

GEOGRAPHIC INFORMATION SYSTEM FOR LESS FAVOURED AREAS (LFA) - PRINCIPLES AND GUIDELINES ELABORATED FOR LOWER SILESIA

Katarzyna Galant, Marta Kąciak, Halina Klimczak¹

Abstract

Integration of Poland into European Union involves different branches of economy, inter alia, agriculture. In frame of the Common Agriculture Policy, the activities which support development of rural areas are undertaken. The compensatory allowances are necessary to well-balanced development of rural areas. The proper delimitation of Less Favoured Areas enables equitable distribution of the EU funds.

The proposed information system for LFA is aimed to help in effective and appropriate determination of these areas based on the current criteria that are specified in official document. Furthermore the databases contain additional information which may also influence on potential productivity of agricultural lands. The created databases enable to perform analysis and studies on various phenomena that play an important role in LFAs delimitation. In the paper, the guidelines for LFA information system are presented and the implementation for Lower Silesia area is described.

Key words

Geographic Information System (GIS), Less Favoured Areas (LFA), compensatory allowances

1 INTRODUCTION

Integration of Poland into European Union involves different branches of economy, inter alia, agriculture. In frame of the Common Agriculture Policy, the activities which support development of rural areas are undertaken. The programming document "Rural Development Plan 2004 - 2006" (PROW 2004 - 2006) specifies aims, priorities and rules of such actions. One of the priorities, called „Activity 3”, is "Sustainable support for agriculture in Less Favoured Areas" [1]. The compensatory allowances in Less Favoured Areas prevent from depopulation of rural areas and loosing their agricultural function. In order to distribute equitable the EU funds, the LFA should be delimited based on up-to-date and accurate data. The paper presents collecting of necessary information in order to create geographic information system for LFA, the organization of acquired data and structure of the databases. Area of Lower Silesia is taken under consideration. The project presented in the paper is carried out in the frame of research grant No 4 T12E 021 28 financed by the State Committee for Scientific Research in Poland.

2 THEORETICAL BASES OF CREATION GIS FOR LFA

The criteria of qualification communes and cadastral districts as LFA are described in above mentioned "Rural Development Plan 2004 - 2006". Three types of LFA are recognised accordingly to following criteria [2]:

- for LFA mountain: altitude and slopes of arable lands (use of Digital Terrain Model)
- in case of LFA lowlands: Evaluation Coefficient of Agricultural Productivity Space (Polish abbreviation: WWRPP) and demographic factor (population density, percent of population involved in agriculture). After analysis it has been distinguished:
 - LFA lowlands' zone I
 - LFA lowlands' zone II
- for LFA affected by specific handicaps: the farm structure (average area farm size and distribution, share of non-agricultural farm), soil erosion, land cover (share of meadows and pastures)

The figure below (Fig.1) presents LFA distribution in Lower Silesia against the administrative division background. Delimitation of LFA in Poland, according to above listed factors, is performed on the spatial data in digital form and using GIS software. The advantage of such approach is a wider range of usage such types of data. Particularly, multivariable analysis of the factors may be performed, the assessment of spatial distribution of LFA can be carry out, hence the tendency in spatial layout of LFA and direction of their development may be noticed. GIS enable presenting the data and performed

¹ Halina Klimczak, Ph.D., D.Sc. (hklimczak@kgf.ar.wroc.pl), Marta Kąciak, M.Sc., Katarzyna Galant, M.Sc. (galant@kgf.ar.wroc.pl), Wrocław University of Environmental and Life Sciences, The Faculty of Environmental Engineering and Geodesy, Institute of Geodesy and Geoinformatics, Grunwaldzka 53, 50 – 357 Wrocław

analysis in form of tables and cartographic models (e.g. "unique values" maps, choropleth maps) as it combines the vector as well as attribute data. While creating spatial information system, specifying the aim of a project is of great importance as it influences on content of databases (quality, quantity, accuracy of data) and their sources.

