ENSURING THE MAINTENANCE OF THE AUTOMATED INFORMATIONAL SYSTEM "STATE ANIMAL REGISTER" IN THE REPUBLIC OF MOLDOVA

Livia Nistor-Lopatenco¹, Angela Mnogodetnâi¹, Alexandru Pantaz¹

¹Technical University of Moldova, MD-2004, Chisinau, Republic of Moldova

Abstract. The goal of this work is to analyze and reflect the importance of developing the Integrated Agricultural Register for the Republic (IAR) of Moldova, which is based on the implementation of the process of Electronic Transformation of Government through the e-Agriculture principle, storage and maintenance of information systems in the agro-industrial sector, management and processing of required data from existing electronic registers in order to streamline the development and implementation of development policies in agriculture. The Animal Identification and Traceability System (AITS), later referred to as the State Animal Register (SAR), is only a component part of the IAR and has as its primary objective the food security and consumer assurance with products of animal origin. AITS is one of the basic subsystems as an integral part of the traceability process of animal products. The SAR Automated Informational System is a set of elements and procedures that allow the identification and registration of animals and holdings, ensuring compliance of the traceability principle. All animals belonging to the bovines, sheep, goats, swine, horses, donkeys and descendant species obtained by crossing them, all holdings in which these animals are kept or handled, either farm, sheepfold, fair, slaughterhouse, will be identified. [1]

1. Introduction

In the last decades, the majority of governmental organizations in the whole world started the organization and management of the geospatial information withing the so-called National Spatial Data Infrastructure. The purpose of them is to reduce the effort duplication of institutions or agencies in the process of gathering and producing of geospatial data, to improve the geospatial data quality and significantly reduce the costs of obtaining them, as well as to create a network of valid spatial data resources that will serve as an important support in decision making. In this regard, the Government of the Republic of Moldova approves the decision for the approval of the regulation regarding the sharing norms of the geospatial datasets and of the related services between public entities and third parties. [1]

The agricultural sector of the Republic of Moldova is going through a period of transformation from the registers on paper to the registers in electronic format. The Integrated Agricultural Register implies the creation of several information systems and their integration on a single platform. These systems aim to collect data from the territory, through the territorial registrars, located in each district, for the administration and management of the agro-industrial complex. One of these systems is the Automated Information System „State Register of Animals” (AIS „SRA”) where, daily, farms and animals such as bovine, sheep, goat, pig, horse, donkey and descendants obtained by cross breeding are registered. [2]

Geographic Informational System (GIS) is used to create, store, analyze and process spatially distributed information through a computerized process. GIS technology can be used in various scientific fields, such as: resource management, environmental impact issues, cartography, etc. [5-8]

2. Purpose

The main purpose of this paper is the study and analysis of the methodology of data framing in AIS SRA,
as attributes, with GIS as the current cartographic basis in the Geospatial Data Infrastructure, which is of major importance in ensuring and developing the branches of the national economy of the Republic of Moldova. The process is part of the regulation on the establishment and management of spatial data through the national spatial data infrastructure geoportal, a web portal that represents a key element within the National Space Data Infrastructure, ensuring the practical and organized access to the spatial data of several public authorities, provides information about this data, ensures the possibility of searching, viewing and downloading spatial data from different sources.

3. Methodology

Specific to a GIS is the way of organizing the managed information. There are two types of information: one graphic that indicates the spatial distribution of the studied elements and the other as a database to store the attributes associated with these elements. [3-4]

As a vector graphic information, which is a method of representing images using simple geometric figures, the county administrative boundaries throughout the country are used in districts. As a database type information, the attributes generated from the AIS SRA are stored, such as the number of animals by species – number of animals and all events with these animals respectively – number of events from all districts of the Republic of Moldova. The data used in this paper represents the situation in the State Register of Animals from the year 2018. The number of animals events are the results of queries on the Oracle BI platform for the period 01.01.2018 – 31.12.2018. [2-5]

| Event name                        | Number of events |
|-----------------------------------|------------------|
| Primary animal registration       | 658423           |
| Export                            | 22371            |
| Import                            | 24638            |
| Disappearance                     | 206983           |
| The death of the animal           | 40819            |
| Loss and recovery of earache      | 757              |
| Finding the animal                | 1232             |
| Traditional animal sacrifice      | 590338           |
| Record of departure               | 704161           |
| Check in arrival                  | 626068           |
| Registration at the transit point | 239              |
| **Grand Total**                   | **2876029**      |

Table 1. Animal events, 2018.

