TRANSFORMATION MANAGEMENT OF ECONOMIC AT RURAL AREAS

Collective monograph

edited by

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The results of investigating the transformation management of economic in the context of developing rural areas have been presented in the collective monograph, based on the positions of inter-subject approach. The peculiarities of financing and state supporting of agriculture under the conditions of modern market economy have been considered. Management, ecological, economic, and social paradigms of developing rural areas have been elucidated. Considerable attention has been paid to the questions of logistic management of agricultural production. The prerequisites for stable management, ecological, social, and economic development of rural areas have been defined. The question of transforming management of economic in the context of providing stable development of rural areas has been investigated.

The collective monograph is a part of research theme “To work out scientific directions of organizational, management, economic, financial and social development, and regulation in agro-industrial complex, on the branch level and in the organization-legal forms of market economy” (the number of state registration 0111U002780)

The monograph is aimed for scientists, teachers, executives and specialists of state administration bodies, specialists of agro-formations, post-graduate students, and everybody interested in the questions of developing agro-industrial complex on the basis of rational nature usage.

The authors express their own opinion which does not always coincide with the position of the editorial board. The authors bear the responsibility for the content of the materials.

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Chapter 1

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DIFFUSION OF MANAGEMENT OF KNOWLEDGE AND INFORMATION TRANSFER IN RURAL AREAS

Abstract: In the modern economy, we can observe a need for an increasingly comprehensive view and consideration of management in agribusiness. Factors connected with management in the sphere of agribusiness caused farmers-entrepreneurs to take into account issues resulting from the process of management a greater extent than before. In an agricultural holding, like in every enterprise, in order to become competitive and survive on the market it is necessary to adjust production to current needs, invest in the development (resulting in the development of rural areas), improve the quality of products and modernise the farm. An entrepreneur-farmer has to predict and effectively meet consumers' needs. The aim of the paper is to show how to take rational decisions in the area of management of an agricultural holding using knowledge, resources and motivation. However, management of an agricultural enterprise, i.e. an agricultural holding, is specific, as decisions that are taken often refer not only to production and investment, but also to creation of activities that resort to solutions in the area of management.

Key words: management, knowledge and information transfer, rural areas, infrastructure

Chapter 2

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MANAGEMENT OF ENOTOURISM AS AN OPPORTUNITY FOR MODERN FARMS

Abstrakt: Wine tourism is one of the directions of tourism development. The attractiveness of this segment of market has caused that many people consider wine-growing and production of wine as a potential source of income. Lately, in Poland, vineyards have also been built, and with it, production of wine has been started. The operations of the vineyard owners may support promotion of region and its assets. The aim of the present article is to present the meaning of wine tourism in agribusiness. Management of wine tourism is an opportunity for farms and inhabitants of rural areas. Particular attention was paid to the development of wine tourism in Poland. Logistics operations in wine tourism were described on an example of one company.

Keywords: wine tourism, enotourism, management in tourism

Chapter 3

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PROBLEM QUESTIONS OF MANAGEMENT OF FINANCIAL EXPENSES AND PERSONNEL COSTS AT AGRICULTURAL ENTERPRISE

Abstract: The contents of developing phases and implementing production the efficient system of production costs management depending on directions were considered in the article. The level of nominal and real manufacturing income of population in Poltava oblast' and in Ukraine was estimated. The structural orientation of costs of agricultural products was defined. The peculiarities of financial expense and personnel costs of agricultural enterprise were generalized.

Key words: management, expenses, financial expenses, personnel costs, agricultural enterprise, management of financial expenses.

