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Using resource and energy-saving technologies in agricultural production as a direction of raising energy efficiency of rural territories

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The expediency of introducing resource and energy-saving technologies in rural territories, specializing in agricultural production, was substantiated in the article. A number of factors, which stipulate the choice of farming system, were given, taking into account economic, ecological, technological-energy, and social factors, which form the efficiency of farming. The peculiarities of different farming systems (intensive, organic, no-till, strip-till, precision, bio-enzyme, biogenic) were considered, which enabled to evaluate their energy and resource-efficiency in rural territories. The estimation of each farming system as to resource and energy-saving was conducted with the aim of their practical using, which will lead to the economy in spending resources and various kinds of energy, increase the productivity of farm machinery and used resources, decrease ecological loading on the environment, ensure energy efficiency of the rural territories and their long-term development.
Keywords: Rural territories; energy saving technologies; agricultural production; farming systems; energy efficiency

Introduction

The present of the rural territories is closely connected with the problems of the rational and efficient using of local natural and power resources; the development of the rural territories and their competitiveness depend on the solving of these problems. Thus, the development of agricultural production as a main specialization of the rural territories is especially topical together with using energy saving technologies, which enable to use rationally natural and power resources under constant climatic changes.

One of the important ecological problems of the XXI century is the global climate changing. At present the impact of this phenomenon is insufficiently understood and underestimated. Global warming, which is determined by meteorologists as raising the average annual temperature of air and the whole climatic system, began in the 70s of the last century, it is affecting now and in the near future will inevitably influence the arable farming on our planet.

Droughts are also the direct consequence of climate changing, they influence negatively crop yields in Ukraine, as the weather component of harvests in our country is more than 50 % (Hryhoriv, 2019). Moreover, it is necessary to mention, that during the previous decades the dangerous tendency of increasing drought recurrence is observed. The term “drought” is understood as the insufficiency or absence of precipitations during a long period of time at higher air temperatures and lowering air humidity as a result of which water reserves in the soil decrease. That is why the most important task facing agricultural producers is searching and introducing the technologies of rational and efficient using local natural and power resources in the rural territories.

It is necessary to mention, that the problems of resource- and energy-saving technologies in agricultural production have always worried scholars and manufactures that is why constant searching the ways and measures to adapt national technologies to modern economic conditions, taking into account ecological factors, was conducted. It is worth mentioning the papers of: M. Bezuhlyi (Bezuhlyi et al., 2016), S. Baliuk (Baliuk et al., 2018), S. Bulygin (Bulygin, 2003), M. Havryliuk (Bezuhlyi et al., 2016), V. Medvedev (Medvediev, 2016), S. Melnyk (Melnyk, 2018), M. Patyka (Petrychenko et al., 2011), V. Pashtetskyi (Pashtetskyi, 2013), V. Petrychenko (Petrychenko et al., 2011), Yu. Tarariko (Tarariko et al., 2015), and others. Practical results of different farming systems were considered by such national and foreign practitioners as: O. Brovarets (Brovarets, 2018), D.R. Gryft (Grift et al., 2018), L.A. Randy (Randy, 2016), D.J. Exert, J.F. Monkiryf (Grift et al., 2018), I. Pavliuk (Pavliuk, 2017), I. Samoilenko (Samoilenko, 2017), M. Timofeev (Timofeev, 2010), and others. However, the researches contain the study of the separate farming systems’ elements, and it does not enable to evaluate their resource- and energy efficiency with the aim of their practical introduction in the rural territories.

Materials and methods

The following scientific methods were the methodological basis of the research: historical-dialectical, analysis and synthesis, theoretical search and abstract-logical, mathematical and statistical analysis based on the research results conducted on farm lands of the private enterprise “Agro-ecology”.

Results and discussion

The aim of the article is investigating modern technologies of agricultural production from the positions of resource- and energy- saving as a modern direction of raising energy efficiency of the rural territories.

The efficient using of local natural and power resources in the rural territories is the most important, ecologically and socially expedient direction, but at the same time, the least used and the least understood means of raising both the level of profitability, life of everybody, and the life under environmental preservation. Thus, first of all, the necessity arises concerning the development of adaptive measures as to the negative impact of climatic changes; such measures have to be introduced organically in the technologies of agricultural production. Secondly, these are technological measures in accumulating, preserving, and rational using of local natural-power resources.

