



An Urban Sustainable development Model Based on the Valid Parameters Existing within Informal Communities

(A Case study on the garbage recycling community in Cairo)

Ahmed M. Albadawy¹, Hesham T. Eissa²

¹Teaching Assistant, Department of architecture, Delta Higher Institute for Engineering and Technology, Mansoura, Egypt.

²Associate Professor, Department of Architecture, Delta Higher Institute for Engineering and Technology, Mansoura, Egypt.

Abstract. : This research is a proposed upgrading model for an existing self-organized urban pattern known as Zabbaleen district in Cairo. The area is a part of Manshiyat Naser settlement which is the largest informal community in the city of Cairo, Egypt. This type of informal urban form and particularly the case study model in hand (Garbage City) motivated authors to discuss the existing potentials of this self-organized community. Those potentials are lessons to learn from; such potentials may change the way of current upgrading methods employed by scholars and professionals. Garbage city is a unique model of self-organized community in a complex urban fabric that offers living and working in one place and has the most efficient recycling system worldwide; an inspiring model of self-built economy and successful recycling system built by inhabitants who live and work in poor conditions. This research suggests a method that considers the advantages and disadvantages of such community as opportunities for upgrading plans. Observing people's behavior is a key parameter in the proposed method of upgrading. The aim is to propose a contemporary model of self-sustained recycling community based on existing social, economic and environmental parameters. The proposed upgrading opens the discussion about how spontaneous urban forms can inspire formal urban planning strategies and vision by observing its structure and growth. Therefore, raising the question of how the future intervention can achieve success through the development of self-organized communities depending on existing parameters?.

1. INTRODUCTION

Globally, one out of eight people lives in slums which mean around billion people live in informal urban communities today. They suffer from poor living conditions such as insufficient living area, housing fragility, and lack of basic services such as drinking water and sanitation (UN Habitat, 2016). While poverty and worst urban housing conditions are some of the used keywords that describe the situation in slums area, many positive features can appear through their independent character as a community, that has self-developed rational economy, innovative living solutions, and

a kind of solidarity that is usually unknown in the planned neighborhoods (UN Habitat, 2003).

Egypt is witnessing a steady rapid growth of population in cities accompanied with wide expansion of informal areas as well. Nevertheless, Slums keep the wheels of the city working in many different ways. Our focus here is: Cairo's garbage city with around 70,000 in population is an example for a productive informal settlement (Fahmi and Sutton, 2010). Garbage city, at the base of Mokattam hills on the outskirts of Cairo, is a district with the majority of people classified as garbage collectors.

“They have created the world’s most effective resource recovery system; they are actually saving our Earth. From out of the trash, they lifted themselves out of poverty and have a solution to the world’s most pressing crisis,” said Garbage Dreams Director and Producer Mai Iskander (IDA 2009).

This research introduces the Garbage City as an example of spontaneous productive community (rather than informal) in terms responding to their living needs without having urban design skills. The formation of urban spaces and its relation to the social behavior and daily recycling process is well considered by inhabitants associated with highlighting important social, spatial and economic aspects that have produced successful recycling community. The main drawback of such informal productive community is garbage recycling process that has insufficient infrastructure, facilities, and associated with environmental contamination. However, we believe this productive recycling community has the opportunities of being a model for future sustainable developed community as it has potentials regarding the way inhabitants structured their place.

2.BACKGROUND

One of the current urban developers’ debates is how the global community deals with slums issue and how academics and practitioners view and develop plans incorporating physical dimensions of urban upgrading within its societal and environmental components (Jean, Jérôme and Yves, 2016). The economic power struggles of the globalized world are considered to be main cause of the slums phenomena (Davis, 2006). Davis also argues the way the world sees slums and its inhabitants as a worst shape of new world.

Also Gouverneur has a substantial opinion regarding same view:

“Informal settlement should not be seen as a problem but rather a consequence of historic and structural deficiencies of developing societies that are experiencing exponential rates of urban population growth... Self-constructed cities are a dynamic form of urbanization in constant transformation, rich in diverse socio-economic relationships and physical morphology and with a unique ability to adapt to local conditions” (Gouverneur, 2015).

An opinion has been derived out of current understanding of slums urban handlings: always

slums treated either in a hostile transaction or in a notional intervention. The first action was mostly a governmental solution to just eradicate the phenomena and the second one usually comes from some charitable agencies and individual efforts. Those are two contradicted views; the first thinks of slums as a problem has to be eliminated and the second considers it a community needs solution. Therefore, this debate affected the upgrading methods in both cases.

In addition, although there is an implicit recognition that world economic policies has a major responsibility in the emergence of informal urban growth, there is a lack of serious decisions to behave with the phenomena and curb the problem from its roots.

In the case of Garbage city, most of official (governmental) upgrading plans lacking objectivity and respect to the social composition and its self-built economy. Their adopted strategy is usually lean to urban demolition and mandatory migration which is consistently faced by the rejection of community (Fahmi and Sutton, 2010).

Same opinion has been concluded in many researches:

“The Zabaleen (garbage collectors slum) are facing a real crisis. The authorities need to look at the effects of their decision could have on local income, employment, economic growth, trade, manufacturing and environmental conditions. I would like to see the operations of the Zabaleen formalized and given a fair chance to use new recycling technologies. The idea of moving them to the desert and squeezing them further out of their trade is not right. These contracts are costing the city big money. Why not spend just 10 percent of such a budget to upgrade the Zabaleen system?” (Kamel, 2003)

On the investigation analysis level there is one of the few considerable researches in 2010 has been introduced by Flavia Conrad and Vanessa Jooss, ETH Studio Basel Contemporary City Institute in Switzerland and titled “Mokattam: World’s largest recycling hub”. The work was a successful try in discussing and analyzing the case in hand from different social and economic perspectives. Locally, some educational organizations and social work groups had been worked on partial applied researches within limited funding to enhance a particular location seeking better living condition (Conrad and Joos, 2010).

3. MOTIVATION

Even though, there is a lack of effective scientific contribution to the case of Garbage city. The high potentials of this recycling collaborative system did not find appropriate reaction from the scholars' community to work on and learn from.

