Agropolis

by mam
# Project Details

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<td>Competition submission:</td>
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Overall view of Agropolis conurbations following housing typology script
Statement about
the Research Content and Process

Description
Agropolis is a design research project for a self-sufficient city in Khataba (Al Jadida), Egypt, that responds to an invited competition by Institut d’Arquitectura Avançada de Catalunya. It examines the rapid increase in peripheral and unsustainable satellite developments of the Nile Delta and aims to redirect the uncontrolled urban sprawl into new agro-urban settlements that grow in accordance with local farming activity.

The Agropolis has self-sufficient transport infrastructures and sustainable use of resources, food and energy production. Its morphology is developed out of pivot irrigation technology, and has a zero carbon footprint. Waste products, including sewage, household garbage and energy are recycled. Liquid waste is processed and used to support local irrigation. Electricity produced by solar panels is integrated into the buildings’ skins, lining roofs and walls, and the irrigation system.

Questions
1. How can an alternative high-tech, large-scale design approach generate sustainable urban development and agriculture in the Nile Delta?

2. How can centre pivot irrigation technology change the way future cities are theorised, planned and inhabited, when used as urban morphological blueprints?

3. How can an exploratory design respond to population growth forecasts and offer sustainable development in an environmentally vulnerable region?
Methods

1. Analysis of Nile Delta urbanism and its historical and geographical contexts to understand its infrastructure, environmental, agricultural and nutritional contexts.

2. Comparative studies of agricultural landscape traditions in the Middle East and North America, especially centre pivot and aquifer irrigation techniques.

3. Design conceptualization and iterations of research into urban water morphologies, food and energy production, and urban infrastructures.

Dissemination

The work has been discussed in *AD Exuberance* and *Futuristic*; reviewed in *Designboom*; and presented internationally in lectures in Syracuse, Madrid, Bogotá, Évora, Toledo, Nottingham, Rio de Janeiro, Lisbon, Cork and San José, Costa Rica.
Introduction

Agropolis is a conceptual proposal for a self-sufficient city in Khataba (Al Jadida), Egypt, designed for an invited competition organised by Institut d’Arquitectura Avançada de Catalunya. The rapid increase in the population of the Nile Delta, especially around Cairo and Alexandria, is forcing hundreds of thousands of people into peripheral and unsustainable satellite developments. This is happening both in the desert, in enclosed condominiums for the rich, and in the Delta, in shanty-town-like settlements for the poor. This proposal is for a series of self-sufficient towns intended to redirect the uncontrolled urban sprawl into new agro-urban settlements that grow in accordance with local farming activity.

Khataba (Al Jadida) is the first of these settlements, designed as a semi-urban and semi-agricultural self-sufficient environment – an Agropolis. The Agropolis has a self-sufficient local population, new transport infrastructures, a mixed programme and, above all, a sustainable use of resources, food and energy production.

Linear and circular agricultural patterns provide the morphological structure for the Agropolis and other new settlements to grow. A matrix of interconnected and complementary urban nuclei develop in the midst of new agricultural land, in particular in the interstices between gridded fields and large irrigation circles using water extracted from existing aquifers. Instead of monocultural zoning strategies, largely used in mid and late 20th-century urbanism, an ecologically balanced and diverse agricultural production would provide food for the community. Khataba (Al Jadida) is designed as a zero carbon footprint agglomeration. Different types of waste products, including sewage, household garbage and energy, are to be recycled. Liquid waste is processed and used to support the necessary irrigation of the surrounding fields. Electricity produced by solar panels is integrated into the buildings’ skins, lining roofs and walls, and some of the circular plots of land.

[fig. 1]
The central aim is to articulate an alternative, design-led model to current development in the Middle East where cutting-edge technologies offer new ways of expressing sustainability, revolutionising city design beyond carbon neutral buildings to large-scale agricultural and energy production. This gives rise to two objectives:

1. To integrate sustainable food and energy production into urban planning through technical investigations and morphological studies.