The following measures, which can be used to withstand climatic problems, belong to the first group: developing a new territory zoning; using drought resistant varieties and hybrids of crops, adapted to a considerably shorter vegetation period; introducing new (niche) drought-resistant crops; using anti-stress chemical, biological, and microbiological preparations, complex micro-fertilizers; applying fermented manure and composted fertilizers; using humates, minerals (bentonite, etc.); controlling phyto-sanitary conditions of sown areas under crops, and others.

For example, according to the data of the National Academy of Agrarian Sciences of Ukraine, the actual shifting of the country’s natural-climatic zone boundaries 100-150 km to the north has been taking place during the recent decades. The vegetation conditions in the traditional sub-zone of the Northern Steppe (Dnipropetrovsk, Kropyvnytskyi regions and others), correspond to the Southern Steppe sub-zone. The sub-zone of the Northern Steppe is gradually shifting to the territories of Cherkasy, Poltava, and other regions, which were traditionally in the zone of the Forest-Steppe (Melnyk, 2018; Tarariko, 2015).

Under such conditions, the currently existing zone set of crops is changing. Apart from the basic crops (winter wheat, corn, and sunflower) the so called niche crops (chick pea, safflower, sorghum, lentil, etc.), which are more drought- resistant and export attractive, take the first place. A number of exotic crops: kivi, date plum, banana tree, red date (Chinese date or unabi), peanuts, batatas, black pepper have begun to be grown in the Southern part of Ukraine, which is connected with warming. Olive trees are also naturalizing.

Secondly, under the raised climate dryness, moisture determines the level of yield capacity. That is why in connection with increasing the role of moisture, as a limiting factor in obtaining harvest, the stereotypes of evaluating the efficiency of arable farming systems and technologies of crop cultivation are changing. Studying and introducing in production the technological methods and systems of arable farming, which enable to receive the planned harvests at the level of the available moisture supply, are becoming topical.

Thus, the need in accumulating moisture in the soil during the autumn-winter and spring periods grows, which can considerably ensure the physiological requirements of crops during the vegetation period and also during the periods between rains, when droughts occur. First of all, it is necessary to mention, that atmospheric precipitations, reaching soil surface, are the most significant for its saturation (each millimeter of precipitations makes 10 t of water per 1 hectare).

So, the necessity to adapt the existing farming systems to the rational and efficient using of natural-power resources in the rural territories arises. There is also the possibility to transfer from one farming system to another one taking into account economic, ecological, technological-energy and social factors (Table 1).

Table 1. Factors, stipulating the choice of farming system.

Factors	Components
Economic	1. Increasing profit, gross product, and sales revenues.
	2. Raising the quality of farm products.
	3. Increasing natural and absolute measures of productivity: labor; basic assets.
	4. Introducing innovations.
	5. Economizing production resources.
	6.The image of agricultural producer.
Ecological	1. Improving the indices of soil components: humus, macro- and micro-elements.
	2. Lowering soil pollution with radio-nuclides, heavy metals, pesticides, and weeds.
	3. Changing the level of bacteria and microorganisms’ activity in the soil.
	4. Positive changing the balance of plant nutrition mineral elements (NPK) in the soil.
	5. Decreasing the level of the content of nitrates, pesticides, heavy metals and chemical compounds in food products.
	6. Lowering the level of farm animal and plant diseases’ incidences.
	7. Decreasing the negative impact on the condition of the natural environment.
	8. Rational nature- and energy management.

Technological-energy	1. The level of efficient using land resources.
	2. Raising productivity (according to the kinds of production).
	3. Decreasing soil tillage, fertilizers' application.
	4. Raising the content of organic substances in the soil.
	5. Increasing farm produce (according to the kinds of production).
	6. Decreasing production wastes.
	7. Repeated or many-time using of resources.
	8. Decreasing technological operations.
	9. Using local alternative energy sources (AES).
	10. Improving qualitative parameters of produce (according to the kinds of production).
	11.Natural and relative expenses indices (economizing) of all kinds of fuel.
Social	1. Raising the level of life of the local population: incomes, consumption of farm products.
	2. Raising the level of employment.
	3. Decreasing the level of diseases' incidences.

The source is adapted (Yasnolob et al., 2018).

Let us consider the main elements of intensive farming system in the context of rational using natural-power resources (Baliuk et al., 2018). The following elements can be mentioned here: the structure of sown areas, scientifically-grounded crop rotation, rational systems of soil tillage taking into account their impact on moisture conservation and rational using, the methods of caring after plants, fertilizing, fighting pests and diseases of plants, using modern farm machinery.

