**Sudan University of Science and Technology**

**College of Graduate Studies**

# Detection of Irregularities of Planning Laws in Residential Areas by using Remote Sensing and Geographical Information Systems

# إكتشاف مخالفات قوانين التخطيط في المناطق السكنية بإستخدام الاستشعار عن بعد و نظم المعلومات الجغرافية

**Thesis submitted as a partial fulfillment to the admission of the degree of M.Sc in Geodesy and GIS**

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# الآية القرآنية

بسم الله الرحمن الرحيم

قَالَ تَعَالَىٰ:

﴿ وَٱللَّهُ جَعَلَ لَكُم مِّنۢ بُيُوتِكُمۡ سَكَنٗا وَجَعَلَ لَكُم مِّن جُلُودِ ٱلۡأَنۡعَٰمِ بُيُوتٗا تَسۡتَخِفُّونَهَا يَوۡمَ ظَعۡنِكُمۡ وَيَوۡمَ إِقَامَتِكُمۡۙ وَمِنۡ أَصۡوَافِهَا وَأَوۡبَارِهَا وَأَشۡعَارِهَآ أَثَٰثٗا وَمَتَٰعًا إِلَىٰ حِينٖ ٨٠ ﴾

**صدق الله العظيم**
**(( النحل الآية 80 ))**

**This thesis is dedicated to:**

The sake of Allah, my Creator and my Master,

My great teacher and messenger, Mohammed (May Allah bless and grant him), who taught us the purpose of life,

My homeland Sudan, the warmest womb;

The Sudan University of science and Technology; my second magnificent home;

My greats Father and Mather, they are never stopping giving of themselves in countless ways,

My dearest husband, who leads me through the valley of darkness with light of hope and support,

My beloved brothers and sisters; they are stands by me when things look bleak,

My beloved kid: Assel, I can't force myself to stop loving.

To all my family, the symbol of love and giving,

My friends who encourage and support me,

All the people in my life who touch my heart,

I dedicate this research.

# Abstract

Urban development is the future vision for urban and transportation development to face economic, demographic and environmental challenges that needed, for sustainable development. Urban development incision mainly from urban development areas that are intended to non-rural development. where we find that the demographic growth is increased in the third world as general and this was accompanied by the rapid demographic growth intensive rural exodus towards big cities as a radiation source of economic and social and scientific development. it resulted unbalanced and unlimited urban development . The research problem runs from the control of urban planning is one of the main tasks under taken by Governments authority .The urban planning process encountered some problems resulting from the weakness of the legislative framework and mechanisms are weak law enforcement and lack of comprehensiveness of the legal rules and regulations of the executive that control the management and implementation of the urban planning process .this research study and discover the violations of the laws of urban planning in residential area using Remote Sensing and geographic information systems , this program provides us with Tools characterized with high accuracy and speed in implementation, working to collect and insert processing ,analysis and presentation and take out the spatial and descriptive information for specific targets to help in planning and decision making. where we were able to monitor the proportion of irregularities in exactly the region by identifying the parcel that violation and the number and type of violation of existing and documented freelancer.

From here, we find that GIS describe all irregularities in the table to assist the local administration make treatment of irregularities linked to the procedures and help to issues fines. find the consideration of the recommendation in the residential area of the parcel even limit the increase of irregularities and encourage vertical housing to reduce the horizontal expansion , which needs to large areas, causing the need for the extension of service networks in large areas.

## المستخلص

التنمية العمرانية هي الرؤية المستقبلية للتطوير العمراني وتطوير المواصلات ومواجهة التحديات الاقتصادية والسكانية والبيئية التي تحتاج للتنمية المستدامة .

التنمية العمرانية شق أساسي من التنمية الحضرية التي يقصد بها تنمية المناطق غير الريفية.

نجد أن النمو الديمغرافي عجل في نمو دول العالم الثالث بصفة عامة ، رافق هذا النمو السريع نزوحاً ريفيا مكثفا باتجاه المدن الكبرى باعتبارها مصدر الإشعاع الاقتصادي والتطور العلمي والاجتماعي نتج عنه تطور عمراني لامحدود وغير متوازن .

إن مشكلة البحث تنطلق من أن التحكم بعملية التخطيط العمراني تعتبر من المهام الرئيسية التي تتولاها الحكومات ، لكن عملية التخطيط الحضري تعترضها بعض المشاكل الناتجة عن ضعف الإطار التشريعي وضعف آليات تطبيق القوانين وعدم شمولية القواعد القانونية واللوائح التنفيذية التي تتحكم بإدارة وتنفيذ عملية التخطيط العمراني.

يقوم هذا البحث بدراسة اكتشاف مخالفات قوانين التخطيط العمراني في المناطق السكنية باستخدام الاستشعار عن بعد ونظم المعلومات الجغرافية حيث يوفر لنا هذا البرنامج أدوات تمتاز بدقة عالية وسرعة في التنفيذ تعمل علي جمع وإدخال ومعالجة وتحليل وعرض وإخراج المعلومات المكانية والوصفية لأهداف محددة تساعد علي التخطيط واتخاذ القرار. حيث تمكنا من رصد نسبة المخالفات الموجودة بالمنطقة بالضبط وذلك بتحديد القطعة التي بها المخالفة ورقمها ونوع المخالفة الموجودة بالقطعة وتوثيقها .

من هنا نجد أن نظم المعلومات الجغرافية تصف كل المخالفات في جدول لتساعد إدارة المحلية في معالجة المخالفات لربطها بالإجراءات الخاصة بالغرامات.

من توصيات البحث النظر في مساحة القطع السكنية حتى نحد من زيادة المخالفات وتشجيع السكن الراسي لتقليل التمدد الأفقي الذي يحتاج لمساحات واسعة مما يسبب الحاجة لتمديد شبكات الخدمات في مساحات كبيرة .

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## List of Contents


| No | Title | Pag.No |
|---|---|---|
| | Abstract | I |
| | المستخلص | II |
| | Acknowledgments | III |
| | List of Contents | IV |
| | List of Figure | VI |
| | **Chapter One : Introduction** | 1 |
| 1.1 | Problem Of Study | 2 |
| 1.2 | Question and Hypotheses | 3 |
| 1.3 | Objectives | 3 |
| 1.4 | Thiese Layout | 4 |
| | **Chapter Two : Physical Planning** | |
| 2.1 | Over View | 5 |
| 2.1.1 | The division of buildings depending on use | 5 |
| 2.2 | Cadastre | 6 |
| 2.2.1 | Types Of Cadastral | 6 |
| 2.2.1.1 | Real estate cadastre ( legal cadastre) | 6 |
| 2.2.1.1.1 | Types of Recording | 7 |
| 2.2.1.2 | Fiscal Cadastre (Tax) | 7 |
| 2.2.1.3 | Cadastre multi purpose | 7 |
| 2.3 | Controls and standards for residential buildings according to the list of construction organizing 2008, the ministry of physical planning . | 8 |
| | **Chapter Three : Geographic Information System** | |
| 3.1 | Introduction | 12 |
| 3.2 | Components of GIS | 12 |
| 3.3 | Georeferencing | 16 |

3.4 Field of application 20

**Chapter Four : Remote Sensing & Photogrammetry**

4.1 Definition 22

4.1.1 Image data 22

4.1.2 Bands 22

4.1.3 File coordinates 22

4.1.4 Map coordinates 23

4.2 Absorption / Reflection spectra 23

4.3 Pixel 23

4.4 Fields of application 23

4.5 Photogrammetry 24

4.6 Branches photogrammetry 25

4.7 Sections photogrammetry 25

**Chapter Five : Methodology And Materials**

5.1 Description of the study area 26

5.2 Sources of Data 27

5.3 work Steps 29

**Chapter Sixth Results & Analysis**

6.1 Result & Analysis 44

**Chapter Seven Conclusion & Recommendations**

7.1 Conclusion 45

7.2 Commendation 45

References 46

# List of Figures


| No | Figure | Pag.No |
|---|---|---|
| 5.1 | The Study Area | 26 |
| 5.2 | The Aerial Photograph For Study Area | 27 |
| 5.3 | Alemtedad Block 2 Georeferenced Shape File | 29 |
| 5.4 | Overlapping The Image on The Map | 30 |
| 5.5 | The Parcel Numbering | 31 |
| 5.6 | The Irregularities | 32 |
| 5.7 | Numbering of Irregularities | 33 |
| 5.8 | Extraction of Irregularities | 34 |
| 5.9 | Extracted Image in Erdas Software | 35 |
| 5.10 | Sampling of Irregularities Image | 36 |
| 5.11 | Classification Process. | 37 |
| 5.12 | The Table Irregularities | 38 |
| 5.13 | The Block 2 Shape File Attribute Table | 39 |
| 5.14 | The Table of Linked Layer | 40 |
| 5.15 | The Final Table of Block 2 Layer | 41 |
| 5.16 | Flow Chart of Work Steps | 43 |

# *CHAPTER ONE*

## *Introduction*

Urban development is the future vision for urban development and the development of transportation and the face of economic, demographic and environmental challenges that need for sustainable development. Urban development incision mainly from urban development areas that are intended to non-rural development and urban development include

(housing and social environment) the provision of facilities and services and create jobs.

Where we find that The demographic growth hurry in the growth of the third world in general and this was accompanied by the rapid demographic growth considering rural exodus towards big cities as a radiation source of economic , social and scientific development.

Which led to urban development and the unlimited, lopsided resulted from this property the state's inability to meet the needs of the population and their needs through different and successive pursued policies in the field of urban development keep indiscriminate expansion of urban areas in a manner inconsistent.

Rules and regulations on urbanisation and planning can be seen as regulatory procedures for controlling land use development in line with a plan (Clarke, 1994).

However, in many cases particularly in developing countries, laws and regulations are relatively not present in planning and housing literatures especially from environmental points of view, except perhaps in relatively specialised studies on housing standards (Karn, 1993).

Control development should be considered in the planning to check the undesirable side effects of land development growth, for instance pollution, congestion, social crime, environmental disaster, and loss of social solidarity. In this regard, Keivani (2009) pointed out poor institutional inabilities are posing threat to implement regulations and manage natural resources of the developing country cities.

Urban definition irregularities are each violation in the urban area if they do not correspond to the laws relating to construction that occurs as a result of lack of access to building permit and irregularities that occur despite the existence of the license.

Urban sanctions Are security measures under taken by the stakeholders in charge of reconstruction against the perpetrators of violations are any penalty imposed by the public authority over the static result of the violation whether or public ownership was due to lack of compatibility of the licenses set forth in the law so that building permits be imposed on the perpetrators , including security measures , whether fine or construction perpetrator of the offenses demolition.

**Interlocutor for this search as:-**

## 1.1 Problem of Study

The research problem that runs from the task of urban planning and control of urban planning is one of the main tasks under taken by Govermentsprocess .

But the urban planning process encountered some problems resulting from the weakness of the legislative framework and lack of comprehensiveness of the legal rules and regulations of the executive that

control the management and implementation of the urban planning process. (Mahmud Hamadan 2010).

The research problem in this study is the lack of commitment to the citizens of the laws of planning limits for properties recorded in residential land , resulting in increases outside the boundaries segment represents an assault on the streets and spaces in neighborhoods.

## 1.2 Questions and Hypotheses

- Digital system utilizing GIS and RS achieve efficient monitoring and efficient analysis.
- GIS and remote sensing are suitable methods for detection irregularities of planning law in residential areas in quick, economical and reliable manner.
- Aerial Photos can detect up to 10 cm (resolution) of irregularities out of boundaries of the parcels.
- Digital image processing software can determine the material by which these irregularities had been constructed.

## 1.3 Objectives

- Design of a digital system with high efficiency, accuracy and low cost to unable the application of the laws of urban planning.
- Studying the possibility of detection of irregularities of buildings outside of the widget and the residential areas using GIS , aerial photography.
- Recording and documenting irregularities.
- Assess the extent of irregularities.
- Proposing a solution management of the problem.

## 1.4 Thesis Layout

**This research contains seven chapters :-**

chapter one introduction, chapter tow physical planning , chapter three Geographic information systems , chapter four Remote Sensing , chapter five Methodology & Materials , chapter sixth Result & Analysis , chapter seven Conclusion & Recommendation , the end References.

