



RIBAT AL FATH BIOPARK: Developing a Design & Education Strategy

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ABSTRACT

Morocco and its citizens face many challenges as climate change, coupled with a lack of focus on sustainable living practices, threaten the country's biodiversity and water resources. The goal of this project was to assist Ribat Al Fath in the development of an educational and recreational biodiversity park where visitors can learn about biodiversity, climate change, and agricultural practices in Rabat. The team conducted background research, interviews, and observational studies to identify key themes related to climate change and agriculture. Based on the results, the team identified an educational strategy for the Biopark, including teaching methods and topics relating to climate change, and developed a 3D design of the Biopark.

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EXECUTIVE SUMMARY

Various ecosystems throughout Morocco are degrading due to climate change, threatening the country's biodiversity and water resources. Sporadic rainfall patterns and temperature cycles have negative effects on the agricultural sector, which accounts for 13% of the GDP (Statista, 2018). Soil erosion, floods, and an existing arid climate pose a challenge to farmers in the agricultural sector. Many problems surrounding climate change go unnoticed because there is a lack of focus on sustainable living throughout Morocco and climate change education in schools. The Moroccan government has implemented several programs to teach farmers about techniques to mitigate the effects of climate change by promoting and encouraging best practices in agriculture, with varying levels of success.

PROJECT PURPOSE & OBJECTIVES

The team's sponsor, Association Ribat Al Fath, is a non-governmental organization based in Rabat with the goal of promoting sustainable living and environmental learning while fostering Moroccan culture and heritage. Ribat Al Fath has a history of taking initiative on environmental issues and educating the community on the problems that Morocco faces.

The goal of the project was to assist Ribat Al Fath in the development of a biodiversity park in the Oum Azza municipality of the Rabat-Salé-Kénitra region. The proposed Biopark will be an educational and recreational space for visitors to learn about biodiversity, climate change, and agricultural practices. The team research goal that guided the project was to create an educational strategy and a design for the Biopark. To achieve the project's goal, the team established the following objectives:

Objective #1: Identify educational topics to be taught in the Biopark and what teaching methods will be used.

Objective #2: Develop a design for the Biopark based on the physical requirements for the educational strategy and recreational spaces.

METHODS & RESULTS

The team accomplished the objectives by receiving a consultation, conducting semi-structured interviews, completing observational studies, and conducting background research. The team interviewed farmers, private school teachers, educational experts, Moroccan experts in environmental fields and non-governmental organizations. The team then analyzed the interviews using a thematic content analysis. The team conducted observational studies at the Jardin Majorelle in Marrakech, Jardin D'essais in Rabat, Tazota Ferme Pedagogique in Tamesna, and the Rabat National Zoo. During each visit, team members documented and photographed the site and completed individual analyses for each site visit, after which a synthesized report of all findings was created. All data collection guides can be found in Appendix B.

The team identified themes that were present in each interview which included climate change, biodiversity, farming challenges, hands-on learning, nature-based learning, and park features. The information gathered by the team through each data collection method was compiled and analyzed to support the team's background research. The interview data was cross-referenced through coding and specific topics and teaching methods were verified amongst a multitude of sources. The coding procedure can be found in Appendix D. Information from observational studies was assembled into a final

observational results summary, which can be found in Appendix E, which includes features from each park model that would work well in the proposed Biopark. The information gathered by the team through each data collection method was used to make recommendations for the objectives.

RECOMMENDATIONS & DELIVERABLES

The team identified educational topics and methods and developed a 3D design for the proposed Biopark. The team recommends that the proposed Biopark utilize the following teaching methods to educate visitors:

Teaching Methods	
<i>Hands-on Learning</i>	Hands-on learning is extremely effective in teaching topics related to climate change and expanding students' appreciation for nature. Teachers and environmental educators emphasized the benefits of hands-on learning for both students and farmers.
<i>Experiential Learning Model</i>	A learning cycle which emphasizes experimentation and reflection in learning, this method encourages students to examine their impact on the environment and is well-suited for teaching environmental topics.
<i>Nature-Based Play & Learning</i>	Nature-based play and learning encourages young children to be creative, solve problems, and respect the environment. Educators and environmental experts expressed the importance of providing a natural space for children to interact with nature.

Based on the team's findings from semi-structured interviews, the team recommends that the proposed Biopark educate visitors on the following topics:

Topics for Students	
<i>Recycling</i>	Educators emphasized that educating students about proper recycling methods as well as their impact on the environment is important.
<i>Air Pollution</i>	Educators and environmental experts emphasized the importance of teaching children about pollution and how their actions affect the environment.
<i>Water Management</i>	Educators, environmental experts, and farmers recommended educating students on basic water management skills to encourage environmentally conscientious behaviors.
<i>Establishing a Connection with Nature</i>	Educators and environmental experts suggested that establishing a connection with nature at a young age ensures that students respect and protect the environment later in life.

Topics for Farmers	
<i>Soil Management</i>	Farmers and environmental educators stressed the importance of teaching sustainable soil management techniques including fertilization techniques, new technology, and pesticide contamination in soil.
<i>Sustainable Water Use</i>	Education on sustainable water use including drip irrigation, rainfall, and runoff collection encourages farmers to practice environmentally conscientious behaviors and preserve resources.
<i>Business Aspects in Farming</i>	Education on best business practices including middlemen, markets, and profits ensures the success of farmers and the agricultural industry.

Based on the team’s findings from observational studies and consultation, the team recommends that the proposed Biopark contain the following park elements, which can be found in the 3D design developed by the team at the end of the section:

Park Elements	
<i>Modular Learning Spaces</i>	Modular learning spaces are multi-functional spaces that enable adaptive learning.
<i>Practical Learning Areas</i>	Practical learning areas enable a combination of theory and practice to be used to educate visitors in the Biopark. Examples of practical learning areas include a greenhouse, fields for farming, olive and grain mill-house.
<i>Nature Play & Learning Area</i>	Nature-based play & learning encourages young children to be creative, solve problems using trial and error, and promotes cognitive processing. A nature play area in the Biopark allows children to interact with natural elements and connect with the environment.
<i>Recreational Areas</i>	Recreational spaces, including a picnic area, pool, local and exotic garden, will make the Biopark a more attractive place for people to visit and enjoy nature.
<i>Pathways & Signage</i>	Directional and informative signage in Arabic and French, as well as compacted soil pathways throughout the park will enhance the visitors' experience.
<i>Commerce Areas</i>	Commerce areas throughout the Biopark will generate revenue and enable the park to have no entry fees. Examples of commerce areas include food stands, a restaurant, and gift shop in the visitor’s center.
<i>Visitor Center</i>	The visitor center will include a welcome area, water museum, agricultural museum, and a gift shop selling seeds, plants, and crops grown at the Biopark.

The final deliverables, including the 3D design of the Biopark and poster which the team developed on behalf of Ribat Al Fath, can be found in Appendix F. The poster, which includes the 3D design as well as information regarding the mission of the Biopark and the team’s identified educational strategy, may be used by Ribat Al Fath to present to potential sponsors to receive funding. These suggestions and deliverables will help Ribat Al Fath realize its goal of developing a recreational and

educational biodiversity park and achieve the association's mission of promoting sustainable living and environmental learning.



3D Biopark Design

References for Executive Summary

Statista. (2018). Morocco: Distribution of gross domestic product (GDP) across economic sectors from 2007 to 2017. Retrieved from <https://www.statista.com/statistics/502771/morocco-gdp-distribution-across-economic-sectors/>

AUTHORSHIP

Justin Amevor, Hunter Kortz, Brent Rolfes, Neema Saberi, and Ilana Zeldin all contributed to the research, writing, and revision of this document. The following table outlines each team member’s key contribution to the project.

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From left to right: Justin, Hunter, Ilana, Brent, and Neema

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1 INTRODUCTION

The effects of climate change have a drastic impact on all aspects of life. Throughout the world, one can see the gradual changes in temperatures, rising sea levels, and increases in drastic environmental events. In Morocco, climate change has altered everyday life, especially for farmers. The country's rainfall patterns and temperature cycles have made it more difficult for farmers to meet the demands of their customers and families. These worsening conditions have affected the average crop yields which impacts the farmers' income. Many farmers and their families have begun to move to the cities in search of jobs because they are no longer able to support themselves through farming (Van der Kooij, Kuper, Zwarteveen, & de Fraiture, C. M. S., 2017). The maintenance of the agricultural sector is vital to the success of Morocco because of the country's heavy reliance on its gross domestic product. The team's sponsor, Ribat Al Fath, and other organizations including the Ministry of Agriculture have begun to address these problems but lack the ability to reach a majority of the farming community. Previous work has done well to identify the pressing problems for farmers, which now opens the opportunity for more work to be done. Knowing the current problems of Morocco, Ribat Al Fath has tasked the team to develop a biodiversity park near Rabat that can help educate farmers and the general population of Morocco on climate change topics.

Association Ribat Al Fath is a non-governmental organization (NGO) based in Rabat, Morocco that focuses on offering the inhabitants of Rabat ways to enrich their lives and improve their city through advocacy of sustainable living, environmental conservation, and education. In collaboration with Ribat Al Fath, the team developed an educational strategy and design for a new biodiversity park outside of Rabat. The proposed Biopark will serve as an education center for farmers on sustainable techniques as well as an education center for the people of Morocco on the effects of climate change, its direct impact on biodiversity in the country, and how to combat it. Ribat Al Fath also wants the Biopark to connect the community by serving as a recreational area for everyone.

The team's research goal that guided the project was to create an educational strategy to develop a design for a biodiversity park in Rabat, Morocco. The team established the following objectives to complete the goal:

Objective #1: Identify educational topics to be taught in the Biopark and what teaching methods will be used.

Objective #2: Develop a design for the Biopark based on the physical requirements for the educational strategy and recreational spaces.

With the help of Ribat Al Fath, the team conducted various interviews with farmers, park design experts, environmental educators, and environmental experts from governmental and non-governmental organizations. The team also completed observational studies at parks throughout Morocco to learn about different aspects of park design. Key findings show educating the community on problems surrounding around water conservation, recycling, air pollution, and establishing a connection with nature should be the focus points of the Biopark. The topics discovered along with the observational studies helped the team establish the recommendation of elements in the park including a garden area, a greenhouse, and modular learning spaces. This report shows how the team achieved these objectives.

2 BACKGROUND

This chapter introduces the region of Morocco in which the proposed Biopark will be built and discusses the effect of climate change on Morocco's biodiversity, as well as the economic impact on Morocco's agricultural sector. This chapter will discuss policies implemented by the Moroccan government to assist farmers in practicing sustainable agriculture to manage the effects of climate change. Additionally, information regarding existing biodiversity park models and examples of teaching methods will be discussed.

2.1 THE REGION OF RABAT-SALÉ-KÉNITRA

Rabat-Salé-Kénitra is one of twelve regions in Morocco, with an area of over 18,000 square kilometers and a population of 4.5 million people, making it one of the most population dense regions in Morocco (Rgph2014.hcp.ma, 2014). Due to its location on the Atlantic Ocean and its vast amount of farmable land, the Rabat-Salé-Kénitra region contributes to about 20% of Morocco's entire GDP (MoroccoWorldNews, 2017). The region is divided into three provinces: Kénitra, Rabat-Salé, and Témara. The location for the proposed Biopark lies within the province of Témara, in the municipality of Oum Azza. Oum Azza is a rural farming community of roughly 6,000 inhabitants, covering a total of 6,200 farmable hectares (A. C. Oulahboub, personal communication, February 20, 2019). It is also home to the Sidi Mohamed Ben Abdellah dam which holds up to one billion cubic meters of water and provides drinking water to all of Rabat and Casablanca (A. C. Oulahboub, personal communication, February 20, 2019). As the community of Oum Azza grows and industrializes through a series of expansion projects, including the construction of a new town, residents will continue to face a number of challenges as a result of climate change.

2.2 CLIMATE CHANGE IN MOROCCO

Rising air temperatures, shortened growing seasons, and droughts are just a few of the problems that contribute to the degradation of North Africa's ecosystems (US AID, 2016). These environmental factors especially affect Morocco due to its position on the Mediterranean and its large agricultural sector, which contributes to 13.06% of the GDP and 18% of exports (Statista, 2018). The various ecosystems in the area are degrading due to rising temperatures, threatening Morocco's biodiversity and water resources (US AID, 2016). The Moroccan government has implemented several programs to teach farmers about techniques to mitigate the effects of climate change by promoting and encouraging best practices in agriculture, with varying levels of success.

RISING AIR TEMPERATURES

The global trend of increasing average temperature is noticeable throughout Morocco and has many impacts beyond agriculture. As seen in **Figure 1**, high, low, and average temperatures in the city of Marrakech have all steadily increased over the past 50 years at a rate of about 0.03 degrees Celsius per year. Similar temperature changes can be seen throughout Morocco (Brahim, Saidi, Kouraiss, Sifeddine, & Bouchaou, 2017).

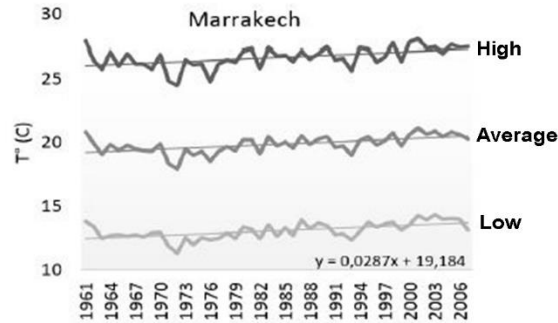


Figure 1: High, Average, and low temperature trends in Marrakech (1378, Brahim, 2017)

Temperatures in the arid regions of Morocco are expected to increase twice as rapidly as temperatures in the rest of the world (Planck Max, 2016). In the north and south of Morocco, temperature changes of two and four degrees Celsius respectively have been observed within the last 40 years (Yassine Ait Brahim et al., 2017). With a trend in rising temperatures throughout Morocco, almost all sectors of the economy will be affected by climate change.

THE IMPACTS OF WATER SCARCITY ON MOROCCO

In recent years, droughts have worsened and are affecting all regions of Morocco. In 2016, Morocco experienced its worst drought in over 30 years, causing a loss of around two thirds of the crop yield (US AID, 2016). From 1980 to 2015, the average annual rainfall dropped from 250 to 150 millimeters (Jobbins, Kalpakian, Chriyaa, Legrouri, & El Mzouri, 2015). In addition, rainfall patterns are less consistent, resulting in downpours when it does rain, which leads to flooding. This change in precipitation patterns hinders the recharge of groundwater supplies which have been overutilized, causing water shortages in certain regions of Morocco (Jobbins et al., 2015; van der Kooij, Kuper, Zwarteveen, & de Fraiture, C. M. S., 2017). Morocco's water resources are expected to decrease 15% by 2020, increasing the frequency of droughts (Convention on Biological Diversity: Safeguarding Life on Earth). To control droughts and floods, Morocco has built 130 dams to hold roughly 18 billion cubic meters of water for farm irrigation and human consumption. The Moroccan government has also created several policies to incentivize water conservation practices. However, water scarcity and rising temperatures are having adverse effects on the country's natural biodiversity.

BIODIVERSITY

Morocco is made up of several distinct ecosystems, each with its own unique landscape and native species. Climate change has negatively impacted many species native to Morocco: over 600 species throughout the country are endangered (Convention on Biological Diversity: Safeguarding Life on Earth). Threats to biodiversity largely stem from human activities, economic development, and population growth leading to land degradation, pollution, and exploitation of resources (Convention on Biological Diversity: Safeguarding Life on Earth). Morocco has adopted several international environmental agreements including the Law on Protected Areas, Law on the Protection of Species of Wild Fauna and Flora, Law on Renewable Energy, in addition to establishing several protected areas within the country as an attempt to preserve its natural wildlife (United Nations Economic Commission for Europe, 2013).

Because of the decrease in biological diversity, there has been a push to educate farmers on climate change and how they can do their part to ensure the success of the agricultural sector.

THE ROLE OF FARMERS IN THE AGRICULTURAL SECTOR

Farms account for approximately 50% of the total agricultural GDP and 40% of jobs in Morocco (International Trade Administration, 2018). The agricultural sector consists of large-scale commercial farms that export goods and small farms that sell produce at local markets and stores or with the help of middlemen. Many farmers support the use of permaculture farming because of its ability to increase crop resilience to environmental changes and their concern for Morocco's biodiversity. However, small scale farmers are unable to implement permaculture techniques because doing so is a financial burden (Mburia, 2016; Kuck, Boecker, Ghahremani, & O'Dell, 2018). There is a large socio-economic divide between farmers since 5% of the largest farms own 33% of the land in Morocco (International Trade Administration, 2018). Large-scale farmers also have a more stable income as they can consistently export their crops, whereas small farmers' income is more dependent on the crop yield, market value, changes in seasons due to climate change, and crop diseases. To support small farmers, many NGOs, including Ribat Al Fath, the Network of Agroecological Initiatives in Morocco, and Crossroad of Agri-Ecological Initiatives and Practice, focus on providing small-scale farmers with resources and techniques for natural farming.

Despite the efforts of the NGOs and the Moroccan government, farmers are beginning to move from rural areas in Morocco into cities in the hopes of finding jobs, resulting in a declining agricultural industry. Families are sending their children to cities in search of jobs and money, which the children send back to the farm, thereby decreasing the motivation and necessity for the families to farm and resulting in an imbalance in the economic system and food resources in Morocco (van der Kooij, Kuper, Zwarteveen, & de Fraiture, C. M. S., 2017). The government has implemented several programs, including the Green Morocco Plan, as an attempt to increase interest, resources, and employment in the agricultural sector.

THE GREEN MOROCCO PLAN

One of Morocco's main policies to increase economic growth and sustainable practices over a 15-year period is the Green Morocco Plan (GMP) established in 2008. The GMP aims to identify areas of improvement in the agricultural sector and develop a plan to support those areas. The main goals of the GMP are to increase agricultural production, increase farmers' income, and create sustainable development in rural areas (Faysse, 2015). One area the GMP promotes is the subsidization of drip irrigation systems to farms around Morocco. However, because Morocco has such a diverse farming culture, environmental experts argue that the GMP is not supporting the farmers in the right way; instead of improving their economic performance, the GMP focuses on enhancing their agricultural production (Faysse, 2015; Achy, 2011). Educating people on sustainability is the first step to combating climate change.

2.3 TEACHING METHODS

The educational system has been evolving over the past decade to include non-traditional teaching methods that involve less classroom time and more active-learning. Three of the most successful

teaching methods for students of all ages are experiential learning model, hands-on learning, and nature-based learning. These teaching methods all involve increasing connection with peers and staying active during the learning process. In turn, this benefits the development of the children's mental and physical health, while also increasing their learning abilities (Powers & Ren, 2018; Kolb & Kolb, 2017).

