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GEOINFORMATION MODELING FOR LOCATION OPTIMIZATION OF LAND PARCELS FOR APIARIES

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Annotation. *The features of the selection of the area for placement of apiaries are analyzed, which will provide a sufficient forage base and productivity of apiaries and at the same time will be safe for the life of bees.*

The possibilities of using geoinformation models for finding the apiaries optimal location have been shown in the research. Finding suitable parcels in a fairly short time is due to the dependence on blossom of entomophily cultures. In the article, it was shown the analysis of different requires for location of bee-garden land parcels and the solution of the automation of work related to the preparation of geo-images of suitable territories.

This research describes the algorithm for making the geo-images reduces waste the time consuming and accelerates the analysis of spatial data for making decisions on the location of apiaries. It was proposed to use spatial analysis for selecting the optimal location of apiary.

As a result of the research, it was established that an algorithm that automate some steps in the creating of land management documentation for beekeeping farms can be used for the location determination of bee-garden land parcels.

Key words: *geoinformation modeling, bee forage, geo-image****.***

Introduction.

Beekeeping is an integral part of the agro-sector; meanwhile it is part of the food supply function of the country's population. The success of the beekeeping farm depends on many factors: the availability of sufficient bee forage and the apiaries location in areas that are safe for bees. In this days and ages, the fragmentation of land is increased and the number of landowners and land users is grown too. Thus the beekeepers have a question how is situated their apiaries, how is provided the optimal forage base for bees and the performance of the apiaries.

All this necessitates of new operational approaches study will provide mapping and the analysis of land parcels location suitable for beekeeping.

Statement of problem. The Law of Ukraine "On Beekeeping" provides the placement and moving of apiaries [1], and according to the Order of the Chief State Inspector of Veterinary Medicine of Ukraine "*On Approval of the Instructions for Diseases Prevention and*

Elimination and Bees Poisoning" [2], there are established requirements for placement and arrangement of apiaries. A clear implementation of the requirements described in the development of land management projects provides a solution to the problem of the safe and productive location of bees.

Both analyzing the territory and taking into account various criteria can be based on the use of geo-information models for selecting the optimal location of apiaries. The need to identify suitable sites in a fairly short time is due to the dependence on the flowering of entomophily cultures and requires the solution of the automation of work related to the preparation of geo-images of suitable territories.

Analysis of recent researches and publications.

The development a problem of using automated decision support systems in planning land use has been covered in works [3-4]. The development problems of the accounting of the forage base of beekeeping have been covered in works [5-6]. The study [7] highlighted the inventory of honey plants in arid zones and how ground-based inventory works supported by GIS-applications.

However, the problem of plot automatic search location optimization for the needs of beekeeping was not covered in the works listed.

Objectives of the article.

The objective of the research is to substantiate the geoinformation model for the automated area determination suitable for apiaries placement.

To achieve the objective of the study, the following tasks were used: to identify the main input and result data; and to substantiate the development and application of the algorithm making geo-images of suitable territories based on the example of a separate administrative territorial formation.

Materials and methods.

The paper aimed on the selection of the area for the optimal apiary location based on usage methods of geo-information analysis and tools of the Idrisi Selva software. To achieve the objective of the study, a model for making the geo-images of areas suitable for apiaries was developed and substantiated. The development of the model used approaches based on the Unified Modeling Language (UML). Geo-images in this study were built on the simulation tools: layer overlay operation, classification methods and reclassification of numerical indices.

The information base of the research is ground investigations and thematic maps obtained according to remote sensing data.

The territory of Boryspil district of Kyiv Oblast was selected as a modeling instance.

The main materials. Analysis of the beekeeping legal provision of [1-2] has shown that in determining the optimal location of apiaries, it is necessary to take into account the needs of users, who will be based on the model being developed and a list of tasks for which the given model is aimed (Fig. 1).

Determination of the apiaries optimal location includes the definition of indicators characterizing the presence of the forage base of beekeeping such as the identification of entomophily plants, which are the source of nectar or pollen, its areas and the terms of blossom meanwhile the absence of harmful effects on bees.

