



Promoting the use of (GIS) for Improvement of Solid Waste Management Services

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Promoting the use of (GIS) for Improvement of Solid Waste

Management Services

Abstract:

Finding sustainable solutions to the problems caused by inadequate information for management of solid waste collection and tracking process is a big challenge of the national priorities in Egypt.

The Participatory Development Programme (PDP) in cooperation with Qalyubeya Governorate and key partners are working on developing an integrated community-based on solid waste management system in the two Egyptian cities, Khanka and Khosoos, in Qalyubeya Governorate.

PDP has been working on promoting the use of Geographic Information Systems (GIS) in planning and monitoring for improvement of waste management policy in the city of Khosoos, and is planning to adopt the same strategy in the city of Khanka.

GIS has been successfully utilised in El Khosoos city to propose the optimal waste collection routes for improving collection efficiency, monitoring performance of operators through tracking of waste collection and the minimum fuel consumption for transportation vehicles, and finally in planning for future optimized resource requirements in terms of materials and human resources..

Keywords:

Solid, waste, management, control, monitor, tracking, optimal, planning, needs, resources,

1. Introduction

The Participatory Development Programme in Urban Areas (PDP) is an Egyptian-German development project implemented in cooperation between the Egyptian Ministry of Planning and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. in cooperation with the Bill and Melinda Gates Foundation (BMGF) – as a co-financing partner in addition to the core-financing of the German Federal Ministry for Economic Cooperation and Development (BMZ) and the contributions by the Egyptian side.

Finding sustainable solutions to the problems caused by inadequate solid waste management practices is one of the key national priorities in Egypt.

The Participatory Development Programme (PDP) in cooperation with Qalyubeya Governorate and key partners is working on developing an integrated community-based solid waste management system in the two cities of Khanka and Khosoos, in Qalyubeya Governorate.

The solid waste management component has five key objectives which are:

1. developing a strategy for an inclusive and integrated waste management system.
2. promoting source segregation and raising awareness of the public on the importance of waste as a resource.
3. building capacities of the key actors engaged in the various processes related to solid waste management.
4. improving living and working conditions of informal waste operators.
5. establishing Integrated Resource Recovery Centres (IRRCs) to promote recycling of both organic and non-organic waste.

The component has been working on promoting the use of Geographic Information Systems (GIS) in the planning and monitoring for improvement of waste management services in the city of Khosoos. GIS has been utilised in; Proposing best waste collection routes for improving collection efficiency, monitoring performance of waste operators through tracking of waste collection and transportation vehicles planning for future resource requirements in terms of vehicles, material human resources et Develop SW maps to be utilized for planning and monitoring.

To complement the work that has been done and make it comprehensive the component started a project for tracking waste collection vehicles mapping their routes using GPS devices which have been installed in the collection trucks.

The purpose is to control and inspect the driving and routing behaviour of all drivers to assure quality of service while also examining optimal routes for the purposes of planning and resource efficiency.

The last of what has been achieved is developed the AVL Automatic Vehicle locator(AVL) fleet management software necessary to process the log files (GPX/KML/CSV) generated by the GPS device to parse them and output analytical reports that help the assessment and optimization of the daily routes and to generate reports which are easy to read by decision makers.

2. Objectives

Establish an integrated community-based solid waste management system, that takes into consideration the informal actors of the sector and facilitate the planning and monitoring functions within the waste management system in Khosoos city in the Qalyubeya Governorate in Egypt.

This will help in achieving the following Impacts:

1. Increased efficiency of the waste collection system leading to environmental and health improvements for the citizens of the city of Khosoos.
2. Reduction of costs of collection for the city administration as a result of better use of existing resources and improved planning and monitoring.

3. Materials & Data

- 3.1 Recent Satellite images , high resolution (1 meter) for the project area picked up on August 2010 cover the project area (Figure 1).



Figure (1).
Satellite image of El Khosoos area 2010

- 3.2 Recent Satellite images, medium resolution (5 meter) for the region of the project area picked up on September 2010 cover the region of the project area (Figure 2).



