

## EVALUATION OF LONG TERM CHANGES IN LAND USE

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**Abstract:** Purpose of this study is to check up way, how to evaluate long lasted changes in land use, thanks to the tools for digital image processing (in this case changes in land use according to aerial photographs). We divide this task into several stages, which we are concentrated on in following article. At first, it is necessary to explore possible information sources suitable for our intentions. It is followed then by description of new process used for finding out changes in land use.

**Keywords:** land use, cadastral maps, aerial photos

### 1. INTRODUCTION

The term nature utilisation is taken as a special summary of technical actions directed on cartographic representation and quality and quantity evaluation of spatial economic effects on earth surface. Information on land use and spatial location of individual countryside cover elements can be used in many fields of human activity. It is most used in agriculture geography, in countryside ecology and other geo-sciences.

Most of works deal with summarising of present land use situation. Land use is a result of settlement development and agriculture in long time. We meet more studies last time, which monitor and rate long lasted changes in land use. These evaluations are done with different methods and different ratio scale. The example of such works are research activities at the Department of Social Geography and Regional Development, Faculty of Sciences of Charles University, focused particularly on evaluation of long lasted changes in land use. Authors have focused on data structure comparing monitored areas in cadastral regions in several time periods and analyse state and development trends of

individual monitored areas (and their percentage area versus global surface area). The classical showcase is part of the text (Bičík, 1996), where land use is observed in particular territory during years 1845 - 1995. These works have disadvantage, that they are based on summarised area values, which are taken as a total of single categories maintain in the cadastral territories, or other administration elements. They display only global loss, increases of individual area category and not spatial changes. Some new works address spatial changes. They use special satellite and aerial photos displaying land surface. Satellite photos can display only big changes and only during the last 30 years (Koželuh, 1993). We have attempted to do detailed analyse of long lasted land use change in particular cadastral territory, as a part of bachelor works in the Department of Geography on West Bohemian University between years 1837 - 1996. We have used maps of a stable cadastral territory, refreshed cadastral maps from the turn of this century, and evaluation of current land use. We redraw land use at the turn of our century and at present, on a background of the stable cadastral map. That way, we cover just small areas, but the research was very laborious.

Purpose of the study is to check up way, how to evaluate long lasted changes in land use thanks to tools for digital image processing (in this case changes in land use according to aerial snaps). We divide this task into several stages, which we are concentrated on in following article. At first, it is necessary to explore possible information sources suitable for our task. Then it is followed by description of new process used for finding out changes in land use and final map outputs creation.

## **2. INFORMATION SOURCES**

### **2.1. Map collection of Central Archive of Geodesy and Cartography**

It has extensive information sources, which have great historical and skilled worth. Essential things are cadastral and land maps, especially original map of Stable cadaster from years 1824 - 1863, cadastral maps, estates maps, technique-economical maps and their written description.

Other extensive funds include military maps from years 1763 - 1884. There were chosen maps of stabile cadaster for evaluation of land use changes. Maps began to rise since the year 1826. There was used Cassini - Soldner (equidistant cylindrical projection in transversal position from Wahlbeck ellipsoid). Cylinder touches cardinal meridian, which came through important trigonometry point - that was Gusterberg for Czech and Sv. Štěpán for Moravia. Only two strips were used. Projection is equidistant in cartographic meridians, it means direction east - west. Axis X rectangular planar coordinate is identical with cardinal meridian. Maps were made in ratio 1:2880, because they count on old scale rate. There were made in ratio 1:2500 later (after 1871). Cadastres were mapped individually, it is called islands map. General map method was

crossing by the help of measurement table, completed by orthogonal method. Map contains only situation subscription drawn with characteristic fractional, from abscises composed lines. The capital elements are lines showing grounds borders. Maps were drawn in colour.

This stable cadaster maps were refreshed about the year 1900. There are mark out individual ways of grounds use in the map. These does not suit to our demand, even so more quality source does not still exist.

We choose to investigate maps from stable cadaster created in thirties of the last century, and furthermore refreshed maps from the years 1900 - 1910.

## **2.2. Air photos from Military Topographical Office in Dobruška (VTOPU)**

VTOPU works with archive containing approximately 800 000 aerial measure negatives prepared by military air force since the year 1936. They produce many kinds of extracted bases for both military and civil users asking for it. These bases could be copies, slides and enlargements. Taking aerial photos did not cover the whole territory of Czech Republic until 1946, when photos were taken only over some areas. The first continual snapshots were done in 1947 - 1956. Photos were made in scale 1:23000. Second wave of this photo taking underwent during years 1957 - 1968. Photos were made in scale between 1:12000 - 1:13000. The whole area was monitored in an inter-system maintain and maps brushed-up fourth times. At present, fifth snapshot is coming. Aerial photos are mostly in ratio 1:25000 - 1:27000, on selected territory 1:10000. It is photogrametry, that is the general method for using and evaluating air measure snaps. It comes to the end era of analogy and optic-mechanical technology and we can observe quick conversion to digital technology and program products like ZEISS-PHODIS and ORTHOMAX. Thogonal aerial measure snap is essential informational element for actualisation of database VTIS and topographical map creation.

We choose aerial photos from three time periods (1947 - 1953, 1970 - 1980, after year 1990) for our research work.