EXPERIENTIAL LEARNING MODEL

The experiential learning model is a cycle consisting of four phases: concrete experience, where the learners experience an activity; reflective observation, where the learners reflect on the experience; abstract conceptualization, where the learners attempt to conceptualize what they observed and create new ideas; and active experimentation, where the learners apply their new knowledge through new behaviors (Kolb & Kolb, 2017). The experiential learning model is more effective than traditional teaching methods for certain topics because it emphasizes the role of action and experimentation in learning. Because most harm done to the environment is through direct human interaction, using an experience-based learning model to teach children about their impact on the environment may result in a more significant educational experience.

HANDS-ON LEARNING

Hands-on learning encourages students to engage in several modes of learning at once: kinesthetic learning, problem solving, and trial and error (Kendra Moyses, 2012). Hands-on learning has been proven to encourage students' creativity and promote cognitive processing. This style of learning allows students to concretely understand how to do something and learn by doing, rather than by listening. A study conducted on the effectiveness of hands-on experiments in learning science found that students who were taught about human impacts on water quality through a hands-on activity that included building a water purification device had higher scores on an assessment and displayed higher levels of thinking on open-ended questions and greater content knowledge than students who were taught using traditional methods (Riskowski, Todd, Wee, Dark, & Harbor, 2009). Hands-on activities, such as conducting small-scale science experiments, expand students' understanding and appreciation for science and allow them to develop skills in critical thinking.

NATURE-BASED LEARNING AND PLAY

Nature-based learning and play is a teaching method designed to support the mental and physical development of children in a natural environment. This style of teaching includes structured activities with specific learning outcomes led by adults, as well as activities that children create while playing in nature. Several studies on children aged 7 to 13 have shown that nature-based learning and play have a positive influence on cognitive development, academic performance, social development, mental health, emotional health, physical health, and stewardship due to the children's interaction with peers, natural creativity, and a stress-free environment. A nature-based learning and playing area is most effective when the area is natural, includes open-ended materials, children have consistent and ample play time, and there are caring adults present. Children who are in a stress-free natural environment while learning have significantly higher self-motivation learning behavior compared to a traditional classroom setting. More than thirty studies have shown that positive experiences in nature during childhood act as motivational factors for pro-environmental behavior during adulthood. (Powers & Ren, 2018)

2.4 PARKS, RECREATION, AND EDUCATION

During the past decade, there has been a decrease in the amount of time children spend outside learning, playing, and exploring (Powers & Ren, 2018). This is due to a lack of available natural spaces close to urban centers and children's lack of interest to learn in an outdoor setting. Studies have been conducted on the positive health and cognitive benefits from playing and learning outside as an adolescent (Powers & Ren, 2018). Yet, there is still not enough awareness about this information for there to be a change in environmental education. Outdoor educational and recreational spaces, such as biodiversity parks, could offer a beneficial outlet for children to have positive natural experiences at a young age to increase their educational drive both inside and outside the classroom.

WHAT IS A BIODIVERSITY PARK?

A biodiversity park is “a unique landscape of wilderness where the ecological native species are assembled together in the form of biological communities which are recreated and maintained over a degraded or marginal land” (Agarwal, 2015). A biodiversity park is a type of park that is designed to preserve the environment and to educate the community on the biodiversity. Biodiversity parks also created to act as a sustainable role-model for the community in which they are located (Agarwal, 2015). Around the world, there are multiple existing biodiversity parks and gardens that work on educating visitors on how to protect their local biodiversity, how to live a sustainable lifestyle, and how to protect the future of their environment.

EXISTING EDUCATIONAL MODELS

The ABQ Biopark in Albuquerque, New Mexico provides educational opportunities for children and adults alike including camps, classes, and overnight programs that teach children and adults about the ecosystems and conservational efforts around the world (Calvani & Campos, 2014). These camps are important for the ABQ Biopark because they are an effective way to educate visitors about sustainability and biodiversity while allowing for a fun and pleasant visitor experience.

The Chicago Botanic Garden in Glencoe, Illinois is a botanical garden with a strong emphasis on educating its visitors on the environment, biodiversity, and botany. The gardens recently completed construction on their new Regenstein Learning Campus, an area that serves 125,000 people a year and offers 1,500 classes (Chicago Botanic Garden). The learning campus includes indoor and outdoor learning spaces, modular class spaces, a nature laboratory, and a nature-based play and learning area. Everything was designed with the intention of providing the visitors with a meaningful educational experience that will bring them closer to nature.

PARKS IN MOROCCO

There are few locations around Rabat that allow for people to enjoy the rich biodiversity within their own country. Parks such as Les Jardins Exotiques de Bouknadel, Le Jardin D'Essais, the Rabat National Zoo, and the Maamora and Ain Houala forests are some of the places people can find refuge from urban life. The parks and forests located in and around Rabat, with the exception of the Rabat National Zoo, do not emphasize education about the environment, biodiversity, or climate change. They are more recreational parks than educational models. Although national parks offer a place for visitors to

learn about the environment as well as enjoy the biodiversity of Morocco, there are no national parks located near the capital city of Rabat. The closest national park to Rabat, Ifrane National Park, is 200 km away (morocco.com, 2018). Having a location near Rabat that focuses on educating visitors on Moroccan biodiversity to help them respect and protect the environment would benefit Morocco.

2.5 ESTABLISHING A BIODIVERSITY PARK IN MOROCCO

A biodiversity park in Morocco could address some of the climate change problems that Morocco has been facing by educating the visitors on the effects of climate change and what children, farmers, and families could do to help protect their environment. A biodiversity park would also be a place for visitors to establish respectful connections with the environment, enjoy the outdoors, and connect as a family. Ribat Al Fath's goal is to make the proposed Biopark into a place that will attract students, farmers, and families to give them a place to relax and learn. Ribat Al Fath has worked in the past with different environmental and sustainable projects to help Morocco. With their next project, they plan to educate the population on more sustainable practices to help protect the future of Morocco. Educating children on climate change, sustainability, and respecting the environment would be a step towards protecting the future of Morocco's biodiversity. Additionally, educating farmers on new sustainable farming techniques that increase their agricultural production and income would help the declining state of the agricultural sector in Morocco. Educating the community at the proposed Biopark could be the best strategy to help the people of Rabat learn about the effects of climate change on their country's biodiversity and agriculture sector, as well as learn how to protect it.

3 METHODOLOGY

The goal of the project was to assist Ribat Al Fath in the creation of an educational strategy and design for a proposed Biodiversity park in the Oum Azza municipality of the Rabat-Salé-Kénitra region. The proposed Biopark will be an educational and recreational space for visitors about topics in climate change, biodiversity, and agricultural practices. The following two objectives were created to accomplish the research goal:

Objective #1: Identify educational topics to be taught in the Biopark and what teaching methods will be used.

Objective #2: Develop a design for the Biopark based on the physical requirements for the educational strategy and recreational spaces.

The following chapter explains how the team completed the two objectives using the methods shown in **Figure 2**. The primary educational target audiences for the Biopark are:

1. Farmers who are interested in learning sustainable agricultural methods
2. Primary and secondary school students

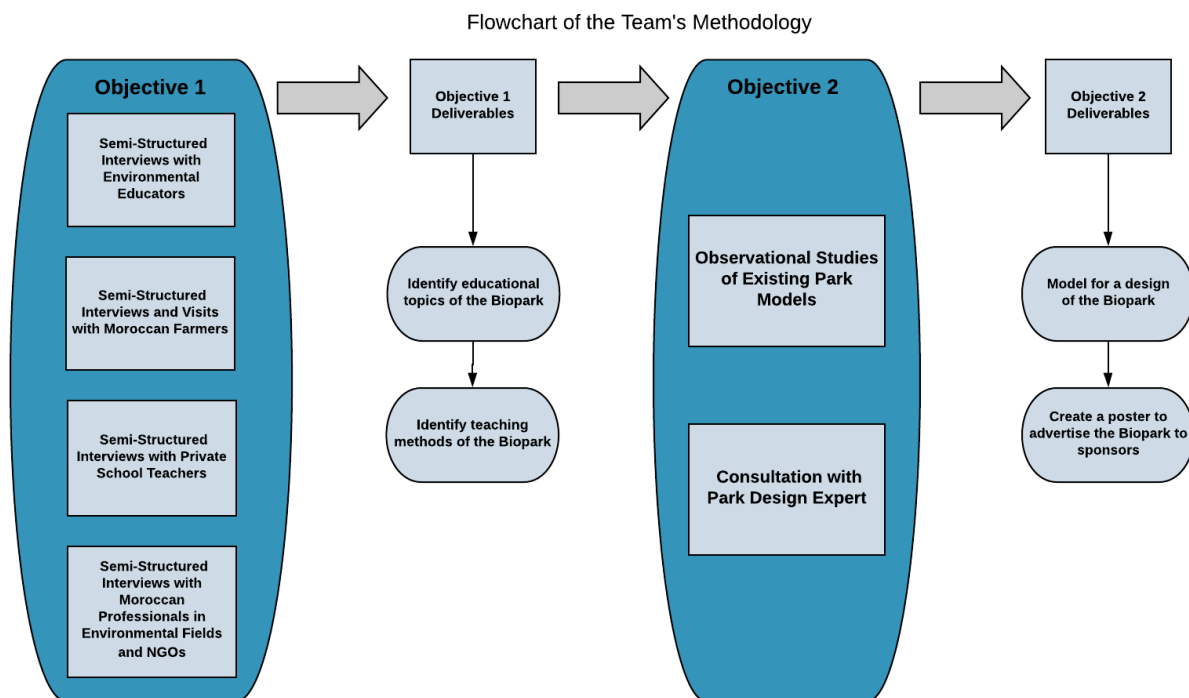


Figure 2: Flow Chart of Objective #1 and #2

3.1 OBJECTIVE #1: IDENTIFYING AN EDUCATIONAL STRATEGY

The team identified the educational topics to be taught in the Biopark and what teaching methods will be used. The educational strategy the team defined from the results of Objective #1 will outline Objective #2 to aid in the design of the Biopark's layout.

SEMI-STRUCTURED INTERVIEWS

Environmental Educators: The team conducted a semi-structured interview with Mr. Drew Wehrle, an environmental educator and the coordinator of school field trips for the Chicago Botanic Garden, and Mr. Abdellatif Khattabi, a professor of environmental studies and engineering. Speaking with environmental educators provided the team with information on teaching methods used for environment-based topics.

Moroccan Farmers: The team visited two farms for the study and interviewed Ms. Samira el Ahrari, from the Tazota Ferme Pédagogique in Tamesna, and Mr. Mustaffa Kahtta, from a small farm in Skhirat. The team conducted the interviews to gather information regarding what farming techniques they use, the challenges they face, and how a biodiversity park may help them improve their farms. The information gathered helped the team decide upon what educational topics should be taught at the Biopark.

Private School Teachers: The team interviewed two teachers from the L'école El Hanane to learn what subjects are taught in schools and what would make the Biopark an attractive destination for school field trips.

Moroccan Professionals in Environmental Fields and NGOs: The team interviewed two environmental professionals: Mr. Akka Chibane Oulahboub, a former employee in the Ministry of Agriculture, and Mr. Boujemaa Gueghlan, the manager of Crossroads International Agro-Ecological Practice (CIPA). Mr. Oulahboub presented the team with information on specific challenges that NGOs and the Ministry of Agriculture face in combating environmental issues in Morocco. Mr. Gueghlan elaborated on the challenges farmers face from climate change and what organizations like CIPA are doing to help them.

Appendix B contains the full list of questions the team asked during the interviews.

3.2 OBJECTIVE #2: DESIGN

The team identified features for the Biopark based on the educational strategy and developed a design for the proposed Biopark. Observational studies of existing park models and a professional consultation with a park design expert was completed to accomplish this objective.

OBSERVATIONAL STUDIES OF EXISTING MODELS

The team conducted observational studies of existing parks that promote biodiversity and environmental conscientiousness including the Jardin Majorelle in Marrakech, Jardin D'essais in Rabat, Tazota Ferme Pédagogique in Tamesna, and the Rabat National Zoo. The team performed site visits and online research for each park. During observational studies, the team documented and photographed the park layout, accessibility to educational materials, what activities visitors are partaking in, and the educational resources and buildings being utilized. After each visit, each member of the team completed an individual analysis. Then the team combined all analyses into a summarized report. Appendix C contains the team's summarized reports of each observational study.

CONSULTATION WITH PARK DESIGN EXPERT

The team reached out to Ms. Eileen Prendergast, the Director of Education at the Chicago Botanic Garden. Ms. Prendergast referred the team to an article she helped write for the gardens that detail how to design park structures to focus on educating visitors. The team developed a reading guide with questions prior to reading the article. After reading the article, the team answered the questions and created a summary of the findings that can be found in Appendix C.

4 RESULTS AND ANALYSIS

This chapter presents the findings from the team's interviews, observational studies, and consultation. The team used thematic content analysis to analyze the semi-structured interviews because it allowed the team to categorize and recognize patterns within the gathered data. Key themes for analyzing the interviews were identified based on preliminary research and input from Ribat Al Fath. The team analyzed the results from observational studies by creating summarized reports for each model and then identifying similarities and differences between them. Once all observational studies were completed, the team created a chart of which elements from each model could be used in the proposed Biopark. The team also received consultation about design elements for parks, which helped in the decision process when creating a design for the proposed Biopark.

4.1 UNDERSTANDING FARMING CHALLENGES

The team collected data during semi-structured interviews with farmers and professionals in relevant fields to understand farming challenges in Morocco. From the data, the team developed findings that established the base of the deliverables. These findings show that problems surrounding climate change such as decreasing biodiversity and diminishing water resources predominantly affect Moroccan farmers. Farmers also face literacy and communication challenges. This affects the farmers' ability to financially support their families and is causing many to send their children to cities in hopes that they will make a better living.

CLIMATE CHANGE

The overall impact of climate change has resulted in environmental challenges that have negatively affected the agricultural sector of Morocco. The effects of climate change have large impacts on resources that are key to farming, such as water and fertile land. The agricultural climate of Morocco encourages the use of monocultural farming, a practice which can have negative effects on biodiversity. Interviewees at the Tazota Ferme Pédagogique in Tamesna and a farm in Skhirat, emphasized the difficulties of conserving water over the past several years. They also claimed that it is becoming increasingly difficult to maintain the same yearly crop yield. Efforts to improve environmental awareness require more education on proper methods of combating and preventing climate change.

BIODIVERSITY

Many farmers in Morocco practice monoculture, which can negatively impact the biodiversity on their farms. According to Mr. Mustaffa Kahtta, a small farmer in Skhirat, small farmers find most of their success in practicing monoculture because of high yields and simplicity of the practice. The widespread implementation of monoculture has adversely affected the variety of crops present in rural farms, taking away the ability for farmers to explore new markets with different crops. The practice of monoculture is still a tool which is widely used by rural farmers in Morocco. As the team learned from Mr. Boujemma Geughlan, when implemented correctly with adequate attention to crop rotation patterns, and limited uses of fertilizers, monoculture can have positive effects on biodiversity. Education on new farming practices and ways to improve farming could help many rural farmers improve their farms.

DIMINISHING RESOURCES

In Morocco, water is one of the most valuable resource; however, the increasing demand for water cannot be supported by current water management techniques. The diminishing supply of groundwater is limiting farming practices and decreasing crop yields, making it more difficult for farmers to earn a living. Throughout the team’s interviews, the topic of water scarcity and the importance of water was raised on several occasions. “The demand [for clean water] is being driven up by an increasing population, economic development needs, and the pollution problem,” said Mr. Abdellatif Khattabi, an environmental educator. The government advocates for the use of drip irrigation since other traditional methods are not as efficient, according to Mr. Khattabi. Many farmers including Mr. Kahtta and Ms. Samira el Ahrari, who manages the Tazota Ferme Pédagogique in Tamesna, have implemented drip irrigation systems on their farms to save water. Pollution has had an effect on Mr. Kahtta’s water supply as well. During the interview with Mr. Kahtta, he mentioned that the salinity content in his well water had increased in recent years, which is affecting his crop yield. As many interviewees described, the shortage of water affects many rural farmers throughout Morocco. Adaptation of sustainable water conservation methods could help support farmers in the future.

Land degradation and desertification are also immediate consequences of climate change in Morocco. According to Mr. Khattabi, the desertification of lands has affected farmers greatly and has made the dry and arid climate more extreme, resulting in more droughts in the recent years. In many regions there is a critical amount of overharvesting of groundwater. The overharvesting of groundwater is causing the land to become dryer because there is not enough rainfall to replenish the groundwater supply. This causes desertification throughout many inland regions of Morocco and is negatively affecting farmers throughout the country.

LITERACY AMONG FARMERS

The team learned that there is a large portion of illiterate farmers throughout Morocco through conversations with Mr. Geughlan. This is true for farmers both in rural and more urbanized areas. As a result, it is difficult for farmers to learn about new sustainable farming techniques. Uneducated farmers are unable to seek out schools or programs to learn new techniques for their farms. Mr. Gueghlan also explained how it is almost impossible for uneducated farmers to begin farming organically because of the stringent registration and documentation that comes with being an organic farmer. Illiteracy also makes it difficult for farmers to know and apply for subsidies from the government. Through an interview with Mr. Akka Chibane Oulahboub, the team also learned that many farmers, especially in rural regions, only speak their local dialect. This makes it extremely difficult to arrange educational programs because of the language barrier. In general, the illiteracy among Moroccan farmers directly impedes their ability to learn new sustainable techniques and achieve organic farm status.

RURAL MIGRATION

Another challenge that farmers face is rural migration. Through interviews with Mr. Gueghlan, the team learned that the behavior of farmers has changed over the past 20 years. With an increase in opportunities for employment and education in cities and with climate change affecting many parts of the agricultural industry, many farmers are sending their children to work and study in cities. Farmers stop farming and live off the money that is being sent back from their children. Additionally, farmers buy

more of their everyday products instead of producing them. This is raising the cost of rural farming and creating a challenge for farmers throughout Morocco. While the Ministry of Agriculture attempts to support farmers, it struggles to communicate with and reach all farmers.

OBTAINING PUBLIC INFORMATION

The Ministry of Agriculture is a valuable resource for farmers. However, it has not been effective in educating a large portion of Moroccan farmers in the topics of climate change, sustainability, and business. Mr. Oulahboub explained how the Ministry of Agriculture only reaches about 10% of Moroccan farmers with their extension services which aim to teach farmers new techniques and establish farmer cooperatives. Information about new sustainable techniques is hard to come by because the Ministry does not have the resources to hire extension agents for all regions of Morocco. Mr. Oulahboub explained how farmers are unaware of the local ministry centers where information is provided. More direction is needed to push farmers to seek assistance from the ministry for help with subsidies, test reports, and organic certifications. Through interviews with Mr. Oulahboub, the team learned that even though the Ministry of Agriculture has many effective farming and sustainability programs, farmers are unable to take advantage of the ministry's resources because of their lack of knowledge of its existence.

4.2 EDUCATION

Both environmental experts and local school teachers identified a lack of education on climate change as one of the most important and necessary problems that should to be addressed. The team collected information regarding teaching methods for climate change and farming topics.