Figure (2).
Satellite image for the region of
El Khosoos area 2010

3.3 Land uses map 2011, include the services, land marks, residential buildings and water canals of the area (Figure 3).

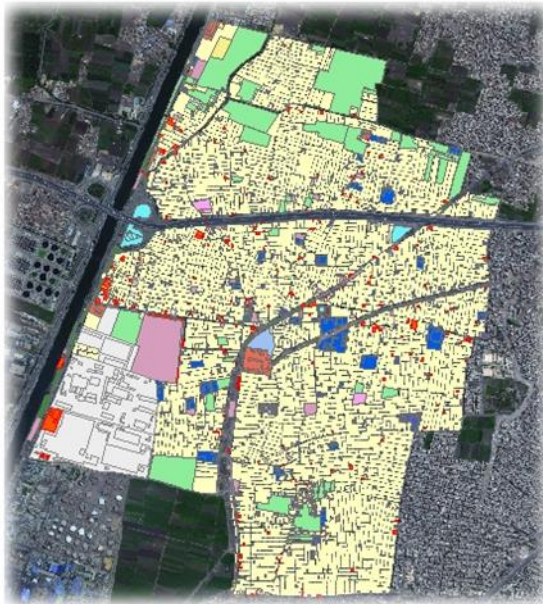


Figure (3).
Land uses of El Khosoos area 2011

3.4 Database of land uses in 2011, include Attribute data of the type of activity (grocery, fast food, restaurant, medical lab, etc), Classifying the activities according to the type and the produced waste, attribute data of residential buildings such as the floor counts, apartment counts, number of units unoccupied and number of services apartments in El Khosoos area, (Figure 4)

Main_id	Sub_code	Main_class	Sub_class	Count
۳	۳۰۱	مصنوع - شُرکات و ورش	مصنوع	۳۵۲
۳	۳۰۲	مصنوع - شُرکات و ورش	شُرکات و مکتب	۲۸۱
۳	۳۰۳	مصنوع - شُرکات و ورش	ورش نجاره	۸۶۹
۳	۳۰۴	مصنوع - شُرکات و ورش	ورش خراطه	۱۰۱
۳	۳۰۵	مصنوع - شُرکات و ورش	ورش الوستل	۱۴۹
۳	۳۰۶	مصنوع - شُرکات و ورش	ورش حداده	۲۵۷
۳	۳۰۷	مصنوع - شُرکات و ورش	ورش دهان - استورچی	۱۰۲
۳	۳۰۸	مصنوع - شُرکات و ورش	ورش رخام - بلات	۷۸
۳	۳۰۹	مصنوع - شُرکات و ورش	ورش بلات	۱۵
۳	۳۱۰	مصنوع - شُرکات و ورش	زجاج و مریات	۹۰
۳	۳۱۱	مصنوع - شُرکات و ورش	ورش منووعه	۲۸۴
۳	۳۱۲	مصنوع - شُرکات و ورش	طباعة	۴۵
۷	۷۰۲	رياضيه	مراكز رياضيه و جيم	۳۹
۹	۹۰۶	تعليمي	ادوات مكتبيه و تصويير مستندات	۲۶۹
۹	۹۰۷	تعليمي	مجلات كتب	۱
۹	۹۰۹	تعليمي	حصانه	۱۷۱
۹	۹۱۰	تعليمي	مراكز تعليميه و حفظ قرآن	۴۹
۱۰	۱۰۰۱	صحي	مستشفيات	۲۵
۱۰	۱۰۰۲	صحي	صيدليات	۵۵۳
۱۰	۱۰۰۳	صحي	مراكز طبيه	۳۰
۱۰	۱۰۰۴	صحي	عيادات طبيه	۱۲
۱۰	۱۰۰۵	صحي	تحاليل و البعنه	۲۹
۱۱	۱۱۰۱	التسويق	اجهزه و ادوات بكمبيوتر و الكومبيوتر و نمازجه	۵۸۹
۱۱	۱۱۰۲	التسويق	عطور و مستحضرات تجميل	۷۵

[illegible]

Figure (4).
The count and Geo-Link of *the activities* and
residential building of El Khosoos area 2011

