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METHODS PRINCIPLES CONSTRUCTION OF SUPPORT AND DECISION MAKING SYSTEMS FOR ORGANISATION COLLECTION AND UTILIZATION ORGANIC RAW MATERIALS

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Annotation. *Analyzed ways to solve the national problems increase biomethane production through optimal planning seeding, harvesting and conversion into biogas energy crops and other organic waste. The proposed functional structure of support and adoption of decisions related to the collection and recycling of organic materials in order to obtain the maximum volume of biomethane.*

Keywords: ***biomethane, decision support system, organic materials, biogas, energy crops***

Problem

Currently, relevant and important problem is nationwide production and the introduction of biomethane to the Ukrainian gas transportation system. In this case to obtain biomethane can be used on large farms biomass and energy crops (EC) of farmland. According to experts [1], only the available waste could produce up to 3.2 bln. of cubic meters biomethane per year. At this 6.5 bln. of cubic meters annually. One of the directions of solving this problem is the widespread use of information technology by which shall be made of existing monitoring and forecasting prospective base of organic raw materials for its processing into biogas complexes (BGC) for maximum volume biomethane.

Forecasting output efficiency of biogas from organic materials (OM) devoted a lot of work. In [2-4] the modern technical level of biogas technology. It is shown that the level of implementation of these technologies remains unsatisfactory. In [5] a review of the use of modern information technologies in agricultural management around the world. Examples of remote sensing and geographic information systems for agriculture, discussed the creation in Ukraine of agrarian resources monitoring system and forecasting yields crops.

Depending on the method of placing recording devices, methods of remote sensing fall to the ground, air and space, but they have one thing in common: to obtain information is by recording electromagnetic radiation reflected or emitted from the earth's surface.

In [6] The methodological principles applying system precision farming, which consists of the following stages: 1) creation of an electronic map of the entire economy; 2) samples of the soil to a depth of 30 centimeters; 3) planned for fertilizing previously obtained coordinates; 4) mapping yields. This system is based on the use of modern information technology.

As the results of the analysis of scientific papers, currently not adequately address issues of development and use of DSS on the organization of cultivation, collection and transformation of organic material into biogas.

The purpose of the article - to develop a functional structure of DSS on the organization of planning cultivation, collection and processing of organic material into biogas.

Main material of research. Biomethane - a biogas (60 % methane and 40 % CO_2), proven to quality natural gas. In different countries the requirements for methane concentrations in the range from 95 % to a maximum of 98 %. In Western countries already use the technology, through which ensured the separation of CO_2 from methane content and bring the latter to 95-98 % for submission to the pipelines. We have the technology have a greater prospect that at any point of Ukraine is a gas distribution network to which you can connect. It is necessary to establish a system of accounting presentation of biomethane into the gas network with BGC.

Typically, BGC tied to sources of raw materials - large farms or in rural areas to farmland where energy crops are grown. Now the practice is rarely to use exclusively manure. Most of the settings for his work uses a silo, remains of corn, and sometimes operate without manure.

The most important task of planning on growing EC using DSS is to place various cultivation energy crops in the area on the basis of geophysical characteristics of each culture.

In terms of output gas give the best result substrates with a high concentration of energy, beets, potatoes, grain waste. Out of methane derived from these plants can reach 350-380 liters/kg organic dry substrate. In addition, the group is operating, which includes fresh grass, beet tops, corn and grain plants, out of which methane is from 270 to 330 liters/kg organic dry substrate. The smallest gas output below 200 liters/kg organic substrate is dry straw [7]. Silage corn today is the most important crop for use in biogas plants. Corn is also called C4 plants because of the large output of dry weight. Technology, which is necessary for processing the crop usually always available to enterprises. Corn sylosuyetsya easy to clean and even use does not cause disturbances in the process of biogas plants. Today is a special variety of corn for use in biogas plants.

The best time to harvest is its readiness for silage and to maximize the volume of biomethane. Typically, corn in the collection should have a dry matter content of 28-35 % and in a state between milk maturity and suitability for flour. In favorable areas for cultivation of different varieties available acreage of more than 8000 m^3 of methane from one hectare of biomass grown. The output of crop silage corn varies between 120 and 270 quintals / hectare, out of gas between 300 and 380 liters per kg organic dry matter [7].

To create optimal in terms of energy crop rotation biomass for BGC need the help of DSS reconcile the three the main factors and exercise:

1. The choice of varieties and consistency of cultivation of high yield of each variety of organic dry mass per hectare per year.

