The Integration of Sustainable Cities in the Marshes (Iraq)

A A Rashid Kbah
AL Muthanna University, collage of Eng. Architectural Dept. IQ

ahmed.architect@mu.edu.iq

Abstract. The extensive marshlands of Mesopotamia represent a unique component of our global heritage and resources. The seas of reed beds were home to ancient communities rooted in the dawn of human history. The wetlands are the locale in which human civilization began with the Sumerian culture more than 5,000 years ago. Scholars regard the marshes as the site of the biblical "Garden of Eden," the "Great Flood," and the birthplace of the patriarch Abraham. On the shores of the marshes, the legendary Epic of Gilgamesh was enacted. World-renowned archaeological sites on the fringes of the marshes include Ur, Uruk, Eridu, Larsa, Lagash and Nina. The current marsh dwellers are our only link with this rich cultural past. Following the end of the Gulf War in 1991, the marsh dwellers were important elements in the uprising. To end the rebellion, the regime implemented an intensive system of drainage and water diversion structures that desiccated over 90% of the marshes. The reed beds were also burned and poison introduced to the waters. It is estimated that more than 500,000 were displaced, 95,000 of them to Iran, 300,000 internally displaced, and the remainder to other countries. By January 2003, the majority of the marshes were wastelands. From this point and to resettling the local community the research trying to present a sustainable village in the marshes that can be built from local materials and depend on the local society.

1. Introduction
Since 2003, the interest in the wetlands in Iraq in general and the Mesopotamian marshlands in particular became one of the most vital point of focus in Iraq. The biological diversity and the environmental, cultural and economic dimensions of this internationally important spot being of extremely high value. This spot had undergone the most vicious deliberate draining campaign during 1991–2003. The deliberate draining was performed according to well established extermination policy of the people and the environment. The UN took the campaign as one of the most damaging catastrophe committed against the environment in the 20th century. Starting from 2008, the water shortage in Tigris and Euphrates rivers due to the policies of the riparian countries, and the climatic changes represented by the shortage in rainfall rates have contributed to the environmental and hydrological deterioration of the marshes. Hammar marsh and the central marshes were once more experiencing draught which left any water there except for some deep depressions inside these marshes. I would like to mention here the water level in Nasiriyah Euphrates came to its lowest rates (17 m³/sec), which was an unprecedented event in Iraq.

2. Green villages project (from nature to people)
Sustainable development of the Marshlands requires a balance between development at the national, regional, and local levels, including a confluence of aspirations from both public and private sectors. The Eden in Iraq project has garnered robust support from all levels of the Iraqi government and the public sector. With your financial contribution and support, efforts to preserve the Marshlands will be greatly bolstered.
2.1. Overview
The pilot project of New Eden Village will take place in the area of Abu al Narsy (Figure 3), within a strip of land perpendicular to the River Euphrates, consisting of (from South to North):
- The land along the canal, stretching between the road and the bank of the River Euphrates;
- The road connecting Nasiriyah and Basrah in all its width;
- The lagoon.

The New Eden Village (NEV) is the first section of a greater project concerning, at this point in time, the area to the East of the canal, part of the Nasiriyah-Basrah Road and a part of the lagoon connected with the canal, covering an area of about 17.4 hectares.

The second section of the project will cover the future settlements along the west bank of the canal and the creation of new islands in the lagoon. The third section of the project will deal with the expansion of the settlement along the Euphrates, both upstream and downstream.

Each of the three areas defined above, includes three different settlement typologies that we are now going to describe (Figure 3).

2.2. Settlements
The village in the stripe between the Nasiriya-Basrah road and the Euphrates.

The village lies along the natural course of the canal that, departing from the Euphrates, flows into the lagoon, feeding it. The canal is the generative element of the whole settlement (Figure 4). The village consists of strips, parallel to the canal and inclusive of the canal itself, with landing places, wharfs, green areas; the bank along the stream, organized as a pedestrian walk; the area devoted to services and public equipments, connected to the riverbank and the Nasiriyah-Basrah through an internal distribution road; the residential plots facing it, that extend themselves, together with fields, up to the lagoon. The village structure has been designed according to the principles of hydraulic safety, in that the different levels both follow the existing heights and consider potential changes in the level of water.

2.3. The canal
The strip along the canal holds a distinctive landscape value; it follows the natural course of the water and includes, by each bight, green areas overlooking the river from 2.00 meters above the level of New Eden Village- Urban layout water, each equipped with small landing places, wharfs, goods exchange areas, pedestrian walks and routes to the village. The bank, standing 3.00 meters above the level of water, has slopes covered with local vegetation and is flanked by the pedestrian service walk, marked by a row of palms. The plots for services and public facilities Beyond the bank is a strip of plots, parallel to the Euphrates, which will hold public equipment and public administration (Figure 4).

More specifically, the first plot to the North is the Police Department, measuring about 1,317 sq.m, followed by the medical centre with a plot of 1,544 sq.m, the market place, stretching for 2,682 sq.m, the public administration offices covering an area of about 1,141 sq.m, the mudhif, with a surface of 1,502 sq.m, the school, with a surface of 4,185 sq.m, and the mosque, extended over 3,032 sq.m. Each plot overlooks the internal distribution road to the East and is bounded by the bank’s slope.