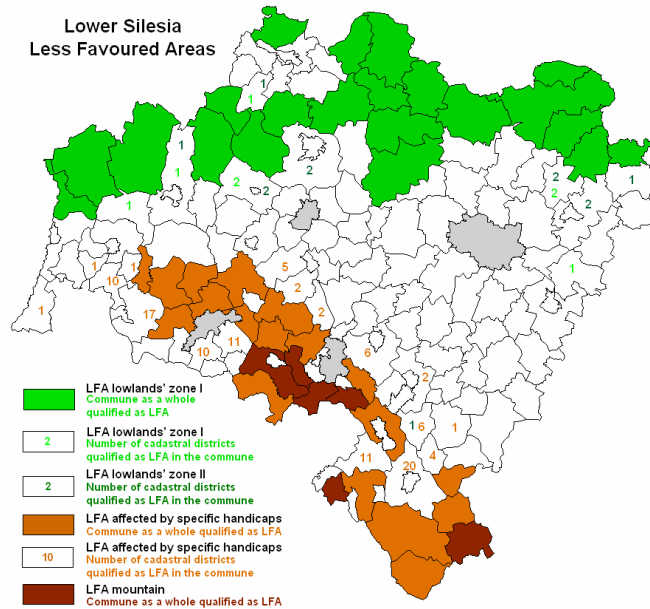


Fig. 1 LFA distribution in Lower Silesia against the administrative division background.

3 THEORETICAL BASES OF CREATION GIS FOR LFA

On the basis of available publications concerning LFA and according to the aim of creation the spatial system, the following range of information necessary for delimiting the LFA and performing various analysis is taken under consideration:

- administrative division
- demographical data:
 - population
 - density population
 - population involved in agriculture
- evaluation of agricultural productivity space
- area of administrative units
- average area size farm
- land use
- farms according to their types and types of economic activity
- data on soils, especially soil quality complexes
- altitudes and slopes of land
- protected areas
- vegetation period

The main components of the system are presented in figure below (Fig.2).

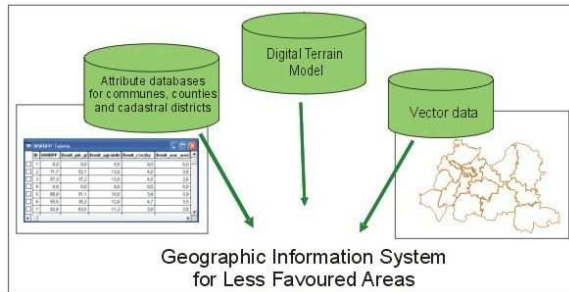


Fig. 2 The components of information system for LFA.

The proposed system integrates vector and attribute data from various sources and layers. The main sources are:

- Central Statistical Office (CSO, in Polish - GUS) – mostly free of charge data and updated every year or in frame of National Census
- digital soil and agricultural map at scale of 1 : 25 000 (long validity of information) elaborated by Institute of Soil Science and Plant Cultivation (Polish abbreviation: IUNG) in Pulawy
- administrative borders: Lower Silesia province, counties, communes elaborated by IMAGIS company and by District Office of Geodesy and Cartography Documentation (Polish abbreviation: PODGiK) – borders of communes for given counties
- digital environmental map at scale of 1 : 50 000 and databases elaborated by Head Office of Geodesy and Cartography (Polish abbreviation: GUGiK)
- CORINE Land Cover database elaborated by Institute of Geodesy and Cartography (Polish abbreviation: IGIK)
- Digital Terrain Model (DTM) elaborated by IGIK
- “Strategy of development of Lower Silesia” document elaborated under supervision of Prof. Zofia Więckowicz

Part of the data comes from existing systems created for different needs, other – is elaborated on the basis of „raw” data or modification of already existing one. The vector data constitutes of various reference units: natural boundaries (occurrence of soil, land cover, protected areas), administrative borders (cadastral district, communes, county) and geometric cells. The last vector base was created based upon the division of Poland into longitude columns and latitude bands in Temkart system. It is significant regarding to digital terrain model as the altitude and slope are stored for each cell.

One has to be aware of various accuracy of the data as it comes from different sources, but on the other hand the integration of wide range of data is an advantage of the geographic information systems.

3 DATA MODELLING

Data modelling is a process of forming conceptual data model by examining the relationships between entities and the characteristics of entities. Afterwards the internal model which specifies logical record structures and access path corresponding to all data is created. In this case the relational model, where the data are stored in a table of records called “relation” or “table”, is implemented. The “relation” has to fulfill some conditions, e.g the records contain a fixed number of fields which must be different from each other; all records are of identical format; each record is uniquely identified by primary key; a foreign key is a field that stores the key of another table.

The data are stored and integrated using MapInfo Professional (.tab file format). According to the application of the proposed system it contains the data that are used for LFA delimitation, as well as the data that may be useful for the LFA qualification in the nearest future. Furthermore the data which enables to perform analysis on phenomena and objects connected to LFA is stored. Most of the data not directly used for LFA delimitation is stored for chosen regions, namely for counties: oleśnicki, milicki, jeleniogórski and kamiennogórski; and communes: Oleśnica, Dobroszyce, Twardogóra, Międzybórz, Syców, Dziadowa Kłoda, Bierutów.

