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Remodeling informality into sustainable housing prototype, Alexandria case, Egypt.

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Executive summary

Urban informality and Encroachment of agricultural lands are two faces for one coin, by which the widespread of slums and imbalance in urban development is leading to the arbitrary urban expansion. These two challenges are tackling hundreds of threats on social health, economy, safety, social security and national stability, especially in developing nations and Arab countries such as Egypt. These arbitrary urban expansion are resulted from the lack of economical feasible housing policies, absence of government's planning control on slums spread and failure of some aspects in new urban communities (NUC) like transportation and social habits.

The main problem of spontaneous urban development is not about building houses and providing various services, but that urban expansions are taking place. It is proved that houses can be provided to the poorest people but this is not enough. The essential trend is to provide a house that fulfills basic needs for occupants in a healthy environment that satisfies educational, entertainment and basic services. Moreover, there are many reasons for the spreading of urban informality such as rapid population growth, high pollution rates, rapid increase of land prices, and public health, and sanitation, development of basic urban services and scarcity of job opportunities. Therefore, governments adopted new solutions like building new cities for low-income to stand for the crawl of informal encroachment on agricultural and desert land, save natural resources and creating environmentally friendly communities. Unfortunately, these cities failed to perform effectively as designed due to mismatch between the concept of new cities and the traditional urban culture, in addition to problems in accessibility, unplanned transportation and social services.

Land issue is not for housing alone but it covers various uses in urban areas. The lack of urban land governance has lead into imbalance between supply and demand of housing in both informal and formal market. Thus, a proper use of land either in hinterland and or urban area land essential to satisfy the increasing demand for housing and other social health amenities.

It is estimated that urban informality are occupied around 60% of Egyptian urban population. The main consequence of this phenomenon is leading to diseases outbreak, the collapse and drop of agricultural productivity and the increase gap of food supply. In addition to, the brutal effect on economy and tourism as tourists will adapt a sense of fear and insecurity towards Egypt, preventing them from enjoying the enchanting beauty of nature. Therefore, the paper will adopt Alexandria city as a case study, combining its characteristic as a touristic coastal city on one side and on the other side it is considered one of the most populated cities with informal houses that exceed 40% of populated area.

Many actions should be taken to control slums resulting from informal housing by inventing solutions to sustain land management and land administration. This will take place by the collaboration of global and regional organizations with governments, many planning authorities, Egypt's Informal Settlements Development Fund (ISDF) and many decision makers. But unfortunately, some of their frameworks and interventions fail to reach their goal due to lack of contact with local and low-income inhabitants, also many obstacles considering land value and investors' development plans. This leads to loss of inhabitants' right in a secure healthy life to maintain their work and livelihood.

This paper will explore two issues; first, it discusses the availability or absence of affordable land plots for the lowest-income sector of the society. Second, the proposal of a sustainable structural prototype housing unit, that will be designed to fulfill the needs of

low-income inhabitants who can't afford employing workers to build their homes, therefore they build them themselves although the lack of construction skills to quickly secure a house for their families. Therefore, if the government adopted this prototype, it will control spread of slums, land management and administration. Moreover, it will guarantee that the housing units achieve structural strength, environmentally friendly, ensuring a convenient social life and finally fulfilling aesthetic senses.

The previous will take place through many stages, starting from: presenting the housing problem in Egypt and most Arab countries, then addressing all possible reasons for this rapid growth in informal settlements in Alexandria, Egypt. Afterwards, a study for the effects of Informality on Nations and inhabitants will be undertaken and followed by concluding the different Approaches that should be embraced by governments and authorities to solve housing problems control informal unplanned settlements. Finally, a comparison between several structure systems will be held to end up with the most convenient structure for the proposed prototype. This selection will be decided after arranging criteria built up on a survey with some of low-income informal houses inhabitants.

In conclusion, the researcher will introduce new solutions to help governments in managing the widespread of slums on agricultural, illegal and state own lands, while leaving the new cities present in the desert nearby undeveloped. A new structure will be proposed to replace the informal weak structures, with demolished walls, cracked walls and bad ventilated spaces due to absence of windows and opening in walls, with a government produced housing units. These sustainable Prototype structures that will reduce the gap between government and inhabitants while following some rules of sustainability and environmentally friendly aspects without harming natural resources. In addition to, protecting inhabitants during extreme weather conditions like raining and help local people to make use of all surrounding resources in obtaining clean renewable electricity, re-use of water for irrigation, and strengthen social relationships between inhabitants. Finally, it will increase the aesthetic value of city and replaces informal unfinished slums buildings with governmental manufactures structures; in return this will return with social, health, economical gains and refreshment in the tourism field for countries.

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Introduction

Informal settlements represent a universal phenomenon, which many countries suffer from worldwide and Egypt is no exception. It took place due to the major population rates increase worldwide. Some countries cannot face this growth due to land limitations, other countries have wide empty lands, but failed to attract citizens to live there and afford houses that satisfy their needs and meet their economics budget.

Moreover, by studying the slums in Egypt, it is discovered that most inhabitants build their homes themselves while not having any experience in structures or building process. The previous lead to the birth of inhumane buildings without any proper finishing and sometimes it is left on bricks without any finishing. Moreover, some parts of building are left deteriorated with very week ceilings and walls, leading to danger on inhabitant's lives and a bad view for the country These informal settlements grow rapidly and away from state control, therefore its inhabitants live in deteriorated buildings with lack of basic services like clean water, sanitary drainage, electricity, paved roads, easily accessible schools and health units.

Therefore, governments should control these informal growth and communicate with its inhabitants to help provide them proper houses to satisfy all needs and affordable for all sectors. Also, it should take wide steps in formal land registration for the poor and enabling people to utilize the advantages of land ownerships.

Methodology

The research has adopted two main methods to fetch for the problems facing housing in Egypt and thus leading to the spread of informality and breakdown of governments' social, economical and educational stability and security.