GENERAL EDUCATION METHODS

Identifying appropriate teaching methods for topics is essential to creating a lasting impact on students. Through a series of interviews, the team identified hands-on learning and experiential learning as effective teaching methods for environmental topics.

HANDS-ON LEARNING

Through data collection, the team verified the background research on hands-on learning that suggests it is an effective teaching method for students and farmers alike. Students and visitors at the Tazota Ferme Pédagogique participate in many hands-on learning activities. One of the workshops at the farm demonstrated the process of turning bread into wheat which included a demonstration from the teacher using the materials in **Figure 3** and time for children to execute the process as seen in **Figure 4**. Other hands-on activities at the farm include making olive oil from olives, milking a cow, planting crops, and using sheep wool to weave a rug.



Figure 3: Materials used in a hands-on demonstration on breadmaking



Figure 4: Students participating in a hands-on activity by kneading dough for bread

Ms. el Ahrari of the Tazota Ferme Pédagogique and the L'école El Hanane teachers agreed that hands-on education is an effective teaching method and teaches children an appreciation for nature. The teachers of L'école El Hanane stressed that hands-on learning engages students' curiosity and interest in the subject, thereby enabling them to absorb and retain more information. The teachers noted that they see a visible impact on the students after visiting the Tazota Ferme Pédagogique and participating in hands-on activities.

At the farming school that Mr. Kahtta attended, farmers were taught using a combination of classroom training and field work. After an in-class instruction, farmers would go to the field and practice what they had just learned. Mr. Gueghlan explained that the education for farmers at CIPA is based on practical learning as well, since this method works for both educated and illiterate farmers. At CIPA, the education for farmers involves classroom learning using a projector and slides with many pictures. Then, the farmers go into the fields and are shown the practical application of what they just learned and are able to apply it by actively participating in the action themselves.

EXPERIENTIAL LEARNING MODEL

When educating others on environmental best practices, the team found that incorporating teaching methods that have various levels of instruction and practice is important. Farming is a common occupation in impoverished areas in Morocco and as a result, many farmers practice generationally passed-down techniques. Combined with high illiteracy rates, this might result in farmers practicing environmentally unsustainable methods. The experiential learning model, which is a cycle that emphasizes experimentation in learning, was found to be an effective way of educating the target audiences on new practices. When interviewing the L'école El Hanane teachers, they praised the method of presenting a lesson, then giving their students several opportunities to apply the lesson, and finally circling back to review the topics they discussed. Mr. Drew Wehrle, the director of field trips at the Chicago Botanic Garden, also supported this method in an interview where he discussed developing an experience that allows participants to learn about environmental topics in a manner that connects multiple lessons through several experiences and visuals.

FARMING EDUCATIONAL TOPICS

Although climate change is an important topic for the entire population of Morocco, it affects the agricultural sector the most. Farmers are discouraged from farming because it is becoming more difficult and less profitable for small-scale farms in Morocco. Educating farmers in sustainability, water management, and business strategies is important for combating climate change in the agricultural sector of Morocco. Through interviews with local farmers and environmental experts, the team developed educational topics for the farming population of Morocco.

SOIL MANAGEMENT

Many farmers in Morocco lack access to information regarding sustainable soil management including new technology, fertilization techniques, and pesticide pollution. While more educated farmers are able to obtain training, others are not and do not implement optimal techniques on their farms.

Mr. Kahtta told the team that he uses organic fertilizer from compost and manure for his crops and rotates fields seasonally to allow for nutrients to penetrate the fields. He also explained that he learned about chemicals, fertilizers, and soil nutrients from the farming school he attended. Now, he watches videos on YouTube and listens to farmer-targeted radio stations to learn about new techniques. However, not all farmers have the opportunity or resources to attend a farming school and as such are unaware of how to sustainably cultivate their land using new and efficient techniques.

At CIPA, Mr. Gueghlan instructs farmers on soil conservation and fertilization techniques. He explained that farmers who practice organic cultivation methods are those who attended agricultural schools or farming training and that most farmers are not able to receive this type of education. Mr. Khattabi voiced similar concerns, explaining that soil management is one of the main challenges faced by farmers in Morocco and that there is a lack of knowledge on proper usage of technology, fertilizers, and pesticides. Mr. Khattabi believes there “should be more training on how to use these resources and where to obtain them.”

SUSTAINABLE WATER USE

Because water scarcity is a large problem in Morocco, the sustainable use of water is incredibly important. Learning proper water management skills is important for farmers of all regions. The Ministry of Agriculture promotes water management by offering subsidies to farmers who use drip irrigation, as shown in **Figure 5**. Mr. Oulahboub confirmed this as an advantageous program for farmers as it saves them resources and money.



Figure 5: Example of Drip irrigation set up in a field of Zucchini in Skhirat

The topic of drip irrigation was prevalent in all of the team's interviews with Moroccan environmental experts. Mr. Gueghlan explained that drip irrigation is one of the main techniques that CIPA educates farmers on. Mr. Khattabi explained that with the decreasing groundwater level due to the large demand created by an increasing population, proper management skills are extremely necessary to ensure water is not wasted or overused. Another technique that was identified by the team through interviews with farmers was rainfall and water runoff collection. Both Mr. Gueghlan and Mr. Kahtta explained to the team that this is an extremely effective way to manage water, especially for small farmers as after a decent rainfall season enough water can be collected for the entire growing season. These water management techniques are essential for farmers to combat water scarcity in Morocco.

BUSINESS ASPECTS IN FARMING

Throughout interviews with multiple environmental educators, education regarding business aspects of farming was stressed to the team. Mr. Gueghlan explained to the team that instructors show farmers methods to produce healthy and abundant crops and explain that farming can be profitable if crops are produced efficiently and effectively. Mr. Gueghlan stresses that this can be achieved mostly with organic farming practices because the demand is extremely high, and the production is low. CIPA advises farmers to farm organically to make more money on their yearly crop yield.

Middlemen greatly affect the ability of Moroccan farmers to achieve a healthy profit on their crops. Many farmers do not have the resources to deliver and sell their whole crop yield directly to consumers or are offered bad rates from wholesale customers. Mr. Oulahboub explained that many farmers would make twice or thrice their profit if they sold directly to consumers. Farmers should be educated on these topics, so they can continue to make a profit. The concept of reaching new markets and market timing was also mentioned by Mr. Kahtta. Mr. Kahtta first sells his crops to a wholesale market in the Temara region, instead of a local market. He does so because in a mainly rural farming area, the prices of vegetables and other goods decrease as the market is flooded. The demand outside of his local region is much higher, and his profit margins are much better even with the added transportation costs. This also holds true with his sale of livestock, especially sheep. Mr. Kahtta takes advantage of Eid al-Adha, a Muslim holiday in August where an animal is sacrificed, by timing the sale of his sheep to the holiday. During the holiday, Mr. Kahtta's profits are much higher than they would normally be. This kind of education may help farmers of all regions in Morocco have a profitable business.

CHILDREN EDUCATIONAL TOPICS

Throughout the study, the team identified the necessity to prioritize the education of children in climate change related topics. By referencing the mission of the Biopark to gather information on educating children, the team compiled the results of the methodology to recommend the best educational methods while emphasizing a connection with nature for children at the Biopark.

CLIMATE CHANGE

The Biopark should prioritize educating children on efforts to combat climate change. Teaching children at a young age about sustainable practices including recycling and water management will foster a long-term appreciation of the environment. At the Tazota Ferme Pédagogique, one workshop educates visitors on proper recycling methods. Teachers from L'école El Hanane expressed that they want students to learn why recycling is important and how their actions affect the environment. Mr. Khattabi, who was

involved in the development of a primary education curriculum on environmental topics, said that core topics in the curriculum included water conservation, air pollution, and plastic recycling.

CONNECTING WITH NATURE

To best educate children on the environment and climate change, the Biopark must establish a connection between nature and students. Ms. Eileen Prendergast and Mr. Wehrle both highlighted the importance of establishing the importance of authentic experiences with nature as a child. Through background research, the team found that natural, nature-based play spaces worked well in providing a space for children to connect with nature. On the contrary, traditional playgrounds that include artificial elements do not establish a genuine connection with nature as well as nature-based play areas do.

4.3 DESIGN REQUIREMENTS ANALYSIS

The team completed multiple observational studies of existing models to understand the best design strategies that would work well in the proposed Biopark. During the observational studies, the team focused on educational and recreational areas of each model. After collecting all the data, the team discussed the major elements of each model and how they enhance the visitors' experience. The team divided different design elements into two categories: primary features, which include main attraction elements and educational areas; and secondary features, which include facilities and required elements for park operations.

PRIMARY FEATURES

Primary features of the proposed Biopark are the main elements that would draw visitors there and the different learning areas. These features include modular learning spaces, practical learning areas, nature-based play and learning area, and commerce areas. The following sections describe the team's analyzed data and why certain design elements are important for an educational park.

MODULAR LEARNING SPACE

Multiple educational centers have started the transition of changing classrooms into modular learning spaces to benefit the educational experience of students. Modular learning spaces are similar to classrooms, but they are adaptable and can serve many purposes. At the Chicago Botanic Garden (CBG) in Illinois, modular learning spaces can act as a classroom, a lunchroom, a botany lab, an arts-and-crafts studio for children, and more. Mr. Wehrle said that modular learning spaces allow students to experience an activity that would not be done at school because they can make the space more functional than a classroom. In addition to being a flexible educational area, modular learning spaces also save space. Mr. Wehrle explained how when school field-trips come to the CBG, the number of students is limited by lunch space. However, modular learning spaces allow students to complete a plant study and eat lunch in the same room. Now, the CBG becomes limited by the physical space of the learning center and not by the size of the dining hall.

Modular learning spaces do not have to be inside areas; outdoor modular learning spaces can serve as drop-in locations for visitors to learn quick facts or complete hands-on activities. Both the Chicago Botanic Garden and Rabat National Zoo utilize outdoor modular learning spaces to enhance the visitors' experience by providing quick and relevant lessons or activities related to their visit. These areas

are designed to be in high traffic areas of parks, with an ease of flow for visitors to drop in and out. They will normally have blank countertops and backdrops to allow for the space to be adapted to any type of activity. **Figure 6** shows one of the outdoor modular learning areas from the Rabat National Zoo. **Figure 7** shows the amphitheater from the Rabat National Zoo. An amphitheater is a type of modular learning area, but specifically designed for talks on different animals being displayed. These drop-in areas are targeted at visitors of all ages to make their experience more meaningful. The CBG offers visitors the opportunity to complete quick hands-on activity and take a small item home, such as a plant. Having a visitor bring home an item they made for free will establish a connection between the visitor and the topic of the activity, as well as remind them of their experience at the park.



Figure 6: Modular learning space at the Rabat Zoo



Figure 7: Amphitheater at the Rabat Zoo

PRACTICAL LEARNING AREAS

Practical learning areas are necessary to complete hands-on activities. Through background research, the team found that hands-on learning enhances the educational experience for all visitors. This was also supported during the team's interview with Mr. Wehrle and Mr. Boujemaa, as well as the observational study at Tazota Ferme Pédagogique. A practical learning area is a space where visitors can learn a topic by completing an interactive activity. For example, for a lesson that teaches students the best method for planting seeds in a field, the practical learning area would be a tilled field. The Tazota Ferme Pédagogique has multiple practical learning areas because they believe in teaching kids about different processes by giving them the opportunity to do it for themselves. The children prefer this method over conventional learning in a classroom because they get to see the products of their work, according to Ms. Samira el Ahrari.

NATURE-BASED PLAY AND LEARNING AREAS

A big factor of early childhood connection between the environment is the exposure to nature and having both recreational and educational experiences in a natural environment. Multiple studies conducted on nature-based play and learning for children have found positive results including beneficial mental health development, social skills, and respect for nature. When speaking about the nature play area at the CBG, Mr. Wehrle stressed that these areas need to be built of completely natural materials to ensure they are effective. **Figure 8** shows what the Nature Play Garden at the CBG looks like.



Figure 8: Nature play area at the Chicago Botanic Garden (Chicago Botanic Garden)

The preschool at the CBG consists completely of outside time for learning or playing. Mr. Wehrle explained to the team how important it is for children to have an experience different from what they would have at school and captivates their educational interest. He said he noticed children are more self-motivated to learn while being constantly exposed to a natural environment.

COMMERCE AREAS

Commerce areas with food stands, restaurants, and gift shops are attractive factors for visitors when they come to a park, and also help keep them in the park when they become hungry. The large parks that the team completed observational studies on had established cafes and other commerce areas. At the main entrance of the Rabat Zoo is a commerce area that has two restaurants and a gift shop in addition to multiple food stands placed throughout the zoo, so visitors do not have to walk back to the entrance to get food. There is also a picnic area in the middle of the zoo for visitors to eat the food they brought from home or purchased there. The Jardin Majorelle in Marrakech had one cafe that was near the entrance on the side of the park. The gardens are five hectares, and during the observational study the team saw that it was inefficient to have the cafe on one side of the garden because it is not the most convenient place for all visitors to access it. A more centralized position for the cafe at the Jardin Majorelle could potentially increase the number of visitors served each day.

SECONDARY FEATURES

The team defined secondary features of a park as design elements that do not contribute to the educational strategy of the park but are important or functional features that contribute to the visitors' experience. From the team's observational studies, secondary features were identified as follows: recreational spaces, signage, pathways, and facilities. The following section details park features that are necessary in the proposed Biopark to make it a well-functioning park.

RECREATIONAL SPACES

A successful design for the Biopark should include elements that are focused on providing entertainment and recreation for the visitors. The ability to connect with nature and other guests will enhance an individual's experience by being able to interact and learn with others congruently. Open spaces that are natural and allow the visitors to dictate their own experiences will help with providing an enjoyable experience and facilitate social learning among park visitors. A base for an inground pool already exists at the Biopark site and would be a desirable component to entertain guests. Tazota Ferme

Pédagogique also had a pool on site which was used in several of their programs and for recreational purposes. A recreational swimming pool would be a desirable feature to include at the Biopark to attract guests and help allow the park to be a year-round commodity.

OTHER FEATURES AND CONSIDERATIONS FOR THE BIOPARK

During the team's observational studies, the importance of additional elements that enhance the visitors' experience, such as signage and pathways, was noted. From the team's completed observational studies, the signage at the Rabat Zoo was the most practical, compared to the Jardin D'essais where the signage was inconsistent and sometimes irrelevant. The Rabat Zoo had signs that were low to the ground to allow children to read them, but the text was large enough, so an adult would not have trouble reading it from a higher vantage point. The signs for each exhibit were informative and educated the visitor on more than just the exhibit. Around the zoo there are large signs with a map of the zoo and information about exhibits in the immediate vicinity on the back of the sign. All signs at the Rabat Zoo were in both Arabic and French, whereas Jardin D'essais had inconsistent signs in French, Arabic, Spanish, and English.

Pathways throughout parks should lead the visitor through in a designed flow, but also give them the opportunity to venture in any direction the like. The Jardin Majorelle has pathways that allow for a natural flow of visitors throughout the park, while still giving visitors the opportunity to stop at any point, change directions, or wander through the garden. This structure made it so there was never an area of the garden that was overcrowded, and visitors were able to see all exhibits. The pathways at Jardin Majorelle were all paved and had railings, preventing the visitor from venturing off the path which gave the garden an unnatural feel, despite being surrounded by plants. The Jardin D'essais had different types of paths through the garden depending on the location including large paved paths that allow the visitors to move from one side of the garden to the other and smaller, gravel paths that break off from the main path into different exhibits and weave throughout the gardens. Both the Jardin D'essais and Jardin Majorelle are in city centers but are able to make the visitor feel like they are somewhere else.

5 RECOMMENDATIONS

This chapter details the team's recommendations for Ribat Al Fath based on findings presented in the Results and Analysis chapter. The recommendations in this section include an educational strategy, which consists of teaching methods and topics within climate change, and a proposed Biopark design.

5.1 EDUCATION STRATEGY

The recommendations in this section include teaching methods and topics for the Biopark's target audiences. The team created a list of educational topics for both children and farmers. The team also identified teaching methods to support the educational topics.

TEACHING METHODS

The team recommends that the Biodiversity park utilize nature play and learning, hands-on learning, and experiential learning as teaching methods for farmers and students. Through a combination of background research and data collection, the team found that hands-on learning is extremely effective in teaching topics related to climate change and helps expand students' understanding and appreciation for nature. Farmers also benefit from hands-on learning because it allows them to gain experience by practicing new farming methods. The team recommends the application of the experiential learning model to lessons in the Biopark, as the model emphasizes the role of action and experimentation in learning. An experience-based approach is well suited for environmental topics as it allows students to examine their effect on the environment and experiment with new environmentally-conscious behaviors. Teaching through nature-based play and learning in the Biopark should encourage young children to be creative, solve problems, and respect the environment.

EDUCATIONAL TOPICS FOR CHILDREN

The team identified the following topics to be taught to children in the Biopark:

Air Pollution

Educators and environmental experts emphasized the importance of teaching children about pollution and how their actions affect the environment.

Water Management

Educators, environmental experts, and farmers recommended educating students on basic water management skills to encourage environmentally conscientious behaviors.

Recycling

Educators emphasized that educating students about proper recycling methods as well as their impact on the environment is important.

Establishing a Connection with Nature

Educators and environmental experts suggested that establishing a connection with nature at a young age ensures that students respect and protect the environment later in life.

The team recommends that the Biopark teaches children about these topics. The team's findings showed that children in Morocco should learn information about climate change as there is a lack of climate change education in schools. Through a combination of classroom learning hands-on activities, the Biopark can provide this education to students.

EDUCATIONAL TOPICS FOR FARMERS

The team identified and recommends the following topics to be taught to farmers in the Biopark:

Soil Management

Farmers and environmental educators stressed the importance of teaching sustainable soil management techniques including fertilization techniques, new technology, and pesticide pollution.

Sustainable Water Usage

Education on sustainable water use including drip irrigation, rainfall, and runoff collection encourages farmers to practice environmentally conscientious behaviors and preserve resources. Water scarcity is one of the most pressing climate change related problems and the team recommends this being a substantial topic focused on at the Biopark.

Farming Business Aspects

Education on the best business practices including middlemen, markets, and selling strategies was feedback seen frequently throughout the team's data collection and results.

The team recommends that the Biopark teaches farmers about these topics. The aim of the Biopark is to show farmers that while using these techniques the farmers will be protecting the environment while also producing better crop yield and increasing profits. The team also recommends that farmers be educated in basic business aspects of farming. The results showed that many farmers are having their profits cut by middlemen and bad market practices. The Biopark should instruct the farmers about the best practices to improve profitability while small-scale farming in Morocco. This education is essential to maintain the agricultural sector of Morocco that is diminishing. All of the educational topics are useful because as farming in Morocco becomes more difficult, demotivating, and less profitable for small scale farms. Through a combination of classroom and hands-on activities, the Biopark can provide this education to farmers in the region and the entirety of Morocco.

