

ECOPLEX

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Abstract

The state of the current food system in Saudi Arabia is extremely unsustainable and with the country ranked third in carbon emissions per capita. It is crucial that solutions are sought out to eliminate the energy intensive processed and consumer culture. This study will look into the food system closely and propose an architecture project that will aim to reinvent the source of food in Saudi Arabia. It will be an environmental project beneficial to the city of Jeddah and its residents. This study proposes Ecoplex project in Jeddah as an initiative for the sustainable sourcing of local food within the city of Jeddah as well as spread awareness of the food system and reconnect people to their source of food. The proposed Ecoplex consists of urban farm, research facility, education and awareness center and the marketplace. Al Rawdah district was chosen for this project based on the site criteria evaluation which benefit by several factors such as easy accessibility, high visibility and mixed use land of surrounding.

Keywords -- Ecoplex, Food System, Urban Farm, Education and Awareness, Marketplace

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INTRODUCTION

Urban agriculture has emerged from growing need to secure food for people. Cities must generate food for themselves, since food distribution becomes more complicated as a metropolitan area grows [1, 2].

Urban agriculture has the opportunity to change the way food is produced and distributed and to make a positive impact on the food system. Generally speaking, instead of growing food in vast farmlands far from where the majority of people are living, urban agriculture brings the farm to the city. It simplifies the process because food produced in close proximity to consumers reduces energy consumption and pollution by minimizing transportation, contributes to the city's nutritional self-reliance by reducing malnutrition and provides social benefits through inexpensive access to fresh, locally grown produce [3, 4].

Urban farming techniques differ from those used in rural areas due to the unique constraints present in cities, such as minimal land available and quality of air and water. Agriculture accounts for 70 per cent of all water taken from aquifers, streams, rivers and lakes [5].

Another key constraint is energy availability, specifically of fossil fuels. Modern agriculture is energy intensive, tractor and transport fuel, producing agri-chemicals and storing and processing food all depend on affordable fossil fuels. Agriculture contributes around 13.5 per cent of global greenhouse gas emissions as a result of traditional cultivation practices [6].

Thus an array of new technologies some complex, some simple, has emerged to combat the problems of traditional agriculture and to overcome the constraints of urban areas. Therefore, Ecoplex is proposed to develop in Jeddah, Saudi Arabia as an alternative solution for the source of food.

CASE STUDIES

There are three agriculture institutes from South Korea, China and Netherlands are considered for the main case studies. All these three agriculture institutes are designed carefully and equipped with advance agriculture technology and they are:

- Ecorium of the National Ecological Institute, Seocheon, South Korea
- Xi'an Greenhouse, Shaanxi, China
- Netherlands Institute for Ecology, Wageningen, Netherlands

Ecorium of the National Ecological Institute, Seocheon, South Korea by SAMOO Architects & Engineers, Grimshaw Architects

The Ecorium has the following three key concepts. Firstly, From the Nature, which expresses the vigorous and dynamic energy through the motive of organic lines of nature and becomes a representative symbol of National Ecological Institute. Secondly, Be the Nature, the Ecorium reproduces the ecological environment of the earth by the up-to-date technology and expertise. Thirdly, With the Nature, which is expressed by creating spaces inducing people to immerse themselves in and communicate with nature (Figure 1) [7].

The project showcases the world's diverse ecosystems as immersive teaching exhibits. The main component of the project is the wedge-shaped greenhouses (biomes) which emulate the key climatic regions of the world; tropical, sub-tropical, Mediterranean, temperate. The fifth climatic zone is represented in a subterranean exhibit that mimics the low-light conditions and maintains the sub-zero temperatures of the polar region (Figure 2).

In plan, they all feature curved semi-circular shapes that are based on the form of lakes left over by moving rivers. These individual climate zones are grouped by a linear podium which also functions as the main exhibition circulation path providing various experiences to visitors. Visitors travel through the biomes, seeing, hearing, smelling and touching flora and fauna from the tropical rainforest, cloud forest, dry tropics, cool temperate and Antarctic regions.

The composition of flowing of mega-structures is supported by ancillary facilities, such as a grand lobby that leads to theatres, cafeterias, and gift shops as well as an observatory deck installed on the main greenhouse [7].