## **2.3. Raster files of Geographical office cadastral map, central databases field**

Vectorial cadastral maps are not still available. Archive include raster equivalent of two map types:

- ♦ **Raster file maps late ground cadaster.** They result from scanning authentic original maps displaying situation in ground cadaster till the time they were replaced with maps showing estates register (50. - 60. ages). They show plot borders too, which expired because of agricultural collectivisation and are taken in a simplified register at present. BPK maps does not change them selves.

- ♦ **Raster file of current cadastral maps.** These files display the situation in the estate cadaster in the time they were scanned (except plots being in the simplified register). Maps are allowed to changes doing by estate cadaster leadership. Their raster files are, as they need it, actualised by repeated scanning.

Both type of maps were scanned by very accurate scanner with density 400 - 1000 dpi and transformed by affinity transformation into ideal size of map sections. Detailed information about scanning and transformation are mentioned in chart joined to every file. Data are given off in CIT format on a medium you choose.

Central database administered and maintained on a central computer in Geomeasurement Office Centre national data file of descriptive information from estate cadaster. Digital data files of descriptive information from estate cadaster are divided into four sections:

- ♦ data concerning cadastral areas,
- ♦ data concerning plots,
- ♦ data concerning estate owners and other competent persons,
- ♦ detailed data about juridical relations to estates.

Archive collect digital data produced by automatic map processing. Maps are getting particular for estate cadaster needs as compensation instead of old fathomed maps. There are mostly maps with scale 1:1000 and 1:2000 created according to prescription for basic map of big ratio (ZMVM) since the end of 70s till beginning of 90s. Cadastral area is organisational element of the archive. There are saved data from about 2500 cadastral areas in Czech republic at present.

## **2.4. Research of selected area**

We choose for research two areas in different parts of South-west Bohemia - cadastral territory of city Rybník, which lies in Domažlice district, just nearby Czech-Bavarian border, out of big and important traffic lines. Second cadastral area is Čkyně. It is situated into furrowed highland Vimperk, in the river Volyňka valley on the highway Strakonice - Strážný (border crossing between Czech republic and Bavaria). We took this choice because of different landscape types and land use.

## **2.5. Consecution in data bases elaboration**

The databases are very various. First intention is to unify used bases to be acceptable for research. First step was scanning the stable cadastral area, refreshed map and aerial photographs and their conversion into the same cartographic projection. We access to choice of image S-JTSK, because there are available cadastral roasters for selected territory.

We apply stable cadastral map scanning and later conversion into cartographic projection to specialised firm, because it is rather difficult task. Moreover, it was

check-up if scanned map correspond to raster bases (maps and air snaps). Failings were repaired.

We create real land use situation on the basis of current cadastral map, thanks to land recognising. By the way, we use classification key in a next chart. This key is particular than map key for cadastral map. That is why we are capable to evaluate current use condition in more details. It is important, that each category from classification scale can be definitely sorted into stable cadastral classification scale.

Furthermore, raster pictures vectorisation will follow. Current cadastral maps will use automatic vectorisation. Stable cadastral maps and refreshed maps must be made handle. Then new attributes about individual territory use will be inserted into vectorised maps. Aerial photos will be used only in the raster form, because they contain more pieces of information in that form.

## **2.5. Land use classification**

1. Arable land
2. Gardens (with vegetable and flowers)
3. Orchard
4. Green plane used for
  - a) reap
  - b) pasture
  - c) not used
5. Woody areas
  - a) thick growth (upper parts touch each other)
  - b) half closed growth (among upper parts of trees are short distances)
  - c) thin discontinuous growth (trees are spread, it is enough space for lower plants)
6. Water areas
  - a) natural flowing (streams and rivers)
  - b) unnatural flowing (channels)
  - c) natural stagnant (lakes)
  - d) unnatural stagnant (pond, water hollow)
7. Swamp areas
  - a) green
  - b) wooded
8. Unproductive areas
  - a) natural (rocks, sandy river deposit)
  - b) unnatural (dumps, rest of quarries)

## 9. Built-up area

- a) with living function
- b) with industry function
- c) with stock spaces
- d) with stock raising
- e) with buildings used for relaxation

## 2.6. Results exploitation

Map backgrounds and aerial snaps for selected areas will be done with previous approach. So the background for analyse of long lasted changes in land use will be prepared. Own analyse will be made covering vectorised map form different time period over. So is set in map, where all information will be printed from work up maps.

This map will evaluate from statistic and content point of view. Furthermore it will be compared with raster and air snaps. We will find answers for next three questions:

1. How have changed the land structure?
2. Which changes are more frequent?
3. How differ changes in land use in different situated KU?

Described methods help to work with other territories. Fresh data backgrounds will be used in further study focused on particular territory.

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## **Resume**

### **Hodnocení dlouhodobých změn ve využívání krajiny**

Cílem této studie je prověřit způsob hodnocení dlouhodobých změn využívání země pomocí prostředků digitálního zpracování obrazu, v tomto případě katastrálních map nebo leteckých snímků. Celý úkol jsme rozdělili na několik etap. Nejprve jsou zhodnoceny možné zdroje informací, použitých při tomto úkolu, konkrétně mapy stabilního katastru, současné katastrální mapy a letecké snímky z Vojenského topografického ústavu v Dobrušce. Dále následuje popis postupu při vlastním zpracování datových podkladů a při zjišťování změn ve využití země. V závěru jsou naznačeny možnosti, jak získané informace dále využívat.