5.2 DESIGN OF THE BIOPARK

The team developed the following recommendations for a layout of buildings and repurposing of existing structures to establish the Biopark design for Ribat Al Fath. Each element was chosen specifically to aid the education of the visitors on the recommended educational topics from section 1.1 and 1.2. Most design recommendations for the proposed Biopark came from the analysis of observational studies discussed in the Results chapter. The rest of the recommended elements are from the Biopark's business plan which Ribat Al Fath shared with the team and can be found in Appendix G. The elements recommended for the proposed Biopark are modular learning spaces, educational farming areas, a nature play area, commerce spaces, recreational spaces, and infrastructural needs. The recommended design for the proposed Biopark can be seen in **Figure 9**; it will be referenced throughout the following section.

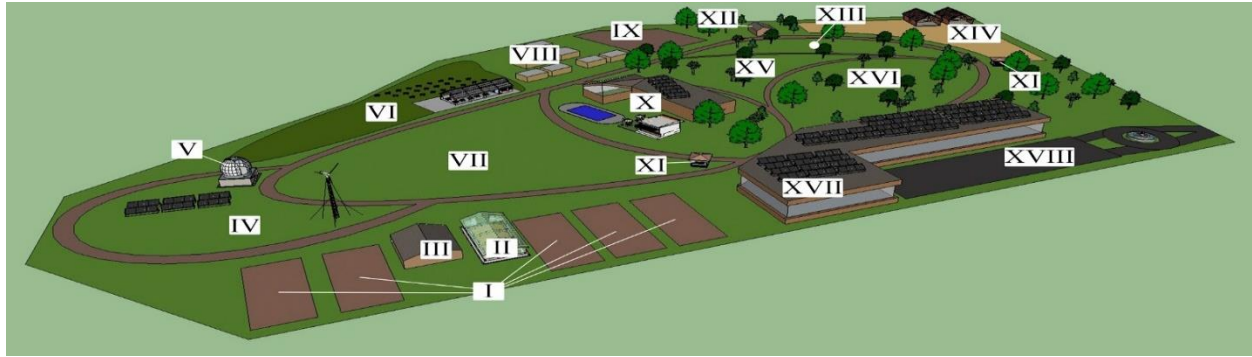


Figure 9: 3D Biopark Design with Area Labels

Table 1
Park Design Legend

I	Educational farming fields for farmers	X	Pool area, pump house, bathrooms, and café
II	Greenhouse	XI	Drop-in learning areas (x2)
III	Tool shed	XII	Olive and grain mill-house
IV	Renewable energy exhibit	XIII	Nature Play Area
V	Observatory	XIV	Animal pens
VI	Restaurant with a picnic area and picnic tables	XV	Exotic plants garden
VII	Grassy area for recreational activities	XVI	Local plants garden
VIII	Modular learning spaces	XVII	Visitor center with a welcome area, museum of water, museum of agriculture, cafe, bathrooms, and a shop for souvenirs, seeds, and plants from the gardens and farms
IX	Educational farming field and garden for children	XVIII	Parking lot and main entrance

MODULAR LEARNING SPACES

To educate visitors with effective educational strategies, **the team recommends that the Biopark implements modular learning spaces to teach all visitors about the different environment-related educational topics.** As discussed in the Results chapter, modular learning areas can be inside and outside areas around a park.

The team recommends repurposing the seven mobile housing structures currently on site into modular learning areas. The rooms should be designed in a minimalistic fashion to work well for activities similar to the following: lab activities, hands-on activities, and presentations. The location of the modular learning spaces can be found in **Figure 9**, at index VIII. The team recommends an interactive display board be included in the space to display information that cannot be visualized. The instructor can also use the display board to teach information to the class before hands-on activities. The current mobile buildings should be modified to allow sufficient natural light into the rooms. Natural light in the modular learning spaces will help connect the students with nature. The team also recommends that each modular learning space has storage cabinets to store the materials for all activities. This will allow the room to be changed on a by-use basis depending on the activity.

The team recommends there to be two outside drop-in areas for visitors to take a break from their visit to complete a hands-on activity. For the proposed Biopark, there should be one drop-in area outside the visitor center and one drop-in area by the gardens. These drop-in areas should be equipped for multiple different activities and programs. The locations of the drop-in areas can be found in **Figure 9**, at index XI. The focus of the drop-in areas for the proposed Biopark should be to give the visitor a quick hands-on activity that will result in the visitor taking something home. This will establish a connection between the visitor and the Biopark, while also giving them something to remember their visit.

EDUCATIONAL FARMING AREAS AND THE GREENHOUSE

To best support hands-on learning and the experiential learning model, **the team recommends an educational farming area for both farmers and children, as well as a greenhouse.** There will need to be areas where visitors can physically practice agricultural lessons taught at the Biopark. The educational topics previously outlined require farming areas where the topics can be demonstrated, explained, and replicated. The location in the proposed Biopark for the farmers' educational farm, children's educational farm, and greenhouse can be seen in **Figure 9** at index I, IX, and II respectfully. Having two separate fields for farmers and children will provide each target audience with their own uninterrupted and specialized experience to learn and will prevent children from accidentally damaging the farmers' crops. The team recommends building the greenhouse next to the farmers' educational farm so farmers can utilize the space to learn about preparing seeds and expediting the growth of crops.

The proposed farmers' educational farm should have several fields for farmers to practice sustainable techniques on different crops. Having designated fields for the farmers will benefit farmers in managing their own farms and facilitate valuable hands-on experiences tied to the educational topics for farmers.

The children's educational farm should also be a gardening area that is specialized to encompass all the educational topics for children. In the farm and garden, children will learn about climate change and how they can play a role in its prevention, as well as how to properly care for plants and the environment.

NATURE PLAY AREA

The proposed Biopark should include a *Nature Play Area* for children to interact with natural elements and connect with the environment. The *Nature Play Area* should be located near the children’s educational farm area to allow children to play and learn in the natural environment of the Biopark. The location can be seen in **Figure 9**, at index XIII. The educational program at the Chicago Botanic Garden involves activities for the children in the *Nature Play Area* throughout the day, sometimes with educational objectives and sometimes for free time. The team recommends the same type of use at the Biopark because of the benefits discussed in the Results chapter. Similar to the Chicago Botanic Garden, the *Nature Play Area* should be about a quarter hectare and include only natural materials like rolling hills, trees, logs, sticks, grassy areas, rocks and boulders, and a shallow flowing stream. All these elements are chosen and laid out with the purpose of encouraging the children to use their creativity and imagination. There should be no man-made features in this area as that takes away from the experience. It is also important for the location of the *Nature Play Area* to be easily monitored by adults for the safety of the children.

COMMERCE SPACES IN THE BIOPARK

The team recommends for the proposed Biopark to incorporate revenue generating areas of the Biopark as Ribat Al Fath wants to access to the park to be free. On the sloped side of the Biopark facing the Mohammed VI Bridge, there should a restaurant area with picnic tables and a grassy area that would also be able to facilitate a space for a farmers’ market on select days of the week. This area can be seen in **Figure 9**, at index VI and VII. The eating area will serve food that is harvested from the fields in the Biopark to promote the farming done at the Biopark.

As another eating option, the team recommends having a smaller cafe near the swimming pool to provide a relaxing area in the center of the Biopark for guests. This area can be seen in **Figure 9**, at index X. The cafe along with the restaurant area should be fashioned in an outdoor setting format to allow a more distinctive connection to nature. There should be a cafe near the pool that is separate from the main restaurant to give visitors the option to stay in the pool area if they are only at the Biopark to swim.

The team recommends that the visitor center at the park entrance should have a gift shop for purchasing educational materials, farming equipment, and souvenirs, as well as seeds and plants from the garden or farms in the Biopark. The visitor center can be seen in **Figure 9**, at index XVII. Including an area for visitors to purchase goods will help market the Biopark to the community and spread awareness of its existence. The proposed Biopark should serve as a place where farmers and children can find essential tools and equipment for agricultural practices that may not be readily available in the Rabat-Salé-Kénitra region.

RECREATIONAL SPACES IN THE BIOPARK

In order to make the proposed Biopark more attractive and enjoyable experience to the visitors, **the team recommends that several recreational spaces be included within the Biopark.** The purpose of these spaces is to attract visitors to the Biopark and make their stay more enjoyable.

The team recommends that the proposed Biopark contains a three quarters hectare garden near the center of the park to help make the area more visually pleasing, show the rich biodiversity within Morocco, and draw visitors to the park. The garden will be split into two areas for visitor to explore both

the local plants and exotic plants of Morocco. The area for the gardens can be seen in **Figure 9**, at index XV and XVI. These plants will be accompanied with signs throughout the gardens to help inform people on what each plant is and where in Morocco it originates from, as well as signs introducing the areas of exotic and local plants to visitors. Another feature that should be included in the garden are benches in peaceful areas to allow visitors to relax amongst the biodiversity of Morocco.

As per the request of Ribat Al Fath, the team recommends that the swimming pool is refurbished at its current location in the proposed Biopark. Safety infrastructure, such as fence, patios, and life-savers, will also need to be added to make the pool safe for all visitors. The location of the pool can be seen in **Figure 9**, at index X. The purpose of the pool is to be a recreational area to attract families and tourists during the warm months, and also give all visitors a place to relax.

As per the request of Ribat Al Fath, the team recommends the reimplementation of the observatory at its current location in the proposed Biopark. The observatory is currently nonfunctional and will need all new equipment. The location of the observatory can be seen in **Figure 9**, at index V. Having an observatory at the Biopark would be a major attraction for all types of visitors as it will bring back the only observatory in the Rabat-Salé-Kénitra region. In the proposed Biopark, it could be used as an educational and recreational area for all visitors for astronomy purposes.

INFRASTRUCTURAL NEEDS

The infrastructural elements of the Biopark are important to creating a pleasant experience for all visitors. The team defined infrastructural elements of a park to be features needed for the function of a park. **The team recommends the implementation of compacted soil pathways and informative signage throughout the park to enhance the visitors' experience.** Compacted soil pathways will provide visitors a natural experience away from the concrete of the city, while also allowing for a clear and specific path for the visitor to follow. Directional signs need to be placed along the pathways to instruct visitors on the location of major attractions and buildings. Informational signs that contain maps of the Biopark, information regarding specific exhibits, and educational information should be placed low to the ground, so visitors of all heights are able to read them. From the data analyzed in the Results chapter, the team recommends signs to contain large text in both French and Arabic.

5.3 DELIVERABLES

As part of the team's recommendations, the team developed an education strategy for the proposed Biopark. This includes a list of topics to be taught to the children and farmers, as well as teaching methods that should be used in the Biopark. See Appendix F for the educational strategy deliverables. The team also created a 3D model of the proposed Biopark, seen in **Figure 9** with an accompanying legend seen in Table 1, taking into account the requests presented in Ribat Al Fath's business plan that can be seen in Appendix G, the educational strategies, and different features analyzed during the team's observational studies.

The team developed a poster for Ribat Al Fath which includes the 3D model, the mission of the Biopark, the Biopark's target audiences, and the educational strategy proposed by the team. The poster can be found in Appendix F. The 3D model and poster can be used by Ribat Al Fath to present to potential sponsors to request funding for the construction of the Biopark.

6 CONCLUSION

The goal of this project was to identify an educational strategy to create a design for Ribat Al Fath's proposed biodiversity park in Rabat, Morocco. Through the team's gathering of data and succinct analysis, the goal was achieved, and the team's deliverables were completed. Difficulties in communication due to language barriers limited the team's understanding of information on rare occasions during interviews, however, this never obstructed the team's overall understanding of the interviews' content.

The recommendations and deliverables documented in this report will aid Ribat Al Fath in obtaining funding from sponsors and developing a more detailed educational strategy and design for the Biopark. The team's recommendations on educational topics for children will engage children in the environment and give them a start for further education on environmental topics. The recommendations for educational topics for farmers will educate farmers on important topics such as soil management, sustainable water usage, and farming commerce which will help them to adopt more sustainable farming techniques in the future. The design for the Biopark will help to give Ribat Al Fath an idea of what the team determined to be a feasible and comprehensive design for the Biopark based on the team's research and findings, as well as the educational strategies and topics that the team recommends for the Biopark.

This report will give Ribat Al Fath a solid foundation on which to base the rest of the development for the Biopark off of. Immediate continued work on this project should be in the research and analysis of a financial plan, including the required funding needed for the development of each element of the Biopark. This will help Ribat Al Fath understand the financial backing needed to develop the Biopark, which would aid them in receiving funding from sponsors. For the future success of this project, the team recommends more detailed educational curriculums, building designs, and park operational logistics to be created to allow for Ribat Al Fath to begin advertising the Biopark to farmers, schools, and families in the Rabat-Salé-Kénitra region.

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APPENDICES

APPENDIX A: GLOSSARY

Permaculture Farming: A method of designing a farm to mimic a natural ecosystem by allowing different plants and animals to live in unison with one another (Mburia, 2016) – Page 4

Kinesthetic Learning: A learning style in which students carry out physical activities rather than learning from books or lectures (Favre, L. R., 2009) – Page 5

APPENDIX B: DATA GATHERING PLANS

ORAL CONSENT FORM

Oral Consent Script

Biopark Team

Brent, Ilana, Hunter, Justin, Neema

We are the Biodiversity Park team from Worcester Polytechnic Institute (WPI) in Worcester, Massachusetts working towards the completion of our Interactive Qualifying Project. We are conducting a research study on different aspects to aid us in the process of implementing a biodiversity park in an area just outside of Rabat, Morocco. We are conducting this research to gather professional opinions, group opinions, and survey statistics on topics related to our project, with the goal of helping us create a better biodiversity park. We have chosen you for this survey/interview/focus group because we believe that you have valuable opinions related to the topics that we are researching, and/or you are part of the target audiences for the biodiversity park and we are interested in your feedback. Your participation in this survey/interview/focus group is voluntary. If you agree to participate we will ask you a set list of questions that will likely begin conversations about the topics of the questions. If you do not wish to disclose any information, you can do so, and you also have the option to stop the process at any time. There is minimal risk associated with this activity as we are not asking you to disclose any information you do not want to. Taking part in this activity is your agreement to participate and to disclose your name and other relevant information, but you also have the option of staying anonymous or confidential. If you give your consent to have your name disclosed, it will be mentioned in our project paper that will be published through WPI's digital library. If our team chooses to quote you in our paper, you will have the option to pre-approve the quoted material before publication.

If you have any questions regarding our research, feel free to contact our team at gr-bioparkRabat19@wpi.edu

If you have any questions regarding your rights as a research subject, please contact Worcester Polytechnic Institute's Institutional Review Board at irb@wpi.edu

Thank you

SEMI-STRUCTURED INTERVIEW QUESTIONS

ENVIRONMENTAL EDUCATORS

CHICAGO BOTANIC GARDEN - MR. DREW WEHRLE

Process order for interview:

1. Introduce the team
2. Read the consent form to the participant and wait for a verbal response.
 - a. Inform the participant that recording has begun
 - b. Remember to keep the responses separate from the participant's name
3. Explain the proposed Biopark and why we are interested in their knowledge.
 - a. "We are working with a local NGO called Ribat Al Fath to help them develop a new biodiversity park just outside of Rabat. Ribat Al Fath's mission is to give the citizens of Morocco the means to contribute towards their community to enrich their lives and improve their city. They also want citizens to play their part in sustainable development as Morocco continues to develop despite the effects of climate change. The Biopark is still in a very developmental phase and Ribat Al Fath is interested in us developing an educational plan and a design layout for the proposed Biopark. The educational plan would consist of what educational topics the Biopark would teach about, the best methods of teaching for the types of visitors, and what resources would be needed to teach about those topics. The design layout would come next and would be a preliminary design for the park with the main features and attractions planned out. We are interested in your expertise and opinions on environmental educational techniques, the activities you plan for school field trips, and what you have learned from working at the Chicago Botanic Garden. Whenever you are ready, we would like to start asking you our questions."
4. Begin the semi-structured interview questions, letting the participant know that they are encouraged to expand as much as possible on each question.

Interview Questions:

1. How long have you been working at the Chicago Botanic Garden?
2. Could you describe your role in more detail and how you believe you make a difference?
3. What is the mission of your educational program and how do you think you are successful in achieving that mission?
4. What teaching techniques have you learned from experience are best when educating children, teenagers, and adults?
5. What goes into planning the different curriculums for each field trip?
6. What are some of the challenges you face when educating the visitors?
7. What types of topics are best taught to children through exhibits compared to hands-on activities or classrooms (and vice-versa)?
8. What educational resources does the Chicago Botanica Garden offer that improves the learning experience for all visitors?
9. In what direction do you see the educational program expanding over the next few years?

10. What are some of the design features of the new Learning Center to aid in the education of visitors?
11. How successful has the Nature Play Garden been in educating children and students on botany and biodiversity subjects?
12. Do you have anything else you would like to share?

MR. ABDELLATIF KHATTABI

Process order for interview:

1. Introduce ourselves
2. Read the consent form to the participant and wait for a verbal response.
 - a. Inform the participant that recording has begun
 - b. Remember to keep the responses separate from the participant's name
3. Explain the proposed Biopark and why we are interested in their knowledge.
 - a. "We are working with a local NGO called Ribat Al Fath to help them develop a new biodiversity park just outside of Rabat. Ribat Al Fath's mission is to give the citizens of Morocco the means to contribute towards their community to enrich their lives and make their city shine. They also want citizens to play their part in sustainable development as Morocco continues to develop despite the effects of climate change. The Biopark is still in a very developmental phase and Ribat Al Fath is interested in us developing an educational plan and a design layout for the proposed Biopark. The educational plan would consist of what educational topics the Biopark would teach about, the best methods of teaching for the types of visitors, and what resources would be needed to teach about those topics. The design layout would come next and would be a preliminary design for the park with the main features and attractions planned out. We are interested in your expertise and opinions on environmental educational techniques, specifically to farmers through your training program. Whenever you are ready, we would like to start asking you our questions."
4. Begin the semi-structured interview questions, letting the participant know that they are encouraged to expand as much as possible on each question.

Interview Questions:

1. Could you give us a little background about yourself and the work you have been doing to support farmers?
2. How do you feel you make a difference in the farming community?
3. What kind of support do you offer farmers? And do you think a Biopark would be able to offer similar support?
4. What sustainable farming techniques do recommend for farmers to use?
5. What kind of education do you provide for farmers?
6. What are some challenges you face when trying to educate farmers?
7. What are the biggest challenges the farmers you work with have?
8. How do you think a Biopark could do to help local Moroccan farmers?
9. How has the decreasing supply of groundwater affected you and other farmers?
10. What topics do you think the biopark should focus on when educating farmers?
11. How could the Biopark help the farmers near it? Farmer's Market? Classes?