The structure of sown areas is determined by plan tasks of manufacturing farm products and, being organized properly, it is one of the important measures of fighting drought by more rational using of precipitations during the vegetation period. For example, winter and early spring crops use autumn-winter moisture reserve and also May and June precipitations more completely. Grain and leguminous crops, which ripen before this period, do not use the precipitation of the following two months at all. Row crops take up summer precipitations better. Taking into account all the above mentioned, it is possible to choose crops in rotation more expediently.

Under the conditions of introducing resource- and energy-saving technologies, the research of organic farming system becomes more topical (Antonets, 2000; Pysarenko et al., 2017); the agro-technical measures of this system are favorable for accumulating, storing and rational using of soil moisture.

One of the technological elements of organic farming, assisting in improving water regime, is soil protecting, moisture preserving, shallow soil tillage 4-5 cm deep, owing to which the vertical orientation of aeration interstices is formed and soil natural structure as well as soil capillarity, formed by decomposed roots and rain worms, are preserved. Compaction horizon (plough landside) is absent at such tillage, the balance of small and large interstices, storing air and moisture, and thus, creating conditions for atmospheric irrigation, is established. The idea of "dry farming" with maximal using the "effect of subsoil dew", suggested by I. Ovsinskyi more than one hundred years ago, is practically implemented (Ovsinskyi, 2004). Such tillage also positively affects the formation of mycorrhiza (Yasnolob et al., 2018), favoring in plant growth under arid conditions.

Following scientifically-grounded crop rotations, using perennial legume grasses, green manure crops, applying fermented manure, using after-harvesting residues, unmarketable part of harvest are also favorable for moisture accumulation. Owing to the above mentioned measures, the organic mass in the soil increases and it makes the soil looser and also raises its ability to retain moisture. Mulching field surface with plant residues is also favorable for lowering soil temperature and moisture evaporation. Thus, at organic farming, soil moisture content during different plant vegetation periods is on the average 28-32% more, than that, where intensive farming is practiced.

Besides, using organic farming technologies is positively reflected on the indices of structural-aggregate soil condition. For example, the coefficient of soil structuring in the layer of 0-10 cm was 9.9 at organic farming system, which is twice higher as compared with the control variant (intensive system) - 4.62. Its value decreases with the depth, it is especially true for the soil depth of 30-50 cm.

Using organic farming system also favors the growth of structural aggregates' water stability. So, the coefficient of structural aggregates' water stability at organic farming is 10, while it is 5.2 at intensive farming.

At durable using organic technologies, the tendency of changing the parameters of water stable soil element - humus - was also detected. For example, the content of humus in soil layer of 10-20 cm was 5.26% at organic farming, while it was 4.70% at intensive farming. The difference reached 1.57% in separate fields at the expense of organic residues' humification. The particular noticeable of soil formation was observed on eroded lands, the yield capacity on which reached that of flat fields after a definite period of introducing organic farming system.

The system is supplemented by a complex of farm machines and mechanisms for overall and inter-row soil tillage.

It is logical, that raising soil fertility positively affects crop productivity. Nevertheless, if, because of insufficient moisture content, there cannot be high harvests at this level of fertility, the using of intensive methods will not raise them. But, when the grown produce is certified as organic, it is possible to get 30-50% and more revenues from its selling.

Thus, wide introduction of organic farming is the optimal reaction of agro-industrial complex on the global warming, because the technologies of this system enable to accumulate and use moisture more effectively at the expense of crop rotations,