# *CHAPTER TOW*

# *Physical Planning*

## 2.1 Overview

The first man on the ground grew up in unstable conditions because he was living on fishing he did not have the space or the stability of the advancement of his own and when he knew agriculture , housing and fertile river valleys began a stable life and of course it was the first of the establishment of housing security.

### 2.1.1 The division of buildings depending on use :-

**Buildings divided into**

- **Residential buildings:-**

  Whether residential buildings or villas.

- **they trade buildings :-** that contain offices , shops

- **public buildings :-** such as schools , hospital buildings and the role of the judiciary and the communities and the role of cinema , theater meeting the stands and galleries, Restaurants ,and clubs, Etc

- **Industrial buildings: -** such as factories of various industries and sledgehammers.

The bishop can be divided according to the materials used in its creation **into three types:-**

- bishop wood

- bishop rail

- Bishop concrete.

## 2.2 Cadastre

Define that Cadastre system for the registration of land holdings illustrates the limits of those lands minute detail and also is a systematic inventory of public information related country real estate located within the country or region within the country.

This inventory relies on a survey of the boundaries of these properties are usually Tmiiv these properties with the titles of great gauges and maps showing these maps as well as for the record real estate.

Per ownership nature , size and value and legal rights associated with

The ownership and short, the cadastre answers the two questions relating to where and how much land ownership.

### 2.2.1 Types of Cadastral

**We can distinguish three types of cadastre**

#### 2.2.1.1 Real estate cadastre ( legal cadastre)

This System has been developed for the registration of properties and real estate, whether residential land or agricultural land as the land registry is a formal process whereby registration rights relating to the property through :-

- Data sheets in kind or register profile this means that there is a formal constraint.
- Land Registry shows the rights and changes along the legal status of specific parts of the property.

- This recording answers the question of how and with respect to this property.

#### 2.2.1.1.1 Types of Recording

**These are three types of recording depending on the nature of registration system.**

- **Registration deeds :-**

Modeled on the real estate in Egypt , where property is registered land and real estate on the name of the person without a reference documentary of the property in the end same , which has led it self to the lack of safe and reliable ownership.

- **Registration of title :-**

Where the registration is linked to land or property and any renovation that occurs to the property is documented in the land registry of the property Example Torens System which is implemented in Sudan.

- **Private convey acing :-**

That is through **Private** dealings out of the formal system.

#### 2.2.1.2 Fiscal Cadastre ( Tax)

The work of this system to collect taxes in the foundation and Zakat.

#### 2.2.1.3 Cadastre multi purpose

**This type is common among modern states multiple features:**

- It can impose a balanced taxes.
- Him the possibility to update databases.

- It refers to the rural places and needs for development.
- solution of land disputes.
- Mortgage bank application
- Forest management**.**

**2.3 Controls and standards for residential buildings according to the list of construction organizing 2008, the ministry of physical planning:-**

The controls and standards for residential buildings which apartment , **houses and villas are as follows :-**

**Coverage ratio:-**

- shall not exceed the coverage rate of about 75% lot size
- Anchored sky lights are not counted if found within the allowable percentage of buildings.
- Coverage ratio is considered at the level of the ground floor.
- The exploitation of more than allowed for the construction of under ground work floor but at least beyond 2.50 meters from any neighbor adjacent space.

**Highs and levels of floors:-**

- The competent authorities determine the building and the number allowed in different residential areas of floors high.
- The over all building of the middle of the road in front of the high level of asphalt segment until the end of the surface droth.

- Residential condominium least net height of 2.7 meters from the floor.
- At least the level of the courtyard from the ground 0.3 m above the sidewalk level.
- At least the level of the ground floor about 0.6 m above the sidewalk level.
- At least high net floor under ground about 2.60 meters.

**Defections:-**

- Measured defections from the edge of the most prominent building.
- Bounce buildings for an end piece that separates the buildings built for two pieces of almlasqtin north and the south on the side but at least recoil from 2.5 m
- Bounce buildings for an end piece between the eastern and western neighbors, including at least 1.50 m.
- Allows the establishment of the main buildings as far as the eastern or western neighbor premises of the third degree and machining which area of 300 square meters or less degrees the other if they meet the following conditions**.**
- Any adherent based neighbor does not allow the establishment of any upper floor it does not use his bishop substrata does not allow the establishment of any stairway or ladder to those buildings.
- Not allowed to open any windows or holes in the walls conjoined on neighbor.

- it does not allow the emergence of a bishop and foundations or any other parts of the conjoined neighbor buildings .
- Authorities may permit the buildings past the buildings on the east end or western neighbor in the case of collective housing projects.
- Allows adhesion buildings and buildings of secondary services in all directions and at altitudes of no more than 3 meters on neighbor and an end to aivbd than 6 m in length and is based service completely separate from the main building.

**Protrusions:-**

- may emerge from the interval between the end piece in the street level of the upper floors , provided that no lved prominence in the street for the amount specified in paragraph (b) below, including at least 3 meters high from the level of the sidewalk , as follows :-
- Be prominence on the first floor and above.
- Have a minimum net height of the balcony on the level of the pavement 3 meters.
- It does not allow the emergence of abalcony for his presentation of less than 10 m on the street.
- Allowed to emerge on the street or spaces below ground level and a depth of at least 1.80 m for purposes when designing the foundations of buildings , fences, so to Atved jutting limits widget 1.0 m are allowed on the first floor or floors which topped the length or part of the front of the building built in the end piece of **land bordering on the road , according to the following :-**
- Rise by 1.80 cm if the road width of 20 m and more.

- Rise by 1.50 cm if the road width of 15 m and more.
- Rise by 1.20 cm if the road width of 10 m and more.
- does not allow the emergence on the road that currently at least 10 meters except protrusions aesthetic untapped condition that dose not Tved about 0.4 meters.

**Special conditions:-**

- Allows job shop one freelancer controls specified by the competent authorities to Atved area of 25 square meters.
- Alpedron not allowed to use for housing.
- It should not lved high walls of villas and residential houses over looking the street or neighbor about 2.50 m from the ground yard.

# *CHAPTER THREE*

## *Geographic Information Systems (GIS)*

### 3.1 Introduction

The U.S Federal Interagency Coordinating Committee (1988) definition stated that a GIS is a system of computer hardware, software, and procedures designed to support the capture, management, manipulation, analysis, modularity and display of spatially referenced data for solving complex planning and management problems.

Generally GIS is defined as a computer based information system that is used to input, store, retrieve, manipulate, analyze and output geographically referenced data or geospatial data, in order to support decision making for planning and management of land use, natural resources, environment, transportation, urban facilities, and other administrative records. This system has the ability to connect the geographical information to non-geographic information relative to them.

### 3.2 Components of GIS:-

- **Hardware:-**

GIS needs many types of hardware to satisfy some of its main functions such as data collection, storage, manipulation, and presentation.

The standard component of the computer are: The central processing unit (CPU) which contains the control unit (CU),arithmetic and logic unit (ALU),input units mainly the keyboard and the mouse, the output units such as the monitor, and the main storage unit.

The wide facilities of the auxiliary storage devices such as compacted discs (CDs) and universal serial bus devices (USB)

Many types of devices are attached to the computer as input devices such as scanners, cameras, digitizers, and many others, Networks hard wares,

such as modems, cables, hubs, bridges and other networks devices, are utilized in GIS to share data, soft wares, and hard wares.

- **Software :-**

The Environmental Systems Research Institute (ESRI): Arcview, Arc info and ArcGis. Arc Gis is composed of many modules such as Arc Map, Arc Catalogue, Arc Toolbox, Arc Reader, Arc Globe, and Arcsine. These modules are functioning in a integrating manner for capturing, managing, manipulating, displaying, and analyzing spatial data.

GIS software's have the capability of performing different functions that are necessary for it. Arc Map (is the main interface of Arc Gis which contains different tools for data presentation, editing, Georeferencing , and other tasks.) Arc Catalogue (contains tools for managing folders and files and other tasks.) Arc Toolbox (contains tools for file's format conversions, feature classes conversions, datum's and map projections conversions and many other tools.)

IDRISI which had been developed by the Graduate School of Geography at Clark University.

Geographic Resources Analysis Support System (GRASS) which had been developed by U.S Army Construction Engineering Research Laboratories (USACERL).

Intergraph's Modular GIS Environment (MGE) and many other systems.

- Data:-

- **Spatial data:-**
    - Spatial data describes the absolute or relative location of geographic features.
    - Spatial data is the graphical representation of the geographic locations in a digital form.
    - Spatial data can be obtained from many different sources in a digital form or in a hard copy.

- Spatial data can be classified into two basic data models: raster data model and vector data model.

- **Raster data model:-**
  - Data model is a set of grid of uniform, regular cells (rectangular or square but it may be triangular or hexagonal).
  - The main sources of raster data models are satellite imageries, aerial photographs and digital image scan of existed maps.

- **Vector data model:-**
  - The vector data model represents the geographical phenomena in terms of the spatial components, consisting of points, lines, areas, surfaces and volumes and each layer in the vector data model must be composed of only one component.
  - The point is an object of zero dimensions called node or vertex, line is the link between two points which has one dimension called link or arc, while area has two dimensions and composed of at least two arcs called polygon or face.
  - Every object is identified in the attribute table or database in a manner that each record corresponds to one object on the map, Objects on the map are identified by numerical or alphanumerical codes called identity (ID).

- **Attributes:-**

Attributes are stored in a table in a manner that each record or row in the table corresponds to geographic object on the map, whereas each property is stored in a column or a field, each object must have an identity (ID) or access key.

**Attribute data models:-**

**Tabular model:-**

This type of data model is outdated in the GIS arena.

It lacks any method of checking data integrity, as well as being inefficient with respect to data storage, e.g. limited indexing capability for attributes or records, etc.

**Hierarchical Model:-**

The hierarchical database organizes data in a tree structure.

Any level in the hierarchy can have unlimited children, but any child can have only one parent.

**Network model:-**

The network database organizes data in a network or plex structure.

This model allows for children to have more than one parent.

Network DBMS have not found much more acceptance in GIS than the hierarchical DBMS

**Relational model:-**

The relational database organizes data in tables, Each table is identified by a unique table name, and is organized by rows and columns, Each column within a table also has a unique name, Columns store the values for a specific attribute, Rows represent one record in the table.

In a GIS each row is usually linked to a separate spatial feature.

The relational database model is the most widely accepted for managing the attributes of geographic data.

**Object oriented model:-**

The object-oriented database model manages data through objects, An object is a collection of data elements and operations that together are considered a single entity.

This approach has the attraction that querying is very natural, as features can be bundled together with attributes at the database administrator's discretion.

**People or live ware:-**

Different levels of people from different disciplines are involved to establish GIS project or organization.

GIS team may include GIS experts (who advise and solve problems for end users) cartographers, system analysts, computer specialists and people specialized in the field of the project in question e.g. geologists, agriculturists, engineers, GIS team also include end users (who seek problem solutions and see final products only in the form of maps and reports), GIS operators of low level of experience who understand the functions of specific system so as to manipulate data and data compilers, who understand the data but not the system.

**Procedures:-**

Procedures include how the data will be retrieved, input into the system, stored, managed, transformed, analyzed, and finally presented in a final output.

Procedures are the step taken to answer the question needs to be resolved.

Transformation processes includes such tasks as adjusting the coordinate system, setting a projection, correcting any digitized errors in a data set, and converting data from vector to raster or raster to vector.

**3.3 Georeferencing :-**

There are two principal methods of georeferencing:

Continuous georefrencing systems:-

Continuous georeferncing implies continuous measurement of the position of phenomena without changes or breaks.

Many geographical phenomena, including property boundaries, manhole locations, building details, and many map details, are measured on a contiuous basis.

**Continuous systems include direct Georeferencing, which involve:**

•Coordinates on the curved surface of the Earth.

•Geocentric coordinates.

• Rectangular coordinate.

**The other continuous system is relative Georeferencing, which includes:**

• Polar coordinates.