LOCAL FARMERS

MR. MUSTAFFA KAHTTA

Process order for interview:

1. Introduce ourselves
2. Read the consent form to the participant and wait for a verbal response.
 - a. Inform the participant that recording has begun
 - b. Remember to keep the responses separate from the participant's name
3. Explain the proposed Biopark and why we are interested in their knowledge.
 - a. "We are working with a local NGO called Ribat Al Fath to help them develop a new biodiversity park just outside of Rabat. Ribat Al Fath's mission is to give the citizens of Morocco the means to contribute towards their community to enrich their lives and make their city shine. They also want citizens to play their part in sustainable development as Morocco continues to develop despite the effects of climate change. The Biopark is still in a very developmental phase and Ribat Al Fath is interested in us developing an educational plan and a design layout for the proposed Biopark. The educational plan would consist of what educational topics the Biopark would teach about, the best methods of teaching for the types of visitors, and what resources would be needed to teach about those topics. The design layout would come next and would be a preliminary design for the park with the main features and attractions planned out. We are interested in your expertise and opinions on farming in Morocco, challenges you face, and any sustainable techniques you use because of the effects of climate change. Whenever you are ready, we would like to start asking you our questions."
4. Begin the semi-structured interview questions, letting the participant know that they are encouraged to expand as much as possible on each question.

Interview Questions:

1. How long have you been a farmer? Do you come from a family of farmers?
2. What kind of crops do you farm and in what quantity?
3. How and where do you sell your produce?
4. Any marketing practices that you use specifically?
5. How do you transport your crops to markets?
6. Do you sell to people in different areas or only one?
7. Do you use sustainable agricultural techniques?
8. Drip irrigation?
9. Permaculture farming?
10. Renewable energy to power daily operations?
11. Water collection and conservation practices
12. Waste management
13. What farming technologies do you use?
14. How do you work and interact with other farmers?
15. Do you have organic certification?
16. Have you seen the effects of climate change on your farm?

17. As a farmer, what are your main challenges?
18. What farming techniques do you wish you knew?
19. How would a Biopark help you as a farmer?

TAZOTA FERME PÉDAGOGIQUE - MS. SAMIRA EL AHRARI

Process order for interview:

1. Introduce ourselves
2. Read the consent form to the participant and wait for a verbal response.
 - a. Inform the participant that recording has begun
 - b. Remember to keep the responses separate from the participant's name
3. Explain the proposed Biopark and why we are interested in their knowledge.
 - a. "We are working with a local NGO called Ribat Al Fath to help them develop a new biodiversity park just outside of Rabat. Ribat Al Fath's mission is to give the citizens of Morocco the means to contribute towards their community to enrich their lives and make their city shine. They also want citizens to play their part in sustainable development as Morocco continues to develop despite the effects of climate change. The Biopark is still in a very developmental phase and Ribat Al Fath is interested in us developing an educational plan and a design layout for the proposed Biopark. The educational plan would consist of what educational topics the Biopark would teach about, the best methods of teaching for the types of visitors, and what resources would be needed to teach about those topics. The design layout would come next and would be a preliminary design for the park with the main features and attractions planned out. We are interested in your expertise and opinions on farming in Morocco, farming educational techniques, the activities you plan for school field trips, and what you have learned from working at the Tazota Ferme Pédagogique. Whenever you are ready, we would like to start asking you our questions."
4. Begin the semi-structured interview questions, letting the participant know that they are encouraged to expand as much as possible on each question.

Interview Questions:

1. What are the topics you teach?
2. Has climate change affected the topics/way you teach over time?
3. Was there a lack of education on these topics in schools?
4. What does a typical day at the educational farm look like?
5. Do you do any classroom learning or only hands-on?
6. What activities do you find children are most interested in?
7. How do you set up field trips with schools? How do you work with the teachers? (Challenges you face with communication and funding)
8. What steps do you take to improve the programs (Self-evaluations and collecting feedback)?
9. For the actual farm, what sustainable methods do you use? What crops? Organic farming?

MOROCCAN PROFESSIONALS

CROSSROADS OF AGROECOLOGICAL INITIATIVES AND PRACTICES - MR. BOUJEMAA GUEGHLAN

Process order for interview:

1. Introduce ourselves
2. Read the consent form to the participant and wait for a verbal response.
 - a. Inform the participant that recording has begun
 - b. Remember to keep the responses separate from the participant's name
3. Explain the proposed Biopark and why we are interested in their knowledge.
 - a. "We are working with a local NGO called Ribat Al Fath to help them develop a new biodiversity park just outside of Rabat. Ribat Al Fath's mission is to give the citizens of Morocco the means to contribute towards their community to enrich their lives and make their city shine. They also want citizens to play their part in sustainable development as Morocco continues to develop despite the effects of climate change. The Biopark is still in a very developmental phase and Ribat Al Fath is interested in us developing an educational plan and a design layout for the proposed Biopark. The educational plan would consist of what educational topics the Biopark would teach about, the best methods of teaching for the types of visitors, and what resources would be needed to teach about those topics. The design layout would come next and would be a preliminary design for the park with the main features and attractions planned out. We are interested in your expertise and opinions on environmental educational techniques, specifically to farmers through your training program. Whenever you are ready, we would like to start asking you our questions."
4. Begin the semi-structured interview questions, letting the participant know that they are encouraged to expand as much as possible on each question.

Interview Questions:

1. How long have you been associated with CIPA?
2. What type of support does CIPA offer for farmers?
3. Could you describe your role in more detail and how you believe you and CIPA make a difference?
4. What is the mission of your educational program and how do you think you are successful in achieving that mission?
5. In what direction do you see the educational program expanding over the next few years?
6. In what ways is CIPA promoting sustainable farming techniques?
7. How has the decreasing supply of groundwater affected you and farmers around Marrakech?
8. What teaching techniques have you learned from experience are best when teaching farmers?
9. What are some challenges you face when trying to educate farmers?
10. What are the main challenges farmers are having when they come to CIPA for help?
11. What types of resources does CIPA provide to farmers that improve their learning experience?
12. How do you think a Biopark could do to help local Moroccan farmers?
13. What topics would you recommend for the Biopark to teach to farmers?

MR. AKKA CHIBANE OULAHBOUB

Process order for interview:

1. Introduce ourselves
2. Read the consent form to the participant and wait for a verbal response.
 - a. Inform the participant that recording has begun
 - b. Remember to keep the responses separate from the participant's name
3. Explain the proposed Biopark and why we are interested in their knowledge.
 - a. "We are working with a local NGO called Ribat Al Fath to help them develop a new biodiversity park just outside of Rabat. Ribat Al Fath's mission is to give the citizens of Morocco the means to contribute towards their community to enrich their lives and make their city shine. They also want citizens to play their part in sustainable development as Morocco continues to develop despite the effects of climate change. The Biopark is still in a very developmental phase and Ribat Al Fath is interested in us developing an educational plan and a design layout for the proposed Biopark. The educational plan would consist of what educational topics the Biopark would teach about, the best methods of teaching for the types of visitors, and what resources would be needed to teach about those topics. The design layout would come next and would be a preliminary design for the park with the main features and attractions planned out. We are interested in your expertise and opinions on environmental educational techniques, the activities you plan for school field trips, and what you have learned from working at the Chicago Botanic Garden. Whenever you are ready, we would like to start asking you our questions."
4. Begin the semi-structured interview questions, letting the participant know that they are encouraged to expand as much as possible on each question.

Interview Questions:

1. How long did you work in the Ministry of Agriculture?
2. What were the most important environmental topics the Ministry focused on supporting and teaching?
3. How do you think Morocco has changed in terms of caring for the environment?
4. What are the main challenges when attempting to combat climate change in Morocco?
5. What do you think people should know more about when it comes to the environment?
6. How do NGO's and the government work together to solve social issues?
7. What are the biggest challenges farmers face today?
8. How has the Green Moroccan Plan made a positive impact in supporting climate change?
9. The GMP offers subsidization of drip irrigation for farmers, do small farms (<5ha) take advantage of it, or is it too difficult for them to receive the subsidization?
10. What should the Biopark focus on when educating students on environmental issues?
11. What should the Biopark focus on when educating farmers on sustainable farming practices?

PRIVATE SCHOOL TEACHERS - L'ÉCOLE EL HANANE SCHOOL

Process order for interview:

1. Introduce ourselves
2. Read the consent form to the participant and wait for a verbal response.
 - a. Inform the participant that recording has begun
 - b. Remember to keep the responses separate from the participant's name
3. Give an explanation of the proposed Biopark and why we are interested in their knowledge.
 - a. "We are working with a local NGO called Ribat Al Fath to help them develop a new biodiversity park just outside of Rabat. Ribat Al Fath's mission is to give the citizens of Morocco the means to contribute towards their community to enrich their lives and make their city shine. They also want citizens to play their part in sustainable development as Morocco continues to develop despite the effects of climate change. The Biopark is still in a very developmental phase and Ribat Al Fath is interested in us developing an educational plan and a design layout for the proposed Biopark. The educational plan would consist of what educational topics the Biopark would teach about, the best methods of teaching for the types of visitors, and what resources would be needed to teach about those topics. The design layout would come next and would be a preliminary design for the park with the main features and attractions planned out. We are interested in your expertise and opinions on environmental educational techniques in the private schools in Morocco, the activities you plan for these topics, and what kind of learning styles work best for these topics. Whenever you are ready, we would like to start asking you our questions."
4. Begin the semi-structured interview questions, letting the participant know that they are encouraged to expand as much as possible on each question.

Interview Questions:

1. How long have you been teaching for?
2. What is your main subject of teaching?
3. Within that subject, what are the main topics you teach your students?
4. What types of hands-on teaching methods do you use in your classroom?
5. Do you think they are successful?
6. How can you measure this? (assessments, exams)
7. Are hands-on methods more or less successful than traditional teaching methods?
8. Do you teach any topics related to climate change (biodiversity, water scarcity, global warming, etc.)?
9. Are your students interested in/enjoy learning about these topics?
10. What would attract you, your students, and your school to a Biopark in the area?
11. What would you like for your students to do and learn during field trips to a Biopark?
12. What kind of methods of teaching do you think would work best during a field trip for the students to learn while also having fun?

OBSERVATIONAL STUDY GUIDES

RABAT ZOO

Goals of This Observational Study:

- Find if there is someone we can interview from the educational workshop center
- Understand what Moroccan visitors expect when attending a zoo in terms of attractions, exhibits, and overall experience. (Differences/Similarities from the USA)
- Learn what the main topics that are taught to visitors at the zoo
- Learn what the normal visitor experience is at the park.
- Observe how the educational areas of the zoo are designed and laid out.
- Learn how the park is laid out and different design features they use around the park to enhance the visitors' experience.
- Learn how the park captivates the interest of all ages of visitors.

Things We are Looking Out For:

- How the average visitor spends their time at the park (guided tour, walk and take pictures, are they reading everything, Interactive activities)
- Location of main park attractions (Near the entrance, middle, or back of the park)
- Design of restaurant section
- How is the educational area laid out and what activities or classes are available?

Things To Take Pictures Of:

- Design of entrance to the park
- Park map
- Design of park's main attraction (how it is presented)
- Signage for exhibits
- Infrastructure (non-features of the zoo, ex: water/electrical sources)
- The layout of different park sections

Education:

- Learn more about the educational workshops offered by the Rabat Zoo?
- What teaching methods are used in the educational workshops?

- How the children engaged with the physical attractions in the zoo?
- What physical designs work for the educational farm?
- What topics are taught in the workshops?
- How are the wildlife conservation programs educated throughout the park?

Signage:

- What type of person are the signs throughout the park geared towards adults, children, or both?
- How many signs are present for every exhibit? Is it dependent on size?
- What language is the information displayed in?
- Are there visuals on the signs as well?

TAZOTA FERME PÉDAGOGIQUE

Goals of This Observational Study

- Examine the design of a farm that focuses on educating visitors
- Observe how students go about learning at the farm
- Understand how the farm's educational programs are structured

Things We are Looking Out For:

- How an average student at the farm goes about the day learning through the workshops?
- How the classes at the farm are structured?
- How is the mill used to educate students?
- How does the farm utilize the pool?
- Are there areas for large groups to congregate?

Things To Take Pictures Of:

- Entrance to the Farm
- Parking lot
- Bathrooms
- Signage
- Infrastructure (non-features, ex: water/electrical sources)
- Animal Pens
- Pool Area
- Seating Areas
- Education Areas

Signage:

- What type of person are the signs throughout the park geared towards adults, children, or both?
- Are there signs indicating what animals or pens someone would be looking at?
- What type of visuals are on informational signs?
- What languages were the signs in?

JARDIN MAJORELLE

Goals of This Observational Study:

- Observe different educational features of the garden
- Observe the signage they have and how it is being used to enhance the visitor experience
- Learn how the park is captivating the interest of all ages of visitors
- Observe the layout of the park and decide on the effectiveness of the design

Things We are Looking Out For:

- Observe how the average visitor spends their time at the park (guided tour, walk and take pictures, are they reading everything, interactive activities)
- Location of main park attractions (Near the entrance, middle, or back of the park)
- Design of restaurant area
- See how the educational area is laid out and what activities or classes are available
- How are the exhibits laid out and set up to interest all ages of visitors?
- See if there are any areas for large groups to congregate

Things To Take Pictures Of:

- Design of entrance to the park
- Park map
- Design of park's main attraction (how it is presented)
- Signage
- Infrastructure (non-features, ex: water/electrical sources)
- The layout of different park sections

Signage:

- What type of person are the signs throughout the park geared towards adults, children, or both?
- How many signs are present for every exhibit? Is it dependent on size?
- What type of visuals are on informational signs?

JARDIN D'ESSAIS BOTANIQUE RABAT

Goals of This Observational Study:

- Learn how the garden is laid out and how the pathways are used to direct visitors around the park.
- Learn how signs are used around the garden and why they are used in certain areas.
- Observe the educational material and buildings that are present and how they enhance the visitors' experience.

Things We are Looking Out For:

- How the average visitor spends their time at the park (guided tour, walk and take pictures, are they reading everything, interactive activities)
- Location of main park attractions (Near the entrance, middle, or back of the park)
- Is there an eating section at the garden?
- What educational material is available (signs, pamphlets, posters)
- Are there areas for visitors to sit or rest? (benches, chairs etc)
- Any unique features to the garden that catches the attention of our group.
- Is there staff on duty, if so, what are they doing to help the visitor experience?

Things To Take Pictures Of:

- Design of entrance to the park
- Park map
- Design of park's main attraction (how it is presented)
- Signage
- Infrastructure (non-features, ex: water/electrical sources)
- The layout of different park sections
- Anything that catches our eye
- How plants are organized (region, aesthetics)

Signage:

- What type of person are the signs throughout the park geared towards adults, children, or both?
- How many signs are present for every exhibit? Is it dependent on size?
- What type of visuals are on informational signs?

CONSULTATION GUIDE WITH PARK DESIGN EXPERTS - CHICAGO BOTANICA GARDEN - MS. EILEEN PRENDERGAST

The objective of this study:

- Understand what considerations go into designing educational spaces
- See how spaces are designed to foster collaboration among the students
- How does nature play into design considerations at the CBG?

Reading Guide Questions:

- What lessons are intentionally taught indoors versus outdoors?
- How are the educational goals of the organizations incorporated in the designs of the buildings?
- How important is thinking about supporting hands-on learning during the design process?
- How does the average visitor feel connected with nature while inside a building?
- What were challenges in designing Nature Learning Centers?
- How are classrooms structured?
- Are there areas that support receiving large groups?
- How did the designers decide on what main features of the buildings that would be implemented in the final designs?
- Is the layout of the buildings designed in any way that the visitors feel a natural flow walking through the centers?

APPENDIX C: TRANSCRIPTIONS FROM INTERVIEWS AND CONSULTATION

ENVIRONMENTAL EDUCATORS

CHICAGO BOTANIC GARDEN - MR. DREW WEHRLE

Interviewee: Mr. Drew Wehrle

Interviewers: Brent Rolfes, Ilana Zeldin

Scribes: Justin Amevor, Neema Saberi, Hunter Kortz

Date of Interview: Thursday, January 24th, 2019

Transcribed by: Justin Amevor

What is the mission of your educational program

The Chicago Botanic Garden's mission statement is "We cultivate the power of plants to sustain and enrich life." Their educational programming is diverse but fits within this main mission. The mission reaches from the preschool programs through their K-12 field trips. As well as yoga and urban agriculture programs for seniors. Our school programs are designed to inspire a love of plants and spark a curiosity about plant-based science that fit into the school curriculum. Their Nature Play programming fosters a love of the environment. Most of the educational programs are designed behind the Next Generation Science Standards. This is a great resource on progressive learning for environmental education which is based on performance standards. Also, the National Science Teachers Association disciplinary core ideas crosscutting concepts, and science and engineering practice. These programs are very nice because they integrate play into children's educational objectives. When Drew plans classes he builds off these standards and uses it as a structural interdisciplinary point.

What are different ways to prove the success of your programs?

This is done through post-program teacher evaluations. Internal evaluation reports during programs to measure student and teacher effectiveness. Internal reports of annual growth in terms of a number of students served and returning school groups suggest we program offering is successful (we do the same reporting and evaluation for our free drop-in programs and our Early Childhood programs). A volunteer maps out every hour of the class to understand what learning looks like, where is attention being drawn, how is conversation flowing, where does the teacher stand. Diversity and demographic reporting for visitation goals set standards to reach for park goals.

What techniques have you learned from experience are best when educating children and teenagers?

Embrace that the field trip is not in the standard classroom. Provide experiences that could not be done back at school. Use a different format for the class. Avoid lectures and bring lots of hands-on materials into the class. Ground the question that refers to plant-science as a local or worldwide problem. Bring in experts and make connections to career pathways. Make the program and content interesting for

all ages by providing room for creativity like a maker space. Our best programs are outdoors and they engage the whole body in learning, regardless of age. His policy is to not do activities that can be done in a classroom. Engage the whole body with learning. Connecting lessons into a frame of relevance. A good resource is The Frame of Relevance literature review. It helps people understand how to make people excited about various topics. Also, remember there is more than just learning objectives in having a good trip. Think about anything that could be a space limiter. Design a space with limiters in mind. Practice with the teaching staff and implementing changes over various iterations based on feedback. Always think of worst possible scenarios, if it rains, if students have disabilities.

What goes into planning the different curriculums for each field trip?

Drafting new ideas based on NGSS standards, writing copy to get them into our print and website editors, writing curriculum around our time format and seasonal materials, organizing and storing program materials, teaching program with education staff, implementing changes based on iterative process, training volunteer docents to lead programs, working with call center and registration office to setup database program registration, advertising with teachers and school group, sharing school reports with garden staff and security, handling buses at drop-off and organizing lunches into the lunchrooms, setting up and cleaning rooms for afternoon adult classes. All of these and more factors go into designing the curriculum.

Volunteers have been instrumental to the success of programs. Make content interesting for a wide group of ages. Think about your own favorite museum experiences. Use a lot more DIY tactics. Many people also want to be outside so aim to focus on lessons in nature.