Firstly, a literature review is undertaken with the help of various publications and official documents to explain the following:

- Defining the term "slums", "Informality", and "agricultural encroachment"
- Analyzing Informal settlements distribution in Alexandria city.
- Reviewing the reasons of widespread of slums in Alexandria city.
- Exploring the bad effect of slums on governments.
- Discussing land plot affordability and availability.

Secondly, the author will propose some solutions to discuss land plots affordability and conclude designs and structures for housing buildings, the previous will take place through several stages like:

- Undergoing a comparison between three structure systems to choose the most convenient structure.
- Explaining briefly the selected structure and reviewing an example.
- Designing a housing unit prototype
- Proposing sustainable implementations..

At the end, a conclusion will be generated to discuss the effect of using this new structure and how it will be assessing the government to keep an eye on informal sprawl and make sure there is a unified proper units with external finishing from one side, and help inhabitants to supervise the building of their own houses and be involved in the process of housing sector from other side. Also, governments should study the reasons of failure of their various steps taken to control informality through the years and try to develop their laws and legislations considering housing.

Section 1 / Definition and spread of informal slums

A slum is considered a poor housing unit that is built away from the eyes of governments and therefore lacks many legal services like electricity, water, sanitation, transportation and infrastructure. Therefore, it is leading to the widespread of unhealthy, unsafe, and socially undesirable residential areas. The main reason for the appearance of slums is the great increase in population that lead poor people can't afford houses that satisfy their needs; therefore they resort to two solutions:

- No secure land tenure, where citizens build on un-owned lands (state owned lands), leading to the term "Informality".
- Or they build homes on privately owned agricultural lands that are not stated by governments as residential areas, leading to the term "Agricultural encroachment".

The previous lead to the appearance of "Slums" that can be described as:

- Unsafe and unhealthy homes (like lack of windows, dirt floor, leaky walls and roofs)
- Overcrowded homes
- Limited or no access to basic services: water, toilets, electricity, transportation
- Unstable homes: weak structures are often blown away or destroyed during storms and earthquakes (Humanity, 2017).

-Informality

On one side, all private investors are investing their capitals in high and middle class housing, leaving the poor people unable to find affordable houses. On the other side, governments are either providing houses that don't meet the needs of inhabitants or they are incapable of affording a large number of housing units corresponding the rapid increase in population rates happening day after day. Therefore, poor citizens started to spread on state-owned lands, leading to unsystematic urban growth in Egyptian cities that in return has lost many of their lands planned for future development and was replaced with unsecure deteriorated communities that lack basic elements of accepted human life.

-Agricultural encroachment

The owners of agriculture lands allowed themselves to misuse the green plots and to illegally permit the Sprawl of buildings, projects, services and the non-agricultural utilization of agricultural. the previous led to the loss of huge areas of agricultural land in Egypt reaching around a million feddans, causing unbalance in agriculture production and many other economical disorders for countries.

Unfortunately, many owners sell their agricultural land plots after subdividing them, but developers illegally misuse these plots by building and erecting extended family houses or villas, while others made demarcation of plots of lands with stones in preparation for constructions. Sometimes infrastructure and services are available on these plots, sometimes they are illegally added, and sometimes they are completely missing (Nassar & Elsayed, 2017).

Egypt was exposed to a revolution in January 2011 that lead to absence of governmental supervision, therefore hundreds of illegal constructions and violations of buildings on agricultural lands have occurred. This led Egypt to lose more than 400,000 feddans (one feddan equals about 1.038 acres) over 40 years, including 90,000 feddans since 2011 due to encroachment activities on the agriculture lands (Samir, 2020).

Widespread of slums in Alexandria, Egypt

The total land area of Egypt is about one million sq. km of which only 7.6 per cent is inhabited, where the total population is approximately 102,334,404 (fig. I), with a growth rate 1.94 per cent (January 2021 est.), which is considered 1.31 per cent of the total world's population. Also approximately 95 per cent of the population lives within 20 km of the Nile River and its delta; vast areas of the country remain sparsely populated or uninhabited. Also, it is calculated that 43.1 per cent of the population of Egypt is urban, while the 57per cent is rural (fig. II) (worldometer, 2021).

Alexandria is one of the most important Egyptian cities on the Mediterranean Sea and is considered the second capital after Cairo. Moreover it is the second city after Cairo with the highest population that reached 3,811,516 while Cairo city reached 7,734,614 and it is now completely different from the first adopted master plan by the City Plan Council in 1918; slums cover approximately 3.25 per cent of the total area of the city and characterized by high population and poor infrastructure (Shalaby, Sherif, & Altan, 2017).

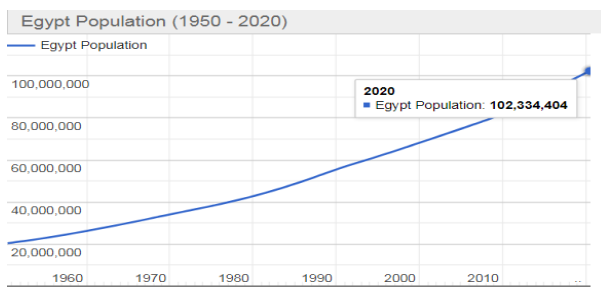


Figure I: Egypt Population (1950-2020)

Source: (worldometer, 2021)

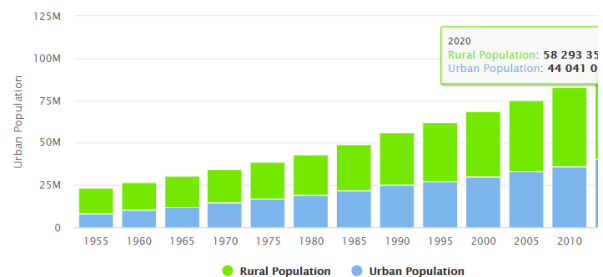


Figure II: Population of urban and rural in Egypt (1955-2020)

Source: (worldometer, 2021)

Moreover, this high population in Egypt and Alexandria city is condensed on a very small fraction of land area. On one hand, inhabitants are attracted to specific areas which are anywhere along water, like the Nile River and Mediterranean Sea in Alexandria, where urbanization, population growth, and economic expansion in industry, tourism and other sectors are presents. On the other hand, governments are not allocating lands for low-income that fulfill their basic needs economically, socially and educationally with the lack of transportation and many essential services. therefore, people created their own informal houses on lands through beating countries' laws, taking over land without tenure or changing governmental land use by converting agriculture lands into informal residential.