Plots are divided from each other by side streets and ramps connecting the internal distribution road with the bank. Each plot stands 2.00 meters above the level of water, with the exception of the mosque, which is 4.00 above the level of water. The internal distribution road The main road providing internal distribution to settlement is connected with the Nasiriya-Basrah. Road next to the bridge crossing the canal and serves the settlement up to the point where it joins with the riverbank of the Euphrates down South. The road gives access to the areas assigned to services and public activities as well as to the residential plots. From the road, all the secondary roads proceed transversally, connecting all the different parts of the village. The cross section of the road is made of a double carriageway, the pedestrian pavement and a row of palm trees (Figure 5).
2.4. The residential plots
Eastwards, the internal distribution road is faced by the residential plots, a total of eight plots, designed
to house families with about 10 members. Each plot, standing at a height of 2.00 meters above the level
of water, is equipped with a 510 sq.m area intended as the site for the residential building and its
appurtenances. Residential plots are closed on three sides by boundary walls standing 1.80 metres that
create a feeling of order and homogeneity along the road. New Eden Village- Urban layout On the
backside of the residential plots, at a height of 0.20 meters, are the agricultural fixtures, destined to local
crops and palm tree rows (Figure 6). On the northern and southern sides of the residential plots are,
respectively, a side road leading to the fields and an irrigation canal.

On the backside of the fields, along the lagoon, is a service secondary road, built with stabilized
material, connected with the Euphrates riverbank to the South and with the Nasiriyyah-Basrah road to the
North. Nasiriyyah-Basrah road to the North

2.5. The dwelling
The design of the residential buildings is based on the reutilization of the traditional typological and
structural elements and materials and the rediscovery of the local living traditions. The residential
building consists of a single floor, with a flat, terraced roof, shaded through a structure topped by straw
mats, devoted to night rest in the hot season. The courtyard disposition of the ground floor rooms is
designed to allow a permanent permeability with the external spaces and shaded areas below arcades
and open galleries, intended for home activities that have to be carried outdoor. The external porch is
also a distributive element and an entrance for the bedrooms. The building is organized around a main
entrance, directly connected with the road, around which are the living room and the kitchen, the latter
being also connected with the entrance trough a small patio (Figure 7).

The main entrance gives access to the arcade and to the porch. The house is designed to be easily
enlarged around the courtyard by adding new modules as required by the different needs of each family.

The house consists of the main entrance, the living room, dining room, kitchen, gentlemen room,
ladies room, children room, different bathrooms for men and women, arcade, shaded terrace. The shaded
terrace is accessible through an external stair. On the side facing the road, the building is based on the
external wall surrounding the plot.

2.6. Construction design
The house, for what concerns the building details, is built on a reinforced concrete platform, isolated
from the soil through a polyethylene sheet. The load-bearing wall is made of clay bricks and is 40 cm
thick. On the facade overlooking the internal courtyard, the wall tapers to 20 cm when it becomes the
terrace parapet, giving walls that sloping look which is typical of the local building tradition. The
horizontal structure is made of clay bricks, rafter, hollow blocks, and a concrete screed on top; along the
brickwork is a reinforced concrete riddle.

The terrace has a parapet and pillars made of clay bricks, while the terrace surface, strawmat over
cane bundles, is supported by a main load-bearing structure of cane bundles knotted side by side.

The same technique applied for the terrace is also used to build the arcade and the porch. The materials constituting the residential plot are reinforced concrete platform as a base for the building,
areas prepared with stabilized material for hard flooring and areas with earth soil for palm trees planting.
Building-wise, the road consists of two carriageways 3.00 meters wide, one for each direction, made of
a single layer of granular bitumen (close binder), 7 cm thick, above a layer of stabilized mixed gravel
for an average thickness of 10 cm, above filling soil stabilized with lime; along the carriageway is
a concrete drainage structure, a pavement of concrete above an electro welded net, a dividing concrete
kerb, an area with earth soil for planting a row of palm trees and, finally, the fencing walls, made of
plastered concrete and with a concrete cover on top.

The materials used for the plots devoted to public and service activities, are large squares of stabilized
material forming parking areas and squares, green areas and areas for the planting of trees, concrete
platforms as a basement for buildings, and concrete fencing walls by the side of the road (Figure 8). The
project area of the villages stands at ±0.00, +1.00 meters above the level of water; in order to reach the
height of the other parts of the project, embankments will be built with filling material, stabilized with lime, following the removal of the superficial part of the soil (and the vegetation) for a thickness of 20 cm and the spreading of a layer of nonwoven geotextile. The whole system of public plots, service plots and residential plots is provided with a network of the underground services of drinking water, sewage and electricity. The plant for the purification of sewage water is close to the Euphrates bank and can be reached through the secondary service road; the drinking water processing plant is along the Nassiriya-Basra road.

2.7. The road and its section
The project around the Nassiriya-Basra road will be located close to the bridge and to the lock regulating the level of water flowing to the lagoon (Figure 3).