There are following subsets of data:

- Administrative units
- Soils
- Valorization

- Demography
- Agricultural areas
- DTM
- Protected areas
- Cadastral districts
- Farms
- Additional data

Administrative units

There are two 'relations' within this subset that refer to counties and communities.

The administrative current borders are of great importance from the system's effectiveness and functionality point of view. In the project the vector data of administrative division elaborated by IMAGIS company is used. For the analysed counties the data is acquired from District Office of Geodesy and Cartography Documentation (PODGiK). Additionally, there is a 'table' of previous administrative units as the vector data referring to communes has been changing (new urban-rural communes). The accuracy of localization of the borders refers to map of 1 : 100 000 for communities and 1 : 10 000 – cadastral districts.

The attribute data delivers information on name and area of the stored administrative units as well enables to join the data from different databases (primary and foreign key).

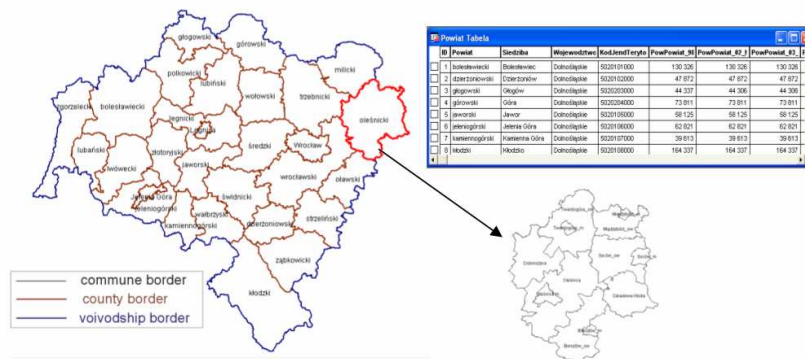


Fig. 3 Part of database referring to administrative units

Soils

The source of vector and attribute data referring to soils is digital soil and agricultural map at scale of 1 : 25 000 elaborated on the basis of up to date analogue one. These maps play significant role in determination of WWRPP indicator which is one of the main factors for LFA delimitation and constitutes the next subset of data.

The most important components of such maps' content are soil usefulness complexes. The attributes for vector database contains a name of complex and its area, as well a type of soil and substratum. It enables to carry out analysis of types of soils taking into account particular characteristics (e.g soil texture), as well as examine the spatial distribution of soil usefulness complexes and soils and their connection to LFA occurrence.

The data has been acquired only for chosen counties: kamiennogórski, jeleniogórski oleśnicki, milicki.

Valorization

The data referring to WWRPP is stored for communes. The source of data is an official case study "Strategy of development of Lower Silesia" elaborated under supervision of prof. Zofia Więckowicz. The optimal solution would be data for cadastral districts, however due to insufficient financial means the necessary collection of data has not been acquired.

As it was mentioned above WWRPP is one of the main factor for LFA delimitation. The indicator express the potential production of agricultural land as a result of natural factors such as: quality of soil, climate, relief, hydrological

conditions. Hence the value of WWRPP is a sum of these items that are quantified according to specified assumptions. The listed factors constitute attributes in WWRPP database.

WWRPP is reliable indicator in process of LFA determination as its validity lasts for long time because the properties of production potential of agriculture land do not change fast within short period of time.

Demography

Demographical data is the second factor used in LFA determination. The data are gathered for counties (one 'table') and communes (one 'table' – for current administrative units, and another for the previous state). Taking into account the aim of the proposed system, the data of following attributes is stored within 1998 - 2005: population, population density, population involved in agriculture (in 2002) and the percent of this population. The definition of 'population involved in agriculture' is given by CSO (Central Statistical Office) [4].

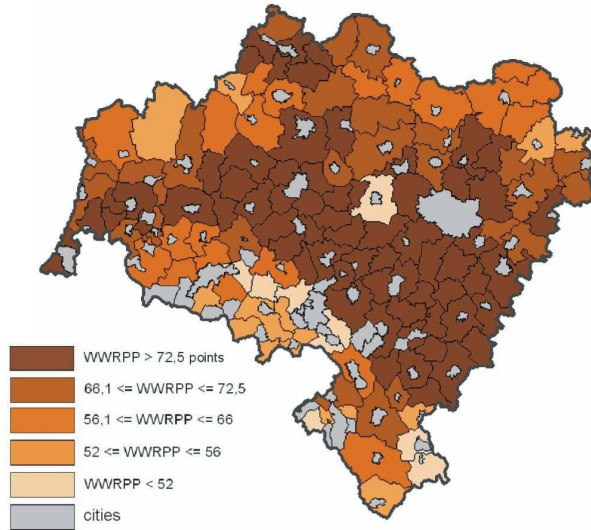


Fig. 4 Choropleth map of Evaluation Coefficient of Agricultural Productivity Space

