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The Geodetic Work for Updating Cadastral Maps within the Nasiriyah Province (Iraq)

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Abstract | **Original Research Article**

The agricultural cadastral maps are of significant important (from engineering and legal reasons). They are the main documents for ownership and land parcels. The cadastral map is approved document by the courts. Therefor resolves the base to disputes of land. This contributes to preserve the property rights of institutions and individuals. In Iraq, the cadastral maps were not given sufficient care and considerations (in term of re-production and updating processes based on modern surveying techniques). So that the cadastral map was a limited usage and they were difficult to be implemented in spatial databases and other related GIS applications. In this study, a number of agricultural cadastral maps were updated. A specified area within the province of Dhi Qar (southern Iraq), the geodetic procedures and processes were implemented. The old geodetic system (Ellipsoid: Clarke 1880, Datum: Nahrwan 1967), and within using geodetic control points on the original agricultural cadastral map, the researcher has identified a number of geodetic control point was identified according to the new coordinate system (Ellipsoid: WGS 84, Datum: ITRF) by using the TOPCON GR5 GPS system in accordance with the static observation mode after then the observed data the second is sent the observation GPS data (as a RINEX file format) via the Internet to the OPUS specialized site for GPS control points correction, this site depends upon the neighbor CORS worldwide global geodetic control points from the observation data), after processing and correction of the sent observation data, the corrected version of the observed data, will be received as a file sent to the user's e-mail. By using the linear transformations between the old geodetic system (Ellipsoid: Clarke 1880, Datum: Nahrwan 1967), and the new geodetic system (Ellipsoid: WGS 84, Datum:ITRF), after then the geometrically corrected cadastral map (in its Raster Mode) preprocessed (editing) under ArcGIS software an0.6 resolution Quick Bird image of the study area was registered on the cadastral map. With collecting field survey data and other data from relevant government departments, the cadastral map layers were vectorized. Agricultural cadastral map was converted to the new geodetic system. The accuracy of the converted hard-copy was inspected according to the half-millimeter standard for the paper map (the tolerance for a paper map with 1:20 000 scale is ±5 meter), the achieved accuracy of total station survey was±3 meters, and about 4 meters with using GPS survey.

Keywords: Geodetic Work, Cadastral Maps, Nasiriyah.

INTRODUCTION

Cadastral maps are basic in identifying property, because those maps are dictated by the shapes, boundaries and locations of various real estate use sites and rights. The cadastral map became official documents in their lawful and art form for the intended purpose. They recorded an advanced step in the world of documentation and are still. Cadastral maps are extremely important to many research centers because specialist's planners and the decision-makers in the public sector know the development of natural resources, control of agricultural land, the calculation of agricultural crops and the identification of the tourism sectors. The problem faced by workers on the cadastral maps is the ways of updating cadastral maps, in large countries in terms of area or states that evolve quickly because they need a lot of time effort and money. Iraq is one of these countries. Particularly about 95% of cadastral maps with scales1: 20,000,1: 10,000 are not updated. The purpose of updating maps is to add landmarks and changes that have occurred in the area such as changing on rivers roads of buildings. To help workers in different departments it has to be identifying the area accurately before starting any project. The modernization of the traditional image is very difficult, as it needs special teams to prepare a modern database

for the region, including (coordinates of borders, contracts, streams of rivers, arable land and investment). These methods need effort, time and a lot of money. Thus, modern methods can reduce these three problems. The idea of using remote sensing, GIS and DGPS in updating maps with the use of satellite images is the proper way to update maps. The integration between GIS, remote sensing and DGPS is the best way to update maps and can achieve the task in low cost, short time and little of effort compared to other methods [1].

Problem statement

The cadastral maps in Iraq are old (most of them were produced in the 1920s or 1930s), and they were produced by the old obsolete manual surveying methods. Thus, these maps are not reliable nowadays, and most importantly, the majority of the referenced points are no longer indicative of the reality after this long period of time. In addition, these maps are based on local coordinate systems which are not currently supported. Therefore, the Iraqi cadastral maps must be updated. From another point of view, there is a necessity to prepare spatial data base (with emphasizing to the cadastral attributes) that to be employed in the planning of the related development projects.

Study Area

The study area is located in DhiQar governorate, in the southern part of the Iraq Fig. (1), in the district of AL Nasiriyah-Batha, the province number (46) which is located, between Longitudes 44E-47E and Latitudes 32-34N as shown in the Fig. (2). The study area was selected for data availability and the possibility of access it, and performing the required surveying operations, this area is considered one of the most important economic region because it contains fertile agricultural land and oil resource.