2. To propose a pilot scheme through exploratory design that accommodates forecast rates of growth sustainably in areas of extreme environmental vulnerability.
Centre pivot irrigation circles in Middle Eastern landscapes
1. How can an alternative high-tech, large-scale design approach generate sustainable urban development and agriculture in the Nile Delta?

2. How can centre pivot irrigation technology change the way future cities are theorised, planned and inhabited, when used as urban morphological blueprints?

3. How can an exploratory design respond to population growth forecasts and offer sustainable development in an environmentally vulnerable region? [fig. 2]
Speculative city design has a rich architectural lineage, envisioning new urban forms to address historical crises, from Howard’s Garden City and Le Corbusier’s Ville Radieuse, to Archigram’s Walking City, Fuller’s geodesic domes and Kikutake’s Sea Buildings.

Unplanned urban gardening and farming has become an increasingly popular global practice in large metropolises. Ancient Egyptians already used community waste to fertilise urban crops; this approach was also used in the culture of Kleingärten (allotments) in the 19th century, which offered ‘green oases’ away from the rapidly industrialising and heavily polluted German cities in which children could exercise and cultivate gardens.

This proposal offers an alternative to renowned Middle Eastern eco-city projects, such as Xeritown in Dubai designed by X-Architects and SMAQ, and Masdar City in Abu Dhabi by Foster and Partners and Mott MacDonald, which have been criticised as gated, luxury enclaves for the wealthy. Agropolis accommodates low-income housing and goes beyond an understanding of sustainability that is limited to construction and building performance, to address ecological and nutritional necessity through local food and energy production.
Methods

Analysis

Cairo’s rapid expansion in the 20th century was achieved at the expense of the Nile Delta. Predicted demographic and urbanising trends led this project to confront three interrelated crises threatening Cairo’s future:

a. Infrastructure

Hundreds of thousands of people are forced into sprouting desert satellite settlements dependent on the capital for jobs and the Nile for resources. Their inflexible planning comprises a typological uniformity of exclusive condominiums that lack vegetation and overstretch energy and transport infrastructure.

b. Environment

This urban sprawl forces over-intensive water use, diminishing the Nile Delta, whose fragile boundaries recede as it extends to Alexandria.

c. Nutrition

Egypt faces an extraordinary crisis in food security and nutrition owing to inadequate national production, particularly in wheat. Cairo is suffering from an acute increase in food imports, making the country increasingly susceptible to price fluctuations of the international markets, with basic goods becoming too expensive for the majority of the population.

[fig. 3–7]

Location of Khatabi (Al Jadida) on the edge of the Nile Delta, north of Cairo

Image in the public domain via NASA
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Location of site close to the Nile River
Unsustainable sprawl of enclosed condominiums on the outskirts of Cairo without environmental preoccupation
Comparative study

Cairo is surrounded by expansive virgin territory governed by flat, arid desert landscape. A comparative study of new environments facing similar ecological preoccupations in the Middle East and the Americas shows settlements not determined by pre-existing approaches to natural and urban sustainability are coping with food demand and population increase by embracing experimental technologies.

Centre pivot irrigation techniques in the United States, pioneered in Arizona and Arkansas and emerging in the Middle East, provide an efficient system where irrigation circles are employed as a means to irrigate large surfaces with very little water which, in turn, is extracted from existing aquifers or rivers. This technology offers the potential to go beyond schemes that mitigate resource consumption by reconfiguring production through integrated environmental and built elements. In this part of Egypt the aquifers are regularly refilled with water from the Nile Delta, turning this system into an ecologically balanced and economic practice. [fig.8–11]
Irrigation circle concepts (Kapil Amarnani Chawla)

Views of sprawling linear housing areas in between urban nuclei along the proposed new railway line linking Cairo with Alexandria with possible expansions of other Agropolises along the Nile Delta

Preliminary computer study plan using Rhino
Design concept

a. Morphological pattern

Water has a functional and symbolic importance in Islamic societies in which wells are organising elements at the heart of the city or settlement. Irrigation patterns traditionally shaped the urban landscape as cities had developed around subdivided strips of agricultural land in thin orthogonal plots.