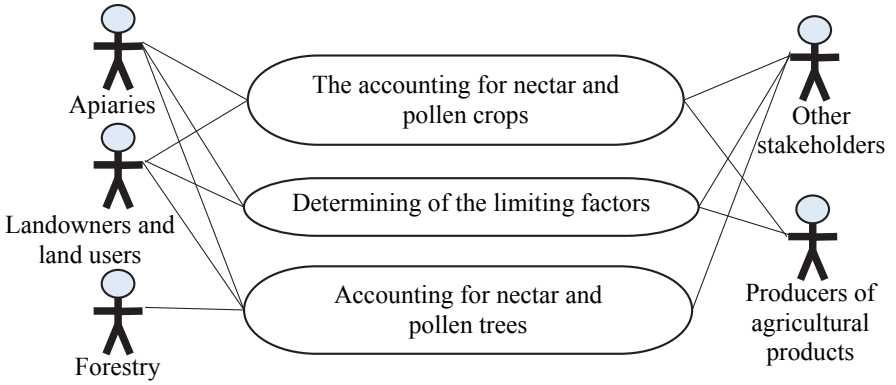

Fig. 1. Classification of task types and users in determining the apiaries optimal location

There are the following models determining the apiaries optimal location by the users: landowners and users, beekeepers such as pedigree and apiaries, producers of agricultural products, cultivating entomophily plants and other stakeholders.

The decision of the land placement problem of the apiaries location is solved using the approach of geoinformation modeling, which, based on the analysis of the set parameters, allows us to find the variant of accommodation, which is the mush more optimal.

The general scheme of the algorithm for creating a geo-image of the suitability of the territories for the location of apiaries was illustrated in Fig. 2.

When Problem statement, should take into account the number of bee families and the direction of activity of the apiary.

During the collection of information about land resources within the analyzed administrative-territorial formation, the study of incoming data sets and their integration.

At the next stage of the task, two issues were considered in parallel: creating a thematic map of the nectar and pollen crops and defining the requirements for the apiaries location. Creation of a thematic map of nectar and pollen crops was based on forest data, crop maps and/or processing of remote sensing data, which was considered in the studies [8].

Requirements for placement of apiaries in relation to neighboring apiaries and other objects were specified in the order [2]. Objects limiting the location of apiaries are as follows: highways and railways, sawmills, high-voltage transmission lines, livestock and poultry houses, wax processing plants, confectionery and chemical industry enterprises, airfields, military landfills, radar, radio and television broadcasting stations and other sources of microwave radiation and the presence of reproductive or quarantine apiaries.

To select the optimal location of the apiary, it was proposed to use spatial analysis, which allows searching of spatial patterns in the distribution of geographic data and interconnections between objects [9].

The next stage of the functional model is the creation of thematic maps of the study area, which provides us-

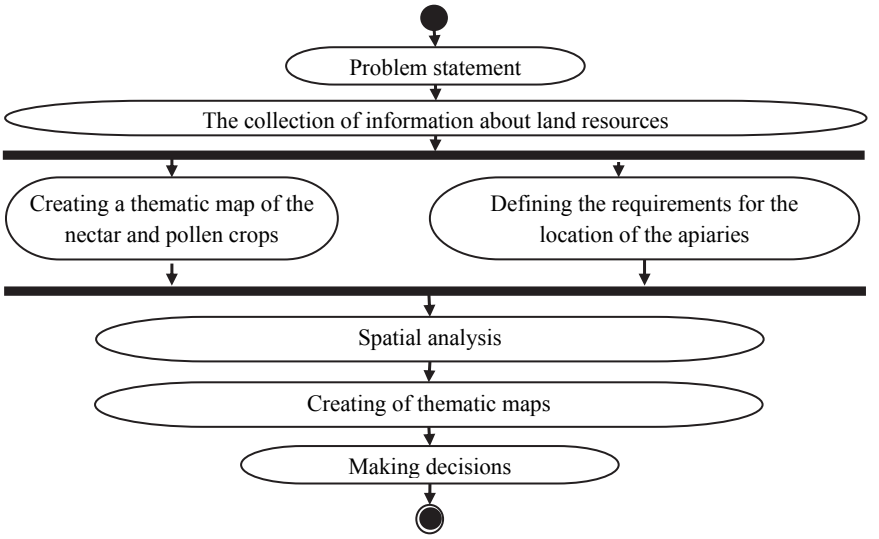

Fig.2. Functional model of the implementation of actions for solving the problem in determining the apiaries optimal location

er-friendly display of spatial data and is the basis for making project or management decisions.