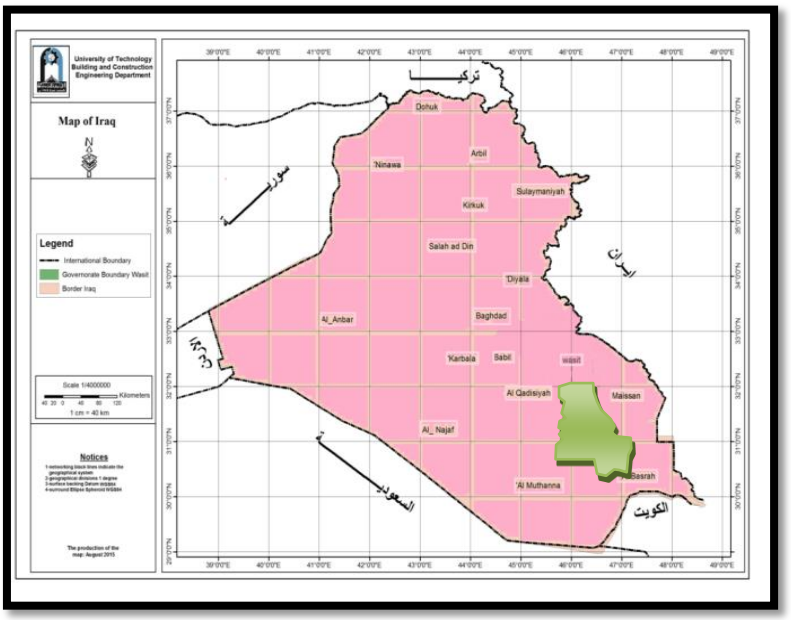

Fig-1: Study area within Iraq (University of Technology)

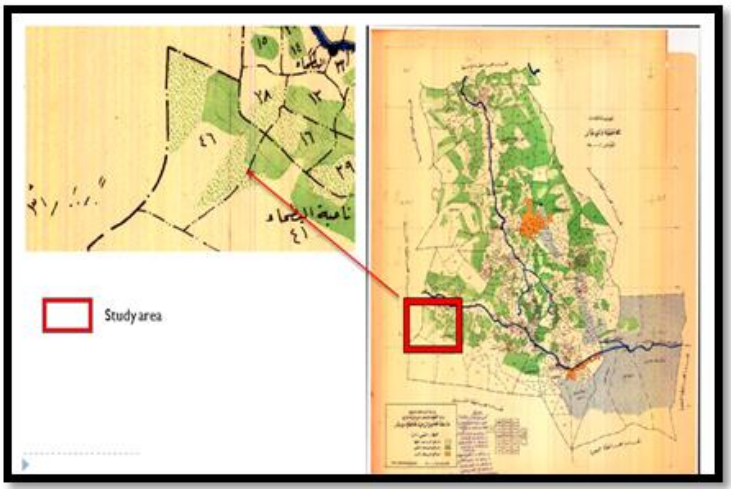

Fig-2: Study area within DhiQar governorate [2]

Used infrastructure, data, Device and software

To perform the aim and objectives of the thesis, different items of (infrastructure, data, devices and software)

Old Geodetic Network

The control points of this network were difficult to be distinguished within. The study area and surrounding regions. However, two control points were obtained within the study area and the surrounding regions in the old system ellipsoid Clark 1880, datum Nahrawon 1967.

Cadastral map

Paper cadastral map as shown in Fig. (3) of the study area with the following specifications:

- Ellipsoid: Clark 1880.
- Datum: nahrwan 1967.
- Projection: UTM zone 38.

Fig-3: Paper cadastral map of the region study [3]

Satellite image

For the purpose of completing the thesis, the available high resolution satellite image of the study area was used; the image used is from Quick Bird Satellite with 0.6 meters. Spatial resolutions shown in Fig (4).