As a result for this diversity of upgrading theories and methodologies, Garbage City as such as other informal areas falls in temporary solutions that have limited effect and far from a complete upgrading plan. The need to more effective urban solutions that respect the advantages of such self-organized community and absorb their historical and social composition is the core for successful upgrading plans. We found in this a great motivation to work on such complete advancement scheme. It is an opportunity to utilize the existing situation to solve the problem.

4. RESEARCH HYPOTHESIS:

We assume that such informal productive community has strong insight of planning its own urban settlement. Therefore, the idea adopted in this research is how to develop such informal community by using existing urban fabrication parameters. Believing that the role of urban developer is to enhance and regulate the existing inhabitant's proposal of elements and spaces, and provide healthy environment of living as well as a successful recycling system in this case.

5. OBJECTIVES

The research arguing adopted upgrading methods by the local authorities and the lack of scientific contribution in the case of garbage city and how they ignore one or more of the site parameters which are essential factors in the upgrading plans. The research objective here is to give examples of informal planning models that would help and enhance urban upgrading methods. That would be possible by employing and enhancing existing parameters rather than ignoring it by starting over. That will be suggested by discussing two levels of the issue which are the perspective and the approach of upgrading for different site parameters.

Specifically, in the case of Garbage City, the experience of the community and their self-organized form is a series of decisions have been made along decades. The research here aims to build a new model for self-sustained community and get inspired by people who already achieved an important experience and provide innovative

solutions that would present an approach to develop informal settlements without replacing it. Furthermore, introducing a future sustainable urban upgrading by extracting the assumed hidden order embedded in informal settlements.

6. METHODOLOGY

A bottom-up approach will be applied in the process of proposed urban upgrading of the case study in hand. The work will rely on deeply probing the existing social parameters through reading of the inhabitants' behavior in forming their environment. Also, studying the actions and reactions to different developing solutions guided by a kind of overarching theory. That would provide a clear understanding of the inhabitants' formation parameters of their community as a framework for the research investigation.

In specific, the research process will follow the following three stages respectively:

- Identification stage of existing site parameters: by investigating and organizing available information that describes the current composition of the community. Such information will be provided through inhabitants' interviews, researchers' observations, and online documentation. That will help in defining community living condition and existing problems as well to extract and build up the required parameters. Those parameters are considered a key element to go further in analysis and propose the proper upgrading accordingly.
- The analytical hierarchy process for previously identified parameters to explore advantages and disadvantages resulted out of employing those parameters. Analyzing those parameters will clarify the potentials of the community's positive outcomes and highlights opportunities as a solid base to make proper decisions.
- The responsive decisions according to the investigation and analytical process. The decisions form the core of design strategy and the proposed upgrading plan.

Finally this research concludes an enhanced open end proposal that encourage urban developers and researchers to consider slums upgrading in their priorities.

7. PARAMETERS IDENTIFICATION

Zabbaleen district is a community of garbage collectors named "Garbage City" considered the highest recycling rate out of all similar recycling systems around the world: up to 85 percent of all

waste is diverted from landfills (Fahmi and Sutton, 2006), while the percentage of the best technology-based recycling system achieve is around 65 percent in Germany. Figure 1 shows the comparison of the highest recycling systems in the world.

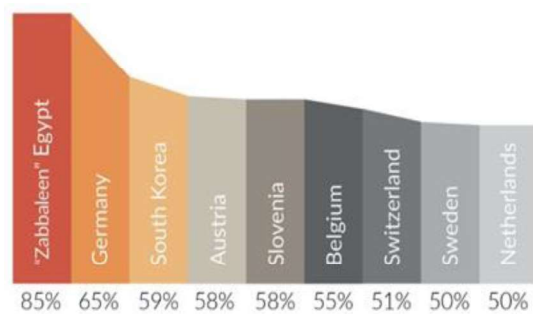


Fig 1. The graph compares the top recycling rates with Zabbaleen district rate. Source: OECD, 2013.

The success of Zabbaleen recycling rate is a key parameter that has motivated the authors to investigate the case and explore the whole process parameters. It is a critical to identify the factors accurately that led to the success of recycling process as well as the factors that cause worst living and environmental conditions in the case in hand. Through this identification process, the aim is to establish a base for conscious interventions and build a parametric model that link the proposed upgrading to the list of different actual parameters.

7.1. SOCIAL COMPOSITION

To define the current social form of the garbage city, we must go back in time a century ago when a group of migrants from El Dakhla oasis called “Wahiya” in the Egypt’s western desert have moved to live and aim for better work opportunities in the capital. Their work mostly was the responsibility of collecting garbage of Cairo’s neighborhoods. Then they collaborated with another group of migrants called the garbage collectors “Zabbaleen”, who came to Cairo close the 1940s. Zabbaleen purchased the waste to feed their pigs in their farms. Over time, the community of Zabbaleen emerged as garbage collectors and recyclers placed at the eastern edge of the metropolis (Fahmi and Sutton, 2010).

The historical origins of Garbage City and their relation to the waste disposal business is what have built the community across all generations. Their work experiences and social distribution networks are a result of self-organization process through decades. This nonlinear complex system of action and reaction

between the community of garbage collectors and surrounding context must be considered in the upgrading process. Authors believe that the upgrading plans have to deal with the case in a sensitive intervention and conscious integration with the community. This is what makes the social dimension a major parameter in the success of upgrading methods. Involving people in the upgrading decisions is required to ensure success for this kind of intervention as they used to build their own community by a self-reliance character and promote the sense of responsibility.

7.2. URBAN PARAMETERS

Three identified sectors for Manshiyat Naser settlement (Figure 2) which are:

- City of the Dead - an Islamic necropolis and cemetery.
- Manshiyat Naser – an informal area adjacent to El Nasr highway.
- Mokattam plateau - Known as Garbage City too (our case study area).