3.5	R	residential building of El Khosoos area
	oad map for the city of El Khosoos, include features of streets, allies, driveways, lanes and attribute data of roads names, types, width and traffic directions (Figure 5)	

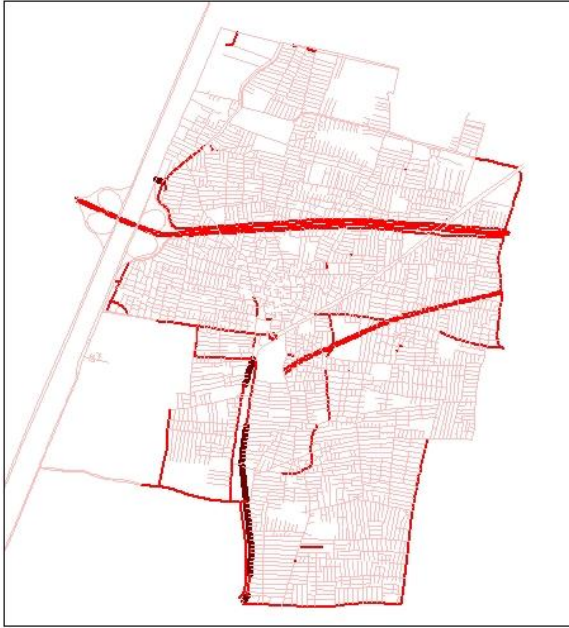


Figure (5).
Detailed roads network of El Khosoos area 2011

- 3.6 Outputs of the field survey which contain map allocation & pictures documentation of solid waste dumps locations in El Khosoos (Figure 6).

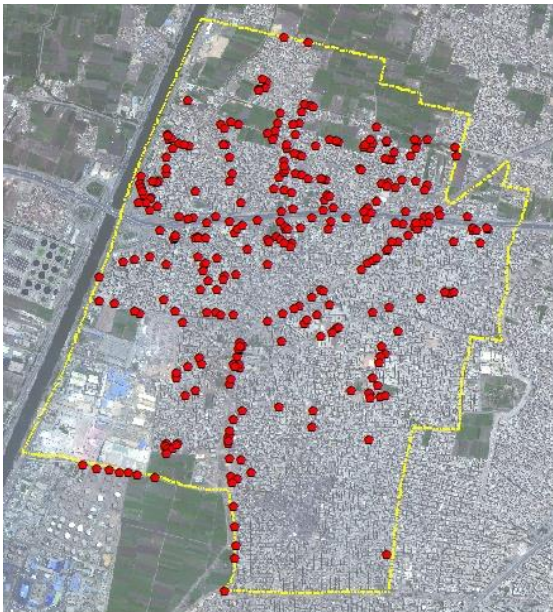


Figure (6).
solid waste dumps locations in
El Khosoos 2012

- 3.7 Using GPS devices which have been installed in the collection trucks to control and inspect



the driving and routing behaviour
(Figure 7).

Figure (7).
Using GPS devices in the collection trucks of the El Khosoos city 2012



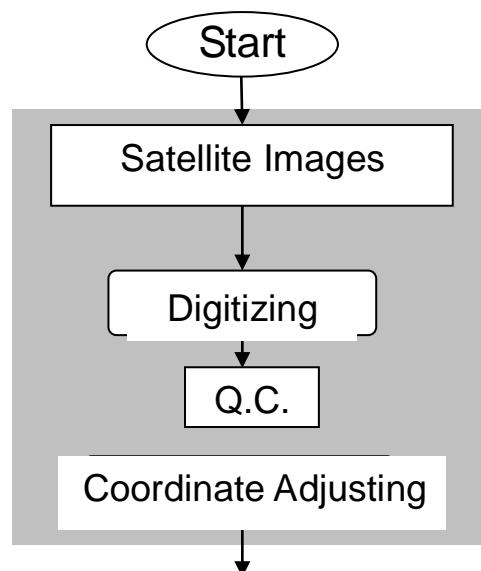
4. Methodology

- 4.1. **Provide training and on-the-job training for specific tasks**
(downloading, matching and geo-reference Google maps & satellites and creating different layers, using GPS & Trimble devices,...etc.) figure (8)