shallow soil tillage, application of organic fertilizers, green manure crops' growing, and also using modern machines and mechanisms for soil tillage.
In connection with increasing climate aridity and especially in semi-desert zones and the zones of risky farming, "no-till" system, that is soil zero-tillage is becoming more topical (Grift et al., 2018; Australian Field Lessons, 2017). At this system, the surface layer of soil is not loosened, direct sowing of crops is used, and soil surface is covered with a layer of crushed plants (mulch). These measures are favorable for moisture preservation and prevent water and air erosion.
Applying fertilizers is conducted while sowing in furrows, cut by the sowing machine. Weed control is based on using herbicides in the period, proceeding the sowing or after it.
The main principle of "no-till" is using natural processes, which take place in the soil. It has been established, that unplowed field is permeated with billions of capillaries 1-2 m deep, which are formed after the decomposition of plant root system and as a result of life activity of different organisms, first of all, rain worms, the number of which in this system is considerably growing. Moisture saturates land through these thin but deep passages. In winter water freezes there and makes the canals wider. In such a way natural loosening and saturating soil with water and also maintaining the soil in natural condition takes place. That is why using "zero" farming technology improves the physical condition of soil after a definite period of time.
One of the basic scientific provisions at zero-tillage is obligatory leaving all plant residues on the surface and their uniform distributing in the field. Mulch considerably decreases moisture evaporation (by 80%), and also assists in moisture condensation in dew (atmospheric condensation) at contacting the atmospheric air with a colder soil surface.
Mulch also retains weed growth, favors activating soil micro-flora, and it is the base for reproducing soil fertility. The effect of suppressing weed seeds' germination begins to be manifested when the amount of post-harvesting residues is 3 t/ha, and this effect increases to 12% at having additionally every 100 kg of residues.
In order to improve soil water regime, lower the development of pests, diseases, and weeds, raise the fertility and natural loosening of soil with plant roots, crop rotation is important. Yearly rotation of grain and broad-leaved crops upsets the life cycle of pests and diseases, and also considerably decreases the problem with weeds, which were not eliminated by herbicides the previous year.
It is recommended to include cover- and green manure crops in rotation to shorten the period of the absence of vegetating plants in the fields and accumulate the layer of plant residues, replenish the soil with post-harvesting substances and decrease field weed infestation, improve moisture supply of the following crops with the help drainage system, formed by the root system of green manure crops. Cabbage crops (white mustard, oil-bearing radish, etc.) are among the best post-harvesting green manure crops. They are useful phyto-sanitation and phyto-reclamation plants. They are especially necessary in crop rotations of cereal crops, ensuring grain succession.
Scientists from the USA (Randy, 2016; Ovsinskyi, 2004) mention, that using this technology it is possible to decrease the amount of used herbicides by crop bio-diversity in rotation, and also by using mulch, sowing cover-crops, and by the effect of synergy and mycorrhiza. These measures lead to raising soil fertility at the expense of microbiological activity; the content of organic substances increases and the stability of soil aggregates raises, which favors the optimization of phyto-sanitary condition of the sown areas.
Thus, using "zero" technology ensures the increasing of organic substance amount; this technology also improves soil water regime, decreases erosion processes, which positively influences the yield and profit owing to effective using moisture and improving plant growth.
The usefulness, which arable farming gets from introducing "no-till" system, will depend on the type of soil, climate, crop, plant growing technologies, and management. Using "no-till" system raises the profitability of farms. So, at comparing "zero" technology with the traditional tillage, it was revealed, that corn, oil-bearing crops and sorghum brought more profits, when "no-till" system was used at their cultivation, than grown in the traditional system.
At present the system of strip-till farming (Pavliuk, 2017; Samoilenko, 2018) attracts agrarians' attention; one of the main tasks of this system is moisture conservation. This technology is simple and clear: only the sown zone is tilled using Pluribus cultivator attached to John Deer caterpillar tractor, while soil between the rows is not touched. The maximal tilling depth is 15 cm. Soil tilling and sowing are conducted simultaneously, so that the prepared strip does not get dry.
Rolling duck-feet wheels on the sowing machine press the furrow to half of its depth, and cover it like a fan with loose soil, which creates a mulch layer, retaining moisture. All the aggregates pass on one technological wheel-track without compacting the soil over the whole area.
Two factors compel producers to go over to the new farming system: the climate and economics. It is also profitable concerning the using of diesel fuel consumption (10-12 l/ha), while at the traditional system 60-80 l/ha are used; it is also expedient agronomically, because moisture preservation is the most important problem.
The system of precision farming (Brovarets, 2018; Samoilenko, 2018) enables to compensate the impact of climate changes, if to consider the field as a separate unit. Precision farming is based on automation processes and introducing innovations, which enable to manage natural resources, control their using, and evaluate the quality of different production processes.
Mapping and zoning of soil properties in the fields are the basis of precision farming. As a result of it differentiated applying fertilizers, changing seed sowing rates, differentiated nitrogen applying for plant residues' mineralization, distance data recording, etc. are conducted.
Moreover, new farm machinery, equipped with the systems of high precision positioning, automatic control, geographic mapping, monitors, sensors, and integrated electronic communications, is used.
In order to introduce the technology of precision farming it is necessary to collect the data about the level of variable soil characteristics in the field, yield and micro-climate, determine the limiting factors in obtaining the harvest by studying the soil

and peculiarities of the fields on the farm (soil structure, agro-chemical properties, soil type, field pattern, water distribution, etc.) Based on the obtained data, the rates of resource application (fertilizers, seeds, etc.) are regulated, as well as maps are made, that is the tasks of taking into account the cost of resources and harvest and also the field potential and yield efficiency are solved.