Agropolis reintroduces water as the centre of activity through sprinkler systems that organise the environmental habitats. The circles provide the basic agricultural infrastructure laying down a framework within which, and between which, there is the potential to grow cities.

The proposal rejects the idea of traditional peripheral urban growth around dominant central hubs, depicted in sociological models such as Ernest Burgess’s concentric zones, Homer Hoyt’s sectors, and Chauncy Harris and Edward Ullman’s multiple nuclei. Agropolis inverts the radial city model, built around agricultural centres to offer a new identity where crops and cities grow symbiotically in a sequence of autonomous linear and circular agricultural morphological patterns.

The circle morphology grows in scale from wastewater purification silos to small public squares, road networks around plots, large agricultural centres and forests. The segmented circles of centre pivot irrigation demarcate multi-cultivated crops, and the cylindrical built form echoes this pattern in an arrangement that gives rise to a variety of interlocking programmes within a controlled spatial framework. [fig.12–29]
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Morphological circle studies (Kapil Amarnani Chawla)
Morphological circle studies (Kapil Amarnani Chawla)

Morphological study with different urban grids inserted between irrigation circles (Kapil Amarnani Chawla)
Detail of in between areas (Kapil Amarnani Chawla)

Detailed expansion drawing with dashed proposed train line
Expansion development diagram of Agropolis in three different stages over a period of ten years.
Different irrigation circle uses, on right with photovoltaic panels

Overview of different nuclei
Stage 1: The existing site is developed to include new elements and improve the overall design.

Stage 2: New elements are introduced to enhance the site's functionality and aesthetic appeal.

Stage 3: The site is further developed to incorporate new, innovative features.

Stage 4: Final adjustments are made to ensure the site meets all necessary requirements.
Various housing typologies and other programmatic distribution on-site

26 (previous page)
One of the urban nuclei with typological subdivision of housing allotments

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Studies of linear path for housing typologies and connection nodes

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Various housing typologies and other programmatic distribution on-site
AGROPOLIS: Strategic Development

- **AGROPOLIS 5: Urban Settlement**
  - Initial Development: 2000
  - Planned: 2020
  - Population: 50,000

- **AGROPOLIS 6: Commercial Settlement**
  - Sustainable Development:
  - Planned: 2020
  - Population: 50,000

- **AGROPOLIS 7: Education Centre**
  - Development of Educational Centres:
  - Planned: 2020
  - Population: 50,000

- **AGROPOLIS 8: Industrial Area**
  - Emerging Industrial Area:
  - Planned: 2020
  - Population: 50,000

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**Strategic Development of the Agropolis 2020-2030**

Date: July 2020
Strategic development between 2020 and 2100
b. Food and energy production

The Agropolis pioneers productive planning, yielding crops in landscaped circles and solar energy in the built form. With food and energy production at the heart of the scheme, it embodies efficient sustainable planning, minimising waste and maximising renewable resource consumption. The proximity to food production and consumption benefits the population, eliminating reliance on external purchases and independently satisfying its demand for food.

The buildings echo landscape forms, but encompass cutting-edge energy production in highly absorbent material using multi-layered skin with solar-pixels. This references MIT research which develops a way to double the performance of traditional solar panels by using dyed glass and fibre optics as a layer placed on top of existing solar arrays. The sheen of these panels on the built form echoes the reflective qualities of water. Circular silos are used for water purification and recycling waste products, which are used to irrigate the surrounding farmland. [fig. 30–38]
Diagrammatic section with sun exposure
View of urban nuclei in Agropolis with expanding linear housing areas in between
Overall view of Agropolis
c. Built infrastructure

By using the left-over spaces that are usually considered to be wasteland, new town centres develop in the interstices between irrigation circles and gridded fields, creating a matrix of interconnected and complementary urban nuclei in the midst of agricultural land. Housing in parallel rows around circles can form streets, with linked networks between settlements directing growth into conurbations. Some houses surround the circumference of circles with wedge-shaped gardens and communal points in centres, while smaller sets of circles become public squares of the city.