To achieve the objective of the research, a geo-information model for selecting the optimal location of apiaries has been developed, consisting of the following blocks:

Block # 1: Initial Data: The model contains primary data which can be obtained from existing maps or thematic processing of remote sensing data.

Block # 2: Data Processing: This part includes the following components:

1. Allocation of danger areas for bees: creation of a class of spatial objects that are harmful to bees and the installation of such objects in buffer zones.

2. Isolation of territories with a sufficient forage base: The creation of a spatial class, indicating the location of valuable plants such as nectar and pollen. Next stage is an establishment of buffer zones around it, at the distance possible to flying bee.

3. Selection of areas suitable for the apiaries location.

Block # 3: Presentation of Results: The model involves the creation of the resulting geo-image in a user-friendly form.

For the automated selection of the optimal location of the apiary, an algorithm is constructed. That algorithm determined the sequence of actions to solve the land-use problem for a certain number of steps. The implementation of the algorithm was accomplished through the IDRISI Macro Modeler as a graphical environment for building and implementing multi-stage models (Figure 3).

The Figure 3 has shown two initial raster images: LANDUSE and THEMATIC MAP. The first one contains information about the types of coverage and types of objects. Another image is a thematic map of types of agricultural and forestry crops. These images can be derived from mapping material of forest tax, farm plans and/or maps derived from remote sensing data.

The following modules were used in the model:

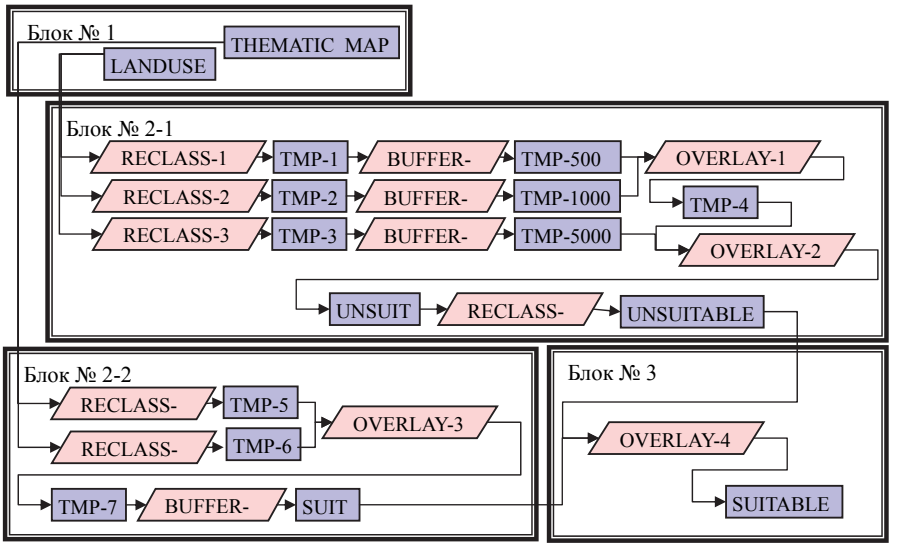

Fig. 3. The model for creating geo-images of suitable territories for apiary

RECLASS performs a selection of coverage types and creates a file with Code 1 for the target coverage and Code 0 for all other types of coverage.

BUFFER makes the distance around the target areas in an editable width.

OVERLAY implements combining layer and datasets.

The developed model was stored in a file and can be used to determine the zones of possible placement of apiaries for other territories.

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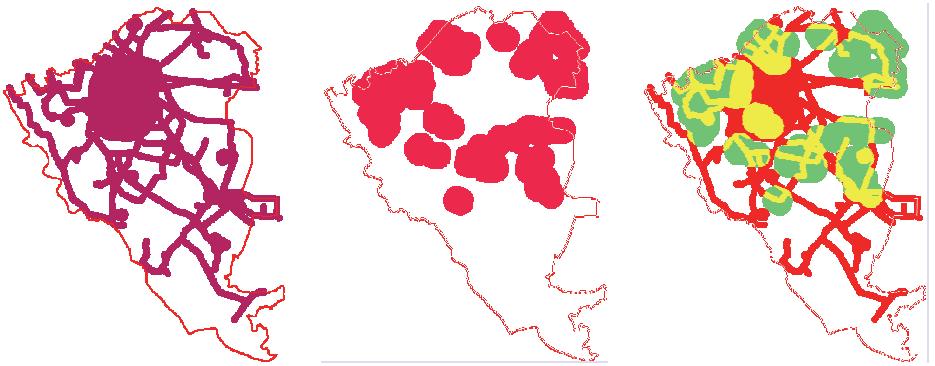

a *b* *c*

Fig. 4. Construction of Geo-Images: (a) – Zones of existing unfavorable conditions for the location of apiaries; (b) – Possible location of apiaries; and (c) – Combining conditions on appropriate and inappropriate territories.