On the southern side of the road, towards a village, in contiguity with the areas for services and public equipment, plots will be destined to small industrial plants, commercial buildings and the foro boario. In detail: to the west side of the canal there are two plots with a small industry destination, covering the area of 2,960 sq.m and 2,270 sq.m respectively, one plot with a commercial building, 1,980 sq.m, to the east side of the canal there is a plot of 382 sq.m, with the public destination (square and green area) closed to the way along the embankment, there is a plot for the foro boario covering an area of 1,569 sq.m and the last plot, 1,230 sq.m, is for the small industry activity. The road, re-designed at a height of 4.00 meters above the water level and the new plots, 3.00 meters above the water, are connected through a slope covered with vegetation and carriageable ramps.

On the North side, towards the lagoon, a secondary service road stretches out of the main road to reach the peninsulas overlooking the lagoon. The peninsulas will provide room for agricultural activities and palm plantations.

2.8. Construction design
The new road, consisting of two carriageways 3.50 meters wide, is built with a single layer of granular bitumen on the surface (close binder), over a stabilized gravel mixture. The road side will be provided with an embankment of earth soil (Figure 6). All the necessary embankments will be built with filling soil stabilized with lime, following the removal of the superficial part of the soil (and the vegetation) for a thickness of 20 cm and the spreading of a layer of nonwoven geo textile.

2.9. The islands in the lagoon
They consist of settlements inside the lagoon, along the canals perpendicular to the Euphrates, made of series of single islands, groups of several islands connected through bridges to service islands (Figure 11). The island system borrows from the ancient tradition of lagoon settlements, based on water buffaloes breeding and lagoon fishing. The placement of the islands has been designed according to the principles of efficiency and effectiveness and respectfully of the natural environment.

Therefore, based on the monitoring of the current state of the places, traces of former island formations have been identified and used as a trace for locating the new islands, appropriately resized and reshaped. The settlement consists of ten islands next to the two defined canals extending beyond the main canal. The islands are of two typologies: single or twinned with a smaller service island equipped with a building used as a shelter for cattle.

Smaller islands are service islands and have a minimum dimension of 480 sq.m, while the other islands range from 1,900 to 16,000 sq.m for the n.10 island only, which has two buildings on it.

On the various islands, eleven buildings will be built, each designed to house up to ten persons.

2.10. The house law coast
The site for building the house inside the island has been determined by studying the predominant direction of the wind, which is North-West, in order to provide a fair amount of natural ventilation. The typological study of the houses has been carried on in accordance with the pre-existing examples, putting great care into the materials and the building techniques. The planimetric disposition of the house provides a series of communicating rooms, divided between daytime areas and night time areas, with
the night time area divided between bedrooms for men and bedrooms for women (Figure 7). The house is designed to allow subsequent enlargements, depending on the needs of each family.

3. Sustainable Development and the Implied Views on Technology

Simple, technically sound, and practical eco-technology-based solution to the escalating sewage and waste problem in the marshlands. Humanitarian health and culture-empowerment project expressed through arts and design. Low maintenance needed following project completion. Effective combination of sustainable management of the marshlands' inimitable ecosystem and the development of the marshlands' social, cultural, and economic benefits. Abets water pollution in the marshes and the Euphrates River. Needed Cultural heritage and craft archive, as well as a site to experience beauty and restoration. Strong local partner (Nature Iraq NGO). The site offers future development through crafts, fruits, and other product concessions.

Figure 1. Drawing of Mesopotamian marshlands during 1973, 2000 and 2004.

Figure 2. Using the reed in the Construction of Guest house

Figure 3. Satellite image – location

Figure 4. General plan
Figure 5. Service road section

Figure 6. Land plan

Figure 7. Land house plans – section – elevations

Figure 8. Island house with sustainable materials
4. Conclusion

1. The main task in building low cost houses in the marshes is to find a simple structural frame which will make the house more durable and more functional. Wall and roof panels were produced using vegetable plants and their fibers after modifying them to be more fire-, insect and moisture-proof. The proposed new technique for housing in the marshes made of panel modules 1.5 m. could be made any size and was well received and utilized by the inhabitants.

2. During the construction stage of the trial embankment, the settlement was increasing linearly with the increase of embankment height in both the reinforced section A and the unreinforced section B. At section A the rate of settlement increased markedly when the height exceeded 3.4 m. The settlement of unreinforced section B was almost twice that of the reinforced section A.

3. For the industrially prefabricated reed board it was observed that when using reed as raw material, with or without adding soft wood, board can be industrially prefabricated with glue and cement for use in partition walls. In this case there is also the possibility of using these prefabricated reed panels in superstructures outside the marsh area. A small production unit was built in the marshes where those panels were manufactured and different binding materials and reinforcing frames were tested.

4. The improvements and protections used for the roofs, floors and frames proved to be very efficient and effective. After one year of observation no deterioration or rotting was observed. This was not the case for the non-treated elements which showed some signs of defect after six months. For the framework, which was very durable, erection was rapid even with the non-skilled, non-trained builders directed by a craftsman, all from the occupants of the experimental village.

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