A series of tests develop programmatic solutions and their application to the site. The ground levels host facilities for agricultural manufacturing, along with small- and mid-scale commerce, workshops for local craftsmen, and cultural/educational/health services on a main street. The upper levels host offices and other ancillary services. [fig. 39–44]
View of six nuclei and linear housing massing between
Programmatic distribution of Agropolis and final views with expanding housing typologies on curved linear path
Dissemination

The authors have discussed the work in the following publications:


The work has been reviewed on various architectural and design websites, including in Designboom (2010).

It has also been presented in national and international keynote presentations and invited lectures:

Keynotes
Privado e Publico symposium, Faculdade de Letras da Universidade Tecnica de Lisboa, Lisbon, Portugal (2011)
Biomimicry Challenge conference, Syracuse University, New York, USA (2012)

Invited lectures
Syracuse University, New York, USA (2010)
ESAyT School of Architecture and Technology, Universidad Camilo José Cela, Madrid, Spain (2010)
Universidad Pontificia Javeriana, Bogotá, Colombia (2010)
Universidade de Évora, Portugal (2011)
Veritas Architecture Festival, Universidad Veritas, San José, Costa Rica (2011)
Universidad de Castilla-la-Mancha, Toledo, Spain (2011)
Nottingham Trent University, UK (2011)
Faculdade de Arquitetura e Urbanismo, Universidade Federal do Rio de Janeiro, Brazil (2011)
Fundação Berardo, CCB, Lisbon, Portugal (2012)
University of Cork, Ireland (2012)

Presentations
LUSO conference of UK-based Portuguese researchers, University of Nottingham, UK (2011)
Related publications by the researcher(s)

Book chapter

pp. 52–57

Journal article

pp. 58–65

Related writings by others

Online review

pp. 67–75
Bloom
by Alisa Andrasek
and José Sanchez

House of Flags
by AY Architects

Montpellier Community Nursery
by AY Architects

Design for London
by Peter Bishop

2EmmaToc / Writtle Calling
by Matthew Butcher
and Melissa Appleton

River Douglas Bridge
by DKFS Architects

Open Cinema
by Colin Fournier
and Marysia Lewandowska

The ActiveHouse
by Stephen Gage

Déjà vu
by Penelope Haralambidou

Urban Collage
by Christine Hawley

Hakka Cultural Park
by Christine Hawley,
Abigail Ashton, Andrew
Porter and Moyang Yang

House Refurbishment in Carmena
by Izaskun Chinchilla
Architects

Refurbishment of Garcimuñoz Castle
by Izaskun Chinchilla
Architects

Gorchakov’s Wish
by Kreider + O’Leary

Video Shakkei
by Kreider + O’Leary

Megafame
by Dirk Krolikowski
(Rogers Stirk Harbour + Partners)

Seasons Through the Looking Glass
by CJ Lim

Agropolis
by mam

Alga(e)zebo
by mam

Chong Qing Nan Lu Towers
by mam

ProtoRobotic FOAMing
by mam, Grymsdyke Farm
and REX\LAB

Banyoles Old Town Refurbishment
by Mias Architects

Torre Baró Apartment Building
by Mias Architects

Alzheimer’s Respite Centre
by Niall McLaughlin
Architects

Bishop Edward King Chapel
by Niall McLaughlin
Architects

Block N15 Façade, Olympic Village
by Niall McLaughlin
Architects

Regeneration of Birzeit Historic Centre
by Palestine Regeneration Team

PerFORM
by Protoarchitecture Lab

55/02
by sixteen*(makers)

Enviographic and Techno Natures
by Smout Allen

Hydrological Infrastructures
by Smout Allen

Lunar Wood
by Smout Allen

Universal Tea Machine
by Smout Allen

British Exploratory Land Archive
by Smout Allen
and Geoff Manaugh

101 Spinning Wardrobe
by Storp Weber Architects

Blind Spot House
by Storp Weber Architects

Green Belt Movement Teaching and Learning Pavilion
by Patrick Weber

Modulating Light and Views
by Patrick Weber