

# **PILOT RESEARCH ON CENSUS MAPPING BASED ON SATELLITE IMAGERY AND WEB-GIS**

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## **1. INTRODUCTION**

In order to revolutionize traditional census, the United Nations Statistics Division is promoting the use of GPS, digital imagery and GIS with census mapping in the new millennium [1]. The pilot research is to find a practicable solution to solve the census mapping problem in line with China's national conditions. The general idea for the pilot research is as follows: based on high-resolution satellite imagery and necessary basic geographical data, delineating enumeration area, drawing census maps and marking buildings adapted to local conditions using web-GIS tools [2]. The enumeration areas should be mutually exclusive (non-overlapping) and exhaustive (cover the entire country) and have boundaries that are easily identifiable on the ground [1].

## **2. METHODOLOGY**

Different countries may follow different approaches towards a digital census database according to their basis of existing information, budgets, technical capabilities and time constraints. China has a vast territory and a large population. In order to count people precisely within limited time, we need rely heavily on the masses. Enumerators all over the country will be employed to delineate enumeration area during pre-enumeration as well as to count people during enumeration.

With this uniqueness the choice of satellite imagery, workflow of census cartography, web tools development as well as training should be adaptive to non-technical enumerators. The whole country is subdivided into lots of pieces of land which are referred to as enumeration areas according to the census geographical framework. The enumeration area delineation is the most important part within the pre-enumeration phase. The pilot research is designed to provide solutions encountered during census mapping.

## **2.1 Which imagery should be adopted as base map**

Satellite imagery can provide great help to create maps for areas for which up-to-date maps are not available or that are difficult to survey using traditional field methods within a reasonably short time-frame. Urban and non-urban areas of different types with diversified population densities may need different imagery with different resolutions. Imagery with resolution 2.5meters (CBERS-02B, IRS-P5, Spot5) as well as imagery with resolution as high as 0.61 meters (Quickbird) are chosen to investigate their capability aiding enumeration area delineation in different types of areas. Other data may include geographic data with different scales, administrative division data, navigation map data etc.. All data should be integrated together and follows the same spatial reference system.

## **2.2 workflow of enumeration area delineation based on imagery**

The workflow of enumeration area delineation based on imagery is developed and tested. It contains following steps: choosing test area and data sources; processing of imagery data; loading imagery and other base map into web-based enumeration area cartography system; delineating supervisor area and enumeration area; field work for validation; evaluation.

The delineating process of supervisor area and enumeration area can be classified into two approaches: a top-down approach and a bottom-up approach. Both approaches should guarantee the boundary consistency, mutual exclusiveness and exhaustiveness. Enumeration officers carve up the town-level administrative divisions from county-level administrative boundary polygon in the top-down approach. Supervisor areas are carved up from town boundary while enumeration areas from supervisor area boundary. The philosophy of bottom-up approach is enumeration areas first through topological operation like polygon constructing from lines and tic points. Then the supervisor area is deduced from enumeration area by dissolve operation. The town boundary is deduced from supervisor area.

## **2.3 Web Tools for enumeration area delineation**

There are many solutions for enumeration area delineation using desktop GIS, paperwork plus scanning etc.. These solutions is compared and discussed from practicality and usability in this paper. According to the designed workflow of enumeration area delineation and census map creation, web based census cartography system is developed using web-GIS technology and tested in the pilot study.

Web-based enumeration area cartography system is a faster, easier, flexible web GIS to delineate, query, manage, and distribute the census map. The design and implementation of the system will be discussed. There are several features, i.e. user registration and permissions, geographic code, delineation of enumeration area, symbolization and

printing of census map etc.. Users can delineate the supervisor area and enumeration area in two different ways: polygon mark and breakline delineation which is detailed in the paper.

### **3. CASE STUDY AND RESULTS**

Our successful pilot experiments in Panjin City, Liaoning Province shows the correctness of our choice of imagery, design of workflow and tools for census mapping. The pilot area covers two counties for supervisor area delineation and one sub-district for enumeration area delineation and building markup. The enumerators are trained to interpret the satellite imagery and delineate the enumeration area step by step.

Test of the web-based census cartography system by enumerators provides promising results. The web system is reliable for its stability, bug-free as well as user-friendly interface as be seen in Fig. 1.

Enumerators who are from local Planning Bureau, local Land and Resources Bureau often has experiences in interpretation of remote sensing imagery as well as digital aerial photo and can delineate supervisor area and enumeration area with little training. Other enumerator with higher education background from statistical office can use the web system with a short period of training. Fig.2 shows the enumeration area as well as buildings delineated during pilot experiment.

### **4. CONCLUSIONS**

This paper investigates the feasibility of different satellite imagery as base map and believes that imagery with 2.5 meters resolution can satisfy most cases in census mapping. To improve the census precision and quality, the new workflow of enumeration area delineation based on imagery is developed and tested. Integration of the bottom-up and the top-down approach is discussed. The web-based census cartography system is designed, implemented and tested for delineating supervisor area and enumeration area online. Enumerators who are from local statistical office can interpret imagery and delineate enumeration area with little training. The proposed solution for census mapping is workable and promising in 2010 rounded census in China.

### **5. REFERENCES**

- [1] Department of Economic and Social Affairs Statistics Division. Handbook on geographic information systems and digital mapping. NewYork: United Nations. 2000.
- [2] Department of Population, National Bureau of Statistics of China. Pilot plan of Enumeration Area Delineation and Census Mapping for the 6<sup>th</sup> Census of China. Unpublished. 2009.

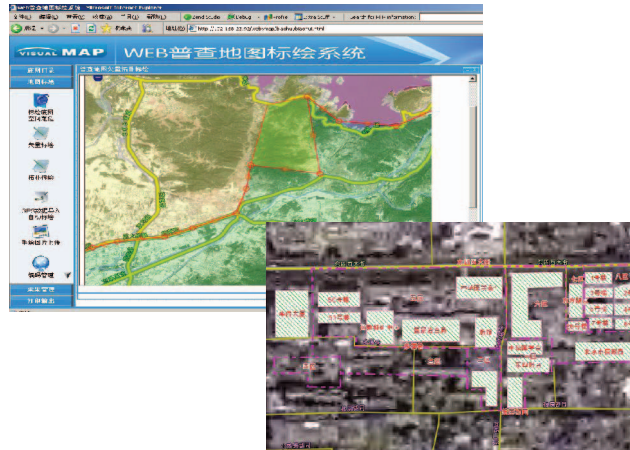


Fig1. Screenshot of the web-based census cartography system



Fig 2. enumeration area delineated during pilot experiment