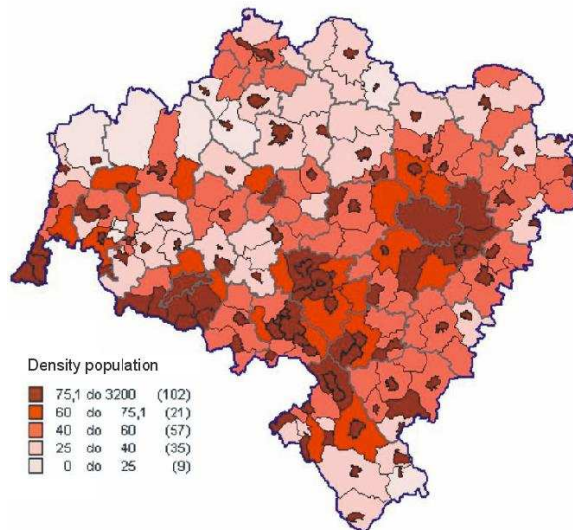


Fig. 5 Choropleth map of density population.

The figures above (Fig.4, Fig.5) present two main factors for LFA delimitation. The choropleth map of WWRPP shows the distribution of this coefficient. The classes of choropleth map equal the ranges of WWRPP used in LFA

determination. The communes with WWRPP over 72.5 points, which is the upper boundary for LFA qualification, are located in the central part of examined area. This map (Fig.4) along with the map of density population may be useful in delimiting the LFAs.

Agricultural lands

This subset of data contains of vector data acquired from CORINE Land Cover database referring to Lower Silesia area as well as attribute data stored for communes.

CORINE (CO-ordination of INFORMATION on Environment) is an information system supervised by European Environmental Agency and one of its part implemented in Poland is CORINE Land Cover (CLC) program. In frame of the CLC program the forms of land cover are defined hierarchically. What is important, the smallest distinguished area is of 25ha size.

The data for communities are more detailed (different types of agricultural lands and the area accuracy of 100m²), but does not show the range of the occurrence of agricultural lands. It gives the information of the structure of land use in administrative borders. Hence these two datasets have contrary application in the proposed system and may be used for different analysis.

DTM (Digital Terrain Model)

The information on elevation and slope is gathered within geometric cells of size 250 x 250 m and 500 x 500 m. This vector base was created based upon the division of Poland into longitude columns and latitude bands used in Temkart system. The database contains additional attributes that have statistical character such as: min. and max. value (of elevation as well as of slope), the mean, median etc.

Protected areas

Protected areas have to be also taken into consideration while delimiting LFAs. The source of these areas are chosen layers of environmental map at scale of 1 : 50 000 such as:

- a form of landscape
- degradation of environmental components and terrain surface
- degradation of soil
- combat degradation of environment
- reclamation of environment

There are some discrepancies (of area and location) in data acquired from CLC database and environmental map due to different accuracy of these databases.

Cadastral districts

This dataset constitutes an example of implementation more detailed databases into the information system. For the optimal system functioning it is recommended to store the data of cadastral borders for communes in which at least one cadastral district is qualified as LFA. At present the works on qualifying particular cadastral districts (in communes that are not as a whole qualified as LFA) are carrying out. Afterwards the chosen communes have to deliver borders of cadastral districts in digital form as well as specified attribute data [3]. This information will enable to determine WWRPP on the level of cadastral district. Hence this dataset is of great importance for developing and improving the LFA information system.

Farms

The subset refers to two kind of farms: "individual" and "agricultural" ones that are defined by Central Statistical Office. The data is collected for communes and enables to perform analysis of agriculture characteristics and direction of its development. It is because of detailed information contained (over 20 attributes), e.g. average size of farm, number of farms, number of farms of agricultural and non-agricultural activity, information on educational attainment of farm owners.

Additional data

There are extra data that also can influence on characteristics of agricultural lands and may be used in the analysis and examination of these areas. The author recommends to assign to this dataset the data on length of vegetation period and soil erosion.

The map of erosion is being elaborated so the data should be available in the future and may extend the LFA information system. It is important factor as the erosion is one of the criterion in qualifying the areas as LFA with handicaps.