• Offset distance.

• Measurement along (road) network.

Direct georeferencing :-

**Datum:**

•As we know, the Earth is not perfect sphere, but more like an ellipsoid with flattening (ellipticity) at poles.

•The shape of the Earth is therefore expressed by the shape of the ellipsoid.

•Various sizes of ellipsoid have been used depending on how accurately it has been possible to measure the shape of the Earth.

•A datum (reference level) is a model (ellipsoid) of the Earth used for geodetic Calculations.

•The common datum for a country or area requires that there are specific Coordinates for the datum origin (starting point), while this point has to have a height in relation to a given sea level.

•Today, many countaries have adopted WGS1984 (World Geodetic System) as a datum; this is based on the center of the Earth's mass.

**Map projection:-**

•Georeferenced data may be drawn on maps only when referenced to a plane surface, not to the curved surface of the Earth

•Various projections are used to represent the curved surface of the earth on the plane surface of a map

•They are classified in three groups according to the underlying geometrical transformations involved (Cylinderical (UTM) – Conical – Azimuthal).

**Coordinate systems:-**

•The geographical coordinates on the surface of the Earth are latitude, Measured in degrees north or south of the equator, and longitude, measured in degrees east or south of Greenwich.

•Position in latitude and longitude are only relative; distances and areas must be calculated using spherical geometry and the earth's radii to the points in question.

•In application, latitude and longitude are usually used in describing major land areas.

•Many countries have national, even local, georeference systems of rectangular cartesian coordinates which permit locations to be given in units of length relative to selected origin.

•Most systems comprise x and y axes and coordinates.

•Coordinate system's orientations may differ, so coordinates should always be identified unambiguously, for example, in terms of compass directions (northing and easting) from the origin.

•Many GISs have facilities for transforming from one coordinate system to another, based on common points in the two systems.

•When the common point is unknown, the parameters for the datum, project method, and coordinate system should be ascertained.

•The best known coordinate system is the UTM grid (universal Transverse

Mercator Grid.

•Geocentric coordinates are based on a rectangular coordinate system with an origin at the center of the Earth.

•The weakness of the geocentric coordinate system is that the elevation reference system is not the same as for normal national elevation systems.

**Elevation referencing:-**

•Most countries have established a national vertical reference system.

•The zero point for an altitude is based on mean sea level.

•The area goes through all points at zero altitude is called the geoid.

•The geoid is affected by the mass of the Earth and therefore follows the Earth's contour: upwards at mountains where there are large amounts of land mass and downwards where there is less.

•Geoid can be defined as the hypothetical surface of the earth formed from sea level and its continuation through the continents at the same level of gravitational potential.

•The fact that a geoid does not have an even surface is not a problem as long as normal theodolites are used which are adjusted with the help of levels affected by the same forces of gravity.

•Problems arise as soon as GPS is used where heights are measured in relation to a mathematical point in the center of the Earth.

•Heights on the surface of the Earth, based on geocentric coordinates, can only be calculated in relation to a mathematical surface –the rotation (reference) ellipsoid-which only approximates the surface of the earth.

•This ellipsoid differs from the geoid.

•The transformation of ellipsoidal height to geoid undulations is impossible without knowing the gravity at either the actual point or the transformation parameters.

Relative georeferencing :-

•Relative georeferencing includes (polar coordinates - offset distance –

measurement along (road) networks).

•Polar georeferencing is based on the measurement of a distance in relation to a reference point and a direction in relation to an axis, usually the north axis, this is known as an indirect georeferencing method.

•Another indirect method is to specify location in relation to details in the Terrain.

•Using the offset distance method, location will be specified using either direction and distance or only distance(s) from specified objects in the terrain such as roads, buildings, or poles.

•Such measurements can be converted to existing rectangular coordinate systems where the coordinates are known for the details from which they are measured.

•Measurements of distances along roads from a given zero (chainage) which acts as a visible point of reference are used for measurements in the road networks.

•A network can have many zero points, often defined from road junctions.

•Where the total layout of the road system is known.

•A road network system, and other types of contniuous networks, such as railways and tram, in many ways provides a schematic or topological

Discrete georeferencing Systems :-

•In discrete georferencing systems the position of phenomena are measured relative to fixed, limited units of the surface of the Earth.

•With this type of system, we know that each object is located within the specified reference units, but the location within the reference unit is unknown.

**3.4 Field of application:**

- Environmental management & conservation.
- Defense & intelligence purpose.
- Governmental administration.

- Resources management in agriculture & forestry.
- Geophysical exploration.
- Telecommunications.
- Utility management.
- Business applications.
- Construction projects.

# *CHAPTER FOUR*

## *Remote Sensing and Photogrammetry*

### 4.1 Definition:-

Is to get the data on a specific target or view through the sensor is far from the target.

### 4.1.1 Image data:-

The image data remotely sensed is a digital representation of the land , the image data in the general term (image) is a digital representation of an image or particular purpose image data stored in the data file and the data.

Consists of numbers only constitute this image representations when he was on the computer screen or printed on paper.

### 4.1.2 Bands:-

Can include image data several bands of information and every scale is a set of data file values for a particular part of the electromagnetic spectrum of light reflected or emitted heat or some other information defined by the investor.

### 4.1.3 File coordinates:-

Reflect the coordinates for the location of the file the pixels in the image and begin to file in the coordinates of the principle of coordinates (0,0) located in the upper left corner in the picture.

### 4.1.4 Map coordinates:-

Expressed in number one in the coordinates of the map projection systems or systems projection.

### 4.2 Absorption / Reflection spectra:-

When rays collide with an object some wavelengths absorbed and some is reflected.

### 4.3 Pixel:-

This term is short of the image element and an element pixel is the smallest part of the digital photo scanning network is divided into image data net work in which each pixel represents a cell by pixel.

### 4.4 Fields of application:

The interpretation of image has a great number of areas of application these include:

- Military intelligence ,
- Environmental ,
- Forestry ,
- Agriculture ,
- Topographic mapping ,
- Coastal area survey ,
- And archaeology , among others spectral,

For some of these applications, interpretation keys with examples of imaged objects to be interpreted have been developed.

Needs planned, which means setting style for the national and strategic planning to resolve problems that are related to the uses of the land are

the two types of data : information on current land use, and information about the capabilities and potential of its natural resources . The satellite scans own natural resources, including out of available devices for imaging and sensing and passing above the earth several times each year, and send the data captured and analyzed by the computers, which is listed by the various uses of the land, The ones we get balance of enormous information at the regional level for large tracts in a single image can checking the distribution of tracts villages and cities scattered over an area of land over the entire province and repeating the continuous monitoring of the same province for different time periods and compare the visuals from period to period we can follow changes in land use agricultural, and calculate the rates of urban expansion over this land.

**4.5 Photogrammetry:-**

Definition of photogrammetry is the art or science obtain quantitative and qualitative information about natural and industrial monuments through the captured images.

Photogrammetry different from the land surveys that deal directly with nature and photogrammetry obtained details and measurements through the images captured by air without friction with nature.

**Photogrammetry featuring for land survey with features the following:-**

- Land survey for large areas very expensive in time , effort and cost compared to the photogrammetry.
- Photogrammetry are not related to a specific time and climate , but while taking aimage.

- The difficulty of dealing with rugged terrain land survey unlike the photogrammetry.

**4.6 branches of photogrammetry :-**

- **Photogrammetry metric :-**

The image used in the preparation of detailed topographic maps, and set the coordinates of points and other purposes cadastral .

- **Photogrammetry explanatory :-**

This area and the means to read the images and recognize of natural and industrial landmarks such as the types of soil and crops or for military purposes , and project planning.

**4.7 sections photogrammetry :-**

- **land survey :-**

In this section , the images taken with a camera placed on a stand on the surface of the ground and used.

- **Photogrammetry air :-**

Used images taken from the air where the imaging machine to be installed in the plane and imaging are depending on the flight plan and flying height is determined.

- **Photogrammetry altsoerbh:-**

The imaging satellite stations and the kind of images are used for explanatory purposes such as meteorology .

Photogrammetry accuracy can be up to 10 cm and by unmanned aircraft technologies as possible up the resolution to 3cm.

# *CHAPTER FIVE*

## *Methodology and Materials*

### 5.1 Description of the study area

The study area is Alemtedad (Block 2) Khartoum Locality, Khartoum State South of Sudan University for science and Technology Southern Compass figure (5.1).

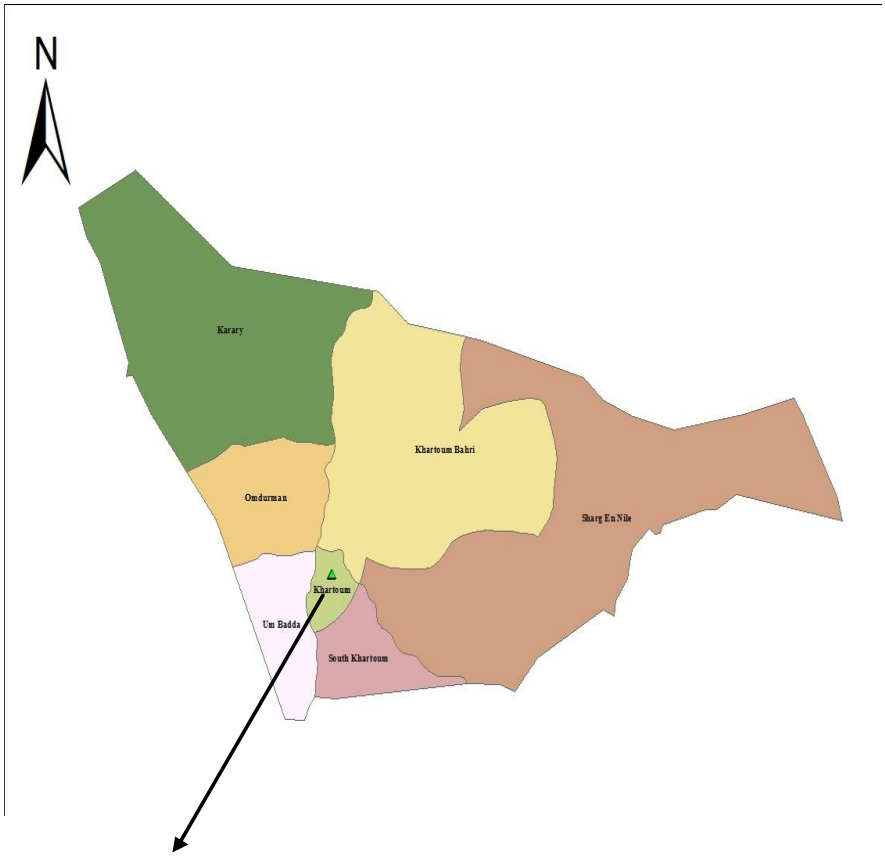



**Figure 5.1 The Study Area**

## 5.2 Sources of Data

**Aerial photograph Figure (5.2) with the following Specifications:-**

Format: - FGDBR

Resolution: - 10 cm

Band: - Three Bands

Source: Khartoum State Survey Department.

Year of Photography: 2008.

Projection and Datum: - WGS84, UTM Zone-36 N.

**Figure 5.2 The Aerial Photograph For Study Area**

**Map with the following Specification**

Format: - DWG

Scale 1:1000

Source: Khartoum State Survey Department.

**Map of boundaries (Frame)**

Format: shape file

Datum: WGS 1984

Projection: UTM Zone 36 N

Source: Khartoum State Survey Department.