What educational resources does the Chicago Botanic Garden offer that the learning experience for all visitors?

The Botanic Garden App. You can download it “GardenGuide”. We also offer experiential bingo sheets (5x5 grid of activities for early childhood) to instill a love of nature through suggestive exploration activities. They also offer free, drop-in, nature play activities. Nature play is a huge focus of our early childhood programs. Our Nature Preschool is outside for all or at least a portion every day. All of their yearly curricula is, and in particular, nature play focused.

Especially for children, there is a focus on nature play. There is also no artificial elements to enhance nature play.

What are some of the design features of the new Learning Center to aid in the education of visitors?

We’ve designed the Regenstein Learning Campus to be an ideal Nature Playspace. There are no forts or slides or plastic play materials on the campus. Instead, there are rolling hills, some gentle and some steep. There is an area, The Runnel, which circulates small 2-inch deep water in a walkable stream. We make rafts and floats from natural objects and send them to float down the runnel. We have logs and rocks for climbing and playing, nothing prescribed and all local natural features. We also have a tunnel of willows to get lost in a maze of branches and leaves. Nature play is supported and valued based on research. I’ve attached a great research summary from PEER that outline the benefits of Nature Play.

How are the modular classrooms laid out?

There are six tables and six chairs. There are very big main windows to allow for a lot of natural light. There are cabinets and an interactive board. The set up is intentionally minimal to tailor to the audience and focus of the objective.

Are the walk-in areas situated at the park?

Areas are in various high and low traffic areas. Some are focused on walking home with a plant. The areas are also focused on the learning goals of that specific area.

For hands-on experiences and other learning methods, what other things are done besides direct instruction?

They focus on teaching lessons around the 5-acre campus. They do various activities around water sources like water quality and lake ecosystems. High schoolers do more around main islands and greenhouses. Classes are very specific to the age group. All the guided workshops are paired with free exploration time. But they have learning goals that they need to check off which could be interdisciplinary.

What is an experience for the average visitor?

Many of the goals are based on seasons. Many people like to overall beauty of the site. A Lot of education is seen through landscape design. Science research, plants, and climate change are common themes seen. Each garden bed represents a plant family that fosters an appreciation of diversity. There are many cultural experiences that foster an appreciation for different plant uses. Overall most programs are focused on foster a love for nature in each way.

How do you go about choosing educational topics to teach?

Seasonal availability and a lot of planning at beginning of the season. Classes are streamlined based on seasonal topics. School evaluations and surveys are great ways to determine topics. hydroponic programming is very low effort and teachers love to work with it.

MR. ABDELLATIF KHATTABI

Interviewee: Mr. Abdellatif Khattabi

Interviewers: Brent Rolfes

Scribes: Justin Amevor, Hunter Kortz, Neema Saberi, Ilana Zeldin

Date of Interview: Friday, January 25th, 2019

Transcribed by: Neema Saberi

Could you explain a little about yourself, your background, and the work you have been doing?

Mr. Khattabi is a professor for at an engineering school in Rabat where he teaches economics, natural resources, rural development, environmental impacts, adaptation to climate change, and sustainable management of natural resources in areas like wetlands and coastal zones.

Have you always been an educator on environmental topics?

Yes, in continued education not always formal where he helps train other educators. Mostly targeting teachers of school children.

Do to decreasing groundwater levels, do you feel the way you teach water resource management has changed over time?

Water levels are a major issue in Morocco. The large demand is being driven up by increasing population, developmental needs, and pollution. The dry arid climate has been causing more droughts which are expected to become more frequent. In many regions, there is critical overharvesting of groundwater which is becoming more important.

What are the factors contributing to the overuse of groundwater?

There are many conflicts of use of groundwater for agriculture and other sectors and uses like tourism, urban development, swimming pools golfing. Investors like to build tourist resorts near coastal areas using water resources. Water is used for cooling and thermal energy which makes many competing sectors for water which makes a conflict of interest in coastal areas.

Have you been working with the educators of the farmers about best practices for their farms?

There are no best practices for farming but there are various programs run by the Ministry of Agriculture that encourage farmers to use better practices like drip irrigation where they can also get subsidized for implementing techniques if they have a farm under 5 hectares. Many gallons of water gets wasted in channels which is why they advocate for drip irrigation. Mr. Khattabi was unaware if there were any educational programs offered by the ministry.

What other big issues are present for farmers and agriculture sector?

There is a lot of research done on agriculture in Morocco. There is a lack of knowledge of proper use of technology, such as fertilizers, and pesticides. There should be more training on how to uses these resources and where to obtain them. Climate change and overharvesting are

For soil, techniques are the main issue of farmers not being aware of new techniques or not being able to do them?

There are two main issues. Lack of education and poverty. 90% of agriculture in Morocco is traditional in rural areas where education levels are low. Most people who are in poverty lack education causing a major issue in rural areas.

Should regulations be improved to help support environmental concerns?

There are already regulations on these issues but many people do not care much about them and many people are not aware of them so there needs to be a push for educating people more on these concerns.

Do you have any knowledge children should be educated on in school to help preserve the environment?

Mr. Khattabi was involved in developing a curriculum on environmental topics. Core focuses of the curriculum were water, biodiversity(marine and coastal), climate change, air pollution, plastics, desertification/land degradation, forests, soil.

How was the curriculum structured with teaching?

Mr. Khattabi worked more on the content of the program. His colleagues were the principal designers of the teaching style.

What were the best teaching methods that helped convey these environmental issues across to your students?

There is no best way to educate people on these topics. It depends on the audience you are educating.

What are the biggest challenges you have faced in educating people?

Making people aware of the environment by creating incentives. Educating people based on what could interest them.

What are the themes of the cooperative of farmers?

Composting, apiculture(beekeeping), harvesting apples, and nuts. One of the cooperatives provides 30-40% of nuts to the region.

Are the cooperatives focus on helping farmers with economics or more th share resources?

Most of the cooperatives focus on helping women develop income opportunities. There are 94 women and they hope to also utilize natural resources.

How many farmers are illiterate vs literate?

Most people in rural areas are farmers where most are illiterate. The rates vary by gender. More men are illiterate than women and the various regions but roughly around 50-60%.

LOCAL FARMERS

MR. MUSTAFFA KAHTTA

Interviewee: Mr. Mustaffa Kahtta

Interviewers: Neema Saberi, Brent Rolfes, Ilana Zeldin

Scribes: Justin Amevor, Hunter Kortz, Neema Saberi

Translated by: Professor Tahar El-Korchi

Date of Interview: Monday, January 28th, 2019

Transcribed by: Hunter Kortz

How do you go about selling crops in this area?

When the vegetables are ready, there is a market in Skhirat, Temara and Rabat. He chooses to go to the one in Temara, I rent a truck and take my produce to the market in that. This is a wholesale market.

Do you use any organic fertilizers?

He uses the manure from the livestock (sheep & cows). He does not use any alternative fertilizers for his crops.

What did you learn at the farming school you attended? What was different from what your dad did as a traditional farmer?

He learned a lot of things related to chemicals, fertilizers, and nutrients in the soil. Things like starting plants in the greenhouse to extend the growing season. Drip irrigation techniques and other new technology. He can recognize different diseases by looking at the leaves of the plants or how they are wilting.

Is there anything else he wishes he knew or was taught in school?

The big problem is that when he has a good crop year, everyone has a good crop year. So, the market gets flooded, the biggest challenge is how to diversify from other farms.

Did the school use hands-on methods to teach farmers or was it mostly just lectures/classes?

Yes, they had training and fieldwork, he is not sure how it works now but they did do hands-on work. A combination of training and field work was good, but they wanted to know more about new technologies.

Do farmers go and get outside training?

No, but the ministry of agriculture has centers around Morocco that you can call, and they will send someone to help you. Whether it is identifying a disease or helping set up new technology, they will assist you. It's also free of charge.

Have you seen any negative changes in the environment or your farm from climate change?

Yes, more extreme things like the summers are hotter and the winters are colder. The crop yield is less than it has been in the past. The salinity level in the well has increased over the years as well. There is a lab in Skhirat where farmers can get their water and soil tested for a small cost as well.

What do you think your main challenges as a farmer will be in the future?

Farming is becoming more expensive as time goes on, the cost of labor and equipment is going up, so it makes it harder to sustain. The model for farming is changing, you have to pay for everything.

TAZOTA FERME PÉDAGOGIQUE - MS. SAMIRA EL AHRARI

Interviewee: Ms. Samira el Ahrari

Interviewers: Justin Amevor, Hunter Kortz, Ilana Zeldin

Scribes: Justin Amevor, Hunter Kortz, Ilana Zeldin

Translated by: Mohammed Salhi

Date of Interview: Tuesday, January 29th, 2019

Transcribed by: Neema Saberi

What are the topics you teach?

The Tazota Ferme Pédagogique teaches a multitude of themes, they teach about life in the rural area, animals, and farming/gardening. The Tazota Ferme Pédagogique has its own curriculum and programs separate from the schools. They also teach basic life skills, such as being safe, cleaning, and sharing. They also show the whole cycle of crops to cooking. For older students, they give more data such as biological information about the animals. In general, they give make it more interesting and complex for the older students compared to the older ones.

Has climate change affected the topics/way you teach over time?

They have felt the effects of changing the climate on a year to year basis when it comes to crops. They have not changed any of their programs because they follow the demands of schools. However, they do have programs about climate change such as a recycling workshop and a sustainability workshop.

Was there a lack of education on these topics in schools?

The Ministry (of education) does not have a clear program in place regarding climate change and sustainability education in schools. Because of this, there is a lack of education in schools and the Tazota Ferme Pédagogique tries to fill the gaps. Samira believes the government should add this to their education plan. In private schools, climate change is not the main subject and usually an extra class or extracurricular activity. The schools that care about this type of education, come four times a year to fulfill this gap in their education.

What does a typical day at the educational farm look like?

The students come to the park, start with breakfast, then break into groups and work in a cycle to go to the workshops that their school has selected. Lunch is served mid-day.

Do you do any classroom learning or only hands-on?

The learning is all hands-on, they mostly do workshops that are selected by the school. They have multiple workshops available.

What activities do you find children are most interested in?

The children are most interested in activities with animals, they enjoy feeding the chickens and getting their eggs. This is only in the spring.

How do you set up field trips with schools? How do you work with the teachers? (Challenges you face: communication, funding)

Most of the communication is through word of mouth. They also have a website describing the farm and its attributes, with contact information. Also, Aljazeera (an Arab TV network) did an interview on the Tazota Ferme Pédagogique and it became famous and got a lot of attention. The schools reserve programs and workshops. However, during the summer the schools have their own programs that they bring to the farm. During the summer it works mostly as a rental space.

What steps do you take to improve the programs (evaluations for yourself, collecting feedback)?

Samira herself observes the workshops as they are going on and evaluates their effectiveness and notes down any issues that go on. She has meetings with the teachers and gives them her observational notes to give them her feedback.

For the actual farm, what sustainable methods do you use? What crops? Organic farming?

They use crop rotation to preserve some of the soil nutrients. They move the fields and plants. They use drip-irrigation as well throughout the farm. They solely use organic farming, it is a Bio-farm. The animals and crops are certified organics by the ministry.

MOROCCAN PROFESSIONALS

CROSSROADS OF AGROECOLOGICAL INITIATIVES AND PRACTICES - MR. BOUJEMAA GUEGHLAN

Interviewee: Mr. Boujemaa Gueghlan

Interviewers: Ilana Zeldin, Neema Saberi

Scribes: Justin Amevor, Hunter Kortz, Brent Rolfes

Translated by: Ahmed Zoukit

Date of Interview: Friday, January 25th, 2019

Transcribed by: Neema Saberi

What is your name and what do you do?

He is responsible for an Organic farm in Marrakesh (Urban Farm) and works for an association (CIPA) that works with farmers in Morocco. This organization teaches farmers about all aspects of agriculture as well as children in school. This organization promotes sustainability. The organization also goes to farms in Morocco to directly teach farmers directly.

What is the layout of the CIPA training farm?

The farm is on 2 hectares of land. There are buildings that work as training centers for teaching farmers.

What is the main goal of training farm?

The main goal of the training farm is to share the education of how the agriculture system and the ecological system work in Morocco.

When you visit farms in Morocco what do you teach to the farmers?

They teach the design of the farm because it is the most important aspect of the farm. They teach the soil conservation and fertilization techniques needed for a farm in Morocco. They teach how to conserve water and how to make seeds. It is mostly based on conservation and sustainability of the farm.

Water scarcity in Morocco is a big topic, what do you teach farmers about water conservation?

At the training farm, they teach about how to manage water within a farm. This includes recuperation of rainwater in a basin that is then used for the farm. However, because of the many different climates in Morocco, they teach many different methods based on region. They try to teach farmers based on their local region and resources.

What are the challenges with teaching farmers in Morocco?

There are different types of farmers, some are educated, and some are not educated and illiterate. They try to make training programs as simple as possible to accommodate to all. There are also motivated farmers and unmotivated farmers in terms of willingness to learn. The motivated farmers come to CIPA for the

information. These farmers pay to reserve training for their farms either at their own farm or at the training center. Even though some people do not have money for training, most people who do not pay are not motivated. For the people who are not motivated, they try to make a direct relation to their farms so they become more motivated to learn. For example, they make the training based on the specific crops they may produce.

How does CIPA explain to farmers that by using their teaching they will have an economic gain because this ends up being the most important?

First, they show that using the methods taught the crops will be more healthy and prolific. The Moroccan people are starting to move towards organic products because currently the demand is very high, and the production is low, so CIPA advises the farmers to farm organically to make more money.

Is it difficult for farmers to receive Organic Certification in Morocco?

Currently, there are two organizations that give out organic certifications. The barriers to receive certification is that it is expensive for most farmers and the requirements are difficult for uneducated farmers. For illiterate farmers, they are not able to complete the registration or the daily journals, which are requirements for certification. The government allows for farmers to group together so they are able to complete the requirements for a certification together.

What are the challenges that farmers face because of climate change?

The behavior of farmers have changed, a lot of farmers have stopped farming and many lands are barren. This is because the children of farmers see that there is not a lot of money in farming, so they go to the city and make money and send it back to their farmer parents. This allows the farmers to not have to work very hard because they do not need to generate income.

For the training center, how are the farmers educated, through a classroom or through activities?

It is a combination of both. For the uneducated people, Boujema has found that one of the main problems is language. Some of them speak Arabic and some speak Berber. In the classroom setting, they found that using a projector with pictures is a good way to teach uneducated people. The education system is based more on practical learning, which is the most important.

How do you think the Biopark help farmers?

It will be important to teach the children of the farmers, so they can continue their studies and won't have to go to the city to find work/education. The Biopark can show that farming is economically profitable.

How do you think a training center at the Biopark should work?

The Biopark should focus on the basic techniques, such as conservation of soil, water conservation, and fertilization (all organic).

MR. AKKA CHIBANE OULAHBOUB

Interviewee: Mr. Akka Chibane Oulahboub

Interviewers: Justin Amevor, Hunter Kortz

Scribes: Ilana Zeldin, Brent Rolfes, Neema Saberi

Date of Interview: Tuesday, January 29th, 2019

Transcribed by: Nemma Saberi

What is your name and what is your experience with the Ministry of Agriculture?

The ministry of agriculture has three aspects, a school to teach people about farming, research centers to develop new plans and methods for farming, and the development of farming in Morocco through extension services. He was a developer agent (extension services). There were multiple different sectors, his first job was in the livestock sector where he introduced the idea of compound foods (vitamins/minerals/grains combinations for animal feed). Next was with Nomad farmers. Then he was the head of the extension program for the Ministry. Improved women autonomy in farming, established coops, and programs, introduced women to packaging and production processes.

What were the challenges in pushing these programs to farmers?

The farmers speak many local languages, up to 30 different regional languages in Morocco. To combat this, the ministry would hire extension agents (men and women) from the region who could speak all of the languages (French, Arabic, and local language). The Ministry uses the farm field school technique. This consists of taking the farmers to a farm and practicing and training in the field. All of the basics for all of the different crops. However, the ministry only gets to 10-15% of Moroccan farmers.

Is the teaching specified for each region?

The teaching is specified for each region, the lessons are determined by the climate, area, and local farming culture.

Would a farmer's market at the Biopark be a good idea, so local farmers can sell their goods straight to consumers?

It would be a good idea because currently, Moroccan farmers lose a lot of money from middlemen. However, this would be difficult to organize because it is difficult for the Biopark to guarantee the quality of the produce. There is little traceability with the produce from the small farmers. It would have to be a limited number of farmers allowed to sell in the Biopark because of this. Local eggs would be easy to sell as well as live chickens, other meat requires more stringent regulations. Moroccan people like buying organic foods versus food from industry. City dwellers would make the trip to the Biopark to buy these organic foods.

How can the Biopark help with farmers looking to get government subsidies?

The Biopark should direct farmers to Ministry centers because the Ministry has many local centers with technicians able to help farmers with the registrations.

How does the ministry plan to increase organic farming in Morocco?

This is being done through contra-programs that teach farmers in organic farming and best practices of organic farming.

PRIVATE SCHOOL TEACHERS - L'ÉCOLE EL HANANE SCHOOL

Interviewee: Private School Teachers from L'ecole El Hanane School

Interviewers: Ilana Zeldin

Scribes: Justin Amevor, Hunter Kortz, Neema Saberi, Brent Rolfes

Translated by: Professor Fabienne Miller

Date of Interview: Tuesday, January 29th, 2019

Transcribed by: Hunter Kortz, Neema Saberi

How long have you been teaching for?

The teachers have both been teaching at the school for more than five years.

What are the main topics you teach your students regarding the environment?

The teachers teach mostly about how to help the environment by recycling and turning off the sink when you brush your teeth, as well as other similar things.

What types of hands-on teaching methods do you use in your classroom?

In the classroom, the teachers do activities with the students, but it is not as meaningful as when they go on field trips and the children are doing things like planting seeds or feeding the animals.

Do you think they are successful? How can you measure this? (assessments, exams)

They measure it by the student's interests in the topics and how they are participating in class.

Are hands-on methods more or less successful than traditional teaching methods?

They tend to be more successful because students enjoy working with things rather than sitting and listening.

Are your students interested in/enjoy learning about these topics?

Yes, their students enjoy learning about the environment and the outdoors.

What would attract you, your students, and your school to a Biopark in the area?

They said that the ability to have the students to hands-on learning where they plant small plants and learn about them is great for the students.

What would you like for your students to do and learn during field trips to a Biopark?

Different things about how plants grow over time, how bread is made, why recycling is important and how different things affect the environment.

What kind of methods of teaching do you think would work best during a field trip for the students to learn while also having fun?

The teachers think that the students will learn best when they are engaged in activities for most of the day, then going through each of the topics with the children after to solidify what they learned while doing the activities.