Figure 1. Immersive environment of the Ecorium [7]



Figure 2. Top view of Ecorium [7]

Xi'an Greenhouse, Shaanxi, China by Plasma Studio

Xi'an Greenhouse project is inspired by the unique synergy brought about by the between natural and artificial environments (Figure 3). The Xi'an Greenhouse takes advantage of the existing natural conditions of its site and complements that with the creation of artificial greenhouses. These greenhouses transform the artificial and natural conditions of the site into a sustainable system to develop into a legacy for the city of Xi'an and its children. It aims to preserve the natural ecology of Xi'an sustainably for its future generations, as well as educate them on the fragility of ecosystems and the importance of coexisting with our natural surroundings [8]. The Greenhouse integrates glass, wood and a little concrete in the facade of the underground part (Figure 4). Through its materiality the building again manifests itself as an extension of the ground with its floors and interior walls made from concrete and bronze is used as expression of local identity [8].



Figure 3. Xi'an Greenhouse bird-eye view [8]



Figure 4. Glazing of the façade [8]

Netherlands Institute for Ecology, Wageningen, Netherlands by Claus and Kaan Architects

Situated on the campus of Wageningen University, Netherlands Institute for Ecology (NIOO) is comprised of a main building with laboratories, offices, a restaurant and an auditorium, and a series of separate buildings for botanical research (Figure 5). When it came time to design a new facility for the Netherlands Institute of Ecology, the clients were adamant that it should support their mission of protecting the environment. Thus, inspired by the sustainable, no waste Cradle-to-Cradle philosophy, Claus en Kaan Architects designed a building with simple materials that can be recycled or reused, a solar array that generates power, and a waste water filtration system that eliminates sewage [9].

To reflect the high-level of ecological and biodiversity research done in the NIOO, the building had to have a strong aesthetic statement. Although the form is simple and linear, it generates an enormous amount of space that stands for the most important principle of the building; informal encounters. The design ensures maximum interconnectivity by encouraging chance meetings between people (Figure 6). Voids provide open connections between the floors, light and air to create a relaxed and inspiring work climate. The clean, strong lines of the form reflect the function of the building as a center for ecological research, yet it is the shaping of the interior that stands out [9].



Figure 5. Front Elevation of the Netherlands Institute for Ecology [9]



Figure 6. Vertical circulation offers connectivity [9]

SPACE PROGRAM

The Ecoplex program is composed of four main zones; the urban farm, research facility, education and awareness center and lastly the marketplace. These main zones will be mainly housed indoors with the exception of the marketplace that will have an outdoor extension. The project is a semi-public building. The urban farm and research facility will be strictly for employees due to their highly controlled and scientific nature. However the education and awareness center and marketplace are accessible for the public and meant to be the social and commercial hub of the Ecoplex.

The urban farm zone has two functions; production and packaging. The production area is where vegetables will be grown in a controlled setting using sustainable urban agriculture processes. Two methods will be used to grow the produce; low volume soil and a quaonics. The packaging part of the urban farm will deal with properly packing the produce to be sold in the marketplace. There will also be special storage rooms to keep the food fresh and protected from contamination.

This will be an ecological research facility with a capacity of 20 researchers with studies focusing on the ecology of Saudi Arabia. In addition, scientific research will be conducted in collaboration with the urban farm to enhance on the sustainable methods of food production.

Education and awareness zone will be an informal education area aiming to raise the awareness of the general population regarding the food system and its impacts. It is an opportunity to reconnect visitors to the source of their food and teach them through interactive exhibition spaces and small workshops how food can be grown sustainably. Furthermore, this zone will be where scientific events will be held for researchers such as symposiums and conferences to share their latest discoveries and achievements.

The Ecoplex market will function as the main social hub of the project. Here is where visitors will come and buy the local, sustainable produce directly from its source. Other recreational facilities include restaurants and cafes that will use the produce of the urban farm. There are also gift shops, open spaces and an open outdoor market during the cool months. The marketplace will have a capacity of 500 visitors and 100 vendors.

Overall Project Area

After calculation each zone separately and assuming their corresponding areas accordingly, Table 1 represents the Gross Area of the four components. These will all be part of the built up area which came to a total of 16,590 meter square. An additional 8,800 meter square is provided as the un-built area and this will include parking space and outdoor activities such as the market extension which shown in Table 2. Thus the total Ecoplex project area is 25390 meter square.