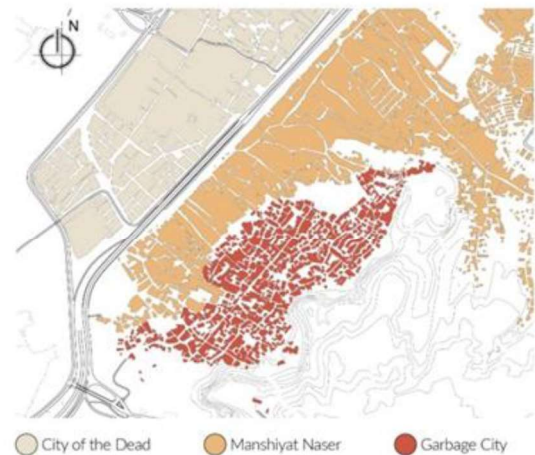


Fig 2. The three sectors of Manshiyat Naser settlement. Source: reproduced from the publisher, ETH Studio Basel, 2010.

The difference in demography in sectors defines the uniqueness of each urban fabric. In the case of Garbage City, this successful recycling system work within a built up conscious urban pattern relied on families’ relations, social communications and secure income. Urban form of Garbage City is a combination of natural configuration and human footprint. Both factors formulate the land through a sophisticated process for decades in order to captivate the social composition and the regular economic growth. What makes this form unique is the independent organization based on inhabitants’ decisions rather than regular urban planning. Those decisions are a respond to the

self-built recycling system and income secure. In the following sections, we select the most three effective factors that influence current urban form.

7.2.1 Urban Morphology: Comparison of the two adjacent sectors Manshiyat Naser and Garbage city illustrated in Figure 3 shows clear differences in morphological operations for living zones “Solid blocks” and streets network “Void spaces”.



Fig 3. Urban fabric differences. Source: reproduced from the publisher, ETH Studio Basel, 2010.

In the case of Garbage City, tons of garbage is stored in streets that brought by trucks to every corner as an essential routine of the daily work process. In addition to the streets, the buildings' ground floors and backyards are used as continuous working platform for inhabitants' daily life activities. That makes the percentage of unbuilt areas bigger than similar ones in other informal communities. The void spaces are vital social and economic parameter for inhabitants and considered as an opportunity for upgrading plans as will be explained later at the proposed upgrading section.

7.2.2 Hazards: In September 6, 2008, 119 people died in the rockslide near the Mokattam plateau in the east cliff of Garbage city (BBC, 2010). The sharp landform for Mokattam plateau is one of the considerable parameters for developing plans. The awareness of how to be protected from such topographical natural disasters is one of challenges that affect any upgrading efforts. Figure 4 shows the distribution of geological hazards in the area according to different levels

of risks. It is clear that the east and south boarders are most dangerous zones.

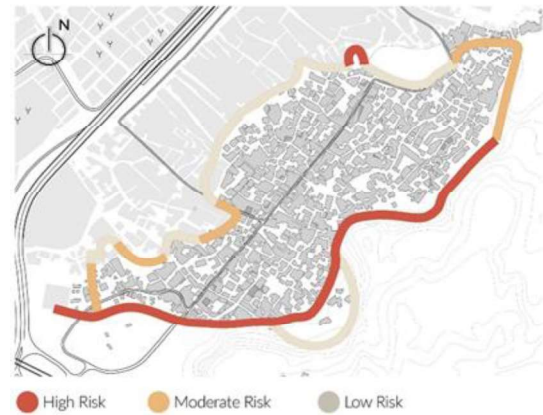


Fig 4. Hazards area in Garbage City. Source: reproduced from the publisher, ETH Studio Basel, 2010.

7.2.3 Buildings' Condition: As shown in figure 5, the worst buildings' condition located at the zone attached to the east plateaus with high and moderate risk hazards. While better buildings' condition found closer to the central main street “El Mokattam Street” which indicates the importance of this street of inhabitants daily life activities. Buildings' condition is one of the crucial factors that directly affect decisions of any upgrading plans. Safe construction is an essential right for the inhabitants' life. That sometime achieved by demolition of dangerous and defective buildings to be replaced. Each decision has its impact especially regarding economic issues.

7.3. ECONOMIC RECYCLING MODEL

Garbage recycling is a major issue in our case study that requires deep understanding; therefore, any upgrading plan should definitely consider this process as a major controlling parameter. To have better understanding of this issue it has been divided into the following aspects:

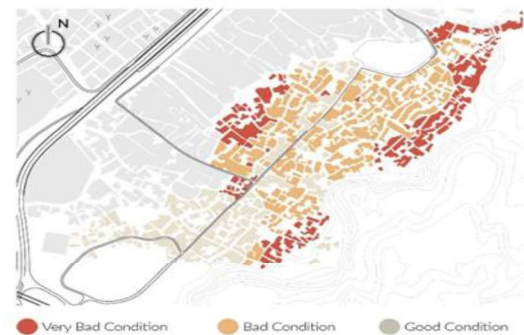


Fig 5. Buildings condition classification in Garbage City. Source: reproduced from the publisher, ETH Studio Basel, 2010

7.3.1. Work Groups: In Garbage City, all family members work in the process of recycling. Mostly men work in collecting garbage or in manufacturing and trading while women and children usually sorting the garbage into two main categories, what can be used (recycled) and what can be sold this process take place in a very organized and efficient way. A circular economic system is running by people who are not just collecting garbage but building up their own life and environment during all recycling stages (Syeda Azeem and S. Bhupatthi, 2013). The work process in Garbage City running by assigning an accurate mission per person, (e.g. one who sort plastic bottle, separate cans parts or use a mechanical devise to wash specific material). Even though, the recycling process can be divided into four major sectors according to the family interest: Collectors, Sorters, Recyclers and Traders. Figure 6 and 7 shows their distribution and percentages of labors of each sector.