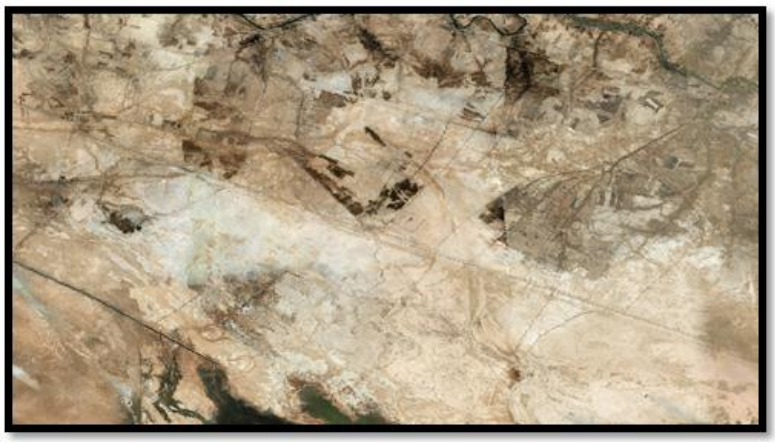

Fig-4: Quick bird satellite image of the study area [4]

Topcon GNSS GPS system

This system consists of two components the first is called the (Base) and the second is called (Rover)[5].

Total station

Total Station is a ground-based monitoring device that combines multiple devices in a single

station. It combines an electronic theodolite to measure the horizontal and vertical angles, the electronic distance measurement (EDM), total station consisting of several parts it is as follows, device, tripods, reflector [6].

Online Positioning User Service (OPUS)

This is a specialized web site for correction of the observed data from the GPS system (with some specification related to the GPS system type and the observation mode). The coordinates obtained from the reports on the site are depended on three CORS stations to get the exact location data for the survey station. After uploading the data to the OPUS service, the CORS sites are chosen due to the compatibility between the user data and the CORS location. Other points are adjusted based on the base point using the Topcon Tools software to refine the coordinates and provide precise positions [7].

Arc GIS Software

GIS is a system of hardware, software and execution to ease the management, manipulation, analysis, Modeling, and displaying georeferenced data to resolve complicated problems related to planning Resource Management Peuquet, 1990.

METHODOLOGY OF WORK

The practical work in the research show in Fig. (5) Is dedicated to the updating (reproduction) of agricultural cadastral map parts.