Table 1. Gross Area of the four components

Zone	Area (m ²)
Urban Farm	5890
Research Facility	958
Education + Awareness	1815
Marketplace	4100
Net Area	12763
Gross Area	16590

Table 2. Un-built area of the project

Zone	Area (m ²)
Landscaping and outdoor activities	3200
Parking (200 lots)	5600
Total Area	8800

SITE SELECTION

There are three propose sites in the city of Jeddah as a viable choice for Ecoplex. Figure 7 shows that the site 1 is located in Al Rawdah district, this site is bound by 2 main roads; Prince Sultan to the west and Al Rawdah Street to the North. The district is a mixed-use area with commercial centers along the perimeters of these main streets and residential areas deeper into the district. Figure 8 shows that the site 2 is located in Al Andalus District, on the intersection of Tahlia Street and Madinah Road. It is a predominantly residential area with a lot of surrounding vacant land. Figure 9 shows that the site 3 is located in the residential and commercial area of Al Faisaliyah District. It's accessible by Tahlia Street and King FahadStreet.



Figure 7. Site 1 [10]



Figure 8. Site 2 [11]



Figure 9. Site 3 [12]

Site Selection Criteria

There are five different criteria are defined to assess the proposed site and determine the optimum location for the Ecoplex. First is the accessibility, where the location has a good road network and there is easily accessed from different parts of the city. Second is the surrounding, where the surrounding area of mixed land uses or a single function such as commercial and residential region. Third is the future expansion of the location. This reflects the ability for the project to expand within its surroundings in near future. Next is the shape of the location area. The shape of the land should match the project such as linear, curvilinear or square shape. Lastly is the view, site has pleasant views are preferable. The site evaluation result is tabulated in Table 3.

Table 3. Site evaluation

Site criteria	Weight factor	Site 1		Site 2		Site 3	
		Rating	Score	Rating	Score	Rating	Score
Accessibility	5	5	25	4	20	4	20
Surroundings	4	5	20	3	12	2	8
Future expansion	2	4	8	5	10	1	2
Shape	3	3	9	4	12	3	6
Views	2	4	8	2	4	1	2
Total	16		70		58		38

Selected Site Analysis

Based on the site evaluation result according to the predetermined criteria as shown in Table 3, the optimum choice for the Ecoplex is site 1. This is the site located in the mixed use Al Rawdah District. It is very easily accessible by Al Rawdah Street and Prince Sultan Street. It is considered to be in the North of Jeddah, in a very well developed area. The site dimensions are 230 m by 120 m.

Environmental

The prevailing wind direction in Jeddah is North West and with the surrounding buildings being low to mid-rise this will not obstruct the wind to the site (Figure 10). Wind direction must be considered in the design phase of the project to allocate functions accordingly.

The urban farm will have a controlled interior environment so it will not be affected by the elements. However functions such as the education hub and market, where there will be large congregations of people, needs to be well ventilated.

Moreover, for sustainability it is always preferred to take advantage of natural ventilation rather than mechanical systems. Conversely, the sun path is vital to consider especially in Jeddah where average temperatures reach as high as 34 °C. Adequate shading devices should be added to protect from the harsh sun rays and prevent heat gain.

Accessibility

The site is well connected to the rest of Jeddah. It has 2 major roads on the west and north sides as well as secondary roads that are best for avoiding congestion in the main roads. There is also a service road present from Al Rawdah Street and this is a strong point as it allows easy entrance into the site (Figure 11). The main issue with the accessibility would be the congestion problem. The main roads, Prince Sultan and Rawdah suffer from congestion especially during rush hours when people are leaving their jobs and at night for those going to the commercial areas. Therefore the entrances must be well designed to avoid the traffic issues of the main streets.



Figure 10. Climatic chart



Figure 11. Accessibility map

Land Use

The surrounding functions of the site range from residential areas to shops and restaurants on the Al Rawdah commercial corridor (Figure 12). The benefit of being adjacent to leisure facilities is that ability of the Ecoplex to be seen by residents who wouldn't necessarily come to visit the project itself.

Residents who might be going to a commercial center in the area would notice the Ecoplex on their way and this may attract visitors. Also the Ecoplex has the opportunity to supply fresh produce to neighbouring restaurants and this will in turn encourage and support the goal of spreading local and sustainable food.