2. Choosing varieties based highly specific for each class of methane and best compatibility nutrients in their mixing.

3. Optimization of the constituents, based on the maximum potential methane among different cultures for example, by improving fat content through the integration of oil crops).

For optimum in terms of energy, crop rotation, use a combination of the best groups of plants C3 and C4. Cold winter plants are experiencing better group C3, while rich in biomass heat-loving plants of C4 experiencing good summer. This makes it possible to double the crop for a year with a total capacity of about 250-300 quintals of dry mass per hectare. A collection of early first harvest can not multiply many weeds, helping to renounce the use of herbicides. Already existing weeds even help increase output of dry matter. This combination helps crops get dry matter yield of 250 quintals/ha and even in bad conditions when adequate rainfall has an advantage over corn. Winter crops act as the best crops for the first harvest.

BGC economic effect depends largely on the cost of production of the substrate, quality, and cost for processing the OM. Therefore, the company that operates the BGC should carefully check the quality and purchased in the market or feasibility substrate cost-effective biomass cultivation on their lands. The primary raw material for BGC may be corn. This culture gives a high energy output and its conservation is relatively simple, given the long experience. Wider crop rotation could be appropriate from an economic and technological point of view. Relatively sufficient number of compost is recommended to expand the range of crops for biogas subsidiary plants.

Consider solve this problem in this sample. Let projected for BGC grow corn and sugar beets on an area of 200 hectares, pushing sugar beet at least 50 hectares.

Criterion optimal process of cultivation, collection and processing of the OM is to maximize profits (Z) by increasing the production and sale of methane gas.

Economic-mathematical model of the production of corn and sugar beet is:

$$Z = 0{,}7x_1 + x_2 \to \max, \quad (1)$$

Under

$$x_1 + x_2 \le 200; \quad (2)$$

$$5x_1 + 25x_2 \le 270; \quad (3)$$

$$2x_1 + 8x_2 \le 80; \quad (4)$$

$$x_2 \ge 50; \quad (5)$$

$$x_1 \ge 0,\ x_2 \ge 0, \quad (6)$$

where x_1 – the required acreage of winter wheat, x_2 - the required acreage of sugar beet.

The technical and economic indicators of growing these crops listed in the table:

№ p/p	Technical and economic Indicators per 1 ha	Agricultural crops		Available resources
		Corn	Sugar	
1	Live labor man-days	5	25	270
2	Mechanized labor man-days	2	8	80
3	Profit, thousand of UAH	0.7	1	

This problem is solved using linear programming methods [8]. In this case, the estimated costs for the supply of substrate to BGC for example maize are offensive structure:

1. Growing - 50%.
2. Cleaning - 15%.
3. Transportation to the silage - 15%.
4. Fixed and variable costs for silage - 13%.
5. Download the substrate in the fermenter - 7% .

Because when corn dry matter content is relatively small, and water - large, in this case the transport costs disproportionately high. Thus, the cost of supply of maize increased by 250-350 USD / ha with increasing distance transportation from 2 to 20 km [9]. This corresponds to an increase of costs up to 25% and therefore impairs economic efficiency BGC.

In this regard, using the DSS have practiced new combined methods of collecting and transporting OM using trucks to reduce the cost of delivery. This is inevitably linked to the performance of large-scale works in transportation of biomass to BGK and export of organic fertilizers on the field. Therefore, increasing the need for coordination using DSS cleaning on the organic raw materials and transportation. The success is timely planning of distribution areas for planting crops, collection and transportation of the substrate and removal of organic fertilizers. When cleaning (especially corn) is the most efficient one-step method in which the transport unit is loaded on the chopper and carries with chopped silage mass directly on. Traditionally used for this tractor trailer or truck with appropriate agricultural equipment.

Depending on the number of used shredders required number of units of transport and local characteristics required coordination using DSS all work on the collection and transport of OS. During the harvest of the OM must consider many factors. In addition to traditional means of coordination (eg mobile phones) in scale cleaning processes all hardware collection and recycling of organic materials together in a network using electronic data processing systems and mobile GIS, DSS is distributed in order to facilitate

For multivariate analysis of the collection and processing of the OS is advisable to use mathematical tools based on fuzzy logic theory and linguistic variables. This method is a combination of interrelated mathematical models, algorithms and methods and allows expert linguistic variable for predicting the usefulness of different methods of collecting and processing operating system, including factors that poured into this process.