Automation of the process of analysis and construction of geo-images helps to increase the efficiency of decision-making. Thus, according to the results of the spatial analysis, intermediate geo-images of areas that are unfavorable to the location of apiaries (Fig. 4a), territories with favorable vegetation (Fig. 4b) and a comprehensive thematic map (Fig. 4c). The last one is the basis for the substantiation of the design adoption of the decision land manager regarding the selection of a plot of land for the location of the apiary.

On the basis of the obtained geo-imaging, in order to comply the Law [1], an analysis of land plots that can be leased or transferred to the property of individuals or legal entities for the placement of apiaries, followed by the development of a project for the internal structure of the apiaries.

Conclusions.

This research deals with the algorithm for making the geo-images reduces the time consuming and accelerates the analysis of spatial data for making decisions on the location of apiaries.

The results of the study can be used to automate some steps in the development of land management documentation for beekeeping farms.

The prospects of further research in this direction lie in the automatic block of the Decision-Making Support System for the apiculture location and develop the internal structure of it.

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Москаленко А., Дьоміна І.

ГЕОІНФОРМАЦІЙНЕ МОДЕЛЮВАННЯ В ОПТИМІЗАЦІЇ МІСЦЕРОЗТАШУВАНЬ ЗЕМЕЛЬНИХ ДІЛЯНОК ДЛЯ ПАСІК

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Анотація. *Проаналізовано особливості підбору території для розташування пасік, що забезпечать достатню кормову базу та продуктивність пасіки і водночас будуть безпечними для життя бджіл.*

У дослідженні показано можливості використання геоінформаційних моделей для пошуку оптимального розташування пасік. Знаходження підходящих ділянок за досить короткий час обумовлено залежністю від цвітіння ентомофільних культур. У статті наведено аналіз вимог до розміщення земельних ділянок пасіки та розроблено і обґрунтовано модель вирішення автоматизації робіт, пов'язаних з підготовкою геозображень придатних для пасік територій.

Дане дослідження описує алгоритм виготовлення геозображень, що зменшує витрати часу та дозволяє пришвидшити аналіз просторових даних для прийняття рішень щодо розташування пасік. Для вибору оптимального місця розташування пасіки було запропоновано використовувати просторовий аналіз.

В результаті проведеного дослідження встановлено, що для визначення місцярозташування земельних ділянок для пасік може бути використаний алгоритм, який автоматизує деякі етапи створення документації із землеустрою для пасічних господарств.

Ключові слова: *геоінформаційне моделювання, кормова база бджільництва, геозображення.*

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Москаленко А., Демина И.

ГЕОИНФОРМАЦИОННОЕ МОДЕЛИРОВАНИЕ В ОПТИМИЗАЦИИ МЕСТОРАСПОЛОЖЕНИЯ ЗЕМЕЛЬНЫХ УЧАСТКОВ ДЛЯ ПАСЕК

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Аннотация. *Проанализированы особенности подбора территории для размещения пасек, которые обеспечат достаточную кормовую базу и производительность пасеки и одновременно будут безопасными для жизни пчел.*

В исследовании показаны возможности использования геоинформационных моделей для поиска оптимального расположения пасек. Нахождение подходящих участков за достаточно короткое время обусловлено зависимостью от цветения энтомофильных культур. В статье приведен анализ требований к размещению земельных участков пасеки и разработаны и обоснованы модель решения автоматизации работ, связанных с подготовкой геоизображений пригодных для пасек территорий.

Данное исследование описывает алгоритм изготовления геоизображений, что уменьшает затраты времени и позволяет ускорить анализ пространственных данных для принятия решений по размещению пасек. Для выбора оптимального места расположения пасеки было предложено использовать пространственный анализ.

В результате проведенного исследования установлено, что для определения места расположения земельных участков для пасек может быть использован алгоритм, который автоматизирует некоторые этапы создания документации по землеустройству для пасечных хозяйств.

Ключевые слова: *геоинформационное моделирование, кормовая база пчеловодства, геоизображение.*