The previous leads to the spread of informal unplanned areas in Alexandria city, all areas are defined by how they were developed and the land tenure that owners have. Therefore, they are divided into three types as following (fig. III):

- The first type is; encroachment on agricultural land. It is found along the southern edges of Montazah, Sharq, and Wassat districts (fig. IV).
- The second type is; illegal settlement on public and voluntary dedicated lands used for charity compliant projects like mosques or religious schools. Developers take such land illegally and erect buildings without proper permits. These lands are mostly located near employment centers like factories or warehouse. Examples in Alexandria on these types are slums above Archeological site, like Tabyet Saleh (fig. V), and slums near factories pollution like Wady El Amar (fig.VI).
- The third type is; unplanned development on Bedouin land, where land ownership in the Egyptian desert is unclear, a piece of land may be owned by the Governorate

or a private party, or even the military, but also be occupied by the Bedouins who claim that the land has been theirs for hundreds of years therefore, they sell land to informal developers. These lands are mostly found in south-western (Al Ameriyah) parts of the city and King Marriout area like Zawyet Abdel Kader (fig. VII) (Nassar & Elsayed, 2017).

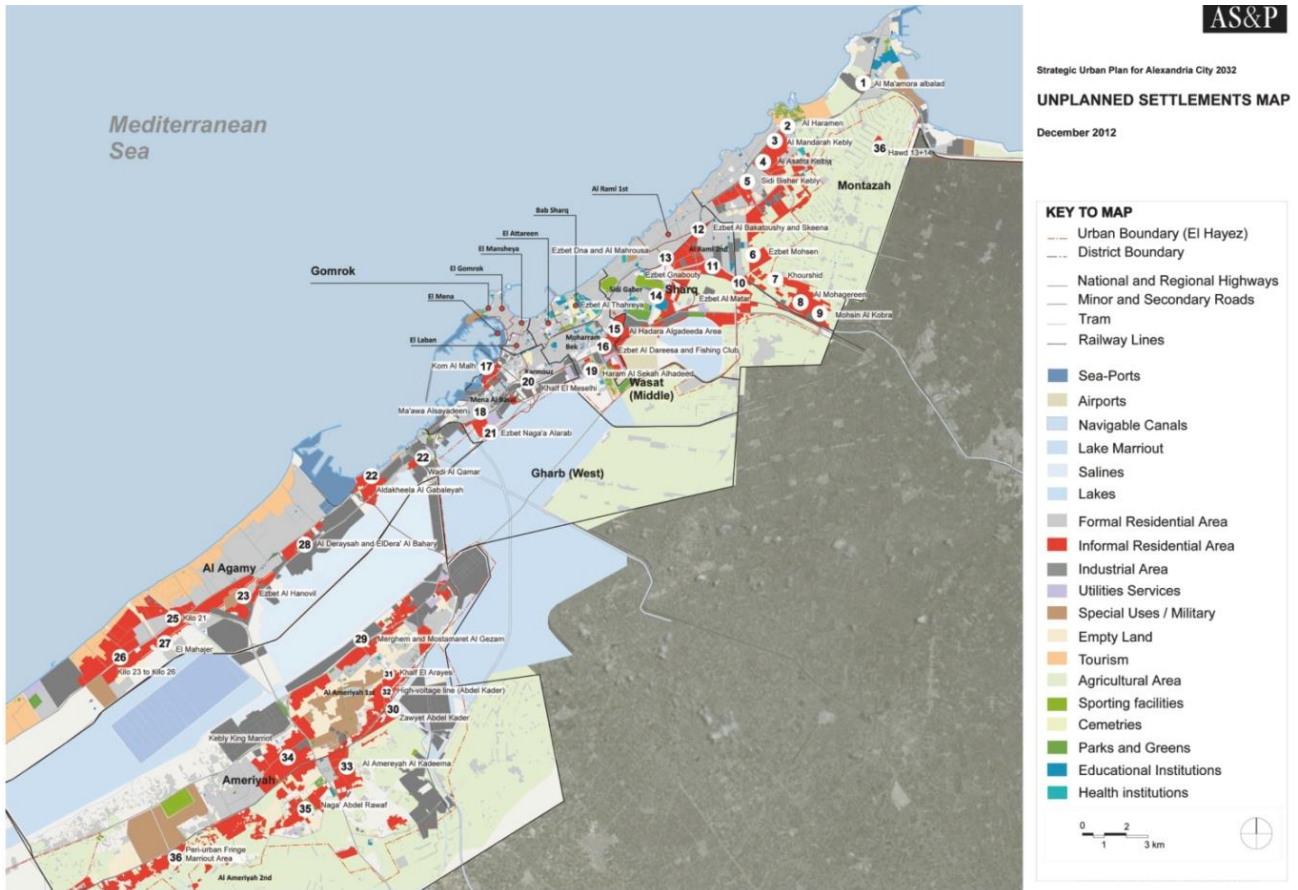


Figure III: Unplanned settlements map in Alexandria city
Source: (GOPP, 2014)



Figure IV: Slums on agriculture land like Ezbet Ibrahim Moussa, Montaza.
Source: (Google Earth, 2021)