To establish a hierarchy of factors that affect the process collection and processing operating system, there is a need for classification according to the coordination of the entire harvest logistics.the following criteria: type of raw material, the amount of raw materials, area cleaning, the distance from the bioreactor, the method of collection, the availability of equipment for collecting necessary workload BGK.

The block diagram of DSS on the organization of the collection and processing of the OS provided Figure.

Since the formal knowledge of experts in the initial stages enough DSS application complete and correct, the situational database (SBD), and specialized knowledge base (BAU) improved during the operation. Models of knowledge is constantly adjusted on the basis of objective information about the correctness of decisions.

The central element of the DSS is a specialized knowledge base, through which creates a mathematical model of the collection and processing of the OM and set the relationship between input variables (parameters of telemetry data) and output variable (identified in the technological process (TP) on conversion to biogas OS). The basis of a mathematical model rests fuzzy knowledge base, which is a set of rules "if-then" that connect TP linguistic evaluation parameters and output estimates OM types.

The adequacy of the model to experimental data is determined by the quality of membership functions in which linguistic evaluations moving in quantitative form. Since the membership function determined by expert adequacy fuzzy BR entirely dependent on the skills of experts.

All possible major transaction process can be summarized as follows:

1. Sat down and planned collection of specially grown biomass reasonably defined areas.

2. Constant monitoring of the system and lots of additional OS.

3. Determining the type, quantity and quality of the OS.

4. Preliminary calculation of potential trade volume of biogas (methane), which can be obtained using this operating system.

5. Previous count cost of planting, cultivation, collection and transportation of the OM, as well as export to the fields of BGC organic fertilizers.

6. Determination of the annual workload of bioreactors BGK and profitability.

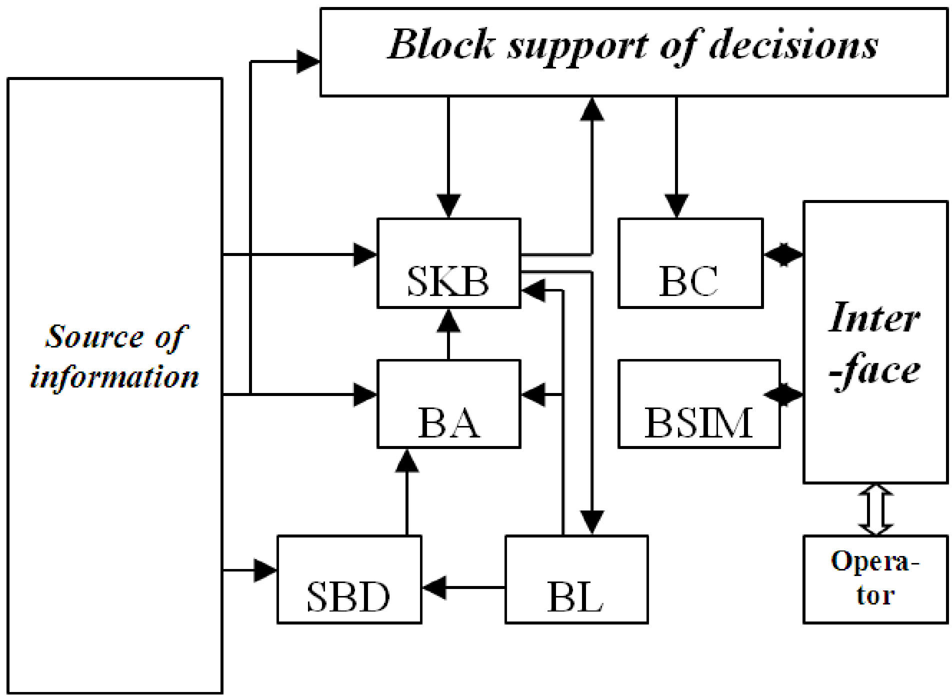

Fig. Block diagram of DSS:

SBD – situational database, SKB – specialized knowledge base, BA – block analysis BL – block learning, BC – block comments BSI – block synthesis information model

Thus, in a complex dynamic environment characterized by ongoing uncertainty and volatility of many factors, the basis of successful operation BGC is the best decision-making using the proposed DSS on the organization of cultivation, collection and processing to obtain maximum operating volume of biomethane.