Chapter 4

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DEVELOPMENT OF RESIDENTIAL AREAS IN HARMONY WITH NATURE

Abstract: The article presents the basic principles of organic (natural) farming in "Agroecology" are: soil preserving technologies, that is, seed bed is processed to depth of 5 cm for all the crops while surface is mulched with harvest residues; soil fertility is restored with the aid of organic fertilizers (manure - at least 24-26 t/ha, non-tradable crop residues and green manure crops); synthetic fertilizers are not applied (nitrogen is supplied through entering legumes into crop rotation (more than 20% saturation); agro-technical measures to protect crops from weeds and stubble crops (cruciferous green manure sown after harvesting, which has allelopathic effect on weeds); crop protection from pests and diseases with the aid of agricultural practices, prevention and biological methods; correction of land use patterns and optimal crop structure modelling. The proposed work based on the example of private enterprise "Agroecology" is used for environmental education in rural schools in Poltava region, as well as in higher education establishment, including Poltava State Agrarian Academy, specialized education centers and non-formal education institutions. The program of residential areas develepment should always take into account human activities and its problems, natural feature and value of the environment (be in harmony with nature), cultural and historical heritage of rural areas.

Key words: agroecosystems, organic farming, crop rotation, biological activity, soil microorganisms, environmental education

Chapter 5

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Chapter 4

DEVELOPMENT OF RESIDENTIAL AREAS IN HARMONY WITH NATURE

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Biosphere is a part of the Earth crust, atmosphere and hydrosphere with its composition, structure and energy determined by past and present activities of living organisms as defined by our compatriot Academician Volodymyr Vernadsky. Biosphere makes up to 0.4% of the planet volume. The problem of increasing biological productivity of biosphere is solved by conservation and improvement of natural biocenoses and agricultural biocenoses [Kots, Morgun, Patyka, Petrichenko, Nadkernichnaya, Kirichenko 2011; Patyka M.V., Patyka V.P. 2014, pp. 5-10; Kalinichenko A., Kopishynska, Kopishynskyy, Kalinichenko 2015, pp. 73-78; Modzelewska, Kalinichenko 2015, pp. 264-271]. Biosphere serves not only as a source of natural resources for the human, but also as a receiver of the waste resulted from production and vital activities; it is much more complex system, it is the foundation of life in which biota itself provides environmental stability. The biosphere has its economic capacity limited, with the excess of the limits disrupting stability of both biota and the environment. Within the limits of biosphere economic capacity ecosystem is capable of quick restoring all kind of imbalances in the environment keeping its state stable in this way. Going beyond the limits leads to failure of biota to establish balance, as well as to disorder of biological cycle of substance, degradation of ecosystems and pollution [Gadzalo, Patyka, Zarishnyak 2015; Hvozdiak, Pasichnyk, Yakovleva, Moroz, Lytvynchuk, Zhytkevych. et al. 2011].

Plant component of an agrobiocenose is formed and ruled by human. For example, agrobiocenose's instability due to the occurrence of adverse weather conditions (such as drought, excessive humidity, overcooling etc.) can be compensated through appropriate farming practices. Temporary stability of agrobiocenose can be supported by human [Kots, Morgun, Patyka, Petrichenko, Nadkernichnaya, Kirichenko 2011; Gadzalo, Patyka, Zarishnyak 2015; Report of the Conference of the Parties on its eleventth session, held in Winthoek, 16-27.09.2013].

At the heart of the biosphere system there is a diversity of its components. This diversity provides stability of the whole system, ensuring survival of its certain part under any local, whole-planet and cosmic processes (solar flares, cosmic showers of ultrahigh energy particles, etc.). However, to preserve the diversity we cannot allow one species (population, clone, etc.) to develop large enough to begin displacing (eating, shading, trampling, poisoning) all other species.

It does not matter to the biosphere system – what species, populations, or individuals comprise it. It is only necessary that they existed in sufficient quantity, diversity and certain balance frames.

At the turn of the 20th and the 21st centuries, humankind did not always act in a positive manner towards the nature. And this very circumstance largely caused aggravation of the world's many political, economic and environmental, ethnic, inter-regional, inter-faith relations problems – these facts were confirmed at the UN conference in Rio de Janeiro (1992) and the Earth Summit in Johannesburg (2002). The debates at the Earth Summit showed joint efforts of all countries in the fields of economics, politics, technology, science, culture and education being capable of preserving environment at some ecologically reasonable level given that collective mind and organized work of the united nations focus on implementation of this idea.