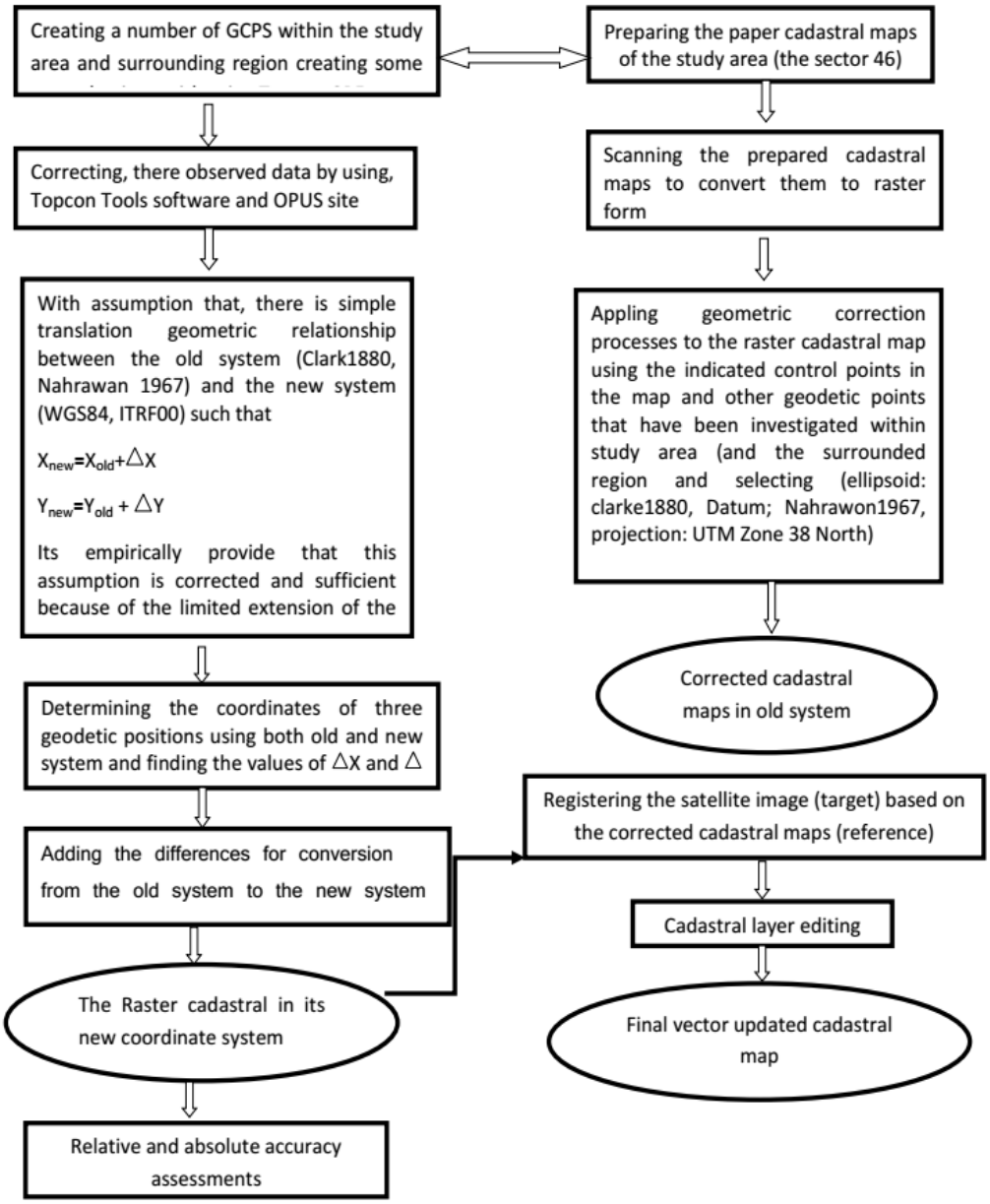

Fig-5: Methodology of the updating (reproduction) of the agricultural cadastral map

RESULTS

Scanning and Georeferencing

Fig. (6) digital raster cadastral map that was Ellipsoid: Clarke 1880, Datum: Nahrawan 1967, it is

noted that, the relative and absolute accuracies (for this map) cannot be, determined to an approachable coordinate system (it is top centric not geocentric system) in the current surveying devices such as the GPSs and the Total Stations.

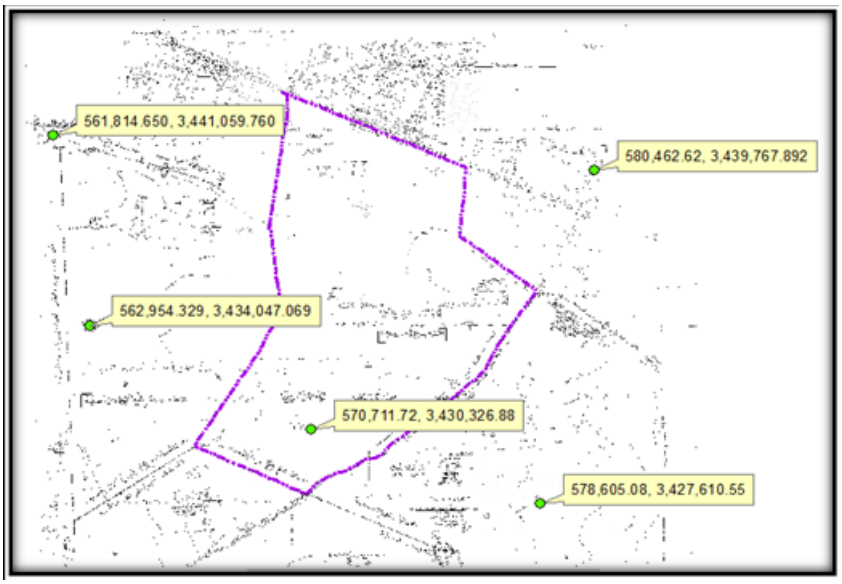

Fig-6: Corrected map with the old system/ Source: Work of the researcher

Old geodetic system

Some geodetic control points in the region are in the old geodetic system ellipsoid: Clark 1880, Datum Nahrwon 1967, were used as shown in the table (1). These five ground features have been selected due to the accessibility as well as the inter-visibility between them that were required for establishing the old terrestrial geodetic.

Table-1: Determined control point in the old system, (General Authority survey)

POINT	Easting (m)	Northing (m)	Control point description
1-	562954.329	3434047.069	High Hill5
2-	561814.650	3441059.760	Point at the top of province59
3-	570711.720	3430326.880	Ishan dahlia
4-	580462.620	3439767.892	Ishan alkreda
5-	578605.080	3,427610.550	Triangulation point within province41

OPUS Results

The file contains the observed data by using TOPCON GR5 system were converted in the tow RINEX file, then, it was sent to the OPUS web site. The corrected data are listed in the table (2).