OBSERVATIONAL STUDIES

RABAT ZOO

Goals of This Observational Study:

- Find if there is someone we can interview from the educational workshop center
- Understand what Moroccan visitors expect when attending a zoo in terms of attractions, exhibits, and overall experience. (Differences/Similarities from the USA)
- Learn what the main topics that are taught to visitors at the zoo
- Learn what the normal visitor experience is at the park.
- Observe how the educational areas of the zoo are designed and laid out.
- Learn how the park is laid out and different design features they use around the park to enhance the visitors' experience.
- Learn how the park captivates the interest of all ages of visitors.

Educational Features of the Zoo

- The Zoo had three modular outdoor areas that were designed to have crowds of people easily be able to flow in and out of the areas. They had blank countertops, storage areas in the back, and roofs. They were all located in high traffic areas, like at the intersection of multiple paths or by the main exhibit.
- There was also an outdoor amphitheater with a grassy area behind where the zoo holds lectures or displays of different animals for the public. It could also be used as a place for groups to gather and listen to talks.
- There is a designated educational area of the park that is designed with pathways that loop around exhibits making the flow of people smooth. The main educational exhibit had displays of different farming processes, like milking a cow or trimming sheep. Each area had a blurb on a sign explaining the process. There was also a petting area where the visitors are allowed to pet, feed, and interact with animals.

Signage and How it Enhances the Visitors' Experience

- There were large zoo maps at every main pathway intersection. On the back of the maps were facts about the animals in the nearby enclosures.
- The signs were geared at both children and adults. Some signs contained very basic information and lots of images, while others had more writing on them. Some of the signs were also very low to the ground so a child of short stature would be able to see it.

- There was at least once sign per exhibit. The sign would be informative about the animal(s) in the exhibit. It would also have a map of the world, telling the visitor where on the map the animal could be found.
- All signs were in French and Arabic.

The Layout of the Zoo and the Effectiveness of the Design

- The park was split into 3 main sections that were shaped like a loop: desert, tropics, and educational farm. Each section had several big 'attractions', located near the middle of each loop. All the animals can be found in Africa, and each exhibit had a map of where in Africa the animal is from. This made the visitors who were interested in seeing the big attractions have to visit the entire loop in order to see them.
- There were small 'cafe' carts around the park with seating areas around them. They also had one large picnic area in the middle with tables and benches for families to eat. In the front, there were several larger restaurants.
- Some exhibits had tall fences making it harder for children to look in, but there were benches a couple feet back that children were climbing on to look in. This did not make any logical sense. Some other exhibits had lower fences, or gaps in the fence. It was not consistent. Our group feels that all exhibits should be able to accommodate children looking in.

TAZOTA FERME PÉDAGOGIQUE

Goals of This Observational Study

- Examine the design of a farm that focuses on educating visitors
- Understand how their farm educational programs are structured
- See how the farm utilizes the pool area for guests

Farming Techniques and Apparatus Used on the Farm

- Drip irrigation is used to water all of the fields.
- In the fields, the crops are rotated to preserve nutrients in the fields.
- The farm practices organic farming but does not have an official organic certification from any governing body
- Plants neat and uniformed trellis to support plant growth
- The farm has pumps to bring water into the farm for crop irrigation

Building and design Structure

- There was a large seating area to receive over 400 visitors.
- There is a pool in the back of the farm for guests in the summer to use for classes and recreation
- There were pens for animals at the back of the farm next to a playground where students could look at the animals.
- The paths were made of dirt near the beginning of the farm and turned into cobble near the pool.
- Roof and building structures were made out of natural materials like wood and bamboo

Guest and student experience

- After paying a fee for the day students received breakfast before rotating into different classes.
- Normal guests could attend the park and observe the fields, animals, and during the summer use the pool.
- The farm had several different areas where they brought groups to learn a different trade, they would then rotate classes after a 30-minute interval.

JARDIN MAJORELLE

Goals of This Observational Study

- Observe the different educational features of the garden.
- Observe the signage and how it is being used to enhance the visitor experience.
- Learn how the park is captivating the interest of all ages of visitors.
- Observe the layout of the park and decide on the effectiveness of the design.

Educational Features of the Garden

- Very little educational features at the garden, however, this was not the mission of the park
- Signs in park describing plant names, however no information about the plants

Signage and how it enhances the visitor experience

- Signage described plant names by showing a drawing of the area you are looking at and then under each plant, the name was written
- Signage also helped divert traffic through the park and to different areas
 - Normal signs for cafe, restroom, and entrance to the museum

How the park captivated the interest of all ages of visitors

- Park mostly for young adults and adults
- Peaceful experience for these age groups
- Not a park for kids, no activities - would also maybe ruin a peaceful experience

The layout of the park and the effectiveness of the design

- The layout of the park aided traffic control throughout the park
 - Direct pathways through the park from section to section
 - Circular paths for areas of high traffic
 - Large open spaces for people to commune around (pictures, relaxing, and sitting)

Average visitor experience

- No guided tours or interactive activities
- Most visitors walk and take pictures of the beautiful plant exhibits and water features
- Most visits last 1-2 hours

Location of major park attractions

- Since the park had more of a circular orientation, the main features (large open spaces) were in the middle and end of the park circle
- Through the park, there were clear areas that were designed for photos or viewing (ex: water features, koi ponds, floating plants)

Restaurant section

- Open restaurant section towards the end of park circle near the edge of the park.
- Expensive

JARDIN D'ESSAIS

Goals of This Observational Study

- Learn how the garden is laid out and how the pathways are used to direct visitors around the park.
- Learn how signs are used around the garden and why they are used in certain areas.
- Observe the educational material and buildings that are present and how they enhance the visitors' experience.

Educational Features of the Garden

- There are two buildings at the gardens: a museum and a pavilion
 - The museum was under renovation during our visit, but is a two-story building with about 8 rooms on each floor, each normally having exhibits in them. It was unclear what the exhibits were about, but we asked an employee and she said there are normally exhibits about plants and the environment.
 - The pavilion is a smaller building with the first floor having three open rooms with educational information. The walls had different information about local plants with information for both adults and children. There is a hands-on activity (wafting box for the smells of plants) in the middle for all types of audiences.
- There are no outside educational areas or activities.
- All educational material was in French, Arabic, and English.

Signage and How it Enhances the Visitors' Experience

- There are small signs next to groups of plants or alone plants telling the visitors what the plant name is.
- There are bigger signs for different areas of the garden, introducing the visitor to the type of plants in that area. These signs have pictures of the plants and a short blurb of information about the plants.
- At the 4 entrances to the park, there are large signs with a map of the park and labels for each of the areas and buildings. It also has a blurb on the history of the park and why it is there.
- The informational signs at/near the two buildings were in French, English, and Arabic. - The smaller signs telling the visitor the type of plants were in Arabic and French. The signs introducing the areas of the garden are only in French.
- There was no consistency between the signage. That might have been due to the renovation taking place throughout the whole garden

The Layout of the Garden and the Effectiveness of the Design

- The garden was laid out to allow people to flow through at their own pace. The garden is in the middle of the city so this makes sense. It allows people to cut through the garden if they're trying to get to another part of the city and just want to walk through nature. - But there is also a chance for people to stroll through many different areas of the garden and spend a couple hours there enjoying plants and flowers.
- The garden has large, wide paths acting as the main paths for the garden for visitors to cut through if they want. But it also connects different areas of the park. These paths were cobblestone and paved.
- There are cutoffs from the main path about every 25-50 meters for visitors to access the different areas/exhibits of the park. These paths were gravel. The smaller paths went all over the place and allowed the visitor to meander around the gardens looking at whatever plants they would like.
- There was not a recommended path for visitors to take because the garden is meant to be more of a natural area in the city and not a guided-tour place.

Average Visitor Experience

- Could last as long or as short as anyone would want.
- There is no entry fee.
- There are no guided tours or recommended paths.
- There are many benches and grassy areas for visitors to relax and enjoy the peacefulness.
- There are no restaurants or food stands.

Location of Major Park Attractions

- The two buildings are close to each other and are on one side of the park by one of the main entrances.
- There are no main exhibits, they are just throughout the whole garden.
- There are a nice paved area and a fountain by one of the entrances on the opposite side of the buildings.

CONSULTATION WITH PARK DESIGN EXPERTS - CHICAGO BOTANIC GARDEN - MS. EILEEN PRENDERGAST

The objective of this study

- Understand what considerations go into designing educational spaces
- See how spaces are designed to foster collaboration among the students
- How does nature play into design considerations at the CBG

The Roots article was a collection of the synopsis from park design experts detailing how their organizations purposed and designed buildings that focus on educating people on nature-related topics. Examples like nature classrooms, laboratories, and gardens are detailed in the explanation of their development.

Reading Guide Questions

How are the educational goals of the organizations incorporated in the designs of the buildings?

The Cadereyta Regional Botanic Garden greenhouse facility was a well designed and constructed building that sees hundreds of visitors a day. The designers started by understanding their goals in wanting to educate others on horticulture and propagation of wild plants. With that focus, they designed material to engage audiences and share ideas with visitors about horticulture. The greenhouse summarizes propagation of native plants in the area and connects the visitors in an immersive experience. By understanding their goal, they were able to identify the best way to educate visitors on horticulture with a greenhouse.

How important is thinking about supporting hands-on learning during the design process?

The Carl Microscopy Centre is a place visitors and scientists can come together to research water drops or invest criminal biologists. The Centre places the ability to conduct hands-on experiences as a first with their guests. Their motto could be described as “the best way to understand science is to do science”. Hands-on learning was placed at an utmost important teaching strategy across the board for these organizations and designed their facilities to utilize the practice. In every lesson, hands-on activity is standard to best educate the students on science and research.

How does the average visitor feel connected with nature while inside a building?

Despite the fact, most of the buildings have four walls and a roof the designers still try to make visitors at The Grunsfeld Children’s Growing Garden feel immersed in a natural learning environment the connects people of all ages. Some of the indoor classrooms lead to designated outdoor learning areas directly connecting with the classroom to a natural setting. Classrooms also provide natural laboratories for planting seeds, nature preschool areas, and gardens. Bring natural elements inside the classroom is vital to establishing a healthy relationship with the outdoors. Most of the classrooms allow for large amounts of natural light to enter the room making the students feel that natural connection with outdoors as well.

What were challenges in designing Nature Learning Centers?

To design the learning centers the projects have very extensive goals and objectives in the requirement elicitation. As a result, countless different consultants and stakeholders must give input in decisions made towards the final designs. The complex amount of specifications the various groups input in is a lot to account for in designing a comprehensive facility for everyone. Also, technical difficulties are constantly impacting these projects, due to the grand scale of the facilities and objectives the organizations try to reach with their projects.

How are classrooms structured?

The SEED Classroom in Phipps Conservatory and Botanic Garden in Pittsburgh is an innovative modular learning space. The room can be adapted to fit the needs of specific groups that occupy it. The purpose of the educational program is to teach students about climate change, and the impact of lifestyle choices of energy, pollution, materials, and water. The classroom itself serves as a tool to elaborate on those topics by purposely being designed to consume net-zero energy and water.

Are there areas that support receiving large groups?

Outdoor amphitheatres were a common structure seen at many of the locations in the article. The usefulness of having building features that can receive large groups was a vital design element in several locations. The ability for social learning to thrive amongst the visitors helps establish a group connection in lessons being presented. The amphitheatres were stationed outdoors which allows for large groups to share common experiences with nature.

How did the designers decide on what main features of the buildings that would be implemented in the final designs?

Most of the organizations gathered many different opinions and personalities from board members, teachers, students, and visitors to decide what was the goal of the structure they were trying to build. Once the requirement elicitation was completed designers solidified their goals and identified what elements they would need to put in their designs to achieve their goals.

Is the layout of the buildings designed in any way that the visitors feel a natural flow walking through the centers?

In the article, there were many occasions where the focus on pathways and trails were described. There was a large focus on preserving a natural feeling along the path while making them accessible for everyone. Trails are made to be handicap accessible and easy for everyone to use. They also have a dedication to preserve the natural qualities of the space. Paths have a natural flow that allows visitors to walk through them not feeling pressured to choose a certain direction but seamlessly guides you through the park.

What lessons are intentionally taught indoors versus outdoors?

The educational programs of the various parks vary from indoor and outdoor settings. These organizations take special care to personalize the lessons based on age groups, teaching focuses, and learning styles. For example, a lesson on soil conservation would typically be taught outdoors with the

ability to physically interact with soil. When planning how educational programs it is vital to consider how the group can best interact with the environment to specialize experiences. Lessons should be conducted indoors or outdoors depending on how well the learning area can best help participants connect with the topics.

APPENDIX D: CODING

CODING GUIDE

1. Educational Topics Codes
 1. Climate Change
 2. Biodiversity
 3. Farming Challenges
2. Educational Strategy Codes
 1. Hands-on learning
 2. Experiential Learning
 3. Nature-based learning
3. Design Features
4. Operational Features

CODING THEME DATA

CODING THEME: CLIMATE CHANGE

Climate Change Coding Themes from All Interviews

They have definitely felt the effects of changing the climate on a year to year basis when it comes to crops. They have not changed any of their programs because they follow the demands of schools. However, they do have programs about climate change such as a recycling workshop and a sustainability workshop.

The Ministry (of education) does not have a clear program in place regarding climate change and sustainability education in schools. Because of this, there is a lack of education in schools and the Tazota Ferme Pédagogique tries to fill the gaps.

Climate change is affecting small farms (extremes are more extreme, higher salinity in rainwater).

Yes, more extreme things like the summers are hotter and the winters are colder. The crop yield is less than it has been in the past. The salinity level in the well has increased over the years as well. There is a lab in Skhirat where farmers can get their water and soil tested for a small cost as well.

Water levels are a major issue in Morocco. The large demand is being driven up by increasing population, developmental needs, and pollution. The dry arid climate has been causing more droughts which are expected to become more frequent. In many regions, there is critical overharvesting of groundwater which is becoming more important.

There are many conflicts of use of groundwater for agriculture and other sectors and uses like tourism, urban development, swimming pools golfing.

Water is used for cooling and thermal energy which makes many competing sectors for water which makes a conflict of interest in coastal areas.

Many gallons of water get wasted in channels which is why they advocate for drip irrigation.

Science research, plants, and climate change are common themes seen. Each garden bed represents a plant family that fosters an appreciation of diversity.

The Biopark should focus on the basic techniques, such as conservation of soil, water conservation, and fertilization (all organic).

This organization teaches farmers about all aspects of agriculture as well as children in school. This organization promotes sustainability.

The teaching is specified for each region, the lessons are determined by the climate, area, and local farming culture.

CODING THEME: BIODIVERSITY

Biodiversity Coding Themes from All Interviews

They use crop rotation to preserve some of the soil nutrients. They move the fields and plants. They use drip-irrigation as well throughout the farm. They solely use organic farming, it is a Bio-farm. The animals and crops are certified organics by the ministry.

The big problem is that when he has a good crop year, everyone has a good crop year. So the market gets flooded, the biggest challenge is how to diversify from other farms.

There is a lack of knowledge of proper use and the ability to use proper technology, fertilizers, and pesticides. There should be more training on how to use these resources and where to obtain them.

Mr. Khattabi was involved in developing a curriculum on environmental topics. Core focuses of the curriculum were water, biodiversity (marine and coastal), climate change, air pollution, plastics, desertification/land degradation, forests, soil.

Composting, apiculture (beekeeping), harvesting apples, and nuts. One of the cooperatives provides 30-40% of nuts to the region.

This is being done by contra-programs that teach farmers in organic farming and best practices of organic farming.

CODING THEME: FARMING CHALLENGES

Farming Challenges Coding Themes from All Interviews

Farming is becoming more expensive as time goes on, the cost of labor and equipment is going up, so it makes it harder to sustain. The model for farming is changing, you must pay for everything.

Hard for farmers in certain areas to communicate with each other

Hard to diversify from other small farms (if someone has a good crop year, everyone has a good crop year, and vice versa)

Ministry of Agriculture that encourage farmers to use better practices like drip irrigation where they can also get subsidized for implementing techniques if they have a farm under 5 hectares.

There are two main issues. Lack of education and poverty. 90% of agriculture in Morocco is traditional in rural areas where education levels are low. Most people who are in poverty lack education causing a major issue in rural areas.

There are already regulations on these issues, but many people do not care much about them and many people are not aware of them so there needs to be a push for educating people more on these concerns.

Making people aware of the environment by creating incentives. Educating people based on what could interest them.

Most people in rural areas are farmers where most are illiterate. The rates vary by gender. More men are illiterate than women and the various regions but roughly around 50-60%.

CODING THEME: HANDS-ON LEARNING

Hands-On Learning Coding Themes From All Interviews

The Ministry uses the farm field school technique. This consists of taking the farmers to a farm and practicing and training in the field. All of the basics for all of the different crops.

The education system is based more on practical learning, which is the most important.

Engage the whole body with learning.

Avoid lectures and bring lots of hands-on materials into the class. Ground the question that refers to plant-science as a local or worldwide problem.

Yes, they had training and fieldwork, he is not sure how it works now but they did do hands-on work. A combination of training and field work was good, but they wanted to know more about new technologies.

The learning is all hands-on, they mostly do workshops that are selected by the school. They have multiple workshops available.

In the classroom, the teachers do activities with the students, but it is not as meaningful as when they go on field trips and the children are doing things like planting seeds or feeding the animals.

They tend to be more successful because students enjoy working with things rather than sitting and listening.

CODING THEME: EXPERIENTIAL LEARNING

Experiential Learning Coding Themes from All Interviews

They also show the whole cycle of crops to cooking. For older students, they give more data such as biological information about the animals.

He learned a lot of things related to chemicals, fertilizers, and nutrients in the soil. Things like starting plants in the greenhouse to extend the growing season. Drip irrigation techniques and other new technology. He can recognize different diseases by looking at the leaves of the plants or how they are wilting.

Connecting lessons into a frame of relevance. A good resource is The Frame of Relevance literature review. It helps people understand how to make people excited about various topics.

Also, remember there is more than just learning objectives in having a good trip.

Make the program and content interesting for all ages by providing room for creativity like a maker space. Most of the educational programs are designed behind the Next Generation Science Standards.

They found that using a projector with pictures is a good way to teach uneducated people.

First, they show that using the methods taught the crops will be healthier and more prolific. The Moroccan people are starting to move towards organic products because currently the demand is very high, and the production is low, so CIPA advises the farmers to farm organically to make more money.

For example, they make the training based on the specific crops they may produce.

At the training farm, they teach about how to manage water within a farm. This includes recuperation of rainwater in a basin that is then used for the farm. However, because of the many different climates in Morocco, they teach many different methods based on region. They try to teach farmers based on their local region and resources.

They teach the soil conservation and fertilization techniques needed for a farm in Morocco. They teach how to conserve water and how to make seeds. It is mostly based on conservation and sustainability of the farm.

The main goal of the training farm is to share the education of how the agriculture system and the ecological system work in Morocco.

The teachers think that the students will learn best when they are engaged in activities for most of the day, then going through each of the topics with the children after to solidify what they learned while doing the activities.