For a long period of rapid industrial development humanity has been ignored natural processes established in biological communities that resulted in danger of disorder in environmental systems productivity. Particularly noteworthy are adverse changes taking place in intensive agriculture [Kots, Morgun, Patyka, Petrychenko, Nadkernychnaya, Kyrychenko 2011]. It is estimated that currently our planet is inhabited by about 30,000 weed species, 10,000 species of harmful insects and other arthropods, 3000 species of nematodes, 120,000 species of fungi, 100 species of pathogenic bacteria and 600 species of pathogenic viruses [Hvozdiak., Pasichnyk, Yakovleva, Moroz, Lytvynchuk, Zhytkevych et al. 2011; Popov, Dorozhkina, Kalinin 2003]. In many countries, synthetic pesticides play a key role in plant protection due to their efficiency against target objects [Trybel, Stryhun 2013, pp. 324-336]. However, their widespread and often uncontrolled use leads to accumulation of pesticides and their metabolites in biocenoses and, consequently, to disturbance of nutrition chains, suppression of natural regulators of the harmful agents number and pollution [Patyka, Makarenko, Mokliachuk, Sereda, Shkatula, Hrynyk 2004]. Agricultural products that contain pesticide residues lose their value and becomes potentially dangerous for human health [Łozowicka, Hrynko, Kaczyński, Rutkowska, Jankowska, Mojsak 2015, pp. 142-150]. Furthermore, the widespread usage of pesticides causes harmful agents' population resistance leading to necessity of increasing doses and frequency of pesticide treatment, which, in its turn, multiplies negative effects [Łozowicka, Hrynko, Kaczyński, Rutkowska, Jankowska, Mojsak 2015, pp. 142-150; Łozowicka, Konecki 2011, p. 107-119; Matyjaszczyk 2011, pp. 217-224.]

Organic (natural) agriculture can prevent the destruction. Most people understand organic farming as an agricultural practice free of synthetic fertilizers and plant protection agents [Antonets S.S., Antonets A.S., Pysarenko V.M., Opara, Pysarenko P.V. 2010; Verhunov, Davydenko, Tovmachenko 2014]. Organic (natural) system is the most advanced way of agriculture. Its core is a desire to create a "living and healthy soil" through support and enhancing life activity of soil microorganisms with well-adjusted circulation and nutrient cycles. In fact, this well-balanced agricultural system resembles natural ecosystem. Organic farming is a system of agro-ecosystems management based on maximal use of biological factors for increasing soil fertility, farming practices for protecting plants, as well as on a range of other practices that provide production of agricultural products and raw materials in a reasonable from the environmental, social and costs point of view way [Antonets S.S., Antonets A.S., Pysarenko V.M., Opara, Pysarenko P.V. 2010; Verhunov, Davydenko, Tovmachenko 2014].

In organic (natural) farming, it is recommended to apply classic rules for crops rotation sequence based on proper organization of the territory and optimal structure of areas for specific soil and climatic conditions of each farm. A special requirement is 25-30% saturation of rotation with nitrogen-fixing leguminous crops, which provide plants with environmentally safe biological nitrogen for 50% and even more of their need. Application of organic fertilizers (manure, liquid manure, green manure, straw, peat, sapropel, bird droppings, etc.) as well as some mineral slow-acting fertilizer (basic slag, potassium-magnesium, basalt dust) leads to fertilizing not plants but soil "to bear healthy plants".

Being a major component of agro-ecosystems, microorganisms are characterized by a wide range of diversity and occurrence in nature. All they have a wide range of functions caused by complex relationships and food webs. Interaction between microorganisms and plants in nature serves a variety of functions, which form stable microbial complexes in agro-ecosystems. Thanks to their close cooperation (e.g. endophytes) microorganisms are often used as alternative fertilizers, herbicides and pesticides [Gadzalo, Patyka, Zarishnyak 2015].

Private enterprise "Agroecology", which located in the central part of Poltava region on the left bank of Psiol River at Mykhaylyk village (Shyshaky district) and headed by Hero of Ukraine Semen Antonets, meets all the above requirements, having long-term experience. Soil there is typical deep low humus medium loam chernozem on loess. Waste soil tracts lie on solid moderately drained watershed plateau. High content of silt (24%), humus (5%) as well as saturation with calcium and magnesium alkali provides relatively high ability to form valuable from an agronomical prospective cloddy-granular structure, enabling the formation of favourable water-physical properties [Antonets S.S., Antonets A.S., Pysarenko V.M., Opara, Pysarenko P.V. 2010].