In addition, there is a park in close proximity to the site. This could allow collaborations between the park and Ecoplex to create educational activities for the public or have an extension of the market in the park.

Visual

There are all generic modular buildings nearby the selected location (Figure 13). This gives the Ecoplex a chance to stand out and be an iconic building within its surroundings.



Figure 12. Land use map

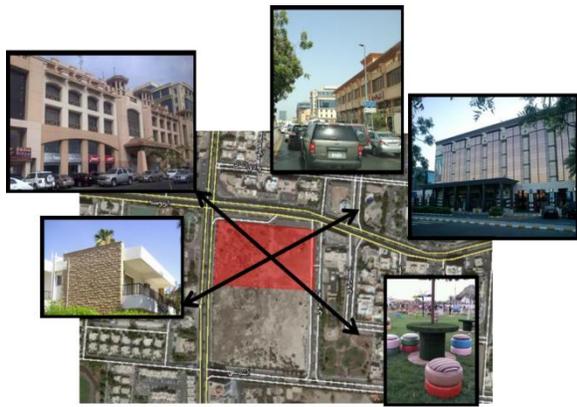


Figure 13. Visual analysis of surrounding

In overall, the selected site potentials are easy accessibility, high visibility, mixed use land of surrounding and oriented of site on north/south axis. The challenges of the selected site are restricted future expansion, congestion and negative views on the west.

ECOPLEX PROJECT

Figure 14 demonstrates the site zoning for this project. The primary zone such as urban farm, market place, education and awareness center are carefully located. The secondary zone such as research faculty, outdoor market and administration is placed according. Figure 15 demonstrates the location of each department in the project's building. The main perspective view of the Ecoplex is shown in Figure 16.

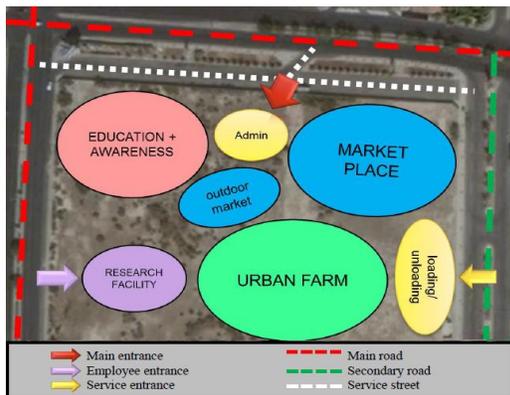


Figure 14. Site zoning of the project

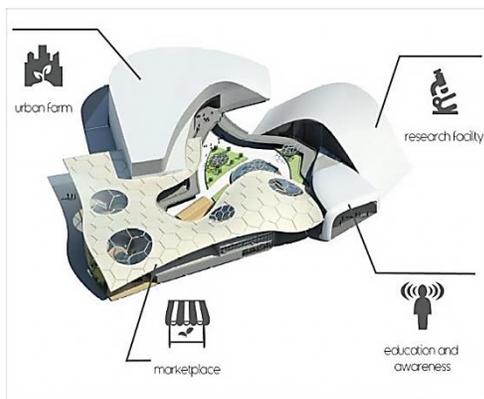


Figure 15. Site zone and allocation for specific department in the building



Figure 16. Main perspective view of the Ecoplex

CONCLUSION

The proposed project is a complex composed of four main components which are urban farm, research facility, education and awareness and marketplace. The selected site for this project is located at Al Rawdah district. The Ecoplex, short for Ecological Complex is an initiative to provide local, organic and sustainable food produce for the city of Jeddah. It aims to spread awareness of personal health and side effects of processed food by enhancing food quality available to the public. It will adhere to the sustainable sourcing of food by growing locally in controlled settings with environmentally friendly processes. The foods can grow locally without the restrictions of climate conditions. Saudi Arabia has the chance to reduce its carbon footprint while at the same time diversify its economy since it will not need to rely heavily of food imports. Thus, produce reaches consumers more quickly in a fresher state and with less carbon emissions. The Ecoplex does not claim to negate rural agriculture and food imports and render them unimportant in the presence of urban farms. However it offers more sustainable option that will helpfully complement the former two methods.

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