Table-2: Results of OPUS site

Point	Easting (m)	Nothing(m)
BM1	580817.042	3439955.030
BM2	595864.398	3439487.512

Coordinates transformation

With that assumption, they are a simple translation geometric relationship between the old system (Clark1880, Nahrawan 1967) and the new system (WGS84, ITRF00) such that.

Xnew=Xold+ X

$Y_{new}=Y_{old} + \triangle Y$

Its empirical provide that this assumption is correct and sufficient limited extension of the region study illustrated as shown in table (3).

Table-3: Coordinate transformation parameters between the old system and new system

	Old system		New *system*			
Point	Easting (m)	Nothing(+m)	Easting (m)	Nothing(m)	△E(m)	△N (m)
Bm1	580462.620	3440142.0213	580817.042	3439955.030	-354.422	187.183
Bm2	595509.996	3439674.665	595864.398	3439487.512	-354.402	187.153

Producing the cadastral map in the new system

Depending on the change in spatial location of points (easting and northing) by adding the average northing (187.168) to northing and average easting (-354.412) for easting for every control point and after the georeferencing process to the cadastral map, the coordinates system was changes into the new system as shown in the Fig. (7).

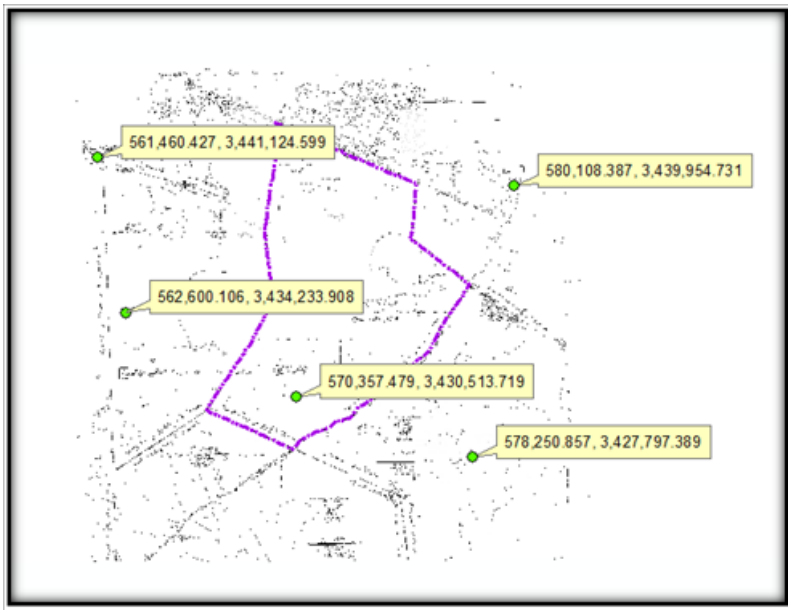

Fig-7: Corrected cadastral map with the new system/ Source: Work of the researcher

The Quick Bird satellite image Registration

The Quick bird satellite image **(target image)** has been registered on the cadastral map (reference image) as shown in the Fig. (8).

This satellite image represents the back ground of the cadastral map in the new coordinates system the resulted image was used to extract the vectors layers of the updated the cadastral map,

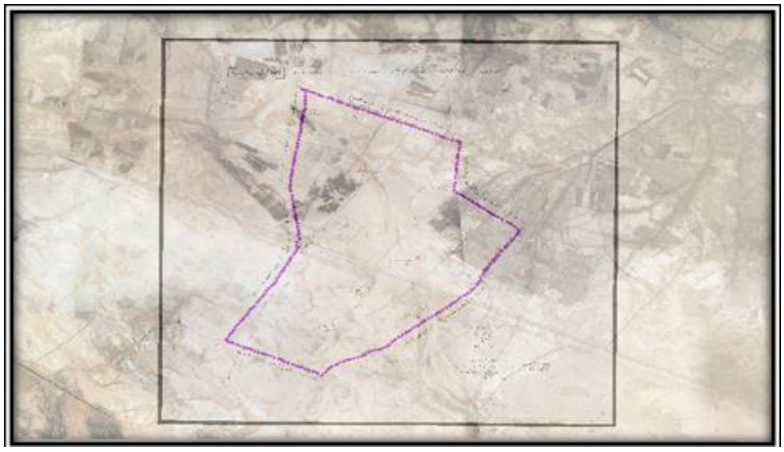

Fig-8: Overlaying the satellite image with the cadastral map/ Source: Work of the researcher

Producing the final updated cadastral map

The final updated cadastral map has been produced by using cartographic outputlay outing provided by the Arc GIS software as shown in Fig. (9) With noticing that this map is reduced copy from A0 size printed map.