This system of arable farming is effective only if each of its points is used, and the system functions as a whole organism. In such case it enables to receive the maximal yield at minimal expenses.

Bio-enzyme technology can also be distinguished among modern alternative farming systems (Samoilenko, 2017). This technology is unique, as it makes fertile even sands in deserts. The authors of this technology directed their efforts at launching and supporting the intensive natural process of biocenosis without excessive saturating soils with tons of mineral fertilizers.

Bentonite, which is a good sorbent and nutrient for autotrophic bacteria, is the basis for starting biocenosis in unfertile soils. It is also a good hydrant (1 g of bentonite absorbs 12 g of water). Accumulating water it swells, 16 times increasing its own weight, and thus, enriching soil with water. In order to ensure heterotrophs with nutrients, it is necessary to add organic fertilizers.

Applying the substrate in desert experiments showed the improvement of soil chemical structure as to all the indices. The applied bentonite accumulates moisture, which comes during the year, and this enables to withstand droughts. Bentonite is applied once in 7-10 years.

So, bio-enzyme technology creates the optimal nutrient and water regimes even in the extreme conditions of cultivating crops, and enables to receive ecologically safe products.

Lately, more and more materials devoted to biogenic farming have been appearing (Timofeev, 2010; Timofeev et al., 2017). New power, organic and biogenic resources are its basis; the organizational-technological and macro-structural changes of these resources can considerably improve moisture supply and soil productivity.

Moreover, mulch layer is formed from crushed shrubbery stems on the lands of intensive using. This ensures eliminating wind and water erosion, forms positive soil water balance. The calculated 10 t/ha of mulch layer biomass, as additional mulch, are applied. Bio-fertilizers are used for decomposing such amount of organic substances.

Locally-vertical type of soil tillage is the second element of the system. Each year in spring 36 vertical drains, having the diameter of 3 cm and depth 40 cm are pressed with a special mechanism on the area of 1 m^2 to absorb rainstorm water in summer and water from intensive snow melting quickly. This also helps to accumulate moisture and eliminate erosion processes.

Planted shrubbery belts across slopes and close planting of shrubbery are also the elements of the system, which are used on low-productive lands having ecological-agro-chemical index less than 30 and the slope - more than 3-5 degrees.

Thus, the development of biogenic system of farming can be directed at maximal using water resources by agro-biocenoses in the conditions of large ravine areas and low-productive lands owing to mulch layer, locally-vertical soil tillage, and shrubbery belts.

Thus, taking into account the presented studies and factors, stipulating the selection of farming system (see Table 1), it is possible to determine resource- and energy-saving of each farming system (table 2), which enables not only to raise the energy efficiency of rural territories, but also their competitiveness.

Table 2. The evaluation of resource- and energy-saving of farming systems.

Factors	Farming systems						
	Intensive	**Organic**	**No-Till**	**Strip-Till**	**Precision**	**Bio-Enzyme**	**Biogenic**
Economic							
1. Income	?	↑	↑	↑	↑	↑	↑
2. Quality	0	↑	0	0	0	↑	↑
3. Productivity	?	↑	↑	↑	↑	↑	↑
4. Innovations	0	↑	↑	↑	↑	↑	↑
5. Economy	↓	↑	↑	↑	↑	↑	↑
6. Image	0	↑	0	0	↑	↑	↑
Ecological							
1. Soil structure	↓	↑	↑	↑	↑	↑	↑
2. Soil pollution	↓	↑	?	?	?	↑	↑
3. Bacteria	↓	↑	↑	↑	↑	↑	↑
4. NPK	↓	↑	↑	↑	↑	↑	↑
5. Produce contamination	↑	↓	?	?	?	↓	↓
6. Diseases	↑	↓	↓	↓	↓	↓	↓
7. Nature	↓	↑	↑	↑	↑	↑	↑
8. Rationality	↓	↓	↑	↑	↑	↑	↑
Technological-energy							