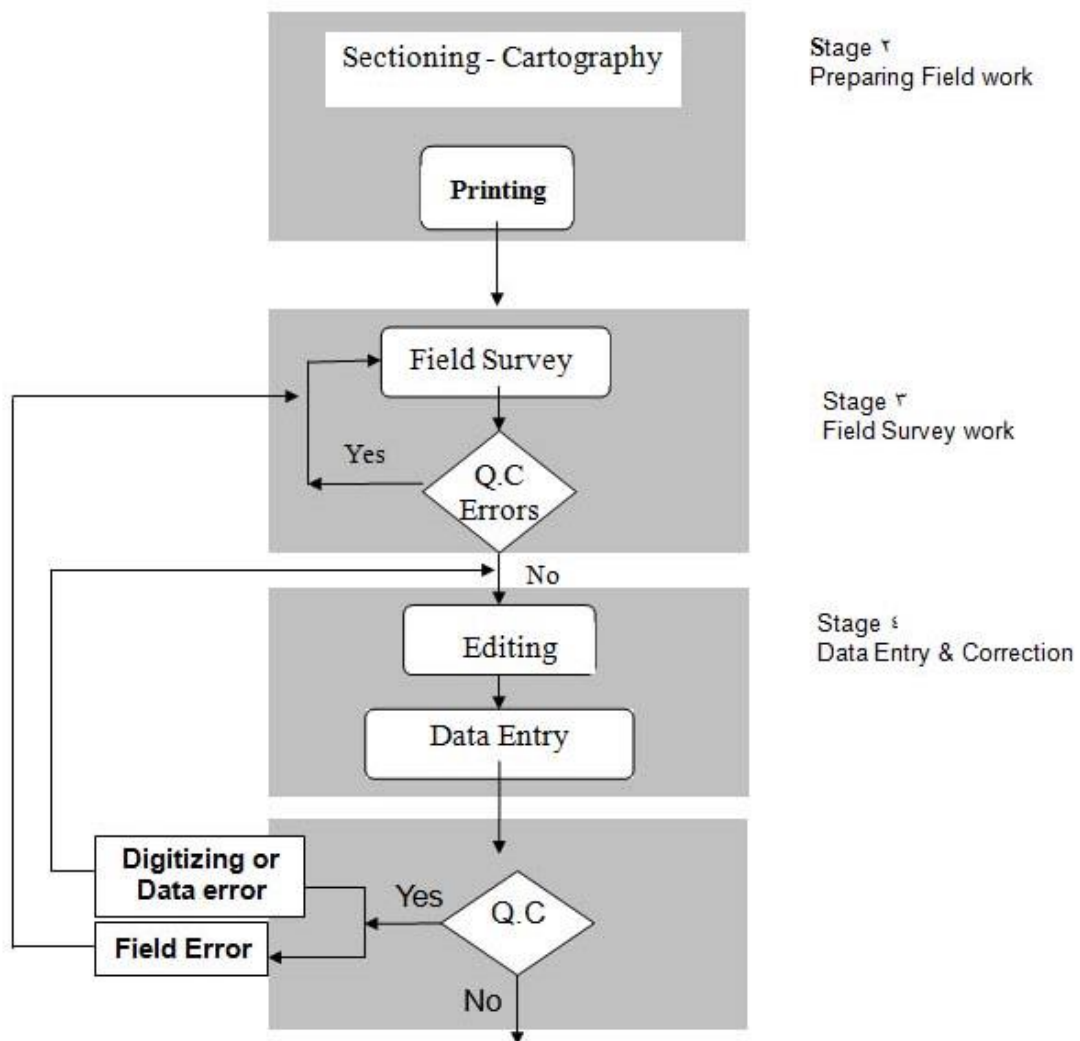
Figure (8).
Training and on-the-job training