## 5.3 Work Steps

- Alemtedad Auto CAD map had been converted to shape file. The shape file had been Georefrenced using Alemtedad boundary shape file obtained from the ministry of planning. The coordinates of the boundary shape file had been observed by GPS to accuracy of 1cm, by Khartoum State Survey Department (Datum : WGS84, Projection Zone-36N) Figure (5.3)

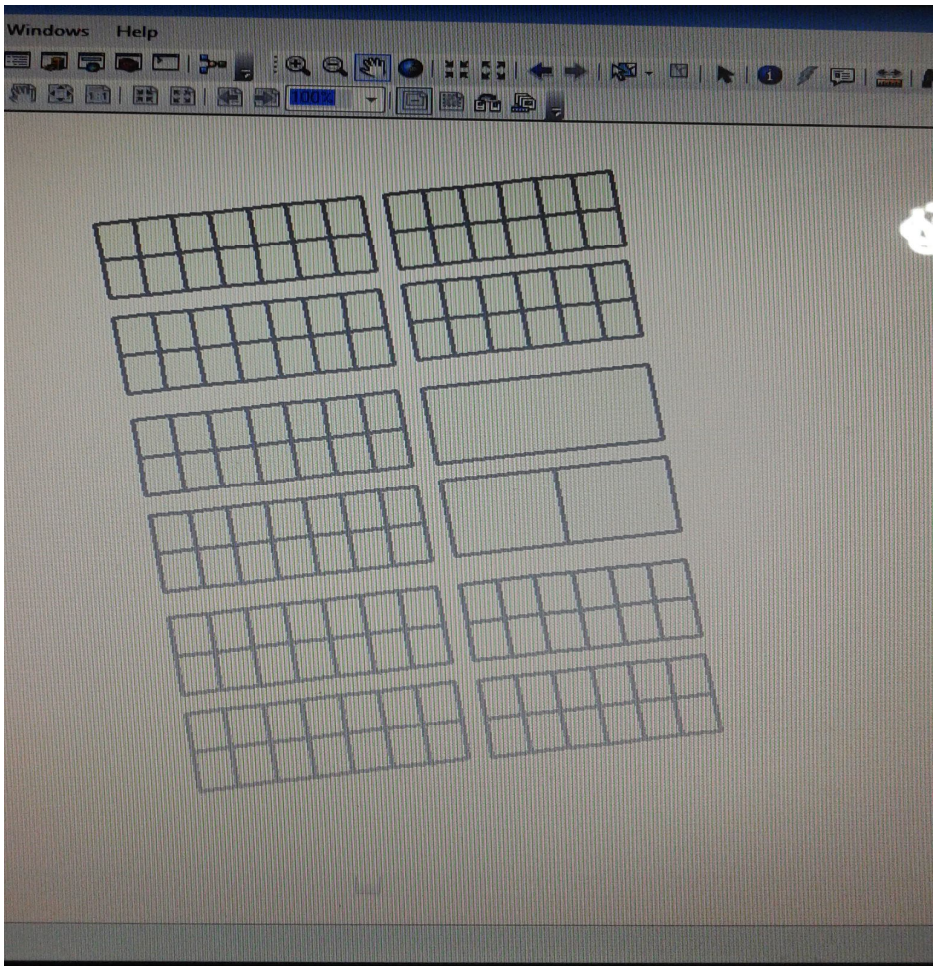



**Figure 5.3 Alemtedad Block 2 Georeferenced Shape File**

- The Block 2 map (shape file) had been overlapped on the image (Block 2 Aerial photograph). Figure 5.4

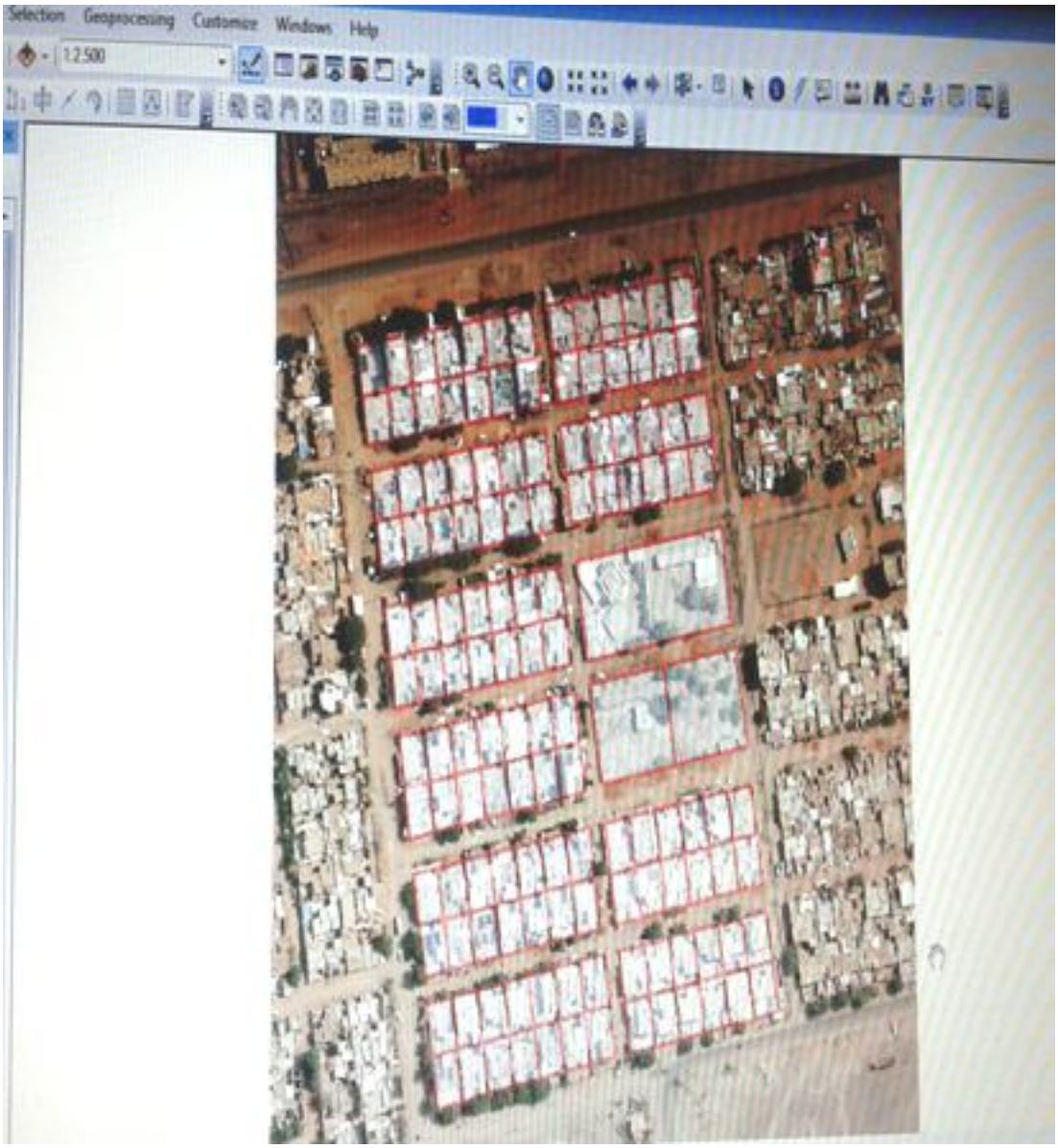



**Figure 5.4 Overlapping the Image on the Map**

- The Number of each Parcel in Block 2 had been edited in the attribute Table of block 2 shape file figure (5.5)

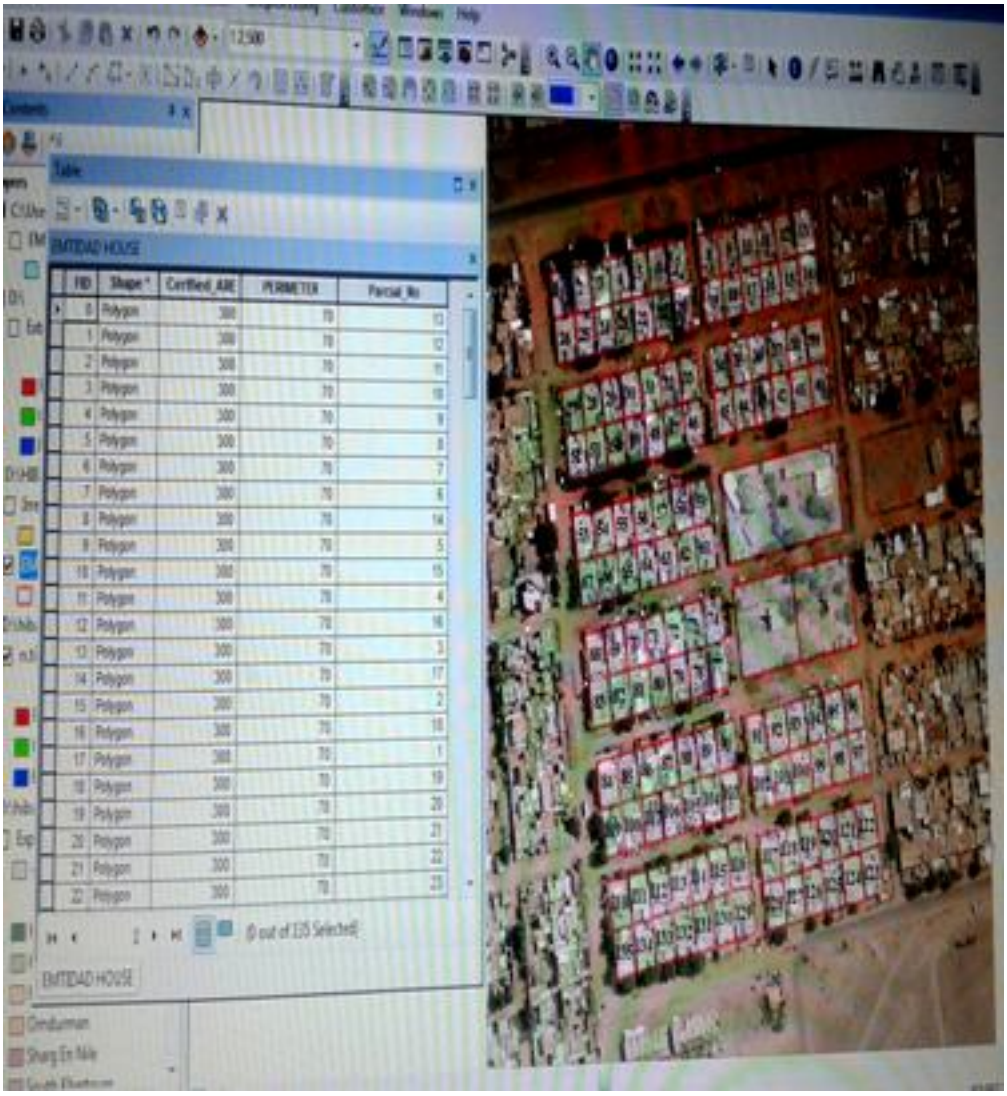



**Figure 5.5 The Parcel Numbering**

- The figure below illustrates the irregularities of Parcels protruding out of the parcels boundaries in yellow colour (trespassing).