Soil protecting agriculture was established at the farm in 1976 followed by soil protecting biological agriculture in 1979, and soil preserving organic agriculture in 1990. Since 1979, the farm produces environmentally safe products for children, therapeutic and preventive nutrition. This is the experience of state and global scale. Delegations from different regions and countries come there to learn this experience.

Yield of grain crops rose by 97% at the farm, in particular of early grain - by 110-116%. Sugar beet yield increased by 64% and sunflower by 74% (Table 1).

Crops rotation, tillage systems, fertilization, crop protection from weeds, pests and diseases, machinery, tending crops systems – all were developed and adjusted at the farm. The best varieties were selected. There is own seed production too. Crops of no lower than second reproduction are growing there. Tillage system switched to minimal soil treatment in 1990. This allowed reducing threefold fuel consumption, costs of tillage, and enabled appropriate timing of technological operations in growing crops [Antonets S.S., Antonets A.S Pysarenko V.M., Opara, Pysarenko P.V. 2010].

In the farm's crop rotation, corn for silage (as a predecessor of winter wheat) was replaced with sainfoin. This was preceded by thorough scientific research. Corn for silage is extremely inconvenient crop in biological agriculture, especially in cold springs. If heat is not sufficient, corn "sits" in the ground, does not grow and weeds overgrow it. Herbicides have not been applied in the farm since 1979 [Antonets S.S., Antonets A.S., Pysarenko V.M., Opara, Pysarenko P.V. 2010]. Therefore, in cold spring they had to mow corn along with weeds and use as green fodder, and then to sow buckwheat. Replacing silage corn with sainfoin allowed obtaining green mass yield of 250-350 kg/ha; it gives good silage, 1 kg of which contains 180 g of protein (to compare - 80 g/kg in corn, animals' need in it -120 g/kg. In addition, sainfoin enriches soil with biological nitrogen.

The farm follows the optimal timing of sowing wheat. These terms provide the best wintering and the least damage from opomyzid, wheat and bread flies. Sugar beets are usually sown early, right after early spring crops. Early sowing, good and even crops against no-plough soil treatment allow diminishing losses from pests, such as beet weevils and beet leaf miner that come out of the soil according to the temperature gradient. The technologies stipulate about 18 preventive measures to avoid the harm imposed by weeds, diseases and pests without using any pesticides in organic farming.

Table 1. Effect of organic farming implementation on increasing crop yield in PE "Agroecology" (metric centner/ha)

Years	Total grains	Winter wheat	Spring barley	Oat	Sunflower	Sugar beet
Yield for 1971-1975 (before implementation)	26.1	29.2	25.2	27.1	16.1	255.0
Average yield for 1986-1990	48.9	63.2	53.3	37.0	28.6	292.0
1991-1995	46.1	57.3	51.2	33.3	21.3	393.2
1996-2000	41.7	43.3	38.2	36.5	24.4	399.6
2001-2005	38.8	48.3	33.8	36.6	16.8	295.0
2006-2010	48.9	56.8	42.5	47.0	23.0	487.7
2011-2014	Stable development maintained					

Source: [Antonets S.S., Antonets A.S., Pysarenko V.M., Opara, Pysarenko P.V. 2010].

Implementation of soil biological farming systems has a significant impact on the livestock industry.

Organic farming system started from first steps towards subsurface tillage, which is a separate trend in agriculture now. Its production's philosophy is to care for the constant reproduction of soil fertility. Fertile land itself is a unique living and constantly self-improving body. There is more than 2 kg of bacteria, streptomycetes and fungi, 100 g of ciliates and other protozoa, up to 50 g of nematodes, mites, springtails, up to 100 g of molluscs, woodlice, spiders, millipedes and other insects, up to 500 g vertebrates in the layer depth of 30 cm of 1 m^2 area. This whole biological mass sustains because it eats out up to 10 kg of organic matter for the season.