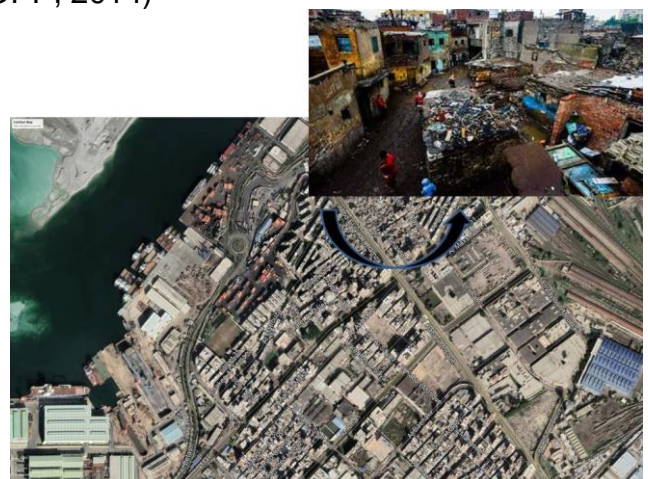


Figure V: Slums on above Archeological site, like Tabyet Saleh, Alexandria.
Source: (Google Earth, 2021)



Figure VI: Unsafe polluted areas near factories like Wady El Amar Alexandria.
Source: (Google Earth, 2021)



Figure VII: Unplanned development on Bedouin land like Zawyet Abdel Kader,
Source: (Google Earth, 2021)

This high population in Alexandria city is increasing day after day due to the migration of citizens from rural areas searching for work and better life, therefore due to lack of money, they settle informally by creating squatter settlements on adjacent agricultural lands. Moreover, it is estimated that between 1980 and 2025 nearly half of Egypt's agricultural land will be lost to informal settlements in the absence of planning or the ability to enforce present laws governing the housing development (UNDP/INP, 2004)

According to ISDF's classifications and estimations, they classified all the previous informal settlements into safe and unsafe areas that need quick intervention. These safe unplanned areas constitute 60% of urban areas with average density of 500 person/ feddan with building height ranging from 4 to 10 floors. They don't need quick interventions from authorities, but they need some maintenance, legalize the services and increase the aesthetic value of the exterior building. On the other side, unsafe areas are estimated to constitute 1% of the urban areas, with an average density of 200 person/ feddan, and the building height ranges from 1 to 2 floors. They are mostly deteriorated, dangerous on inhabitants and surrounding environment and do require deliberate intervention. The Settlement Development Facility (ISDF) has classified these unsafe areas into 4 grades of risk, which were ordered according to the degree of risk and thus the urgency for intervention (GOPP, 2014) (UNICEF & ISDF, 2013):

- Grade One: areas that threaten life including those located under or above sliding geological formations, in floodplain areas; or under threat from railways accidents.
- Grade Two: areas of unsuitable shelter conditions including buildings made of makeshift materials, e.g. shacks, sites unsuitable for building, e.g. solid waste dump sites or ruined buildings.
- Grade Three: areas exposed to health risks including those lacking accessibility to clean drinking water or improved sanitation, located in the vicinity of industrial pollution, or located under electrical power lines, like Wadi El Amar in Alexandria beside industrial zone.
- Grade Four: areas of instability due to insecurity of tenure including areas located on the territory of state-owned land, on sovereign quarters or on the territory of endowments.

Section 2 / Informality and land affordability in Alexandria, Egypt

Reasons of Informality

There are many Factors causing the spread of informal houses whether on agricultural lands or state-owned lands. According to classifications proposed by (Afify, 2004) on the reasons of the spread of informal settlements, the paper reclassifies the reasons according

to three aspects of governmental, economic or social aspects and they can be summarized in table I as follows:

Factors leading to the spread of Informality	Exploring and Explaining the reasons	Aspects		
		Government	Economic	Social
Demand and supply in housing sector	There is an imbalance between the demand, resulting from unstoppable high population growth rates, and the supply of formal low-income houses for urban expansion. The government supply high and mid-high houses which is not affordable by most of its citizens. Therefore, between the government's neglect ion of providing low-income houses from one side, and abstention of the private investors from this type of housing, this lead the poor to informally build their houses themselves on un-owned or agriculture lands.			
Renting	Spread culture of housing ownership and the income gap compared to the economic cost of housing construction leading to an increased gap between supply and demand.			
Laws	Presence of Inadequate laws for the regulation considering housing market and renting of private enterprise and investment, which causes the withdrawal of the private sector from the housing investments.			
Security stability	Egypt has directed its budget and resources to the successive wars that it has faced war in the late 60's and early 70's.			
Migration	There is a misplaced believe that for better standards of living are in cities only, leading the rural to move to large cities searching for job opportunities that are mainly concentrated in cities like Cairo and Alexandria, where basic infrastructure and markets are available.			
Urban expansion	Inconsiderable rates of urban and industrial expansion, which outstripped the capacities of existing urban areas.			
People building themselves	Due to economical conditions, citizens build their homes with their hands to save the cost of labors, while having no experience in building field. These self-designed and self-built houses with local materials are week because loads are not calculated and they are mostly left with red bricks without external finishing.			
Unemployment	Increase in unemployment rates from one side and the failure of governments and relevant authorities in providing appropriate houses for unable inhabitants, forcing people to build informally in any convenient place from their view.			
Capital Accumulation	The accumulation of capitals in specific places far from the housing of workers, also companies do not always provide housing for workers/ therefore, employees who can't afford buying new houses or bear the transportation cost from house to work, they just build an informal house in the closest spot to work.			

Source: Researcher, 2021

According to all the previous reasons, Egypt has imposed many contemporary policies to stand for the slums growth and provide low-income citizens with suitable houses, but these policies failed to work efficiently due to many reasons. These are: the lengthy negotiation procedures, the lack of political will, inadequate cost recovery, poor choice of site location in terms of job opportunities, social services, site accessibility, transportation, and finally the incorrect implementation process (Soliman, 2009).