Figure (5.6)

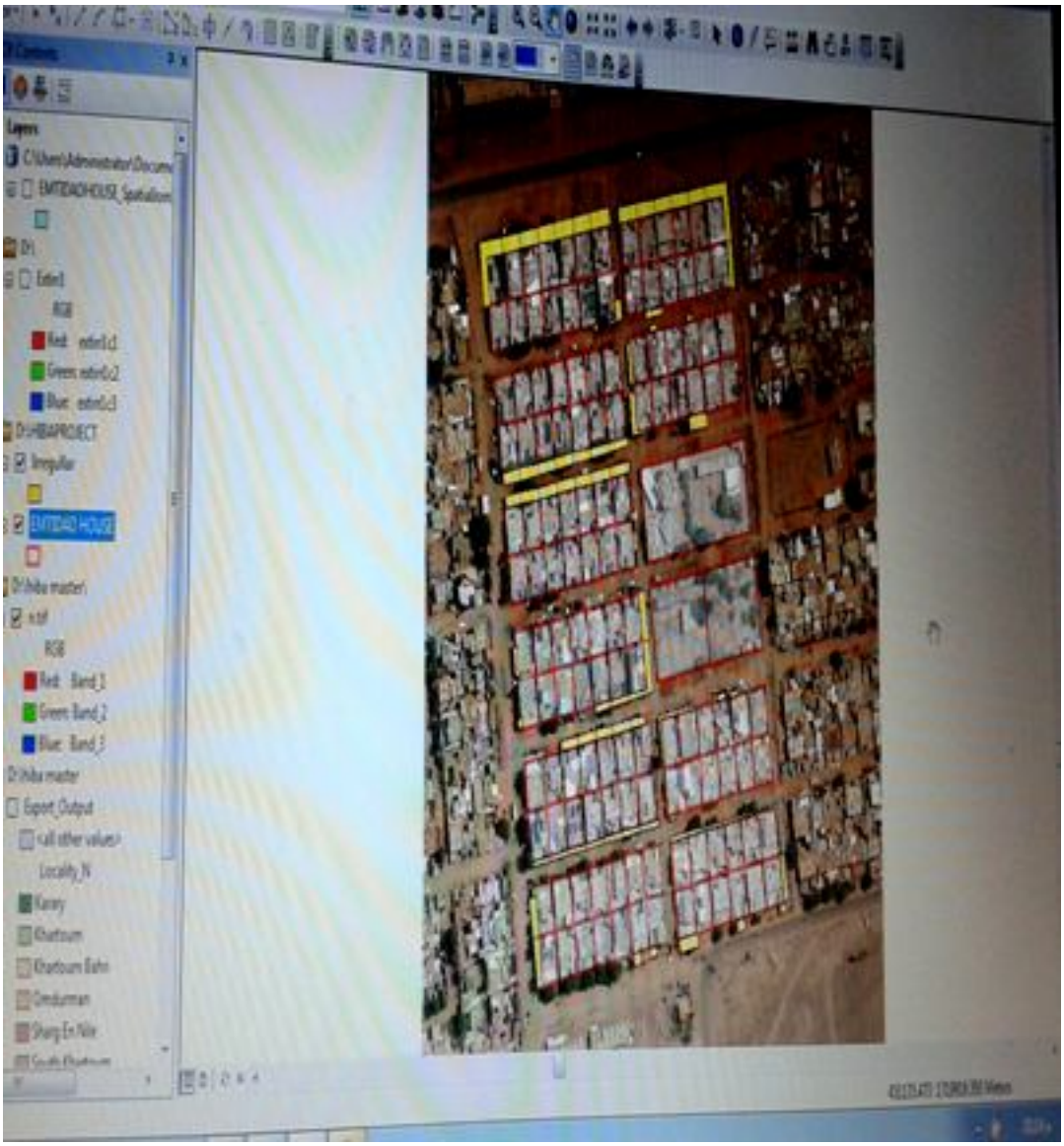


**Figure 5.6 The Irregularities**

- The irregularities had been numbered by the same parcel Number the figure (5.7)

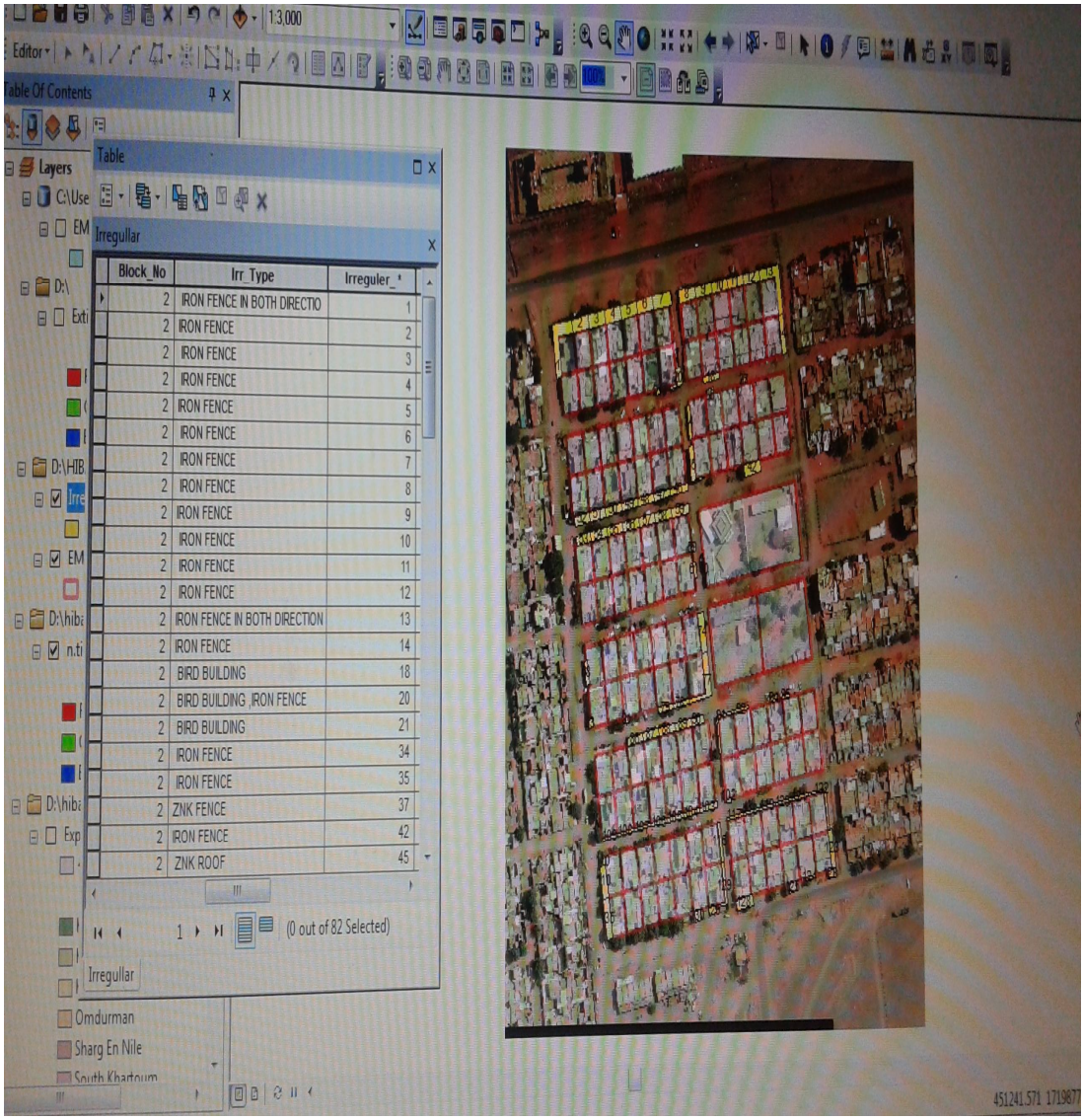



**Figure 5.7 Numbering of Irregularities**

- The figure below shows the process of Extraction of irregularities from block 2 image Figure (5.8)

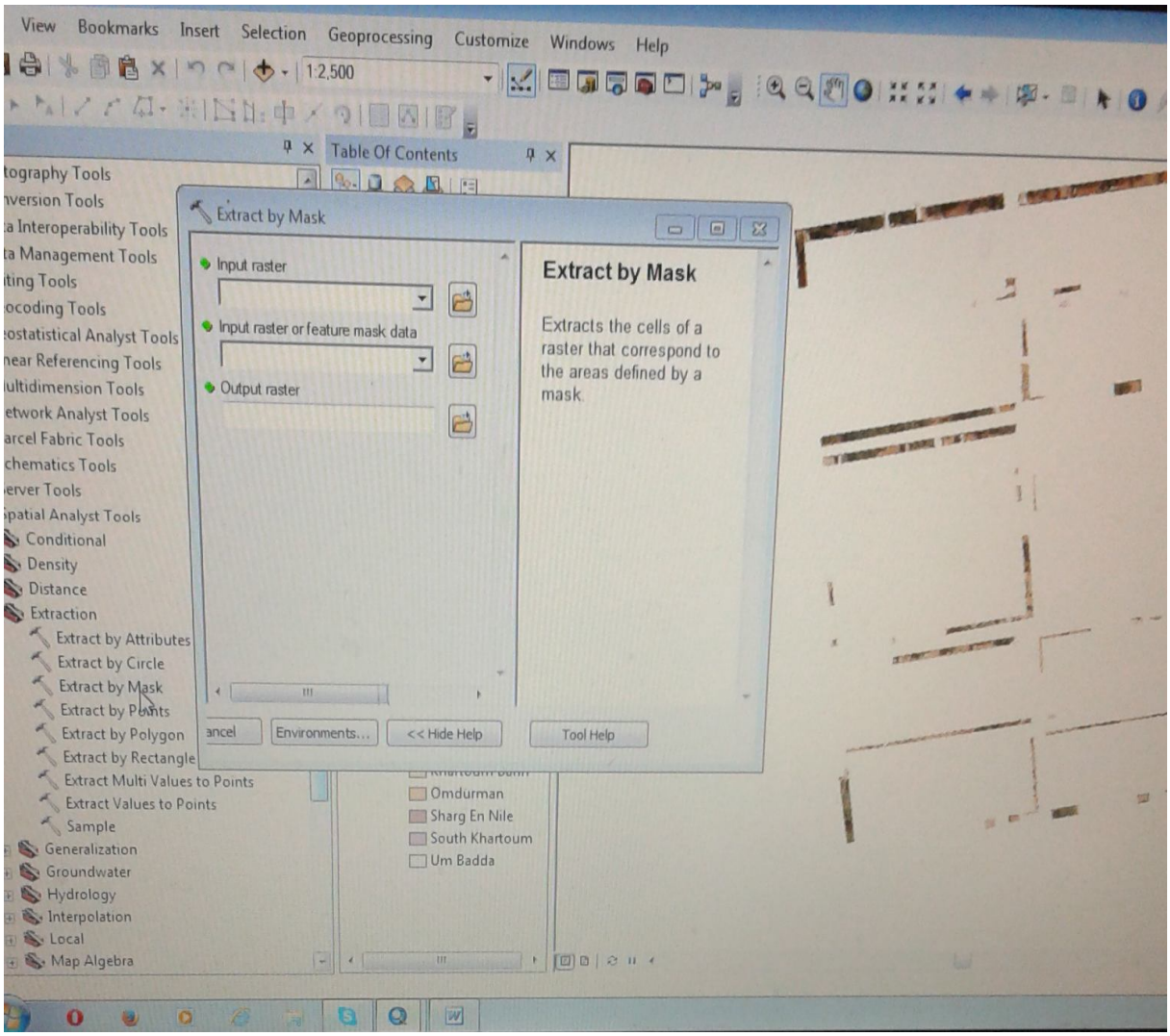



**Figure 5.8 Extraction of Irregularities**

- The figure (5.9) below shows the Extracted image open in Erdas Software.