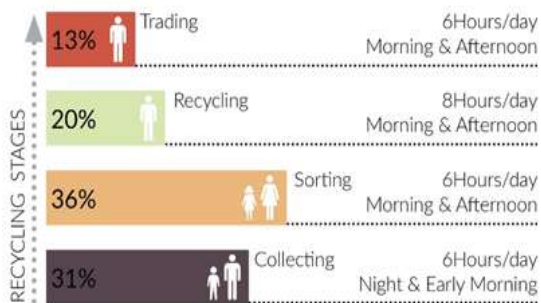


Fig 6. The diagram shows the percentage of each sector in the recycling cycle, workers gender and work hours per day. Source: reproduced from the publisher, ETH Studio Basel, 2010.

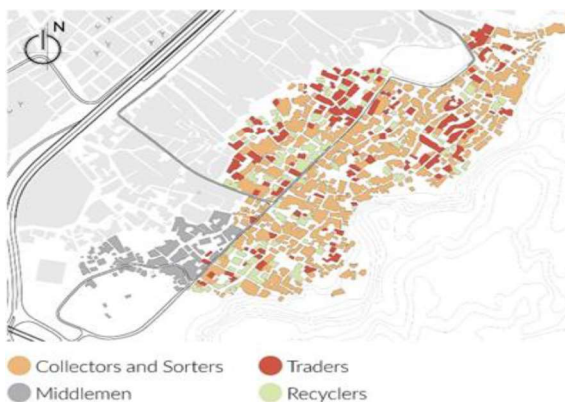


Fig 7. Distribution of recycling workers in Garbage City. Source: reproduced from the publisher, ETH Studio Basel, 2010.

7.3.2. Daily Recycling Process: Time is a critical issue for Garbage City inhabitants. They organize the day hours according to their work process starting 3.00 am when garbage collectors spread

out into Cairo streets. During early morning hours, recyclers sell recycled materials to traders and receive sorted bags. From 8.00 am to 10.00 am recyclers start their work and women occupy streets to sort the arrived garbage packages. The whole process of sorting and recycling happens during the day hours and end around 6.00 pm. This complicated process has its own details that cannot be covered extensively in the research in hand. But the point needed to be considered: the system they already have cannot be replaced easily. With a sensitive intervention, we must improve the environment to be healthy and respect what they had built for generations. Figure 8 (a), (b), (c) and (d) show different shots for the daily garbage storage and recycling process for plastic bottles.



Fig 8. Selected shots for garbage storage, transition and plastic bottles recycling. Photos by Elliott D. Woods, 2011

7.4. ENVIRONMENT

Garbage City as a name can draw a clear imagination for what is happening there. Tons of garbage spread in all the city occupying streets, backyards, and even inside of buildings. This worst quality of life expanded in contrast with successful recycling process. It is complicated situation that has been built over weak infrastructure and different forms for poverty. In the following sections, we will illustrate features of this hard living and environment conditions that defines the research main problem.

7.4.1. Lack of Facilities: Lack of infrastructure services such as pure drinking water supplies and sanitation network is a major problem that has negative effect on inhabitants' life quality.

Also, lack of schools and healthcare centers significantly affects the physical and intellectual condition for the community through generations. Consequently, illiteracy and diseases have been spread in the community forming most important outcome that affect inhabitants' behavior as well as the district urban context.

- 7.4.2. Pollution Causes Through the site visit and tens of published interviews; it has been noticed with no doubt that the whole recycling process integrates with peoples' life and environment. Tons of garbage packages move vertically and horizontally in the open air. High levels of pollution affect the consistency of air, health, and all adjacent space. Figure 9 shows how garbage occupies public spaces and how local people unfortunately adapted with what causes environmental pollution.



Fig 9. The frame shows the environmental perception of garbage city dwellers. Photo by Ayoung Shin, 2009

In addition, the worn infrastructure is another cause of high pollution level. Although they are protecting Cairo neighborhoods from garbage effects on the environment and achieve

the most effective worldwide resource recovery system, they do not have the access to improve their own community environment. It is obvious that the lack of knowledge and Eco-friendly technology is one of the major pollution subsistence.

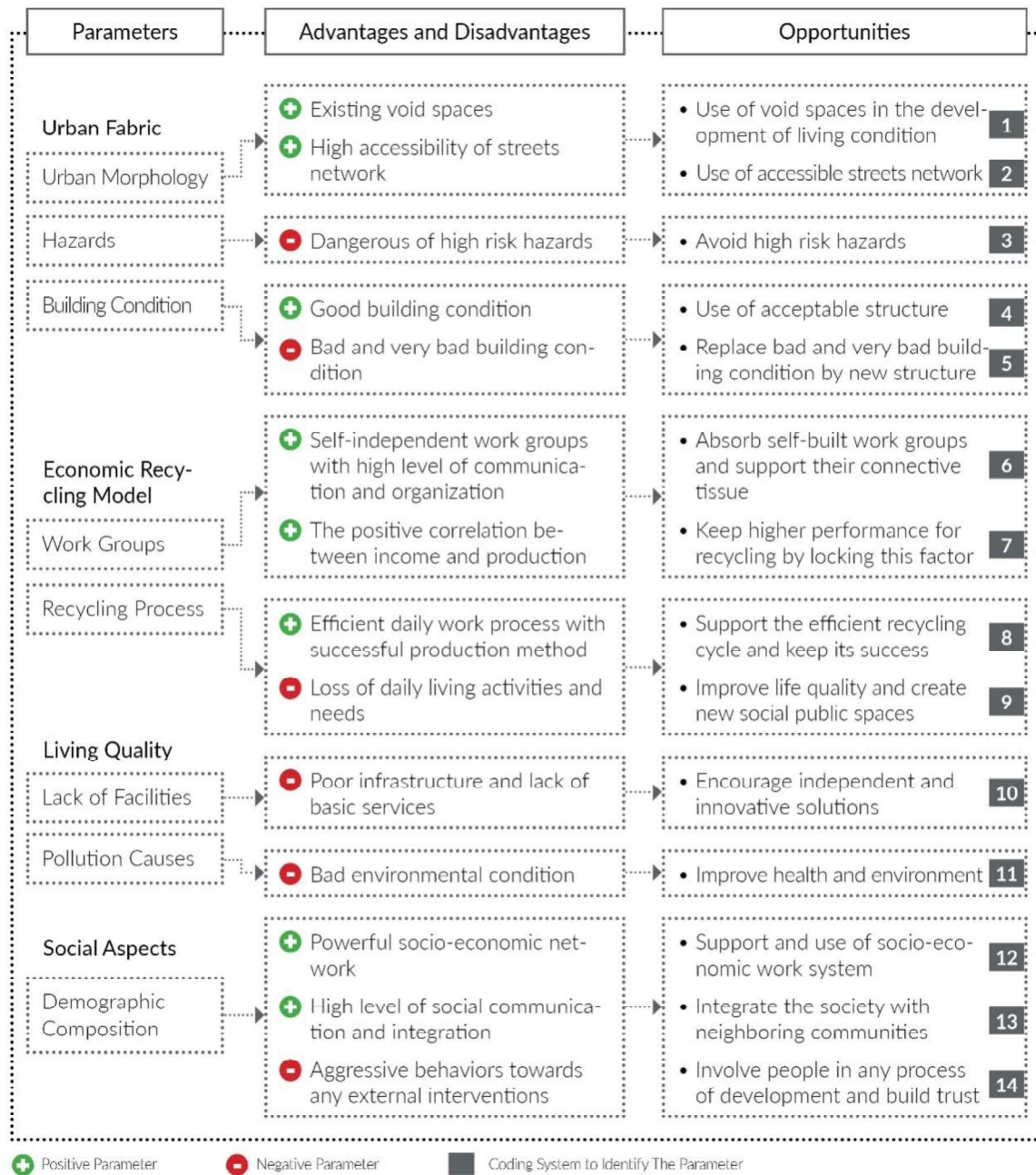
Based on what have been furnished so far, authors adopted an approach that breakdown the whole composition of the case study into identified parameters. It is assumed that identification stage will facilitate measuring and analyzing those parameters. Therefore, the reliability and feasibility of upgrading plan will be established in a way that would increase the probability of successful intervention.