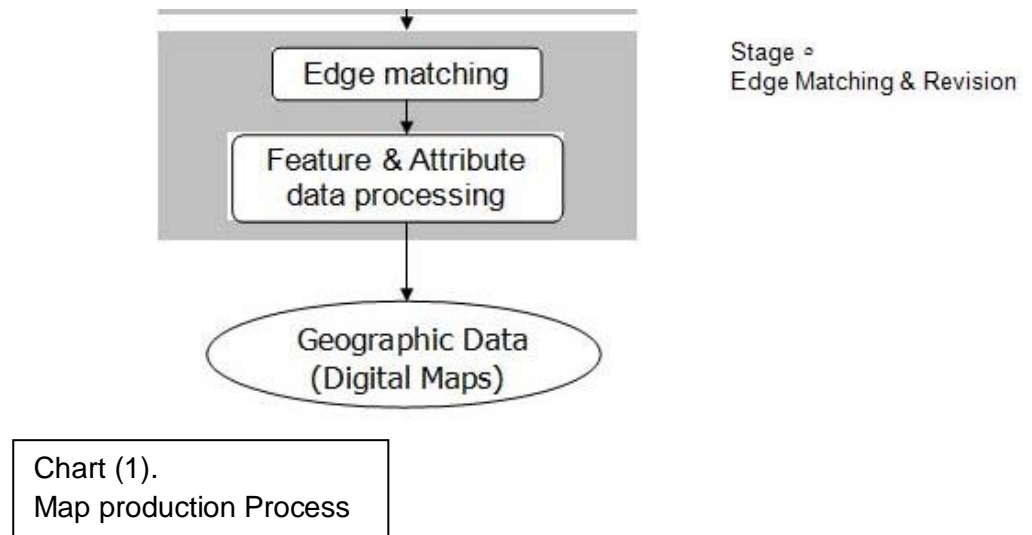
- 4.2. **Create the base maps of El Khosoos area using satellite image (chart 1)**



Stage 1

Digitizing to create
the base map





4.3. Prepare the field survey maps and data collection: (chart 1)

- 4.3.1. El Khosoos area was divided into small zones totalling 99.
- 4.3.2. Each of the 99 zones contains relatively small number of buildings to be surveyed. Cartography work was completed to produce the maps for each zone
- 4.3.3. Data sheet was designed to include all required data items to be collected.
- 4.3.4. Printed maps for the 99 zones (99 maps for collecting activities and another copy of 99 maps for collecting buildings information) were distributed for the field surveyors along with the data sheets.
- 4.3.5. The task of data collection was completed by an extensive field survey to all of El Khosoos city's buildings, 35,693 building using the recently updated map (Figure 8).



Figure (9).
Field survey to collecting data of El Khosoos area

4.3.6. The field survey was done by foot, block by block to collect the requested data

4.3.7. Some of the data were collected by visual observation, e.g. Buildings' floor count and activities. Other data depended in engaging in Q&A process with tenants, building owners or neighbours

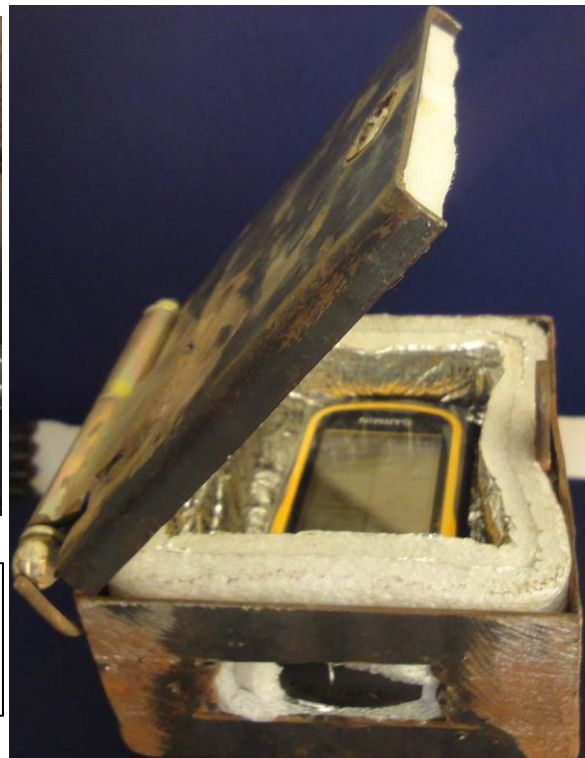
4.3.8. Data entry, data processing and Geo-Link of all collected data to the recent