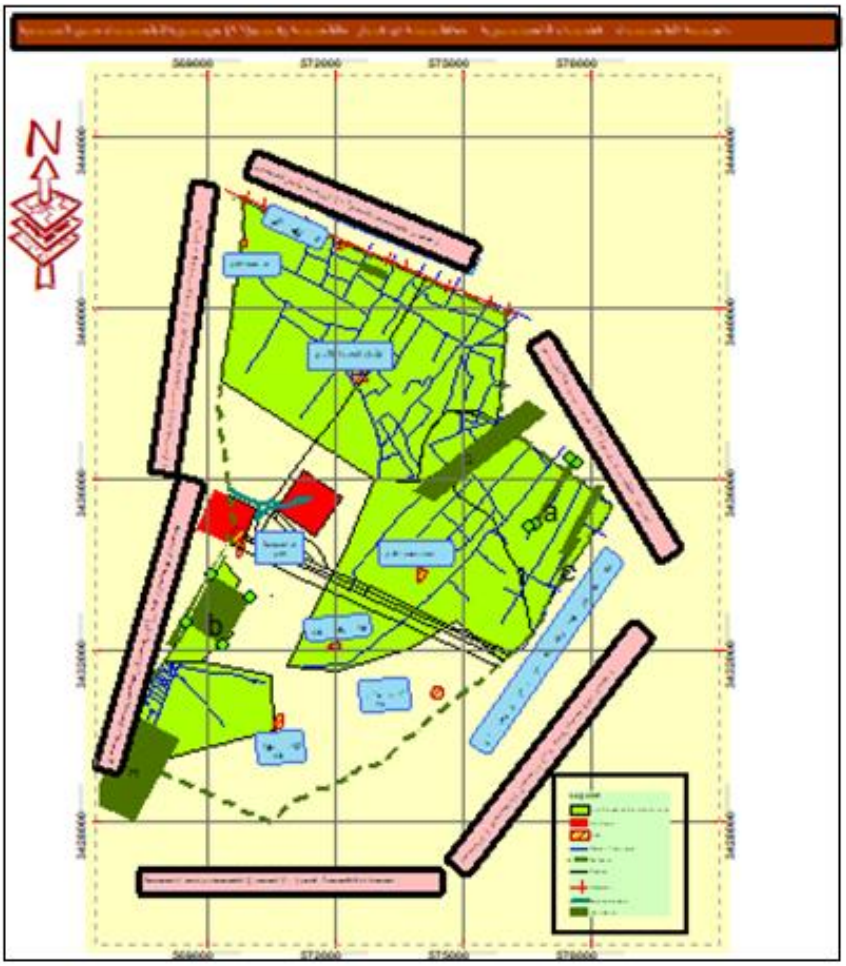

Fig-9: The updated cadastral map/Source: Work of the researcher

CONCLUSIONS

1-For the purpose of updating the Agricultural cadastral maps, it requires a great geodetic effort. This is by determining a set of horizontal geodetic control points in the area being updated; these points are a part of the national geodetic horizontal control point network.

2-There is a great difficulty in finding the positions of the horizontal geodetic control points within the study area in particular and in the overall southern regions of Iraq in general, because most of them have been destroyed and there are no real efforts by the concerned authorities to maintain them.

3-The original plastic layers for the agricultural cadastral Maps are more accurate than their ordinary paper printed version.

4-There are no specific criteria and standards for agricultural cadastral maps (that have been previously produced), in terms of horizontal spatial accuracy as well as the cartographic output layout.

5-The concerned directorates (the General Authority for Surveying, the Ministry of Water Resources and the General Authority for Agricultural Land - Ministry of Agriculture) do not have standard criteria for the technical specification of the updated agricultural cadastral maps; from the following aspects:

(A) The minimum required accuracy (degree and order of the geodetic network) of the used horizontal geodetic control points for each scale of the map under updating process.

B) The minimum required accuracy of the adopted GNSS device, with other related software and accessories.

C) GNSS-Observation methods

D) The cartographic output layout of updated maps as well as other related assures such as in Paper size, map details, legend, grid system etc.

Due to the presence of farmer's contractors, it may request the re-cutting of the parcels (within each province) into sub-parcel (with no more than 50 dunams for each one). As a result of the lack of capacity in the field Surveying of the concerned entity (the agricultural division in that area), this led to many property disputes among contractors.

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