8. ANALYTICAL PROCESS

According to the previously identified site parameters, upgrading opportunities (reactions) are to be derived from the defects of the built environment and the benefits of existing social and economic composition. This analytical process will lead to suggest the upgrading proposal of the Garbage City. The suggested upgrading strategy accommodates bottom up thinking to figure out reasonable decisions that fit with multiple aspects of urban and environmental problems. Simply opportunities would be employed to allow advantages to be used and the disadvantages to be eliminated as possible.

The purpose of this analytical process is to present the hierarchy of upgrading approach stages in the research and open the discussion of how the incoming interventions will absorb or add to what is already exist. Table 1 present the sequence of upgrading process according to the existing site parameters. That took place by reacting properly to each parameter (coding system that reacts to existing parameter)

Table 1. The diagram presents the bottom-up thinking approach by identifying the parameters' advantages and disadvantages in the community; and detecting opportunities accordingly. (By Authors)



9. SUGGESTED UPGRADING MODEL

Based on decisions made out of previously stated opportunities a suggested upgrading plan will be presented in this section. Major reasonable decisions have been considered to fix problematic parameters or enhance the performance of existing positive parameters. The research adopted design decisions and furthermore evaluated the process to build an enhanced model of urban upgrading. A list of major decisions and their relevance to opportunities illustrated in Table 2; those decisions are a direct response to the advantages and disadvantages of existing informal community of garbage city

.Table 2. Major decisions of urban development method and their links with coded highlighted opportunities. (By Authors)

Major Decisions					
1	2	Divide the urban fabric to smaller clusters of self-development groups	1	6	Convert El Mokattam street to a pedestrian area for social and life activities
6	8		9	11	
10	12		13	14	
3	5	Demolish very bad building condition and replace it by garbage containers in the eastern edge of the city	6	8	Invest Eco-friendly technologies to enhance the environment condition and separate living spaces from the work platform
8	9		9	10	
11			11		
2	8	Construct outer ring road to serve the recycling process to avoid intersecting with living activities and replace existing cars by sustainable transportation	7	8	No changes to the motivations of the production process
9	10		12	14	
11					

The study here proposes an urban upgrading plan and space treatment inspired by Garbage City concept as an example of a successful productive community and transfers it to a more integral healthy model of recycling community. Inhabitants’ behavior, work experiences and other settled parameters are key elements in the suggested upgrading process. Our proposal aims to enhance the living and environment condition through particular changes in the recycling process without affecting the success of the system and current income flow for inhabitants.

The major decisions taken previously were employed to upgrade an actual model for the site through specific design concepts that consider the constant and variable site parameters. The model has its multidimensional principal components that fit with the complexity of the socio-economic model. The suggested upgrading plan presented in three urban design concepts that employ the previously stated decisions as it follows:

9.1. WORK-LIVE CELLS

The idea of work-live cells has been generated through dividing the existing urban pattern into smaller units (each is a cluster of buildings) that serve as living and working place (Cells). Assuming that average of 40 to 70 buildings per cell would help in controlling the upgrading plan and the recycling process. The main purpose of this subdivision is to manage the massive urban problems by breaking it down into conceivable scale which can be handled by a group of people. In addition, adopting a parallel developing process for the group of cells and creating a competitive environment which motivates inhabitants to cooperate among themselves instead of applying conventional upgrading methods.

Work-Live cells defined as subdivisions controlled by a selection of streets network. The high accessibility of current streets network will be used in the process of streets selection considering the balance among sizes of cells. In addition, an outer road assigned for heavy cars movement will be constructed to reduce one of the main pollution causes. Figure 10 (a), (b) and (c) show how the selection process can be achieved and how the outer road connecting the inner streets.