Effects of informal slums on community

There are numerous negative effects for unplanned urban growth on communities' especially on third world countries like Egypt. These negative impacts will be affecting many aspects like health, safety, environmentally, economically, aesthetic values and disasters. All the previous will be summarized briefly as the following in (fig. VIII):

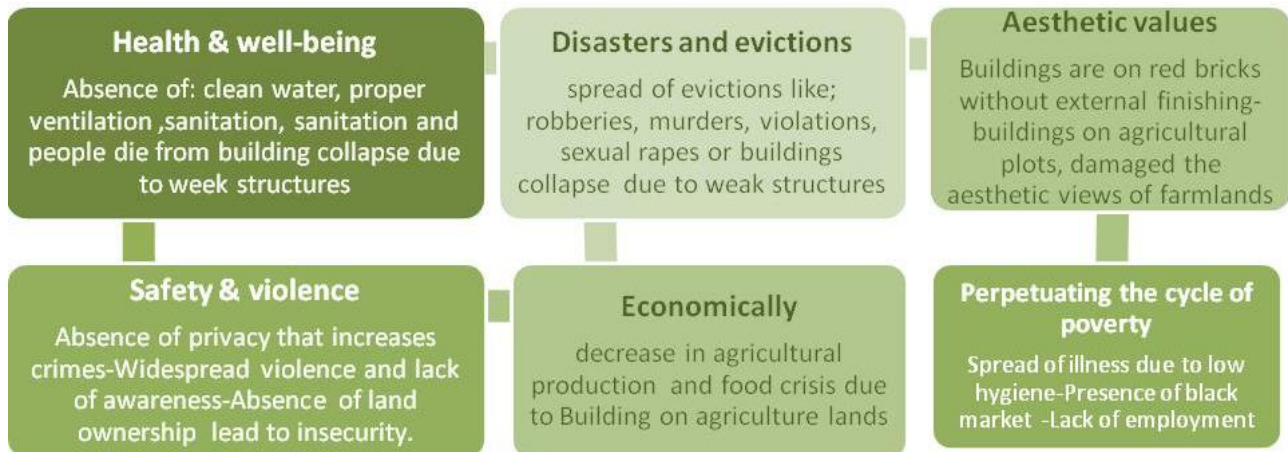


Figure VIII: Effects of informal slums on community
Source: Researcher, 2021

Governors and decision-makers are distracted of a major psychological crisis concerning citizens' feelings of security and justice, as Due to absence of land ownership for low-income residence in Egypt, whether in planned or unplanned areas, they do not hold titles to their properties. This prevents them from full exploitation of land ownership like applying for mortgages and feeling secured by owning legally their homes (Golia, 2015).

As a conclusion on all negative impacts of informal slums, it is found that it doesn't affect negatively on its inhabitants only, but on all surrounding natural environment and the whole country. This lead to a great decrease in society productivity and values, imbalance in the Egyptian urban system and harder living circumstances that affects people psychologically, physically and healthily. Therefore, it is a necessary to develop an integrated urban policy that puts all State efforts in building new cities and desert hinterland villages, and developing informal settlements in the framework of a clear general plan that implements priorities (EEAE, 2018).

-Land plots affordability

Land availability, affordability and locations are one of the main obstacles facing housing problems in Egyptian cities. Alexandria has indicated that the urban poor have relied on informal access to urban land leading to the creation of huge quantity of squatter settlements. Therefore, a conclusion was generated that security of tenure or legal title of the land or tenure recognition in practice, is directly correlated with the available resources of the squatter and the degree of government involvement in land acquisition (Soliman, 2009).

There are many concerns and issues related to land, and it will be gathered in the following points:

Land Price and market: Some of governmental interventions to develop slums and control their growth, has lead to a sudden increase in land prices and imbalance in land markets, this in return lead to the inability of the low-income people to live formally develop their homes. These interventions can be summarized as follows. First, in case of a project development in a fringe area which has transportation accessibility, work opportunities and is thus suitable for urban residents, the project has also led to increased speculation and land acquisition by the private sector in these areas example the west sector of Alexandria. Secondly, the commercialization of land through public auction helped to raise land market prices and encouraged landlords to subdivide their land either legally or illegally in order to compete with the government's prices. (Soliman, 2009)

Land Ownership: Governments have to facilitate the steps to reduce the time and fees of formal registration of property and supporting the development of local institutions that will govern property registration fairly and transparently. On one hand, Egypt should work to reduce urban sprawl through an assessment of urban land markets and legal and regulatory impediments to developing land within urban boundaries, including an evaluation of current construction, land-use planning regulations, and zoning enforcement. On the other hand, Egypt takes steps to improve slum conditions, including efforts to regularize land rights within informal settlement areas (LandLinks, 2010).

Land Location: Officials and decision makers should communicate and listen more to citizens to understand their needs because sometimes the housing problem is not due to absence of houses, but is due to presence of houses insufficient for inhabitants and not satisfying their needs. Moreover, some low-income communities, which are created by governments to solve housing problems and upgrade slums, have problems concerning transportation, linking them with cities main spines, absence of job opportunities and lack of main services like schools and hospitals.

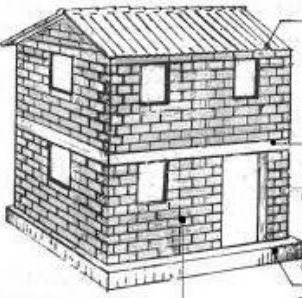


Section 3 / New structural proposal to control slums spread

-Structural housing units

A comparison will be held between three structure systems, to choose the most convenient one to be adopted by Egypt as a solution for informal housing. This structure will have two main roles; firstly, allow governments to rapidly exchange the deteriorated buildings and slums with strong, good aesthetic, well-designed and humane structures. Secondly, assess governments to control the future informal growth by providing low-incomes with economically feasible houses. Therefore, the following comparison will select the best structure for both governments and citizens. Three structures will be chosen for studying, the first two are considered the most famous, traditional and widely used structures in Egypt, which are load-bearing system and skeleton system. Finally, the third structure is a new one that is not used frequently in Egypt, but used abroad and famous for its rapid construction and economic gains. Finally, the most suitable structure will be reviewed within an example, and then used to propose a design for housing unit.