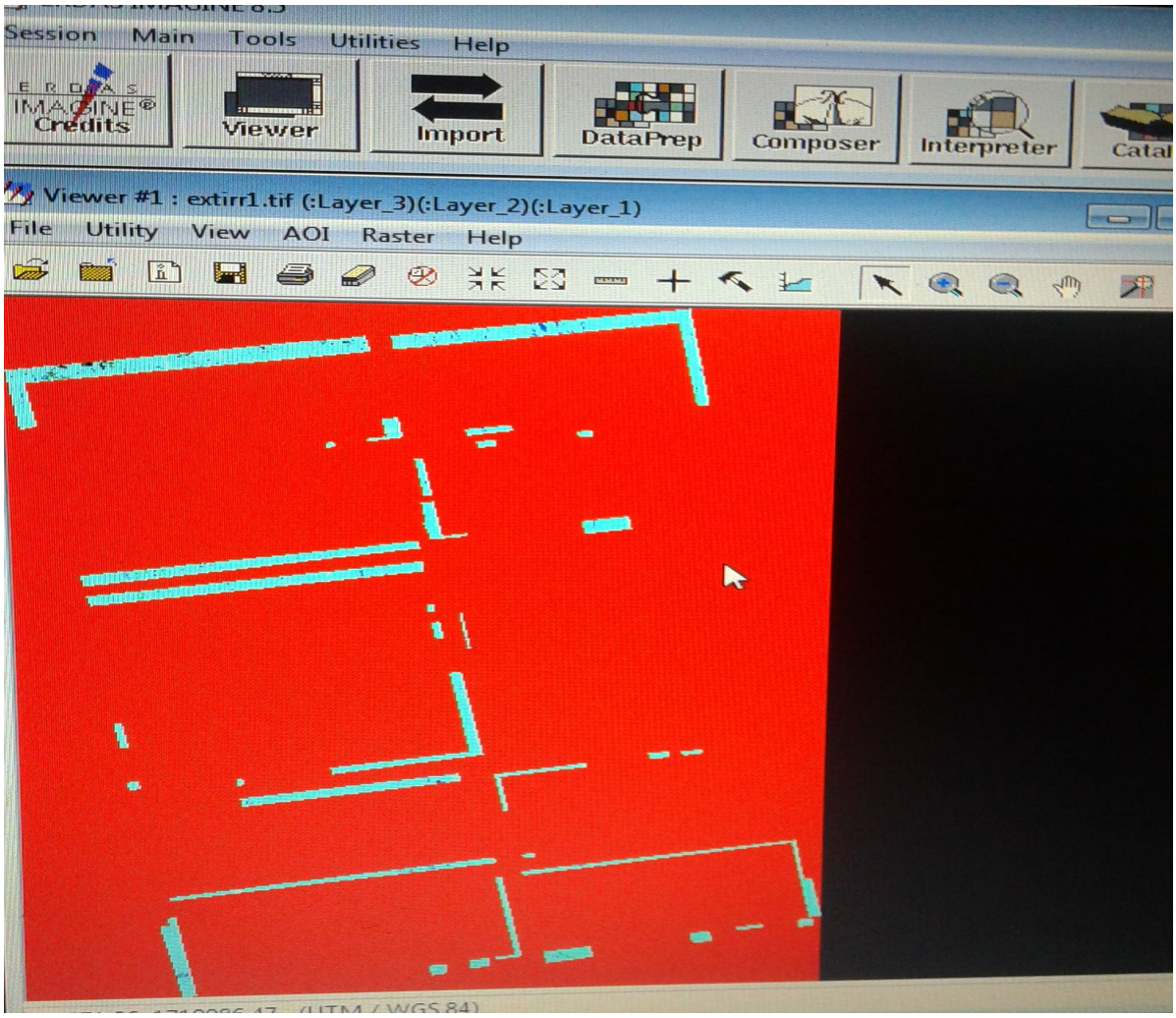



**Figure 5.9 Extracted Image in Erdas Software.**

- In Erdas four Samples of irregularities image had been prepared to be used in the supervised classification

Figure (5.10)

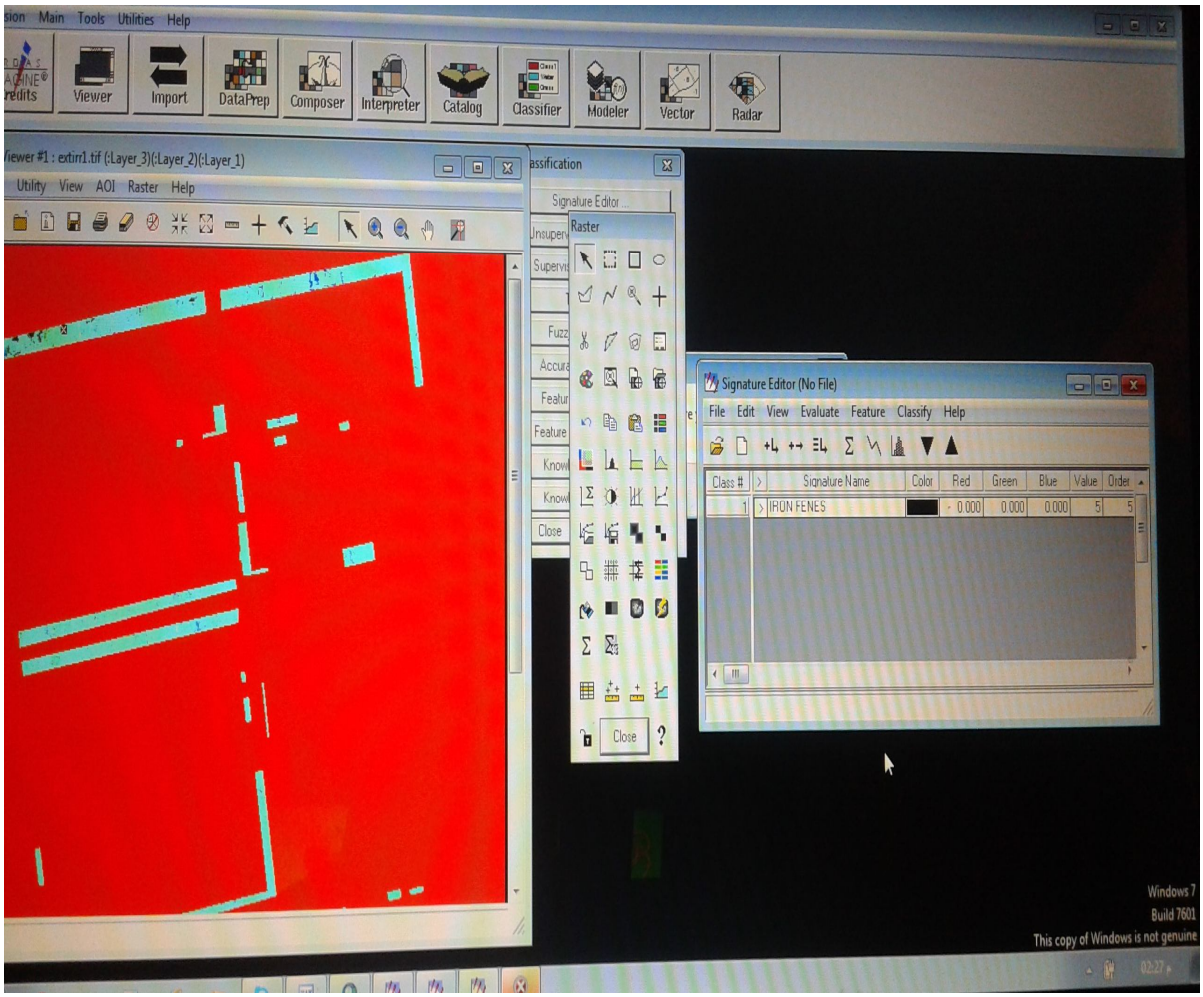



**Figure 5.10 Sampling of Irregularities Image**

- The irregularities image had been classified by the samples that had been prepared in figure 5.10 Supervised classification had been applied figure (5.11)

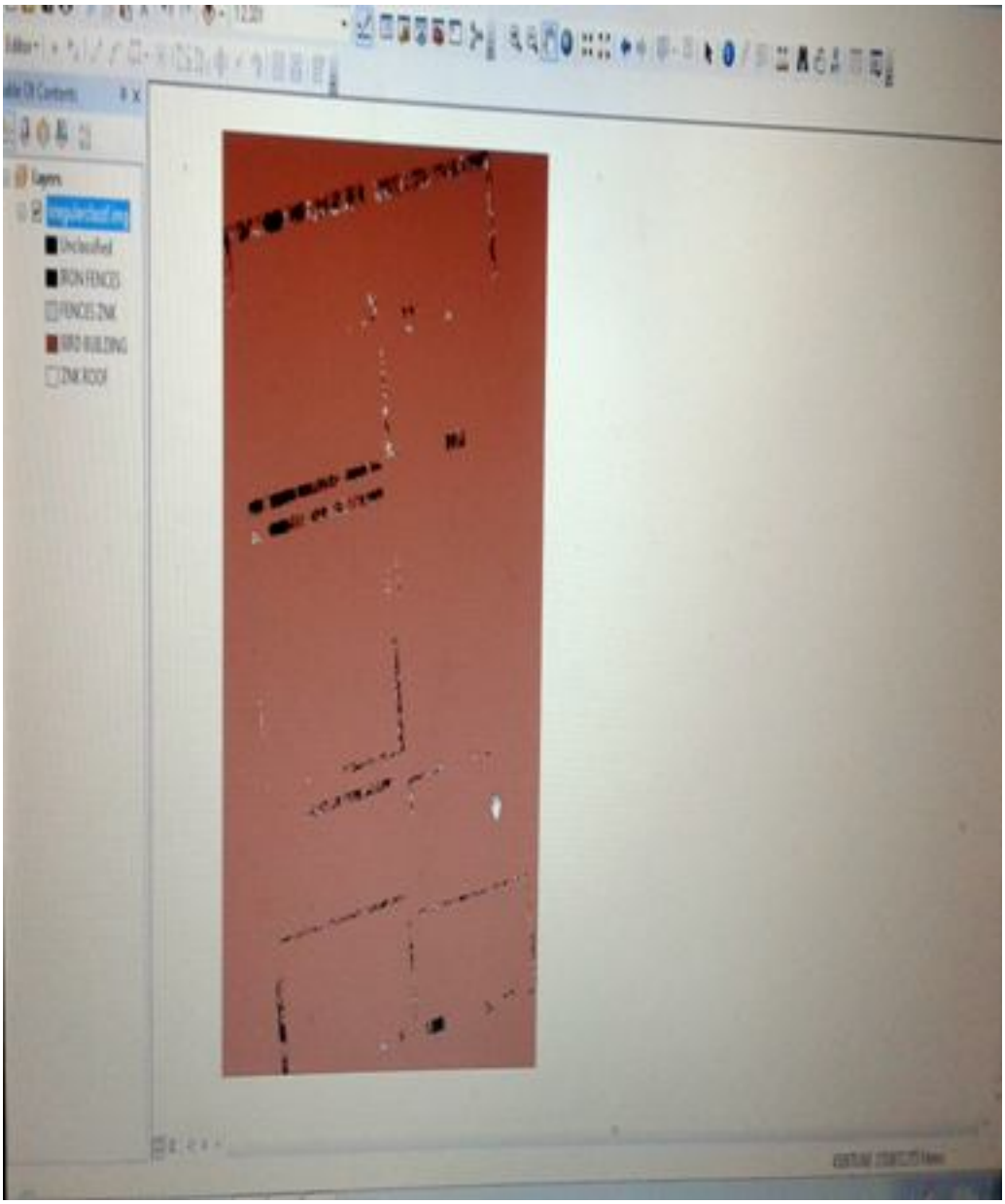
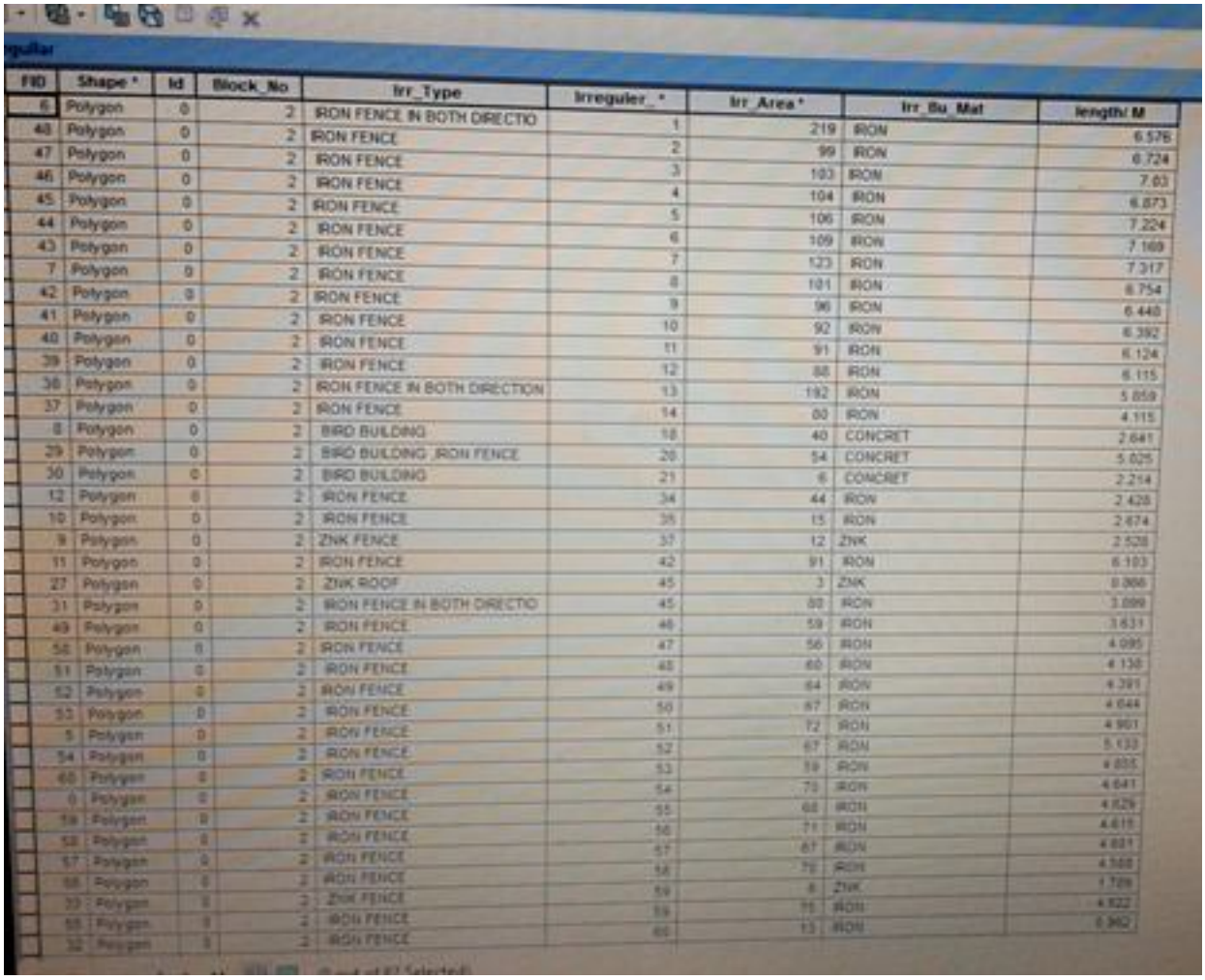