This unique plurality of plants, animals and microorganisms, and especially their biodiversity that thrive in the conditions created for them - this is the vivifying soil, which best properties are preserved and multiplied in fields of “Agroecology”. Life organization of biodiversity, especially microbial life, is based not primarily on the genome, species or ecosystems, but on use of terrestrial resources diversity according to the principle of labour division, which follows from the history of the life evolution on earth.

What is special about development of “Agroecology”? It exploits natural factor. That is, helps nature in every way to ensure everything taken from the ground being returned back into it. How can it be done? First of all with the aid of crop rotations. The second, seeds should not bring pathogenic microorganisms into fields. And let us say again, “Agroecology” is the only farm saturating crop rotation with 20% legumes, while the average figure in Ukraine is 6%. It provides plants with natural available biological nitrogen fixed from the air by microorganisms (bacteria). Plants give nutrients to microorganisms and microorganisms fix nitrogen. There is about 8 tons of nitrogen in air over every square meter of earth's surface. However, nobody can use it, except these microorganisms. Air always circulates in soil and nodule bacteria living on the roots of legumes, associative and free-living, reduce this nitrogen to available for plants ammonia nitrogen. This nitrogen is not harmful for environment, it decomposes slowly, not instantly as fertilizers do. When applying fertilizers, only 20-21% of their amount is uptaken by plants, and the rest just get into water bodies and foods. Contrary, biological nitrogen remains in soil [Patyka., Hnatiuk, Buletsa, Kyrylenko 2015, pp. 12-20].

For the ability of leguminous plants to enter into symbiosis with specific for a particular species or group of species nodule bacteria they may live in different soil and climatic conditions of Ukraine being able to fix up to 125-380 kg/ha of atmospheric nitrogen per growing season (Table 2) [Verhunov, Davydenko, Tovmachenko 2014; Patyka, Hnatiuk, Buletsa, Kyrylenko 2015, pp. 12-20; Kots, Patyka, Morhun 2009, pp. 344-386; Patyka, Tykhonovych, Filipiev, Hamaiunova, Andrusenko 1993; Patyka, Kots, Volkohon, Sherstoboieva, Melnychuk, Kalinichenko, et al. 2003]. Thanks to symbiotic nitrogen fixation, legumes form a high yield of low-cost vegetable protein without application of expensive, energy-intensive and environmentally hazardous mineral nitrogen fertilizers. After harvesting, more than 30% of biologically fixed nitrogen remains in stubble and root residues and then used by the next crop [Tihonovich, Provorov 2009].

Inoculation of seeds with efficient strains of nodule bacteria obtained through breeding process allows realising up to 15-50% of symbiotic nitrogen-fixing capacity, and the remaining reserve can be used by the means of optimization conditions for the symbiosis functioning.

Table 2. Symbiotic nitrogen fixation and biological nitrogen income in Ukraine

Crops	Nitrogen fixation (kg of nitrogen/ha/year)	Nitrogen remained in soil (kg/ha)	Equivalent nitrogen fertilizer dose (kg/ha)
Legumes (pea, soya, vetch etc.)	50-90	10-20	25-35
Perennial legumes (alfalfa, clover, sainfoin, sweet clover etc.)	90-380	60-120	120-250

Source: [Patyka, Hnatiuk, Buletsa, Kyrylenko 2015, pp. 12-20].

Ukrainian microbiologists and producers of microbiological agents possess a complete set of production and reserve strains of nodule bacteria. Their efficiency in different legumes is shown in Table 3.

Table 3. Effect of nitrogenization on yield and nitrogen fixation in legumes (data of geographic net of experiments)

Crops	Average increase in yield (% to control)	Additional accumulation of protein (kg/ha)	Increase in nitrogen fixation (kg/ha)	Increase in nitrogen fixation (%)
Pea	10.5	102	15–20	30–35
Vetch	12.4	120	20–25	30–35
Soya	18.0	225	35–60	40–60
Lupine	16.6	170	35–55	35–50
Clover	12.0	240	50–70	30–40
Sainfoin	15.5	260	60–80	40–60
Alfalfa	16.8	460	90–120	50–70
Galega	27.8	620	110–150	50–80

Source: [Patyka, Hnatiuk, Buletsa, Kyrylenko 2015, pp. 12-20].