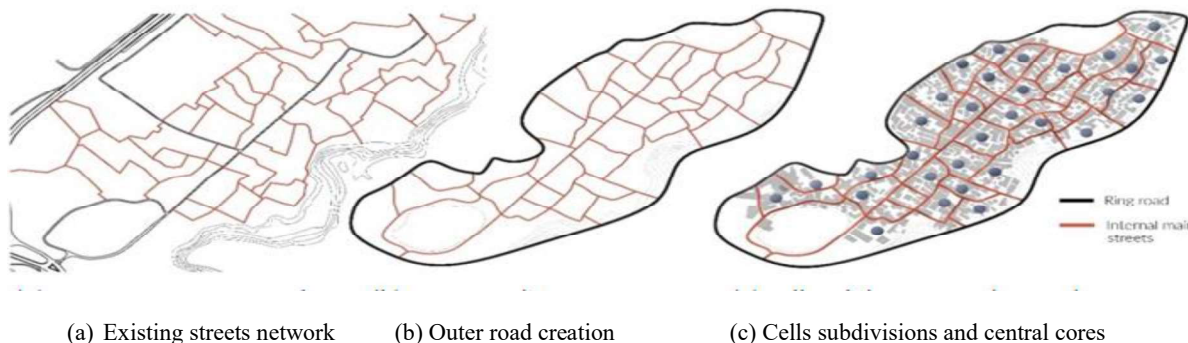


Fig 10. Work-Live cells creation according to the selection process of streets network (By Authors)

9.2. ELEMENTS OF URBAN FORM

Toward effective upgrading, technology has to play a role in the community life to enhance living quality and facilitate the recycling process. Speaking of which, upgrading of a sustainable transportation system (by reducing the use of fuel-based vehicles) for internal streets network has been suggested. The technology can initially release the limitation of people movements and local materials transportation. The use of this type of sustainable technology (e.g. electrical, solar vehicles... etc.) would be a transitional step for wider use in neighboring communities later on. Figure 11 show the distribution of those adopted transportation methods inside and outside the community.

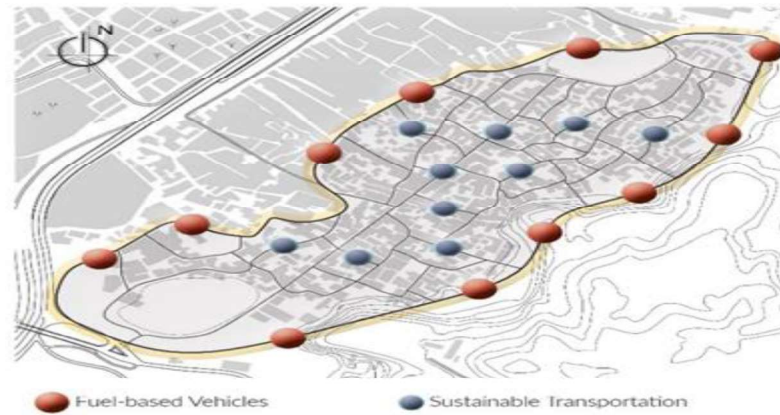


Fig 11. Adopted sustainable transportation system (By Authors)

One of the major troubles in the Garbage City is the huge amount of stored garbage and received tons of garbage every day. Inhabitants store tons of garbage in streets, ground floors, back yards and even inside some of building floors and roofs. Our suggested model proposes to build several garbage containers close to the eastern edge of the outer road to receive this amount of garbage. This new construction will replace the buildings in poor condition and high risk hazards (illustrated in figure 04 and 05). Accordingly, this barrier of garbage containers will keep residents safe away from rockslide zone. On the other side, traders will be moved to the opposite side near to the western edge of the outer road to receive recycled materials after going through the whole process lies in between those edges as illustrated in Figure 12.

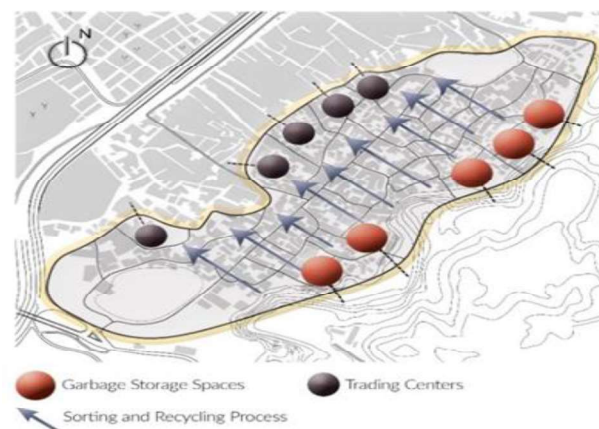


Fig 12. The distribution of materials and proposed modification of recycling system (By Authors)

By organizing vehicles network and relocating garbage packages and sorted, recycled materials, our strategy aims to afford inhabitants more public spaces and pedestrian zones. Currently, El Mokattam Street is a vital path for cars movement with tons of garbage in the daily process. Our proposal aims to convert this street to a pedestrian walkway gradually and use the two ends of El Mokattam Street as public parks. In harmony with our design strategy of using sustainable transportation with the limitation of speed inside the city, we raise the use of streets and public spaces as pedestrian zones to encourage people to communicate effectively. Their social composition needs to be absorbed through the layout of the city. Figure 13 indicates to the locations of El Mokattam Street and the proposed parks.

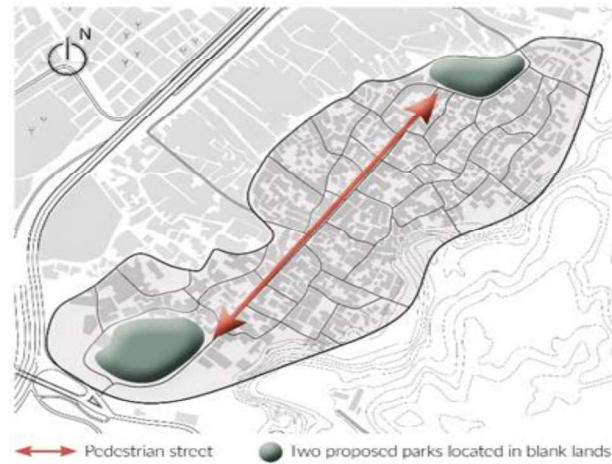


Figure 13. The position of El Mokattam Street as a vital pedestrian walkway and the two proposed parks.at the two ends (By Authors)

9.3 CELL OPERATION SYSTEM

Within the concept of Work-Live cells, each cell has its role and performs as a part of the whole recycling system. By focusing on the scale of the cell, two proposed urban solutions will illustrate the use of site parameters as reference for upgrading plan. Each proposal shows different use of public spaces and environmental treatment for the recycling process. Figure 14 shows the existing urban situation before upgrading proposals.