**Figure 5.11 Classification Process**

- A shape file had been for the irregularities and the attribute table had been completed by adding six fields as follows: Block No, Irregularities type, irregularities No (same parcel number), irregularities Area, irregularities Material, length. the figure (5.12).



| FID | Shape * | Id | Block_No | Irr_Type | Irreguler_* | Irr_Area* | Irr_Bu_Mat | length/ M |
|---|---|---|---|---|---|---|---|---|
| 6 | Polygon | 0 | 2 | IRON FENCE IN BOTH DIRECTIO | 1 | 219 | IRON | 6.576 |
| 48 | Polygon | 0 | 2 | IRON FENCE | 2 | 99 | IRON | 6.724 |
| 47 | Polygon | 0 | 2 | IRON FENCE | 3 | 103 | IRON | 7.63 |
| 46 | Polygon | 0 | 2 | IRON FENCE | 4 | 104 | IRON | 6.873 |
| 45 | Polygon | 0 | 2 | IRON FENCE | 5 | 106 | IRON | 7.224 |
| 44 | Polygon | 0 | 2 | IRON FENCE | 6 | 109 | IRON | 7.169 |
| 43 | Polygon | 0 | 2 | IRON FENCE | 7 | 123 | IRON | 7.317 |
| 7 | Polygon | 0 | 2 | IRON FENCE | 8 | 101 | IRON | 6.754 |
| 42 | Polygon | 0 | 2 | IRON FENCE | 9 | 96 | IRON | 6.440 |
| 41 | Polygon | 0 | 2 | IRON FENCE | 10 | 92 | IRON | 6.392 |
| 40 | Polygon | 0 | 2 | IRON FENCE | 11 | 91 | IRON | 6.124 |
| 39 | Polygon | 0 | 2 | IRON FENCE | 12 | 88 | IRON | 6.115 |
| 38 | Polygon | 0 | 2 | IRON FENCE IN BOTH DIRECTION | 13 | 192 | IRON | 5.059 |
| 37 | Polygon | 0 | 2 | IRON FENCE | 14 | 60 | IRON | 4.115 |
| 8 | Polygon | 0 | 2 | BRD BUILDING | 18 | 40 | CONCRET | 2.641 |
| 29 | Polygon | 0 | 2 | BRD BUILDING ,IRON FENCE | 20 | 54 | CONCRET | 5.025 |
| 30 | Polygon | 0 | 2 | BRD BUILDING | 21 | 6 | CONCRET | 2.214 |
| 12 | Polygon | 0 | 2 | IRON FENCE | 34 | 44 | IRON | 2.428 |
| 10 | Polygon | 0 | 2 | IRON FENCE | 35 | 15 | IRON | 2.674 |
| 9 | Polygon | 0 | 2 | ZINK FENCE | 37 | 12 | ZINK | 2.528 |
| 11 | Polygon | 0 | 2 | IRON FENCE | 42 | 91 | IRON | 6.103 |
| 27 | Polygon | 0 | 2 | ZINK ROOF | 45 | 3 | ZINK | 0.966 |
| 31 | Polygon | 0 | 2 | IRON FENCE IN BOTH DIRECTIO | 45 | 80 | IRON | 3.099 |
| 49 | Polygon | 0 | 2 | IRON FENCE | 46 | 59 | IRON | 3.631 |
| 50 | Polygon | 0 | 2 | IRON FENCE | 47 | 56 | IRON | 4.095 |
| 51 | Polygon | 0 | 2 | IRON FENCE | 48 | 60 | IRON | 4.138 |
| 52 | Polygon | 0 | 2 | IRON FENCE | 49 | 64 | IRON | 4.391 |
| 53 | Polygon | 0 | 2 | IRON FENCE | 50 | 67 | IRON | 4.644 |
| 5 | Polygon | 0 | 2 | IRON FENCE | 51 | 72 | IRON | 4.901 |
| 54 | Polygon | 0 | 2 | IRON FENCE | 52 | 67 | IRON | 5.133 |
| 60 | Polygon | 0 | 2 | IRON FENCE | 53 | 59 | IRON | 4.655 |
| 0 | Polygon | 0 | 2 | IRON FENCE | 54 | 73 | IRON | 4.641 |
| 59 | Polygon | 0 | 2 | IRON FENCE | 55 | 68 | IRON | 4.629 |
| 58 | Polygon | 0 | 2 | IRON FENCE | 56 | 71 | IRON | 4.615 |
| 57 | Polygon | 0 | 2 | IRON FENCE | 57 | 67 | IRON | 4.631 |
| 56 | Polygon | 0 | 2 | IRON FENCE | 58 | 70 | IRON | 4.568 |
| 55 | Polygon | 0 | 2 | ZINK FENCE | 59 | 8 | ZINK | 1.709 |
| 61 | Polygon | 0 | 2 | IRON FENCE | 59 | 75 | IRON | 4.922 |
| 32 | Polygon | 0 | 2 | IRON FENCE | 60 | 13 | IRON | 0.962 |

**Figure 5.12 The Table Irregularities**

- The block 2 shape file attribute table had been completed by adding the following fields : Certified Area , Perameter , Parcel No figure (5.13)

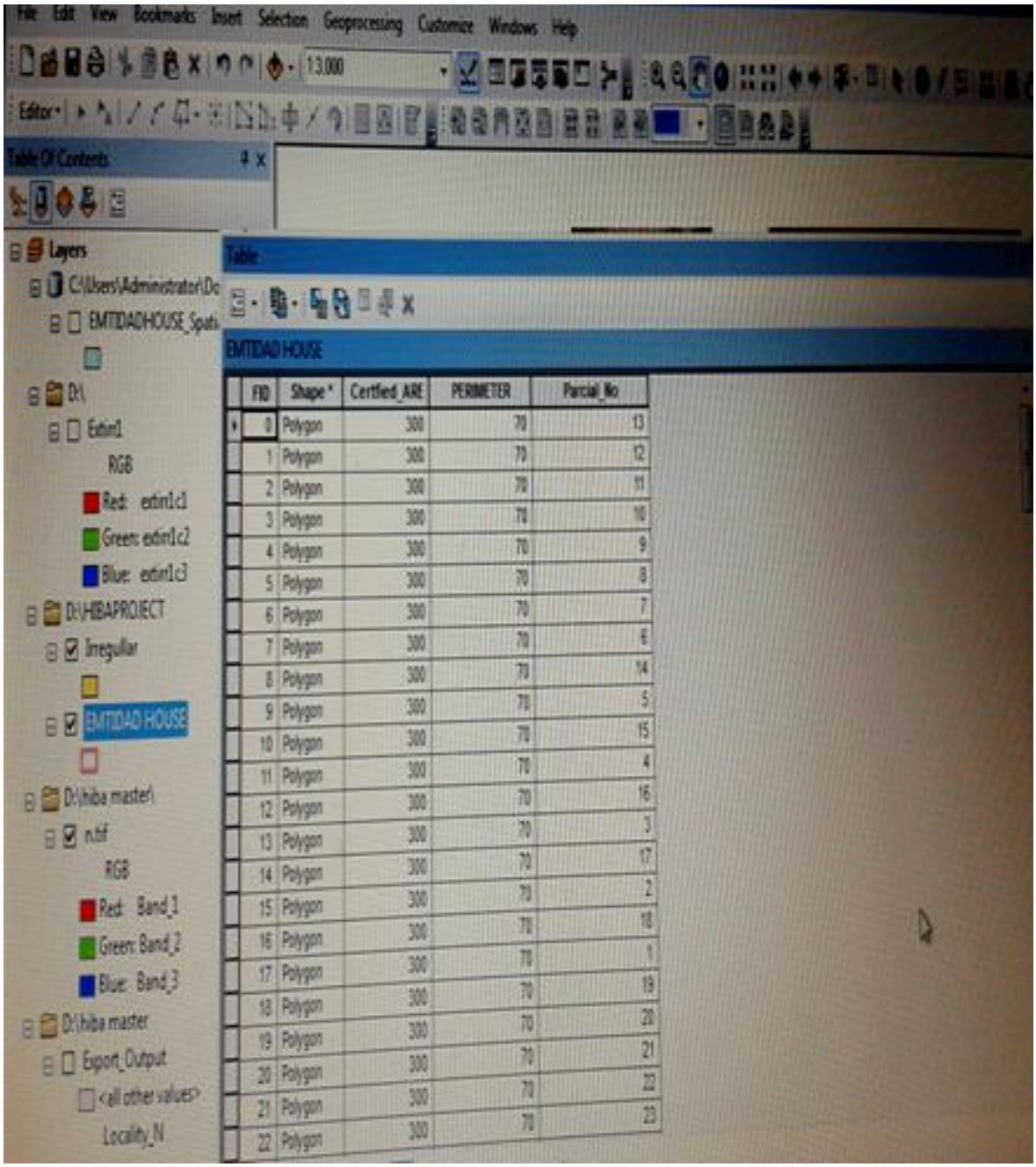



**Figure 5.13: The Block 2 Shape File Attribute Table**

- The block 2 shape file attribute table and the attribute table of Irregularities shape file had been linked together taking parcel No and irregularities No using Spatial join tool. figure (5.14)