Fig. 1. Events graph, 2018.

Due to the information associated with the graph, the Geographic Information Systems benefit from all the query opportunities offered by the database systems and in addition can easily provide analyzes oriented to certain geographical areas. [2]

Quantum GIS is one the Open Source / Free programs – initially a map viewer. QGIS is developing very energetically, becoming one of the most important GIS software currently used in this study. It has a nice and easy to use graphical interface. [2-4]

QGIS is the program used to create digital maps, reflecting the up to date status of animals on the territory of the Republic of Moldova. By combining the graphic data with the text characteristics of each district, the maps representing the species and the number of existing animals, as well as the map with the total number of animals in each district of the country, are obtained. These maps are designed so that they are visible and easily read by those interested due to gradual colors obtained on the number of animals. [3,10]

If the notion of System represents a set of interconnected elements that work together in order to achieve a certain objective, then the combination between GIS and AIS SRA is a map specific to the agricultural field, which is very useful and necessary to the interested ones. The integration of the graphic database with the attribute database, within some systems, forms a single entity called the digital map, which is a collection of graphic symbols, to which a collection of features (attributes) is attached for each object represented on the map.
4. Results

According to this principle, seven digital maps were created where the geographical data were used, which represents the coordinates of the spatial points that make up 39 polygons (the administrative boundary of the district) and the non-spatial attributes measured at certain time points in text format – numbers extracted from the database AIS SRA database, representing the number of animals (see columns in table 2) or events with these animals (see table 1).