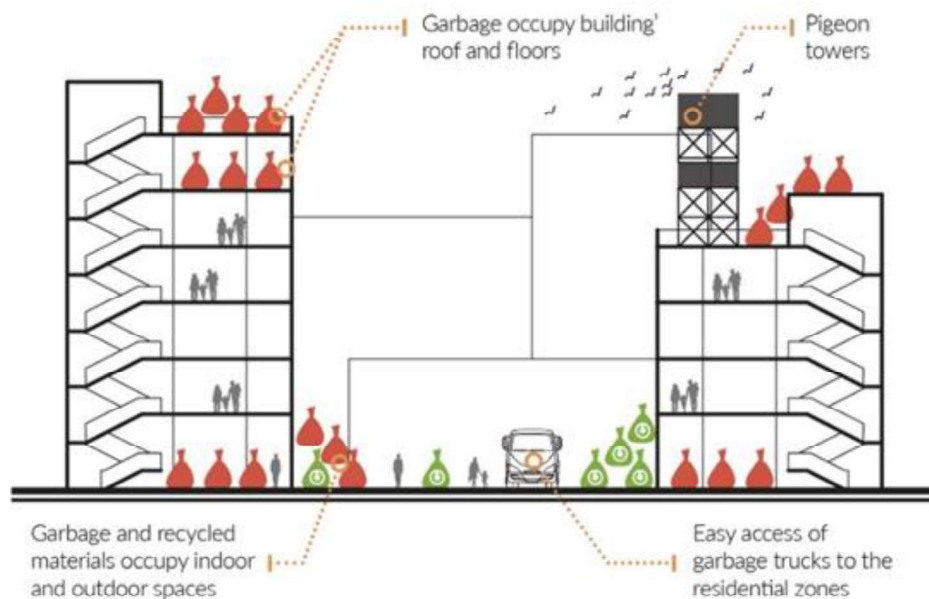


Fig 14. Existing use of spaces and distribution of pollution causes (By Authors)

9.3.1 Indoor Recycling Proposal: The main approach of this proposal is to limit the work business in the buildings' ground floor and employ technological solutions (could be passive) to ventilate the workplace targeting healthier work environment. In contrast, save outdoor spaces for social activities along with the use of electrical devices on fixed rails to transfer different materials during recycling process in-between cells and buildings in isolated packages as illustrated in Figure 15. At larger scale storing daily garbage in the eastern edge of the city in new containers will leave the ground floors available for work spaces. Presumably, the ground floors area will absorb the whole outdoor sorting process; therefore, the outdoor will be used as public space for social activities and landscaping. Clearing the outdoor spaces for social and outdoor activities will create breather green courtyards that will work as lungs for the district and enhance the environmental condition. Also, roof gardens will replace the use of the roofs as extra storage spaces for garbage. To have a better environment for work place in ground floors a ventilation system is to be constructed to filtrate and renew the polluted resulted from garbage.

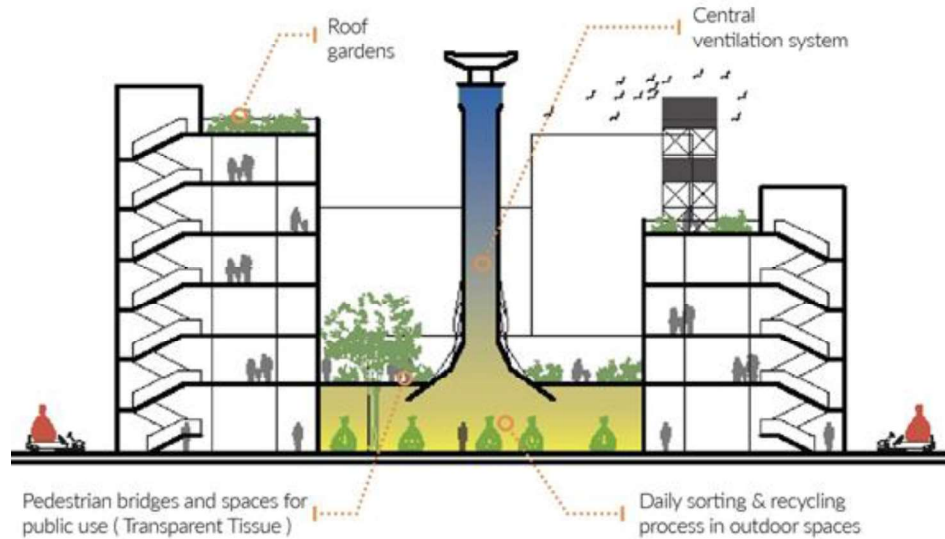


Fig 15. Indoor recycling approach as a proposed urban upgrading model (By Authors)

9.3.2 Vertical Separation Proposal: Since the whole recycling process happens in the ground level of buildings and attached open spaces, a vertical separation is suggested between work platform and living area to be located in upper floors. By keeping the work process in streets partially, a network of light bridges is proposed to connect the city at the first floor level. Figure 16 presents the process in an abstract design sketch. The idea here is to create a separate pedestrian zone above the ground level which mostly contains the daily work and materials circulation. On the other hand, the air pollution shall be reduced and treated using ventilation towers. The pressure difference will passively make suction of the polluted air from lower levels to the upper openings of the tower. Continuing with inhabitants conducts in work, the outdoor spaces in the lower level is to be used for sorting and the ground floors inside buildings for recycling process. In this proposal as well, technology will play an important role in this proposal to build a kind of transparent tissue above the work platform to allow daylight to penetrate to workplace and afford dynamic upper level for circulation and social activities without overlapping with work area.