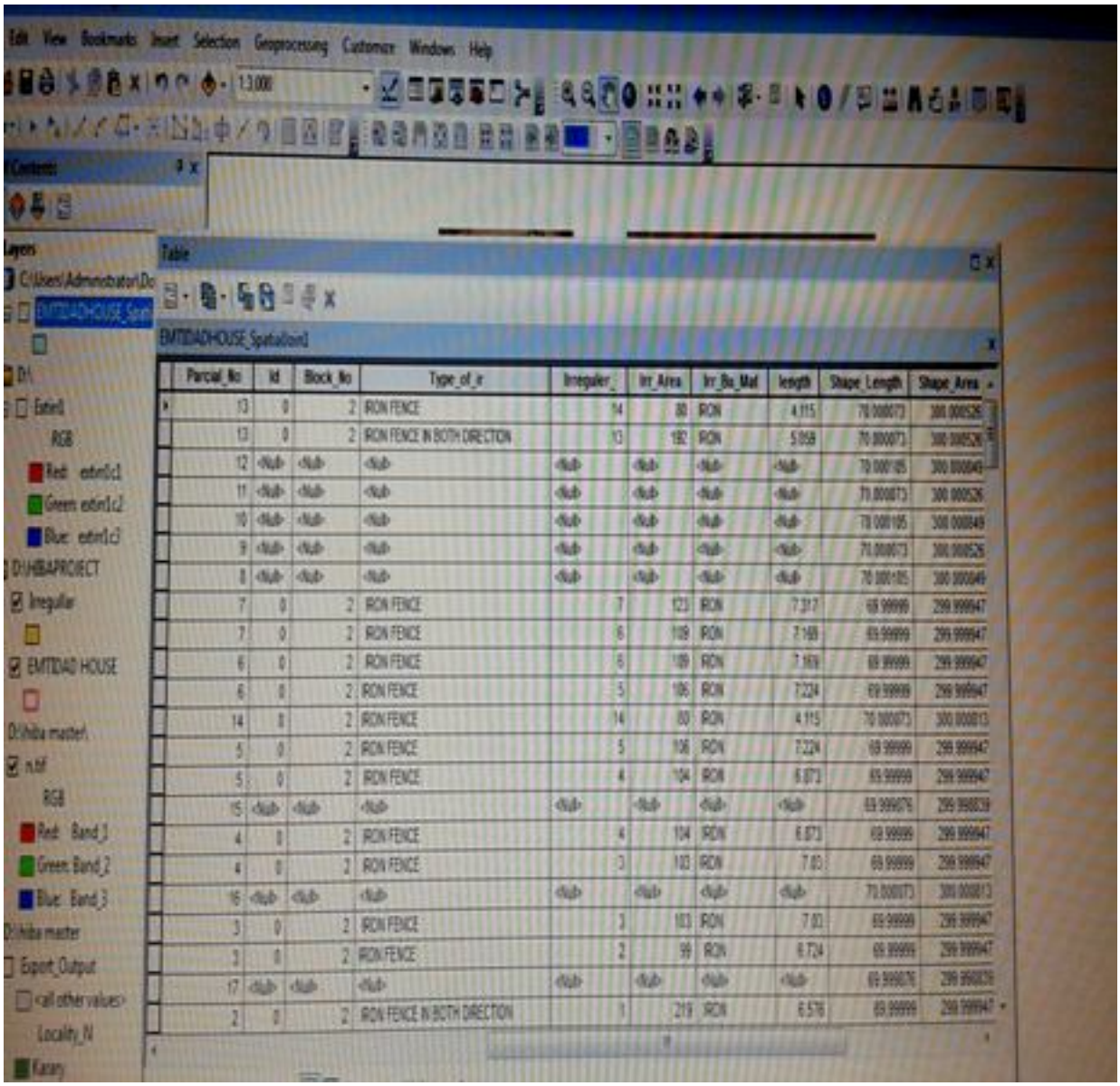



**Figure 5.14 The Table of Linked Layer.**

- The actual area of the parcels had been calculated including certified area and irregularities area in the field current area applying the field calculate Tool. the figure ( 5.15)

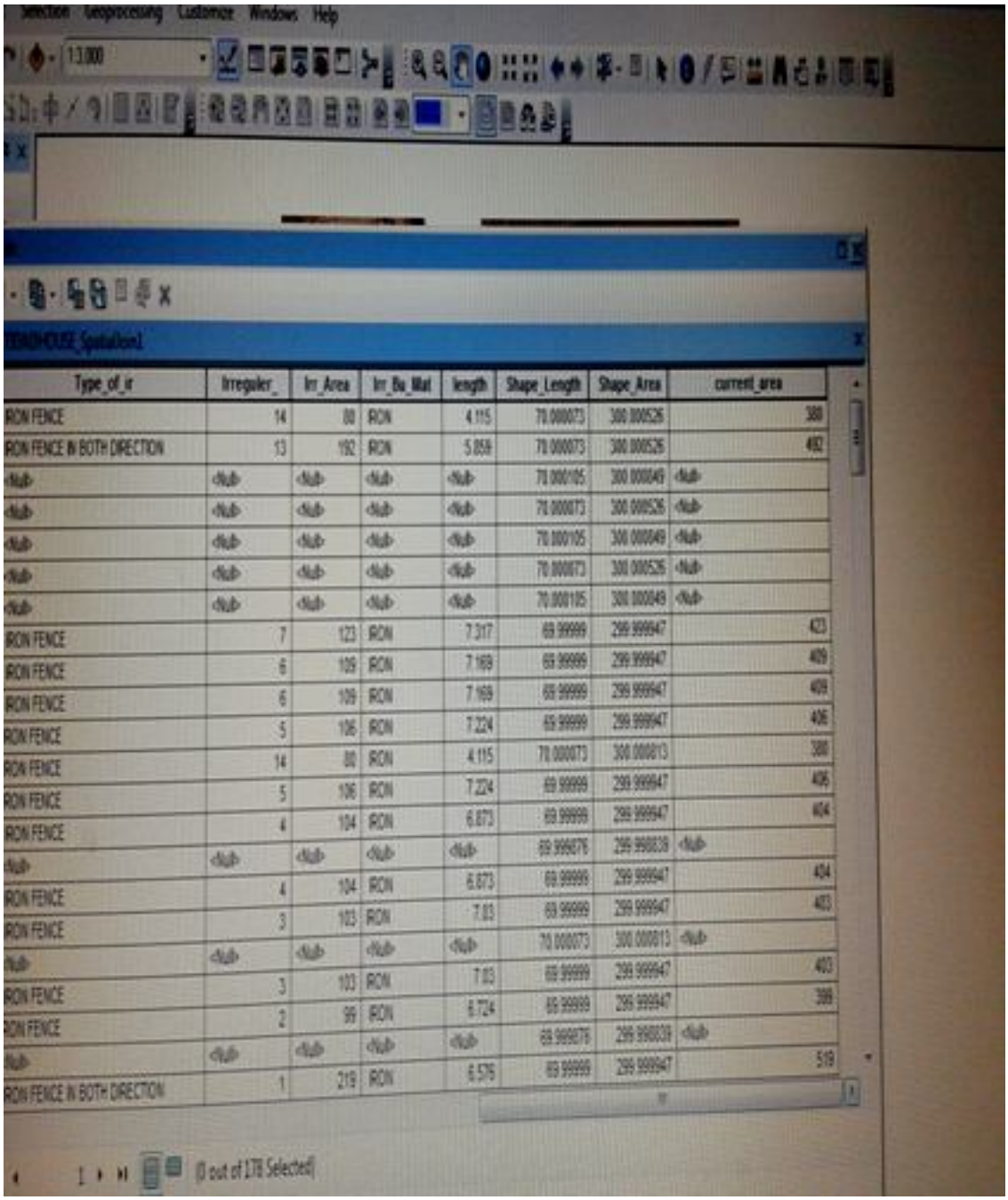



**Figure 5.15 The Final Table of Block 2 Layer**

- The actual area had been compared to show trespassing areas for each parcel and the percentage of parcels including irregularities
- Number of parcels with irregularities 120
- Number of parcels without irregularities 58.
- Percentage of trespassing block 2  67.4%

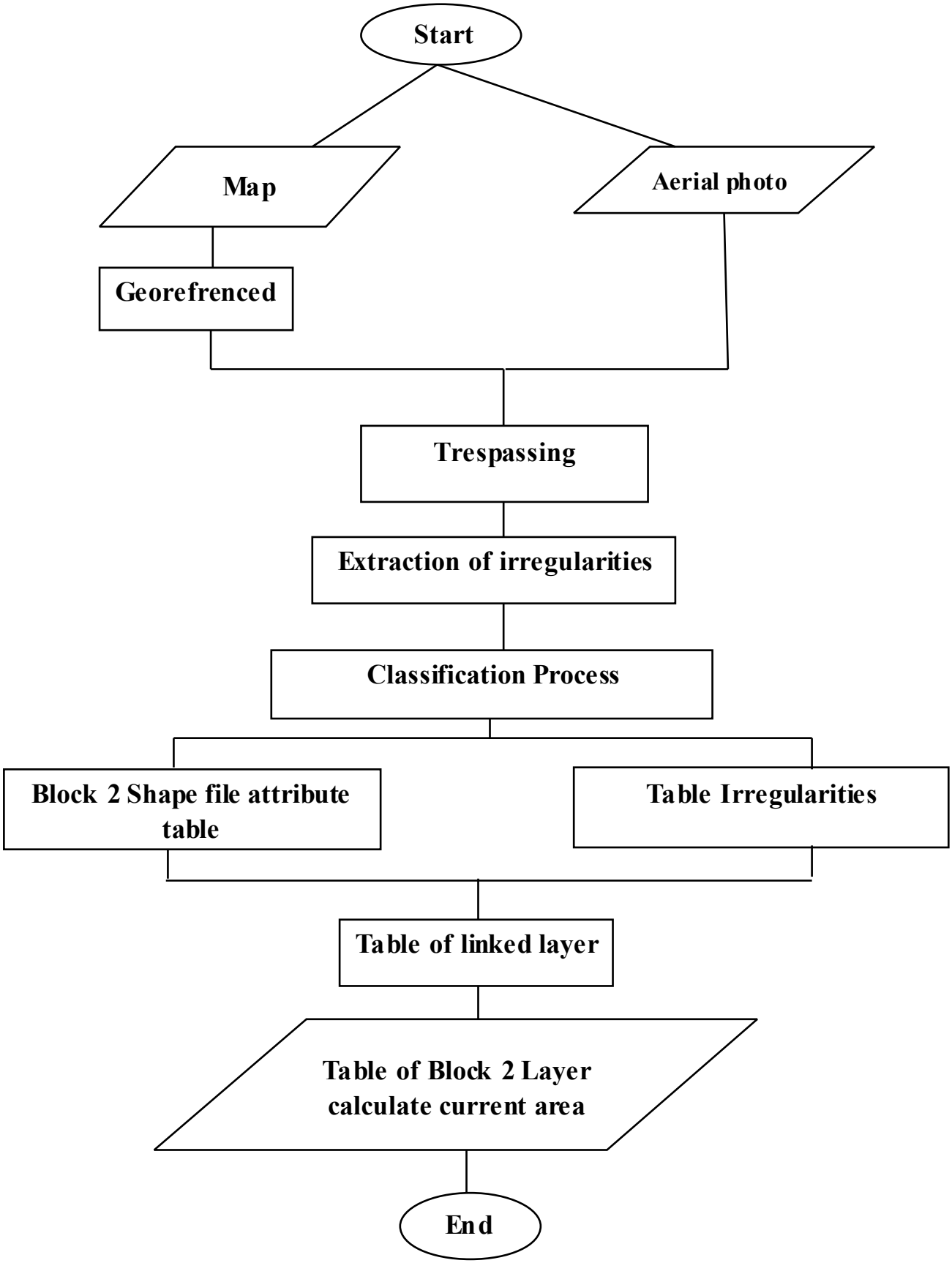



**Figure 5.16 Flow Chart of Work Steps**

# *CHAPTER SIXTH*

## *Results & Analysis*

- Aerial photograph of 10cms which had been used for the detection of irregularities out of plots boundaries had shown construction of physical structure as shown in figure 5.6.
- These irregularities had been recorded in irregularities layer as documentation for management use as show in attribute table in figure 5.12.
- Assessment had been conducted to show the extent of irregularities and number of parcels with irregularities.
- The study had determined materials used in the construction of irregular part which are: zinc, iron and concrete as shown in figure 5.11.

# *CHAPTER SEVEN*

## *Conclusion &Recommendation*

## 7.1 Conclusion

**This study had concluded the followings: -**

- Digital Techniques has the capability of detection of irregularities of planning laws in residential areas up to 10 cm.
- By GIS all irregularities had been recorded in the attribute table of parcels layers.
- Local administration can manage the solution of the irregularities in the residential areas using the recorded data.
- The study had shown high percentage of 67.4% of the Irregularities.

## 7.2 Recommendations

**The study recommends:-**

- This method is recommended to identify irregularities inside the boundaries of parcels.
- Aerial photographs can not discover irregularities under the trees so anther remote methods like RADAR is recommended to be used.
- As sustainable solution of the irregularities, local authorities are recommended to encourage vertical housing to reduce the horizontal expansion, which needs large areas, causing the need for the extension of services networks.

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