Conclusion

Based on the analysis of problems of management activities and the factors that influence the efficiency of BGC developed functional structure of decision support system that best adapted to the challenges for the organization planning the cultivation, collection and processing of organic raw materials to biomethane for further supplies in distributed gas transportation system.

References

1. Гелетуха Г.Г. Про майбутнє біометану. [Електронний ресурс]. - Режим доступу: http://forbes.ua/ua/opinions/1390912-pro-majbutne-biometanu.

2. Сидоров Ю. І. Сучасні біогазові технології / Ю. І. Сидоров // Biotechnologia acta, v. 6, no1, 2013. [Електронний ресурс].- Режим доступу: http://biot_2013_6_1_6.pdf.

3. Гелетуха Г.Г. Перспективи біогазу в Україні / Г. Г. Гелетуха // Економічна правда, 2013. [Електронний ресурс]. – Режим доступу: http://www.epravda.com.ua/columns/2013/07/3/383399/.

4. Гелетуха Г.Г. Развитие биогазовых технологий в Украине и Германии: нормативно-правовое поле, состояние и перспектива / Гелетуха Г.Г., Кучерук П. , Матвеев Ю. Б. – Киев-Гюльцов, 2013. – 71 с.

5. Кобець М. І. Використання сучасних інформаційних технологій в системах сільськогосподарського менеджменту /М. І. Кобець . [Електронний ресурс]. – Режим доступу: http://undp.org.ua/agro/pub/ua/P2005_05_08_05.pdf.

6. Россоха В.В. Технологічні трансформації в агропромисловому виробництві України: тенденції та результати / Россоха В.В., Соколов Д.О. [Електронний ресурс]. – Режим доступу: http://forbes.ua/ua/opinions/1390912-pro-majbutne-biometanu.

7. Эдер Б. Биогазовые установки. Практическое пособие / Эдер Б., Шульц Х. [Електронний ресурс]. – Режим доступу: http://www.zorg-biogas.com.

8. Вітлінський В.В. Математичне програмування: Навч.-метод. посібник для самост. вивч. дисц. / Вітлінський В.В., Наконечний С.І., Терещенко Т.О. – К.: КНЕУ, 2001. – 248 с.

9. CLAAS – эксперт биогаза. [Електронний ресурс]. – Режим доступу: http://www.claas.ua/blueprint/servlet/blob/76286/24194e1a7b4ba98391b583db7173bc37/biomass-brochure-biogas-expertise-data.pdf.

10. Интеллектуальные системы поддержки принятия решений: теория, синтез, эффективность [Тарасов В.А., Герасимов Б.М., Левин М.А., Корнейчук В.А.] – К.:МАКНС, 2007. – 335 с.

МЕТОДИЧНІ ЗАСАДИ ПОБУДОВИ СИСТЕМИ ПІДТРИМКИ ПРИЙНЯТТЯ РІШЕНЬ ДЛЯ ОРГАНІЗАЦІЇ ЗБОРУ І УТИЛІЗАЦІЇ ОРГАНІЧНОЇ СИРОВИНИ

Д. Комарчук, С. Шворов, П. Охріменко, Д. Чирченко

Анотація. *Аналізуються шляхи вирішення національної проблеми збільшення виробництва біогазу за рахунок оптимального планування сівби, збирання та переробки біогазових енергетичних культур і інших органічних відходів. Запропонована функціональна структура системи підтримки прийняття рішень, що стосуються збору та утилізації органічних матеріалів для отримання максимального обсягу біометану.*

Ключові слова: ***біометан, система підтримки прийняття рішень, органічних матеріалів, біогаз, енергетичні культури***

МЕТОДИЧЕСКИЕ ПРИНЦИПЫ ПОСТРОЕНИЯ СИСТЕМЫ ПОДДЕРЖКИ ПРИНЯТИЯ РЕШЕНИЙ ДЛЯ ОРГАНИЗАЦИИ СБОРА И УТИЛИЗАЦИИ ОРГАНИЧЕСКОГО СЫРЬЯ

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Аннотация. *Анализируются пути решения национальной проблемы увеличения производства биогаза за счет оптимального планирования сева, уборки и переработки биогазовых энергетических культур и других органических отходов. Предложена функциональная структура системы поддержки принятия решений, касающихся сбора и утилизации органических материалов для получения максимального объема биометана.*

Ключевые слова: биометан, система поддержки принятия решений, органических материалов, биогаз, энергетические культуры