The data on vegetation period are acquired from theoretical part of environmental map. There is a relationship between LFA and this factor, especially in the mountain and hilly areas. There are two databases: one containing length of vegetation period (min., max. and average) for counties (only attributes data) and vector data – the localization of meteorological station. The authors agree with a suggestion that the data of length of vegetation period should be converted into continuous form on the basis of discrete data if the system is extended for whole Poland.

Input of additional data which may constitute new criteria for LFA delimitation may help in more detailed and accurate qualification new areas as LFA.

The Figure 6 presents the scheme of relationships between some of the above described datasets ('tables').

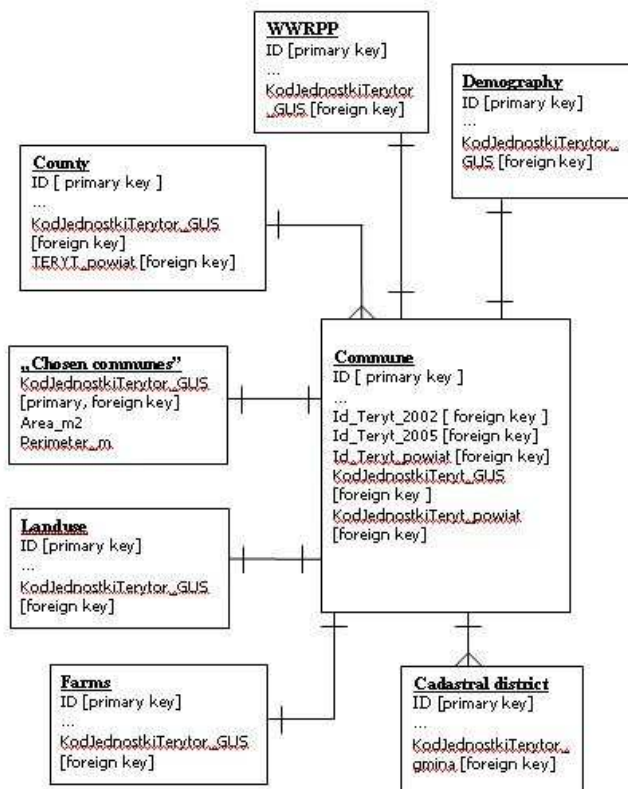


Fig. 6 Scheme of relationships between chosen tables.

Less Favoured Areas map

The important element of LFA information system is the data which defines the range of occurrence of LFAs (Fig.1). That is necessary in performing analysis on the other data stored in the system and commenting the outcomes. There are three datasets (for lowlands, mountain, and affected with handicaps areas) which contain the communes as a whole qualified as LFA. The fourth database delivers information on number of cadastral districts qualified as LFA in each community.

4 CONCLUSION

The agricultural areas in Poland characterize worse natural conditions than in countries of West Europe. Hence the compensatory allowances are necessary to well-balanced development of rural areas. The proper delimitation of Less Favoured Areas enables equitable distribution the EU funds.

The proposed information system for LFA is aimed to help in effective and appropriate determination of these areas based on the current criteria that are described above. Furthermore the databases contain additional information which may also influence on potential productivity of agricultural lands. The created databases enable to perform analysis and studies on various phenomena that play an important role in LFAs delimitation. In the paper, the guidelines for LFA information system are presented and the implementation for Lower Silesia area is described.

Literature

- [1] Plan Rozwoju Obszarów Wiejskich na lata 2004 – 2006 [*Rural Development Plan 2004 – 2006*]. Warsaw, Ministry of Agriculture and Rural Development, 2004
- [2] Rozporządzenie Rady (WE) nr 1257/1999 z dnia 17 maja 1999 r. w sprawie wsparcia rozwoju obszarów wiejskich ze środków Europejskiego Funduszu Orientacji i Gwarancji Rolnej (EFOGR) oraz zmieniające i uchylające niektóre rozporządzenia, Dziennik Urzędowy Wspólnot Europejskich z dn. 26 czerwca 1999 r.
- [3] <http://www.lfa.iung.pulawy.pl/list.html> - Institute of Soil Science and Plant Cultivation website concerns LFA
- [4] <http://www.stat.gov.pl/> - Central Statistical Office website

Reviewer

Prof. Ewa Krzywicka-Blum, Ph.D., D.Sc., Wrocław University of Environmental and Life Sciences (professor), Grunwaldzka 53, 50 – 357 Wrocław, Poland, ekblum@kgf.ar.wroc.pl