### Table 2. Number of animals, December 2018.

| ID | District       | Total by district |
|----|---------------|-------------------|
| 1  | Anenii Noi    | 707 | 102,866 | 3,322 | 8,290 | 353 | 2 | 124,658 |
| 2  | Basarabasa    | 1,560 | 2,344 | 28,169 | 4,734 | 298 | 64 | 36,793 |
| 3  | Briceni       | 6,938 | 4,261 | 10,072 | 1,518 | 1,035 | 7 | 23,931 |
| 4  | Bălți        | 1,161 | 1,909 | 2,845 | 1,475 | 118 | 1 | 7,569 |
| 5  | Cahul        | 5,209 | 16,045 | 65,168 | 15,192 | 1,248 | 484 | 103,736 |
| 6  | Cantemir     | 6,046 | 14,785 | 51,941 | 7,332 | 1,846 | 425 | 82,375 |
| 7  | Ceadir-Lunga | 3,758 | 4,592 | 37,450 | 16,492 | 435 | 82 | 82,812 |
| 8  | Chișinău     | 1,679 | 1,472 | 3,262 | 3,213 | 260 | 7 | 9,858 |
| 9  | Cimișlia     | 3,609 | 3,064 | 26,340 | 3,255 | 301 | 48 | 56,857 |
| 10 | Comrat       | 4,122 | 7,392 | 40,316 | 7,015 | 441 | 561 | 60,058 |
| 11 | Călărași     | 2,670 | 46,132 | 2,221 | 1,678 | 87 | 0 | 52,775 |
| 12 | Chîțomi      | 5,231 | 5,888 | 9,304 | 5,629 | 2,697 | 7 | 29,756 |
| 13 | Chișinău     | 10,908 | 8,961 | 26,897 | 11,404 | 380 | 6 | 58,056 |
| 14 | Dondușeni    | 8,122 | 3,771 | 3,991 | 2,977 | 883 | 3 | 19,747 |
| 15 | Drochia      | 14,587 | 5,534 | 11,080 | 6,403 | 1,167 | 10 | 38,781 |
| 16 | Dobrogea     | 1,508 | 3,450 | 1,170 | 1,526 | 192 | 0 | 7,869 |
| 17 | Edineț       | 12,991 | 5,616 | 13,046 | 7,419 | 1,028 | 0 | 40,777 |
| 18 | Făleşti      | 12,876 | 10,921 | 11,769 | 6,532 | 1,596 | 6 | 52,209 |
| 19 | Fălești      | 14,481 | 12,431 | 19,060 | 6,962 | 1,899 | 13 | 65,943 |
| 20 | Glodeni      | 10,665 | 10,334 | 24,470 | 9,530 | 1,674 | 2 | 54,877 |
| 21 | Grigoriopol  | 0 | 570 | 263 | 0 | 0 | 0 | 773 |
| 22 | Hârșova      | 14,259 | 21,050 | 52,495 | 14,025 | 2,444 | 1 | 104,271 |
| 23 | Ialoveni     | 6,007 | 8,429 | 11,035 | 3,650 | 297 | 5 | 29,723 |
| 24 | Leova        | 2,764 | 2,174 | 19,214 | 2,469 | 698 | 8 | 27,327 |
| 25 | Nisporeni    | 3,283 | 27,801 | 16,181 | 6,582 | 1,779 | 0 | 55,718 |
| 26 | Ornea        | 3,841 | 2,164 | 3,394 | 1,035 | 486 | 1 | 10,714 |
| 27 | Ocnița       | 6,110 | 13,101 | 10,447 | 8,087 | 1,187 | 7 | 40,339 |
| 28 | Oancea       | 3,178 | 14,882 | 2,620 | 4,453 | 1,072 | 0 | 26,328 |
| 29 | Râșca        | 1,643 | 0 | 203 | 0 | 0 | 0 | 1,643 |
| 30 | Rîșcani      | 9,591 | 7,310 | 9,335 | 4,612 | 1,122 | 0 | 31,970 |
| 31 | Soroca       | 12,513 | 8,163 | 8,314 | 5,499 | 1,109 | 1 | 35,899 |
| 32 | Slobozia     | 3,541 | 8,330 | 3,371 | 3,338 | 1,004 | 2 | 19,366 |
| 33 | Slobozia     | 11,590 | 8,291 | 28,472 | 7,465 | 1,123 | 0 | 56,953 |
| 34 | Sînculeți    | 1,979 | 2,693 | 40,447 | 15,211 | 689 | 279 | 61,258 |
| 35 | Telenești    | 5,557 | 9,448 | 29,341 | 5,499 | 1,949 | 1 | 52,225 |
| 36 | Tighina      | 14,408 | 19,808 | 26,677 | 5,644 | 1,385 | 3 | 69,705 |
| 37 | Vâlcea       | 1,343 | 6,636 | 24,801 | 2,794 | 96 | 59 | 55,629 |
| 38 | Valea lui Dragnea | 4,291 | 12,988 | 6,620 | 3,581 | 1,181 | 0 | 26,677 |
| 39 | Valea lui Dragnea | 4,291 | 12,988 | 6,620 | 3,581 | 1,181 | 0 | 26,677 |
| 40 | Sântandrei   | 6,083 | 4,368 | 8,259 | 5,723 | 368 | 8 | 24,809 |

The map represents the total number of animals registered at the end of 2018 year (see table 2 last column) an is displayed in a special area of the QGIS program window. The map depends on the vector in its plan, enlarged or reduced. The image of the map and the legend are dependend on each other. [3-4, 9-10]

Other maps are obtained from the number of events with these animals, which can be generated from the AIS SRA database from any period of time. Thus, we have below the map which represents the event of primary registration of animals from all districts of the country, according to the attached table (see table 1, first line and Fig.1).