The following table II gathers many information about the selected structures and covering many aspects like: definitions, heights, loads movement, foundation, wall thickness, labors, materials and finally the advantages and disadvantages of each structure, all data gathered after several references (Mahajan, 2019) (Tutorial Tips Civil, 2018) (Eren, 2013) to allow the researcher to choose the most convenient structure for slums development and governmental stand for informal settlements.

Table II: A comparison between bearing wall, skeleton and box-unit structures.

Points of comparison	Bearing wall	Skeleton structure	Box-unit Structure
Images			
Definition	<p>Oldest structure, but now it is rarely used, only in rural areas and slums.</p>	<p>It is used mostly in construction nowadays</p>	<p>It is an industrialized construction system and not as old as old bearing and reinforced structure.</p>
Load movement	<p>Almost all the walls are load bearing walls.</p>	<p>Column supporting beam supporting slab. Walls are not but are partitions or screens.</p>	<p>Boxes are self-supported 3D spatial elements formed by the combination of wall panels and floor units</p>
foundation	<p>Load bearing subsoil walls are taken deep into the subsoil foundation.</p>	<p>Only column are taken deep into and provided with foundation footing.</p>	<p>A foundations base is set under the construction to bare the loads of box units</p>
Walls thickness	<p>Minimum 20 cm, depends on height</p>	<p>Exterior walls: 20 cm Interior: 10 cm or less</p>	<p>The unit dimension is height:3m, width:3.5-4m and length:6-10m)</p>
Materials used in construction	<p>Wall are usually constructed of bricks or stone</p>	<p>Column, beam and slab are all o reinforced concrete.</p>	<p>Pre-fabricated units in factories, made of steel and concrete</p>
height	<p>Three to Four floors</p>	<p>It can reach 75 floors</p>	<p>It can reach 15 floors</p>
labors	<p>High number of labors is needed as they stack masonry units over others. Skilled and non-skilled labors are needed</p>	<p>Fewer labors are needed compared to the load bearing structure. All labors should be skilled</p>	<p>The entire structure is factory-built, then transported to site. Therefore, it needs minimum number of labors as it is mechanization-based.</p>

Economically	Not Feasible at mega structures, as the cost will not decrease when production increase.	Not Feasible at mega structures, as the cost will not decrease when production increase.	Factory build repetitive unit is more feasible than other construction, the more units produced, the less overall
Advantages and Disadvantages	<p style="text-align: center;"><u>ADVANTAGES</u></p> <p>1-Tools and equipment used are simple and cheap. 2-High fire resistance 3-Cost of repair is low 4-Highly durable and solid.</p> <p style="text-align: center;"><u>DISADVANTAGES</u></p> <p>1-Due to rare presence of land plots in Alexandria with limitation of this structure's heights and impossible presence of cantilevers; therefore it will not achieve the highest benefit of lands and won't accommodate the largest number of people. 2-Most structures collapse during earthquake disasters 3-The construction process is slow as it depends on human process 4-It consumes more green resources, as it is considered the most structure that consumes masonry 5-Less flexibility in design and walls should be identical in all floors 6-Floor area is reduced due to thick walls</p>	<p style="text-align: center;"><u>ADVANTAGES</u></p> <p>1-High resistant to earthquakes 2- Speed in construction. 3-It is a greener construction, as it consumes less masonry 4-More flexible in architectural design 5-Multi-story buildings can be achieved easily and accepts cantilever presence; therefore it makes the best use of small land plots and can accommodate high number of residents. 6-More floor areas are available due to thin walls</p> <p style="text-align: center;"><u>DISADVANTAGES</u></p> <p>1-Cost of repair is very high 2-High cost at mega structure projects 3-Construction is mainly in site, therefore it will be affected through weather conditions and consume more time. 4-In case of self-built by inhabitants, it may cause its collapse due to miscalculation of loads.</p>	<p style="text-align: center;"><u>ADVANTAGES</u></p> <p>1-Strong structures as modules that make up a building are stronger and more durable than those built traditionally 2-Shortest construction time and speed of implementation 3-Higher durability and flexibility than conventional constructions. 4-Environmentally friendly 5- During construction: Disruptions are avoided, and no damage to neighboring buildings caused 6-Not affected by weather conditions. 7-Suitable for buildings containing a high degree of service units like housing. 8- Quality assurance at a high level is best achieved through off-site production and controls 9-Carried out prior to installation. 10-Construction is safe due to the use of modular units, allowing inspections at the manufacturing stage. 11-All necessary finishes are applied during manufacturing in factory and thus prepared</p> <p style="text-align: center;"><u>DISADVANTAGES</u></p> <p>1-Threats of Monopolies and Monotonies. 2- Organized changes in design and less choice. 3-Transportation difficulties.</p>
Source: Researcher, 2021			

-Selection of the most convenient structure with example

It is figured that the prefabricated “Box-unit” is the most structure because it has the most advantages and least disadvantages, therefore it matches the need of both governments and citizens to provide and obtain proper houses and control houses supply that meet population growth. These prefabricated units are transported to the building site; they are then assembled to form the box-unit. All necessary finishes are applied and thus prepared ready for use, units are delivered to the site for erection. Therefore, these units are considered an affordable, quick solution to housing shortages as the repetition in units’ production allow ease of transport and ensure scale economy in production.

Factory building enables production in a controlled environment unaffected by weather conditions as it is mechanization-based construction method manpower-based workmanship. It only takes around 50 per cent of traditional construction time to complete such structures. Moreover, modular construction can sometimes be greener than site-built construction, due in part to reduced site disturbance, decreased on-site construction time, and less waste production as a result of factory-based material recycling (Eren, 2013).