CODING THEME: NATURE-BASED LEARNING

Nature-Based Learning Coding Themes from All Interviews

Our school programs are designed to inspire a love of plants and spark a curiosity about plant-based science that fit into the school curriculum. Their Nature Play programming fosters a love of the environment.

This is a great resource on progressive learning for environmental education which is based on performance standards. Also, the National Science Teachers Association disciplinary core ideas crosscutting concepts, and science and engineering practice. These programs are very nice because they integrate play into children's educational objectives.

Their best programs are outdoors, and they engage the whole body in learning, regardless of age.

Think about your own favorite museum experiences. Use a lot more DIY tactics. Many people also want to be outside so aimed to focus on lessons in nature.

They also offer free, drop-in, nature play activities. Nature play is a huge focus of our early childhood programs. Our Nature Preschool is outside for all or at least a portion every day. All of their yearly curricula are nature-based, and in particular, nature play focused.

Especially for children, there is a focus on nature play. There is also no artificial elements to enhance nature play.

Nature play is supported and valued based on research. I've attached a great research summary from PEER that outline the benefits of Nature Play.

Areas are in various high and low traffic areas. Some are focused on walking home with a plant. The areas are also focused on the learning goals of that specific area.

They focus on teaching lessons around the 5-acre campus. They do various activities around water sources like water quality and lake ecosystems. High schoolers do more around main islands and greenhouses.

Yes, their students enjoy learning about the environment and the outdoors.

CODING THEME: DESIGN FEATURES

Design Features Coding Themes from All Interviews

Think about anything that could be a space limiter. Design a space with limiters in mind. Practice with the teaching staff and implementing changes over various iterations based on feedback. Always think of worst possible scenarios, if it rains, if students have disabilities.

The Botanic Garden App. You can download it “Garden Guide”. We also offer experiential bingo sheets (5x5 grid of activities for early childhood) to instill a love of nature through suggestive exploration activities.

We’ve designed the Regenstein Learning Campus to be an ideal Nature Play space. There are no forts or slides or plastic play materials on the campus. Instead, there are rolling hills, some gentle and some steep. There is an area, The Runnel, which circulates small 2-inch deep water in a walkable stream. We make rafts and floats from natural objects and send them to float down the runnel. We have logs and rocks for climbing and playing, nothing prescribed and all local natural features. We also have a tunnel of willows to get lost in a maze of branches and leaves.

There are six tables and six chairs. There are very big main windows to allow for a lot of natural light. There are cabinets and an interactive board. The setup is intentionally minimal to tailor to the audience and focus of the objective.

A Lot of education is seen through landscape design.

The farm is on 2 hectares of land. There are buildings that work as training centers for teaching farmers.

CODING THEME: OPERATIONAL FEATURES

Operational Features Coding Themes from All Interviews

Seasonal availability and a lot of planning at beginning of the season. Classes are streamlined based on seasonal topics. School evaluations and surveys are great ways to determine topics. hydroponic programming is very low effort and teachers love to work with it.

Classes are very specific to the age group. All the guided workshops are paired with free exploration time.

Drafting new ideas based on NGSS standards, writing copy to get them into our print and website editors, writing curriculum around our time format and seasonal materials, organizing and storing program materials, teaching program with education staff, implementing changes based on iterative process, training volunteer docents to lead programs, working with call center and registration office to setup database program registration, advertising with teachers and school group, sharing school reports with garden staff and security, handling buses at drop-off and organizing lunches into the lunchrooms, setting up and cleaning rooms for afternoon adult classes. All of these and more factors go into designing the curriculum.

Volunteers have been instrumental to the success of programs. Make content interesting for a wide group of ages.

Mr. Khattabi worked more on the content of the programming. His colleagues were the principal designers of the teaching style.

The students come to the park, start with breakfast, then break into groups and work in a cycle to go to the workshops that their school has selected. Lunch is served mid-day.

TABLE OF THEME COUNTS

Theme	Number of Mentions in Interviews	Rank
Climate Change	29	1st
Biodiversity	10	7th
Farming Challenges	12	5th
Hands-On Learning	11	6th
Experiential Learning	21	2nd
Nature-Based Learning	14	3rd
Design Features	13	4th
Operational Features	9	8th

APPENDIX E: OBSERVATIONAL RESULTS: FINAL SUMMARY

Bolded statements are features that the team identified to consider in the final design.

Jardin Majorelle

- In each area, there are signs that outline the plants you are looking at and labels them to tell you the names of each one. This was needed because visitors have to stay on the paths and cannot get close to some plants.
- **Directional signs pointing visitors towards major attractions.**
- Paved paths that were designed and laid out to help the flow of visitors throughout the garden. There is a natural flow through the garden, but visitors can go in whichever direction they want.
- **There are multiple points of interest where visitors could rest in an open area while also having the opportunity to take pictures of a peaceful/visually pleasing scenery.**
- Major attractions and features were dispersed around the garden.
- The restaurant and bathrooms were at the end of the loop around the garden.

What Features Would Work Well in Our Biopark?

- Directional signs that point visitors to main attractions as well as a guide to follow the paths of the Biopark.
- Having rest areas and park benches throughout the Biopark so visitors can find normal seating in multiple areas near the garden.

Jardin D'essais

- Two educational buildings: a museum and a pavilion. The museum is under renovation, but normally has exhibits on plants. The pavilion had educational information about the environment and a hands-on exhibit.
- **There were three different types of signs: small signs next to plants displaying the names, medium signs introducing different areas of the park, and large signs with a map of the garden on it with labels and a history blurb. The signs were in English, French, and Arabic, but there was no consistency between them.**
- **The garden had different sized paths to direct the flow of traffic. There were large, paved paths to allow people to cut through the garden to get from one side of the city to the other. But, from the large path, there were smaller, gravel paths that broke off, so visitors could go walk through all the different areas and plants of the garden. A visitor could spend as little or as much time as they would want at this park because of how the paths were laid out.**

- There were grassy areas and benches around the garden to allow visitors to rest and relax wherever they would like. The garden was laid out so when the visitors enter the park, they become isolated from the city.
- There is a nice fountain area at one the entrances, a rose garden at another, and the museum at the other. These areas give a good impression to the visitors when they first walk in.

What Features Would Work Well in Our Biopark?

- Signage should accommodate the different types of visitors to the Biopark. The text should have different languages to be more accessible. There should be different heights to accommodate adult and children viewings.
- The paths should be made of dirt for ease of access, but they should have a trim on the side to make the pathways look nicer.

Rabat Zoo

- **Modular outdoor, drop-in, learning areas.**
- **Outdoor amphitheater with a grassy area behind where the zoo holds lectures and displays of different animals for educational and entertainment purposes.**
- **The signage at the zoo was nice and consistent. Every sign was in French and Arabic. Most signs were at a height where small children would be able to easily read them, and the text was big enough to allow for adults to be able to easily read them too. The signs next to each exhibit explained more than just what the exhibit was about.**
- The educational area of the zoo was well designed too. It was in loops to allow for visitors to flow through the area well. There were displays and explanations of different activities relating to agricultural processes as well as a petting zoo area.
- The zoo was split into three different areas, separating exhibits by climate zone of Africa.

What Features Would Work Well in Our Biopark?

- Modular learning spaces should be the principal learning area at the Biopark. The flexibility of a modular learning space will be ideal to educate visitors at the Biopark in conjunction with hands-on practice in the fields.
- An outdoor amphitheater would be a useful space to allow large groups to congregate and learn together.
- Signs should be consistent with each other

Tazota Ferme Pédagogique

- **Pool area with a seating section**

- **Several workshop areas where students would sit and learn a trade or skill. After 30 minutes the groups would rotate to a different section of the park and learn the new skill at the different section.**
- **Drip irrigation system with a pump to irrigate crops.**
- **Animal pens in the back of the farm with ostriches, camels, dogs, horse, and birds**
- **Playground with swings and slides in front of the animal pens.**
- **The paths were made of dirt near the beginning of the farm and turned into cobble near the pool.**
- Buildings and roof structures made with natural structures. Eating areas had roof coverings with support beams made out of bamboo.

What Features Would Work Well in Our Biopark?

- The pool area at the Biopark should be utilized in a similar fashion. There should be a small cafe area to allow people to rest.
- The fields should utilize drip irrigation to manage the crops.
- The Biopark should have animals that the visitors can interact with. They will be able to be used for lessons like milking cows and getting eggs from chickens.
- A nature play area should be incorporated so children can freely play at the Biopark. Unlike a normal playground, all the elements of the nature play area will be natural and avoid having man-made attractions to allow the children to connect naturally with nature.
- In areas of the park where more people would congregate the paths should transition to a more solid base like cobblestone

APPENDIX F: DELIVERABLES

LIST OF EDUCATIONAL TOPICS

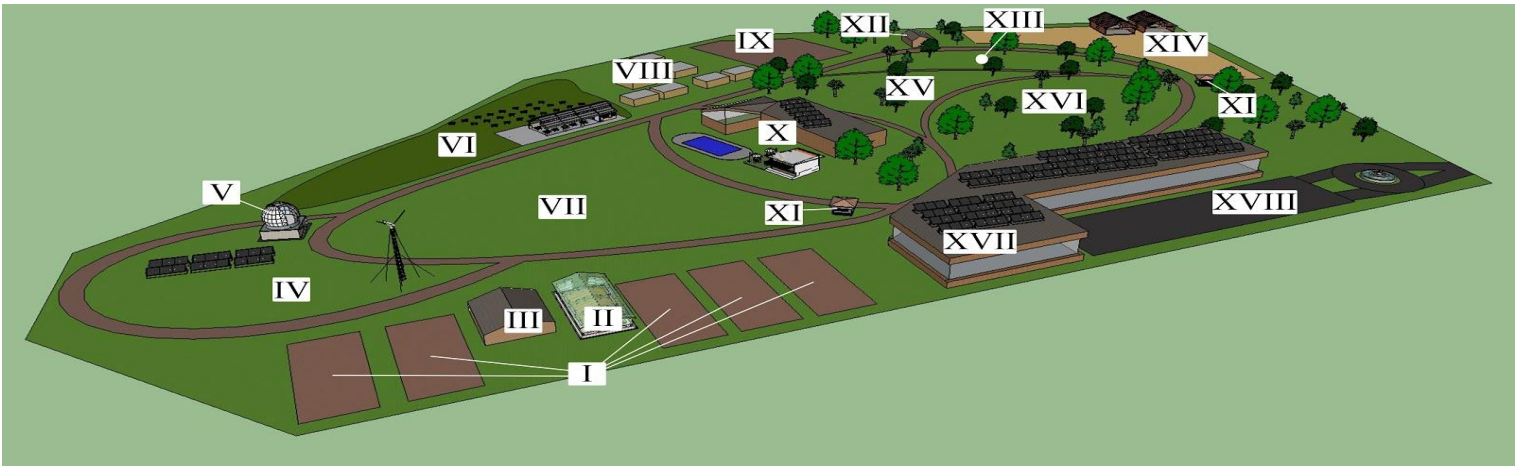
Teaching Methods	
<i>Hands-on Learning</i>	Hands-on learning is extremely effective in teaching topics related to climate change and expanding students' appreciation for nature. Teachers and environmental educators emphasized the benefits of hands-on learning for both students and farmers.
<i>Experiential Learning Model</i>	A learning cycle which emphasizes experimentation and reflection in learning, this method encourages students to examine their impact on the environment and is well-suited for teaching environmental topics.

Topics for Students	
<i>Recycling</i>	Educators emphasized that educating students about proper recycling methods as well as their impact on the environment is important.
<i>Air Pollution</i>	Educators and environmental experts emphasized the importance of teaching children about pollution and how their actions affect the environment.
<i>Water Management</i>	Educators, environmental experts, and farmers recommended educating students on basic water management skills to encourage environmentally conscientious behaviors.
<i>Establishing a Connection with Nature</i>	Educators and environmental experts suggested that establishing a connection with nature at a young age ensures that students respect and protect the environment later in life.

Topics for Farmers	
<i>Soil Management</i>	Farmers and environmental educators stressed the importance of teaching sustainable soil management techniques including fertilization techniques, new technology, and pesticide pollution.
<i>Sustainable Water Use</i>	Education on sustainable water use including drip irrigation and rainfall and runoff collection encourages farmers to practice environmentally conscientious behaviors and preserve resources.
<i>Business Aspects in Farming</i>	Education on best business practices including middlemen, markets, and profits ensures the success of farmers and the agricultural industry.

Park Elements	
<i>Modular Learning Spaces</i>	Modular learning spaces are multi-functional spaces that enable adaptive learning.
<i>Practical Learning Areas</i>	Practical learning areas enable a combination of theory and practice to be used to educate visitors in the Biopark. Examples of practical learning areas include a greenhouse, fields for farming, olive and grain mill-house.
<i>Nature Play & Learning Area</i>	Nature-based play & learning encourages young children to be creative, solve problems using trial and error, and promotes cognitive processing. A nature play area in the Biopark allows children to interact with natural elements and connect with the environment.
<i>Recreational Areas</i>	Recreational spaces, including a picnic area, pool, local and exotic garden, will make the Biopark a more attractive place for people to visit and enjoy nature.
<i>Pathways & Signage</i>	Directional and informative signage in Arabic and French, as well as dirt pathways throughout the park will enhance the visitors' experience.
<i>Commerce Areas</i>	Commerce areas throughout the Biopark will generate revenue and enable the park to have no entry fees. Examples of commerce areas include food stands, a restaurant, and gift shop in the visitor's center.
<i>Visitor Center</i>	The visitor center will include a welcome area, water museum, agricultural museum, and a gift shop selling seeds, plants, and crops grown at the Biopark.

GOOGLE SKETCH-UP OF PROPOSED PARK DESIGN




Park Design Legend


I	Educational farming fields for farmers	X	Pool area, pump house, bathrooms, and cafe
II	Greenhouse	XI	Drop-in learning areas (x2)
III	Tool shed	XII	Olive and grain mill-house
IV	Renewable energy exhibit	XIII	Nature Play Area
V	Observatory	XIV	Animal pens
VI	Restaurant with a picnic area and picnic tables	XV	Exotic plants garden
VII	Grassy area for recreational activities	XVI	Local plants garden
VIII	Modular learning spaces	XVII	Visitor center with a welcome area, museum of water, museum of agriculture, cafe, bathrooms, and a shop for souvenirs, seeds, and plants from the gardens and farms
IX	Educational farming field and garden for children	XVIII	Parking lot and main entrance

POSTER DEVELOPED FOR SPONSER

ENGLISH




RIBAT AL FATH BIOPARK: EDUCATION STRATEGY AND DESIGN
 Developed by Justin Amevor, Hunter Kortz, Brent Rolfs, Neema Saberi, and Ilana Zeldin of Worcester Polytechnic Institute (Worcester, MA, USA) on behalf of Association Ribat Al Fath









Ribat Al Fath
 Since 1988, Ribat Al Fath has promoted cultural activities to support the heritage and identity of the city and has enabled citizens to play their part in the process of sustainable development.




Biopark Mission
To Promote Sustainability, Biodiversity, and Climate Change Awareness Through Community and Education by Development of a Biopark in Oum Azza








Learning Areas


-  Water Conservation
-  Air Pollution
-  Recycling
-  Establishing a Connection with Nature
-  Soil Conservation
-  Business Aspects in Farming

Teaching Methods


-  Experiential Learning Cycle
-  Nature-Based Play & Learning
-  Hands-On Learning

<p>Greenhouse</p>  <p>Farmers can practice the skills they learn</p>	<p>Garden</p>  <p>Gardens display local and exotic plants</p>	<p>Visitor Center</p>  <p>Contains welcome area, museum, and gift shop with plants</p>	<p>Commerce Areas</p>  <p>Café and food stand generate revenue</p>	<p>Modular Classrooms</p>  <p>Multi-functional spaces enable adaptive learning</p>
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FRENCH




BIOPARC RIBAT AL FATH: UNE STRATÉGIE ET UN DESIGN ÉDUCATIF
 Développé par Justin Amevor, Hunter Kortz, Brent Rolfs, Neema Saberi et Ilana Zeldin de Worcester Polytechnic Institute (Worcester, MA, États-Unis) pour le compte de L'Association Ribat Al Fath









Ribat Al Fath
 Depuis 1988, Ribat Al-Fath promeut des activités culturelles pour soutenir le patrimoine et l'identité de la ville et permet à chaque citoyen de jouer son rôle dans le processus de développement durable.




Bioparc Mission
Promouvoir la sensibilisation à la durabilité, à la biodiversité et au changement climatique par le biais de la communauté et de l'éducation en développant un bioparc à Oum Azza








Domaines D'apprentissage

-  Conservation d'eau
-  Pollution de l'air
-  Recyclage
-  Connexion avec la nature
-  Gestion de sols
-  Aspects commerciaux de l'agriculture

Méthodes D'enseignement

-  Cycle D'apprentissage Expérientiel
-  Jeu et Apprentissage Basés Sur la Nature
-  Apprentissage pratique

<p>Serre</p>  <p>Les agriculteurs peuvent mettre en pratique les compétences acquises</p>	<p>Jardin</p>  <p>Les jardins présentent des plantes locales et exotiques</p>	<p>Centre de Visiteurs</p>  <p>Contient un espace d'accueil, un musée et une boutique de cadeaux avec des plantes</p>	<p>Zones de Commerce</p>  <p>Un café et un stand de nourriture génèrent des revenus</p>	<p>Salles de Classe Modulaires</p>  <p>Les espaces multifonctionnels permettent un apprentissage adaptatif</p>
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APPENDIX G: RIBAT AL FATH BUSINESS PLAN

RAF PROJECT OF THE DAM FIELD

Summary note (V1)

I / BASIC DATA

- The total area is 4931m²
- The land has trees : No tree will be torn except in case of force majeure.
- The land includes scattered buildings : These constructions will be valued, none will be destroyed except in case of force majeure.
- The land will be valued through 5 components : i / The component ecotourism »That does not require land ; ii / The extension component on " agriculture, livestock, forest Which requires land for production and construction ; iii / The " school farm Which requires demonstration spaces and a play park ; iv / the astronomical observatory ; v / The water museum.
- In addition to these areas specific to the 5 components of the project, there are spaces for common infrastructures : catering, parking, circulation.
- Establish the costs of basic investments.
- Establish the cost of operation.
- To think about the legal form

II / SURFACE SUMMARIZATION

II.1 / CROPS, LIVESTOCK, FOREST ETC

- Arboretum 10000 m²
- Slope sloping to plant on the terrace 10000 m²
- Forest Grove (4120 +5880) 10000 m²
- Culture annual 4000 m²
- PAM 2500 m²
- Water 500 m²
- Nursery 400 m²
- Standard 200 m²
- Field of composting 200 m²
- Hydroponic hydroponics 80 m²

S / T 1 (32000 + 5880) 3 7880 m².

II.2 / AREA ALREADY OCCUPIED : Pool observatory

S / T2 500 m²

II.3 / WATER MUSEUM

ST3 2500 m²