### Table 3. The primary registration of animals event distribution, 2018.

| ID | District      | Number of animals |
|----|---------------|-------------------|
| 1  | Anenii Noi    | 116146.00         |
| 2  | Basarabasa    | 3114.00           |
| 3  | Briceni       | 2903.00           |
| 4  | Bălți         | 2313.00           |
| 5  | Cahul         | 2903.00           |
| 6  | Cantemir      | 2313.00           |
| 7  | Ceadir-Lunga  | 13782.00          |
| 8  | Chișinău      | 2527.00           |
| 9  | Cimișlia      | 3673.00           |
| 10 | Comrat        | 14789.00          |
| 11 | Criuleni      | 84978.00          |
|   | Town          | Value   |
|---|--------------|---------|
| 12 | Calărași     | 11414.00|
| 13 | Căuşeni      | 13897.00|
| 14 | Dondușeni    | 4122.00 |
| 15 | Drochia      | 11829.00|
| 16 | Dubăsari     | 1324.00 |
| 17 | Edineț       | 4943.00 |
| 18 | Florești     | 78195.00|
| 19 | Făleşti      | 10878.00|
| 20 | Glodeni      | 8253.00 |
| 21 | Grigoriopol  | 773.00  |
| 22 | Hîncești     | 30379.00|
| 23 | Ialoveni     | 2982.00 |
| 24 | Leova        | 4782.00 |
| 25 | Nisporeni    | 36617.00|
| 26 | Ocnița       | 2950.00 |
| 27 | Orhei        | 13557.00|
| 28 | Rezina       | 45053.00|
| 29 | Ribnița      | 1698.00 |
| 30 | Șoțcani      | 7122.00 |
| 31 | Soroca       | 13151.00|
| 32 | Strășeni     | 4849.00 |
| 33 | Singeriei    | 8385.00 |
| 34 | Taraclia     | 5565.00 |
| 35 | Telenenești  | 7639.00 |
| 36 | Ștefan Vodă  | 5227.00 |
| 37 | Ungheni      | 19211.00|
| 38 | Vîlchești    | 9306.00 |
| 39 | Șoldănești   | 4732.00 |
|   | Total general| 658423.00|

At the base of these maps is uploaded the free OpenStreetMap geographical dataset.

The maps representing each animal species are also created, the data being generated from the AIS SRA where they are updated daily (see table 2 column 3 and 4).

According to the same procedure, another 4 maps are created representing the distribution of each species of animals at national level: goats, sheep, horses and donkeys, mentioned in table 2, columns 5, 6, 7 and 8.

The alert department of the AIS SRA automatically positions the alert registered in the system by the veterinarians in the territory after the outbreak detection and confirmation. With a single click on the alert marked on the map we see the details of the respective alert: the location, the type of infection, the type of animal, the outbreak radius, the holding, the type of holding and the name of the owner. The alert remains registered in the system, only changing its active or inactive status. [3-6]

Fig.3. The primary registration of animals event distribution, 2018. [9-10]
Fig. 4. Distribution of cattle. [9-10]

Fig. 5. Distribution of swine. [9-10]

Fig. 6. Alert management. [9-10]

5. Conclusions

The creation of the thematic maps reflecting the data registered in the AIS SRA aims not only at the citizens’ access to information (transparency), but also their integration in the National Infrastructure of Spatial Data, which ensures the interoperability of the spatial data between the public entities, both at the national and international level by harmonizing the data according to ISO/TC211 standard. [9-10]

Digital maps in the field of agriculture are created for viewing, processing and analyzing information regarding the respective field. The data is text type. [3]
After scanning, a map becomes a spatial database on a 1:1 scale. The spatial information contained can be transformed using the functions of a GIS, functions that allow printing or plotting at any scale and in any projection. [10]

If necessary, maps can also be created for each event (see table 1). Spatial data can be easily supplemented with maps for viewing farms and slaughterhouses as well as their number, type and geoposition. [2]

Descriptive data (attributes) that characterize spatial data are recorded in a relational database. With the help of a Database Management System, they can be optimally controlled, organized and manipulated. These are edited repeatedly, at certain time intervals, including data that characterize not only the year preceding the editing, but also data from previous years. The agricultural domain requires updates of the frequent digital maps (monthly, or even weekly). [3-4]

Thematic maps of the agricultural field from the point of view of destination are informative maps. A national Spatial Data Infrastructure can be regarded as both virtual network created to allow the development and sharing of geographic digital information and resources at national level. [3-4]

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