4.4. Installing the GPS devices in the collection cars and development of a GPS software:

which would enable the easy recording of data and the generation of reports to facilitate the planning and monitoring functions within the waste management system in Khosoos Figure (10)



Figure (10).
Installing the GPS devices in the collection
trucks of the El Khosoos city 2012



5. Challenges/limitations of methodology

5.1. The provided training and on-the-job training for El Khosoos local administration staff to do a specific tasks

- 3 out of 8 from El Khosoos local administration GIS personnel who received the field survey training course move to another position and the 5 remaining staff continue working in the field which led to suspension of the work and extending the required period for completion.
- Also 3 out of 6 who received the GIS training are stopped attending the training course, Thus there are only three persons are doing all the GIS work which affect also in delaying the project time

5.2. Obstacles for Buildings information collection

- Construction activities are in the increase daily, Floors are added and buildings are modified. Floor count can change between the time it is collected and the time it was reviewed. (Couple or few days)
- Agriculture land is under vigorous construction daily
- Old buildings are rapidly demolished and new construction take place. Suspicious of illegal building & unlicensed construction activities
- Buildings are build adjacent without appear ant and clear separation for neighbouring buildings. That obstructed visual inspection & count
- Streets width is very narrow in some areas & buildings Balconies are too close to each other's. That causes difficulties in the count.
- Lying. Building owners and/or tenants are not providing accurate information regarding number of apartments, vacant apartments, and temporary residence apartments. Tenants and landlords fear consequences of any unexpected government action (Taxes, violation, demolishing orders, etc)
- Landlords and/or tenants demolishes first floor walls & change apartments into stores and the opposite is true in some cases
- Some activities like workshops are illegally inside the building and sometimes in the high floors. There are strict common rule not tell about those activities.
- High crime rate. This factor scared people away from telling accurate information. Suspicious of theft is a factor. People suspected that the surveyors are planning to break into the temporary occupied apartments

5.3. Installing the GPS devices in the collection cars

- Installation the GPS devices daily in the morning before starting the car trip and taking them off at the end of the day needs to have a person and his/her replacement in case of his/her absence to ensure the follow-up of the car trip daily.
- Realizing that the device is spying on the car's track sometimes leads to obstruct the work of the device, such as covering it by a something to disconnect the satellite signals
- Some narrow streets which have a high buildings lead to a weak satellite signal and thus lack sufficient precision to record tracks cars

6. Results and conclusion

6.1. Institutionalising a Solid waste management Unit:

Establishing of solid waste management unit with 11 staff to developing an integrated solid waste management strategy through them and all stakeholders
Figure (11)



Figure (11).
Solid waste management unit staff

6.2. Capacity Development for Partners:

Severla training and on-the-job training courses have been conducted which include the following skills: Mapping, Urban Survey and Report writing

6.3. Actual Results from Implementation

6.3.1. Building the capacity of the partners (employees) involved taking them step by step through the process of understanding and effectively using GIS as a mapping tool. For instance, we train them on reading maps, collecting different types of satellite images, and then producing a base map and add to it the relevant information (layers). Figure (12)



Figure (12).
Capacity building for Solid waste management unit staff



6.3.2. Additionally the capacity development plan educates the partners on urban survey methods; such as field surveys and information assigning on the maps and other skills related to field work, Total of 22 field surveyors were fully dedicated to the project to collect, revise, data entry, data processing and quality control (Figure 13)



Figure (13).
Field surveyor in El-Khosoos area

6.3.3. Calculate the volume of waste generated daily by apartments, activities and others as the total number of occupied apartments in El Khosoos city are 140592 , the account of the activities are 37927, (Table 1)

Sector	Apartment no	Family size	Population	Weight Ton
Sec_1	67512	5.3	357,536	214.5
Sec_2	21351	4.15	88,587	53.2
Sec_3	26553	4	106,212	63.7
Sec_4	6915	3.95	27,561	16.5
Sec_5	18261	4.7	85,777	51.5
Total	140592	4.42	665,673	399.4