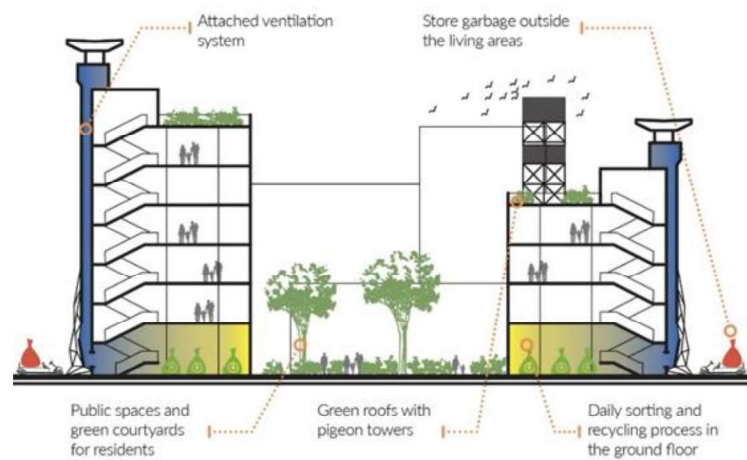


Fig 16. Vertical separation approach as a proposed urban upgrading model (By Authors)

10. DISCUSSION AND CONCLUSION

The argument we strongly embrace here is that upgrading plans for informal urban slums should respect the existing parameters of each individual community. In most cases, developers deal with the situation from a point of view that does not acknowledge the strengths of such kind of urban pattern as it assumed to be a complete disorder. In the case of Garbage City, most of governmental upgrading methods have lacking of social investigation and dissipate the power of self-built socio-economic profile of the district inhabitants. Most of official and local interventions deal with informal urbanism without bearing in mind the causes beyond its

emergence and growth of such communities. Local governments have mostly proposed evicting the community from the site which threatens their social sustainability and economic stability.

A bottom-up approach has adopted in this research through an analytical process to extract beneficial parameters from the case study. The approach aimed to explore the potentials of existing urban fabric and employ it into the process of upgrading. Regarding the case in hand (Garbage City), the community has built the most efficient recycling system worldwide which is protecting the capital from thousands of tons of garbage per day. Garbage City is an exceptional model for a productive community who has built unique socio-economic system and competitive recycling strategy despite the fact of lacking the technology-based methods in the modern world.

The research highlighted the need of learning from the potentials of self-organized communities within the urban context. Authors in this research have introduced an experimental design process towards sustainable environment. The perspective discusses how this successful recycling system could help local inhabitants to improve their environment condition with rational intervention. Through a series of upgrading suggestions, the adopted approach indicates the importance of enhancing the surrounding context of work-live spaces to achieve sustainable upgrading.

With the proposed environmental upgrading, it could be suggested that Garbage City case study represents effectively the notion of the sustainability with its three pillars: economy, society and environment. The establishment for sustainability in this community achieved through the self-built economy of solid waste management by organizing the social connections within family members in this process. In contrast, the environment has the lowest consideration in their process which needs sensitive intervention and cooperative interaction with the community issues.

Recycling City of Cairo "RCC" is the proposed model of self-sustained community who reformulates the concept of Garbage City and introduces a formal model of self-organized community for the global community. The model promotes a futuristic vision for community-based solid-waste management which can exist in Cairo, New Delhi, Rio De Janeiro or anywhere else.

11. FUTURE WORK

This research is part of ongoing comprehensive study of Garbage City as a recycling community shaped in informal urban form. The study will contribute in the upgrading plan for Garbage City and deals with the details of urban solutions integrated with the development of recycling process as well. This research is a suggested model for upgrading method that need to be discussed with the scholars' community as well as the professionals. As a part of future work, we look forward to adopt parametric thinking approach through the use of identified existing parameters. Aiming to increase the efficiency and success of upgrading approaches for global informal communities and build a vision for the future city that absorb all forms of human behavior within the context of sustainable environment and the evolution of technology.

ACKNOWLEDGMENTS

Authors would like to thank the team of master thesis work titled "Recycling City of Cairo" at Dessau Institute of Architecture, 2012: Ahmed Albadawy, Marzieh Gholami and Marta Sowinska. And thank parametric collaborations studio teacher, Christos Passas for his cooperative supervision. In addition, we must thank the teamwork of "Mokattam - World's largest recycling hub", ETH Studio Basel Contemporary City Institute for their valuable research, 2010.

REFERENCES

- [1] BBC News, 2010, "Egypt jails government officials over Cairo rockslide", Online report.
- [2] David Gouverneur, 2015, (Planning and Design for Future Informal Settlements: Shaping the self-constructed city", Routledge.
- [3] Flavia Conrad and Vanessa Joos, 2010, "Mokattam - World's largest recycling hub", ETH Studio Basel Contemporary City Institute. Switzerland.
- [4] IDA International Documentary Association, 2009, "Meet the Filmmakers: Mai Iskander- 'Garbage Dreams'", Tom White, Online report.
- [5] Jean-Claude Bolay, Jérôme Chenal and Yves Pedrazzini, 2016, "Learning from the Slums for the Development of Emerging Cities", Springer.
- [6] Kamel, L., 2003, "Integrating local community-based waste management into international contracting", In Proceedings of the CWG Workshop on Solid Waste Collection that Benefits the Urban Poor, Dar El Salaam, Tanzania.
- [7] Mike Davis, 2006, "Planet of Slums", Verso.
- [8] Syeda Azeem Unnisa and S. Bhupatthi Rav, 2012, "Sustainable Solid Waste Management", Apple Academic Press, USA.
- [9] UN-Habitat, 2003, "Challenge of Slums: Global Report on Human Settlements", United Nations Human Settlements Programme
- [10] UN-Habitat, 2016, "Slum Almanac 2015-2016: Tracking Improvement in the Lives of Slum Dwellers", the PSUP team Nairobi, United Nations Human Settlements Programme.
- [11] Wael Fahmi and Keith Sutton, 2006, Cairo's Zabaleen garbage recyclers: Multi-nationals' takeover and state relocation plans, Habitat International, Elsevier Ltd.
- [12] Wael Fahmi and Keith Sutton, 2010, Cairo's Contested Garbage: Sustainable Solid Waste Management and the Zabaleen's Right to the City, Sustainability.