1. Land management	↑	↓	↓	↓	↓	↓	↓
2. Productivity	↓	↑	↑	↑	↑	↑	↑
3. Soil tillage, fertilizers	↑	↓	↓	↓	↓	↓	↓
4. Soil organic substances	↓	↑	↑	↑	↑	↑	↑
5. Production	?	↑	↑	↑	↑	↑	↑
6. Wastes	↑	↓	↓	↓	↓	↓	↓
7. Resource using	↑	↓	↓	↓	↓	↓	↓
8. Technological operations	↑	↓	↓	↓	↓	↓	↓
9. Alternative sources of energy	0	↑	?	?	?	↑	↑
10. Produce quality	↓	↑	0	0	0	↑	↑
11. Fuel	↑	↓	↓	↓	↓	↓	↓
Social							
1. Population	↓	↑	0	0	0	0	0
2. Employment	↓	↑	0	0	0	↑	↑
3. Diseases	↑	↓	↓	↓	↓	↓	↓

Notes: ↑ - increasing (growing), ↓ - decreasing, 0 - has no influence, ? - the final impact is questionable.
The source: The author's development.

Thus, in our opinion, considering the economic factors, such farming systems as organic, bio-enzyme, and biogenic are the most optimal ones because they are profitable provided that the products' quality is preserved, and such systems are investment oriented. The intensive farming system is the most inefficient, as its profitability considerably depends on natural-climatic conditions. Concerning other farming systems, it is expedient to mention their average economic efficiency level, because the economizing under these systems occurs concerning certain indices (technological operations, fuel-lubrication materials, etc.) Moreover, they do not affect the quality of products and their image.

The similar rating of farming systems also concerns ecological factors, because at organic, bio-enzyme, and biogenic systems no or almost no chemical fertilizers and means of plant protection are used, while they are used in other systems. The only thing should be mentioned, that their application at no-till, strip-till, and precision farming systems is held according to the standards and taking into account the previous studies (mapping, zoning, investigating soil properties of fields, etc.) with using modern machinery and technologies.

The evaluation of technological-energy factors has shown, that the intensive farming system has been remaining the most expensive and unproductive system. At the same time, other systems are almost equal, except using alternative energy sources (it depends more on the producer, but not the system) and the quality of final products (because chemical means are used even by following the standards).

Concerning social factors organic farming is leading, as by its essence it presupposes social effect and it is possible to be used on farmsteads. While bio-enzyme and biogenic systems do not sufficiently influence the population living standards, nevertheless the revival on unproductive lands enables to increase the population employment and decreases the level of disease incidences, because chemical means and fertilizers are almost not used. At no-till, strip-till, and precision farming systems the minimizing of operational processes takes place, so the number of employees decreases.

Thus, judging by the conducted estimation, the conclusion can be made that having fertile soils in this country the organic farming system is the most resource- and energy- saving, because the system takes into account natural processes and does not harm the environment, but on the contrary, it favors its restoration. Besides, organic products cost 30-50% more, than traditional products, under constantly increasing demand on the world food markets. Unfortunately, the development of research and introductions of its results in organic farming both in our country and abroad are sufficiently behind the production requirements. It is the lack of knowledge that explains producers' indecisiveness to start introducing the organic farming system on their farms, though this system has been introduced and has successfully been functioning on the world known farm "Agro-ecology" in Poltava region. But, unfortunately, one has to agree with the words of the famous French microbiologist Luis Pasteur that "the established truth, even the brightest one, is not always easily recognized".

Conclusion

Summing up our research, it should be mentioned that the development of the rural territories is impossible without using modern resource- and energy- efficient technologies in agricultural production. It is expedient to introduce progressive soil protective, ecologically safe and efficient directions in arable farming development taking into account economic, ecological, technological-energy, and social factors. Under such conditions the following measures are urgent: the using of energy saving means of soil tillage, which enables to increase the productivity of farm machinery and used resources; decreasing the expenses and ecological loading on the environment; adapting the agrarian production to new climatic conditions; constant using of modern energy- and resource-saving technologies of crop cultivation, shortening the terms of spring field work, and, generally, following the regulations of conducting all technological operations. These measures favor the sustainable development of agricultural production, and, hence of the rural territories, as they are based on the principles of the "golden rule" of ecology, which has to be constantly introduced in life at the level of the farm. This rule is: the global ecological problems are solved locally. All the above presented facts and suggestions are promising for further research with the aim of their practical using.

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