Eventually, an example on box-unit structure will be reviewed to complete the reveal of this structure. The example is “Homes for All – Dortheavej Residence”, located in Copenhagen in 2013 and designed to be a Danish non-profit affordable housing for low-income inhabitants (fig. IX). It contains 66 homes distributed on five floors each with space of 6,800 sq m. The view of hard concrete shells is softened by the magnificent arrangements of buildings into a long meandering wall that curves around a nearby courtyard and is clad in timber planks. Additionally, this softness is continued by a factory implementation of interior wood and concrete, leaving the apartment with an area ranging between 60 to 115 sq m (Arch20, 2018).



Figure IX: Homes for All – Dortheavej Residence
Source: (Arch20, 2018)

- Design of the housing prototype

The paper will introduce a structural design unit that can do the following:

- Creating new communities for slums’ inhabitants to live in
- Developing existing slums and using this structure for new buildings on empty lands, infill structures and replacing demolished buildings.
- Demolishing existing slums and rebuilding them rapidly in a formal design and following the laws.

Therefore, according to the previous studies of structure systems, slums formations and citizens’ needs, box-unit prefabricated units are designed with a size 4*9 meter and height

3.5 meter. These units are supposed to be manufactured in governmental factories and under its supervision and also will be well finished internally and externally. Moreover, by using one module unit with area 38 m^2 , it can be used as a residential studio for one to two inhabitants, whether single person or married couples, with one bedroom, living area, a bathroom and an open kitchen (fig. X). While, by adding two module units together, a small apartments will be formed for a family as it will be with an area 76 m^2 consisting of three bedrooms, living area, a kitchen and a bathroom (fig. XI). By adding more modules, bigger apartments will be created with various areas like 114 m^2 , 152 m^2 and more if needed.



Figure X: One box-unit module forming a 38 m^2 studio
Source: Researcher, 2021

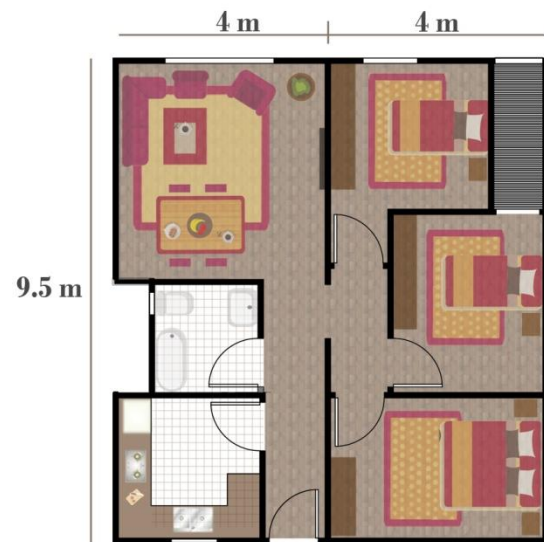


Figure XI: two box-units modules connected together to form a 76 m^2 apartment.
Source: Researcher, 2021

Residential buildings can be made up of both single studios (38 m^2 modulated with blue color) and family apartments (76 m^2 modulated with red color) (Fig. XII). Also, Box-units can be distributed either vertically or horizontally (Fig. XIII), according to the land plot area and height regulations in each zone in Alexandria city. Finally, these pre-fabricated units can be transformed into sustainable ones through many methods that are explained briefly in (Barakat, 2020) like:

- Green roof
- Water recycling in building
- Natural resources methods for energy generation
- Garbage and pollution control through smart pneumatic waste conveyance system

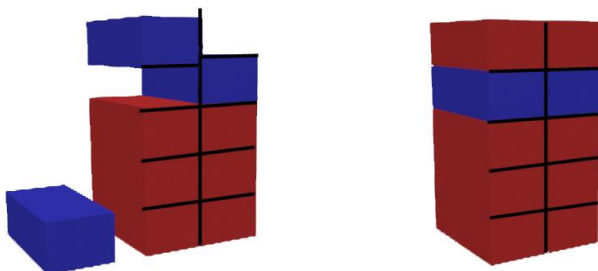


Figure XII: Box units distribution and implementation vertically
Source: Researcher, 2021

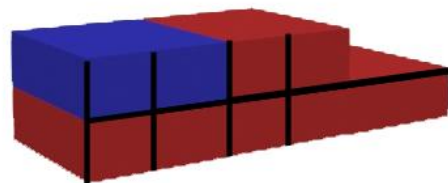


Figure XIII: Box units distribution horizontally
Source: Researcher, 2021

Conclusion

Many Nations and countries worldwide such as Egypt have faced a universal phenomenon summarized in the cancerous spread of informal settlements and expansion whether on state owned deserts, urban lands or agriculture land. These unplanned urban slums are built away from the eyes of the governments, therefore it is deteriorated in many aspects like sanitation, electricity, clean water and many social services that effects negatively on inhabitant's life. The paper fetches many obstacles to return land management to government in Alexandria city, as it is observed that many land decisions are unhelpful to people and discouraging them from building under governmental control and assist.

On one side, the vast majority of Egypt's territory is unusable or low-value desert. Its agriculture and population are condensed at the narrow Nile River Valley and Delta, about 4% of Egypt's total land and this affect agriculture lands massively as significant amounts of crops are being lost each year through degradation and urbanization. The government is countering this trend with massive and expensive efforts to reclaim land from the desert. On the other side, tenure informality is a key characteristic in informal settlements and in many cities like Alexandria, where private sector target is to develop land and invest their capitals in housing for high- and middle-income groups, therefore urban poor may have no option than living in informal settlement. There, inexpensive informal housing units were built, but not connected to services and they were built without benefit of governmental planning or any planning in general.

A production of a sustainable prototype housing structure is considered a save to assist in rationing constructing on agricultural land, new non-exploited lands that can be controlled by government and decreasing the negative impact of self-built houses on land. This pre-fabricated box-unit system is chosen as it is mainly employed in structures containing a high degree of service units, such as hotels, public housing blocks, student dorms, educational buildings, commercial structures, hospitals, and elevator shafts. Moreover, this structure is based on inhabitants needs and will allow government to pay attention to land plots importance and not just building communities for low-income, but also creating social economical areas that satisfy the inhabitants needs and still connected directly to cities and job opportunities.

