

Interviewee demographic questions:

1. Type of Food Vendor (Street vendor, super market, restaurant)
2. What is your job title?
3. How long have you worked here or owned the store (if they are the owner)?
4. About how many customers do you serve per week? (Provide a range after talking to sponsor)
5. We will create the options for these ranges after consulting with our sponsor.
6. What percentage of your customers are tourists?
 - 0-5%
 - 6-25%
 - 25-50%
 - 50-75%
 - 75-100%
7. Who is in charge of ordering the produce that you sell?
 - If it is them: Where do you get your produce from and what do you consider when deciding where you get your produce for?
 - If it is not them: Where do they get their produce from? What do you believe are their reasons for choosing where they get their produce?
8. Are you ever asked if your produce is “organic”? “Pesticide-free”? If, so how often?
9. Refer to Appendix E about labeling
10. Do you know what these labels mean?
11. Are you ever asked where your produce is from? If, so how often?
 - If they are a restaurant: Do you track where the produce you use is from?
12. Would you sell produce for more if it was labeled “organic” or “pesticide-free?”
13. Do you think your customers would pay more for produce labeled as “organic” or “pesticide-free”?
14. Which type of your products is purchased the most?

Appendix E: Survey for Label Recognition

Are you aware of different food labels? Select which, if any, you recognize (Ecolabel Index, 2017)

1. 
2. 
3. 
4. 
5. 
6. 
7. 
8. 
9. 
10. 
11. 

Appendix F: Comparative Case Study Questions for AEC Employees

- Introductory Statement: Thank you for agreeing to answer some questions for us. We are a team of students from an American university researching farming practices and agricultural extension resources in Morocco.
- Confidentiality Statement: It would be beneficial to our team to be able to use your name and this AEC's name, although if you do not wish for us to share this information we will omit your name and only use it as a reference for ourselves.
- Do we have your permission to share your name and your AEC's name?
- (If in person): Do we have your permission to take an audio and/or video recording of this interaction?

Questions:

1. Interviewee: _____
2. Role at AEC: _____
3. What farmers do you service?
 - Large-scale or small-scale?
 - What types of crops do they grow?
4. What resources or services do you offer?
5. How many farmers utilize these services?
6. Do you offer your services in different languages?
7. What form are these services offered in? [Check all that apply]
 - Digital Literature
 - Printed Literature
 - Videos
 - Training Sessions at AEC
 - Training Sessions at farms
 - Other: _____
8. Do you charge people to use these services?
9. Out of all of the resources that you offer, which are utilized the most?
10. Do you track how your resources and training sessions affect farming outcomes for the farmers that turn to your AEC for support?
 - If so, would you mind sharing this data with us?
11. How do you market your services to farmers?