Table (1).
Volume of generated Solid waste by sector

6.3.4. Re-divide the collection sectors based on distribution of street width, street type, the population and their sizes (Figure 14) to reach balanced deviation in the generated solid waste (Table 2)

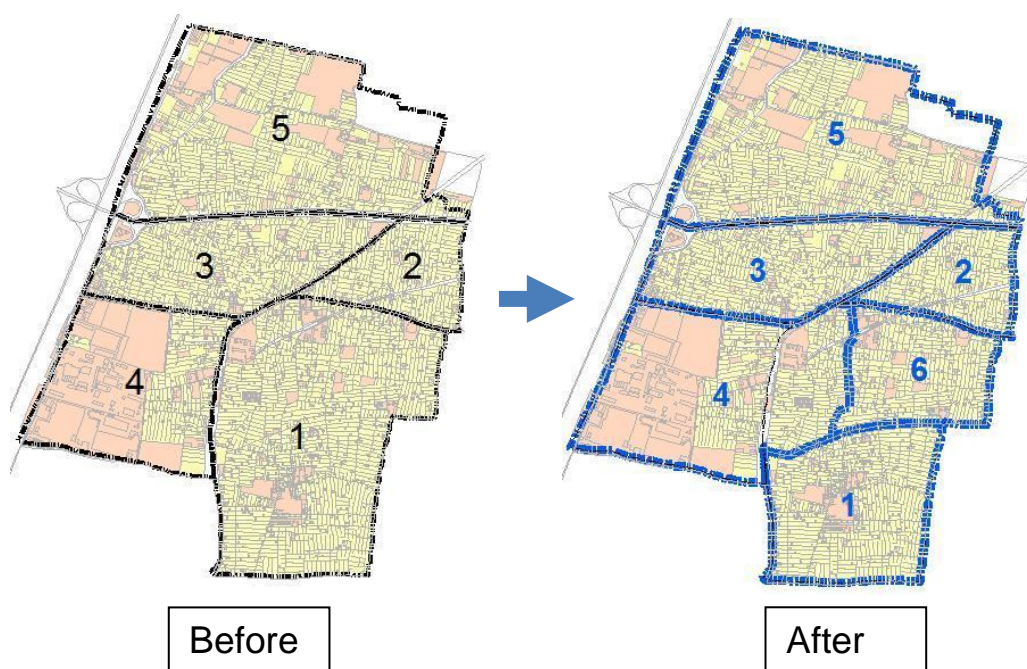


Figure (14).
Re-divide the collection sectors in El-Khosoos area

Sector	Apartment_no	Family_size	Population	Weight Ton
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Sec_1	33394	5.3	176,801	106.1
Sec_2	21456	4.15	89,136	53.5
Sec_3	26553	4	106,212	63.7
Sec_4	18453	3.95	88,310	53.0
Sec_5	18261	4.7	85,777	51.5
Sec_6	22901	5.3	121,284	72.8
Total	140592	4.42	665,673	399.4

6.3.5. Identify 398 dump sites location with its pictures to monitor performance of waste contractors through tracking of waste sizes using Trimble device Figure (15)



Figure (15)
Dump site in El Khosoos area

6.3.6. Complete activity report is creating daily includes: Overview of complete vehicle activity throughout the day including vehicle stops, parks, in-transits, speeding events, idling, driver status, number of daily trips and communications. Figure (16)



Figure (16)
Collection trucks report

GIS has been successfully utilized in Khossoos city, as a very efficient planning tool in the field of solid waste management which can contribute to the improvement of services provided especially by identifying the size of the problem, and monitoring the collection services. However the implementation of the GIS related activities was faced by a number of problems. On the one hand the vulnerable political situation in Egypt caused a delay in the implementation of some of the project activities, especially that many of the activities are dependent on field work, which was sometimes very difficult to implement as a result of security related factors. Additionally, the project is currently facing sustainability problems related to operations of the solid waste management unit in Khossoos city and which is manifested in a high turnover rate of employees. The project over the coming period will work on better institutionalization for this unit in order to ensure sustainability of activities.

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