There are many effects of this new Structural prototype on upgrading slums and controlling informal settlements. On one side, "box-unit" structure system could be considered a safe for governments as it will allow them to:

- Control informal growth with houses manufactured by the hands of government itself and make the best use of small lands,
- Rapid exchange of week demolished informal buildings with governmental manufactured buildings with minimum land area and least time.
- Replace the unfinished deteriorated structures with pre-fabricated units that are finished externally and internally in factories, this lead to a better aesthetic view and environmentally friendly buildings.
- End the series of disasters and evictions due to demolish and collapse of informal houses on inhabitants.
- Produce these box-units through governmental factories where the increasing of production will guarantee more economical feasible houses with less costs.
- Compensate governmental loss in control and not achieving the maximum benefits of self-helping Egyptian projects due to five reasons:

- First, most residents left all the work to contractors or subcontractors, and their roles were limited on week administration.
- Secondly, the project agency did not provide alternatives to the standardized non-local building materials offered, which the poor have neither the budget nor knowledge to use.
- Thirdly, a lack of cooperation among the residents owing to the fact that they came from different backgrounds, hampered self-help.
- Fourthly, the lack of loan provision to the poor slowed down the process of construction.
- Finally, there is an official insistence on construction in permanent materials, not traditional mud brick for example, but low-income groups cannot afford this form of construction, especially if it is to be completed within a limited time.

On the other side, these structures are attractive to low-income citizens as:

- Self-built week structures made by inhabitants, will be replaced with factory-manufactured strong and durable units.
- Time saving as they are the fastest housing solutions as they are delivered to site with complete exterior and interior finishing. Once they are assembled at site, they are ready to be inhabited.

These effects have positive impacts not only on governments and stakeholders, but also on citizens and therefore by applying it, this will lead to a complete renaissance to countries and satisfaction in all aspects. Moreover, this structure will change both the past and the future, as the already existing slums will be upgraded rapidly to create a decent life saved houses and will control the future by creating environmentally sustainable communities for low-income people.

References

1. Afify, A. M. (2004). TOWARDS STIMULATING MODERN URBAN UPGRADING POLICIES FOR INFORMAL SETTLEMENTS IN EGYPT.
2. Arch20. (2018). Homes for all Dortheavej Residence Bjarke Ingels group. Retrieved January 30, 2021, from Arch20: <https://www.arch2o.com/homes-for-all-dortheavej-residence-bjarke-ingels-group/>
3. Barakat, P. N. (2020). Urban Landscape Potential to Sustain Architectural Development, Case-Study: Moharam-Pasha Compound, Alexandria, Egypt. *Journal of Engineering Sciences Assiut University*, 317-327.
4. EEAE. (2018). Urban Expansion and Informal Settlements Phenomenon. In E. E. Agency, *Urban Areas Expansion* (pp. 122-131). Egypt: Ministry of Environment.
5. Eren, O. (2013). BOX CONSTRUCTION SYSTEMS APPLICATION PRINCIPLES. *Transformation through Construct*.
6. Golia, M. (2015, January 15). Egypt's Need for Low-Income Housing. Retrieved February 3, 2021, from Policy Analysis: mei.edu/publications/egypts-need-low-income-housing
7. Google Earth. (2021, February). Alexandria, Egypt.
8. GOPP. (2014). Strategic Urban Plan Alexandria 2032. Alexandria: General Organization for Physical Planning of the Arab Republic of Egypt.
9. Humanity, H. f. (2017). Habitat for Humanity® Great Britain. Retrieved January 11, 2011, from <https://www.habitatforhumanity.org.uk/what-we-do/slum-rehabilitation/what-is-a-slum/>

10. LandLinks. (2010, September). Land Links Egypt. Retrieved February 2, 2021, from USAID : <https://www.land-links.org/country-profile/egypt/#1529004622788-bd9da56c-a0b3>
11. Mahajan, B. (2019, August 4). Difference Between Load Bearing and Frame Structure. Retrieved January 27, 2021, from Civiconcepts: <https://civiconcepts.com/blog/difference-between-load-bearing-and-frame-structure>
12. Mansour, S. F. (2016). The economics impact encroachment on agricultural land in Egypt. *Egyptian J. Desert Research*, 235-250.
13. Nassar, D. M., & Elsayed, H. G. (2017). From Informal Settlements to sustainable. *ELSEVIER*, 2367–2376.
14. Samir, S. (2020, September 12). Cancerous building on agricultural lands should be curbed in Egypt. Retrieved January 11, 2021, from Egypt Today: <https://www.egypttoday.com/Article/1/91878/Cancerous-building-on-agricultural-lands-should-be-curbed-in-Egypt>
15. Shalaby, H. M., Sherif, A., & Altan, H. (2017). The impact of the informal area expansion on the urban natural ventilation of Alexandria. Springer .
16. Soliman, A. M. (2009). Housing the urban poor in Egypt: a critique of present policies. *International Journal of Urban and Regional Research* , 65-86.
17. Tutorial Tips Civil. (2018, September 3). What is super Structure? and difference B/W load bearing & Framed structure. Retrieved January 27, 2021, from Tutorial Tips Civil: <https://tutorialstipscivil.com/civil-topics/load-bearing-structure-vs-frame-structure-for-civil-site/>
18. UNDP/INP. (2004). The Egypt Human Development Report. Egypt: United Nations Development Programme, and The Institute of National Planning.
19. UNICEF, & ISDF. (2013). Multidimensional Child Poverty in slums and unplanned areas in Egypt. Egypt: UNICEF.
20. Worldometer. (2021, January 12). Egypt population. Retrieved January 12, 2021, from <https://www.worldometers.info/world-population/egypt-population/#:~:text=The%20current%20population%20of%20Egypt,of%20the%20total%20world%20population.>