Today, “Agroecology” possesses a whole complex of tests to determine physiological nitrogen optimum for growing crops. One of them is calculation of nitrogen and phosphate fertilizers doses necessary to obtain planned harvest for a particular field taking into account indicators of soil fertility and biological nitrogen fixation capacity.

Approximate calculations of fertilizer doses taking into account symbiotrophics of soya are shown below. The calculations should take into account indicators of biological nitrogen fixation, as well as nitrogen, phosphorus and other elements utilization indexes. For example, the farm is planning to obtain yield of soya grain of 2.5 ton/ha (Table 4).

To form one ton of seeds soya uses 85 kg of nitrogen. Soil is loamy chernozem with pH of 6.8-7.0, easily hydrolysed nitrogen content in soil of 6.2 mg/100 g. Arable soil layer contains 186 kg/ha of nitrogen. Index of utilization nitrogen from the soil is 60-75%. That means that plants can uptake 139.5 kg/ha of nitrogen from the soil. To obtain the planned harvest plants need additionally 73 kg/ha of nitrogen. It can be supplemented through symbiotic nitrogen fixation in amount of 106.2 kg/ha, which is more than enough for plants.

Table 4. Calculation of mineral fertilizers doses (taking into account symbiotrophic of soya) to obtain grain harvest of 2.5 tons/ha

Index	Easily hydrolysed nitrogen	P_2O_5 according to State Standard (DEST)
Content in arable soil layer:		
mg/100 g of soil	6.2	1.5
kg/ha	186.0	45.0
Coefficient of utilization from soil (%)	75.0	25.0
Utilization from soil during vegetation season (kg/ha)	139.5	11.2
Take out per 1 kg of grain (kg/ha)	85.0	28.5
Uptake by crops for vegetation period (kg/ha)	212.5	71.3
Shortage to obtain planned yield (g/ha)	73.0	60.1
Symbiotic fixation of nitrogen:		
%	50.0	–
kg/ha	106.2	–
Assimilation of phosphorus through phosphate-mobilizing microorganisms		
%	–	25.0
kg/ha	–	17.8
Shortage of mineral fertilizers to obtain planned yield (kg/ha)	–	42.3

Source: [Patyka, Hnatiuk, Buletsa, Kyrylenko 2015, pp. 12-20].

The highest attention should be paid to the ways of controlling microorganisms inhabiting pre-root and root zone of plants. This trend has been intensively developed in the leading countries of the world for more than 40 years. It is called associative nitrogen fixation, which is more large-scale than symbiotic one [Kots, Morgun, Patyka, Petrichenko, Nadkernichnaya, Kirichenko 2011; Umarov, Kurakov, Stepanov 2007]. Long-term research on usage of diazotrophes when growing cereal crops allows to conclude that in modern conditions due to nitrogen fixation we can obtain increase in yield equal to application of 30 kg/ha mineral nitrogen [Kots, Morgun, Patyka, Petrichenko, Nadkernichnaya, Kirichenko 2011; Umarov, Kurakov, Stepanov 2007; Dobereiner 1983, pp. 330-350; Steenhoudt, Vanderleyden 2000, pp. 487-506]. Introduction of diazotrophes in wheat rhizosphere improves total nitrogen content in rhizosphere and phytomass, but cannot fully cover the needs of plants in this element [Kots, Morgun, Patyka, Petrichenko, Nadkernichnaya, Kirichenko 2011; Volkogon 2000, pp. 51-58; Eckert, Weber, Kirchhof, Halbritter, Stojfels, Hartmann

2001, pp. 17-26]. Diazotrophe based formulations promote increase in winter wheat yield by 0.16-0.43 t/ha, raw protein content in grain by 0.2-0.5% and the total protein yield by 2-13%. Commercial formulation Diazofit is recommended for growing wheat, rice, rape, while Ryzoenterin – for barley (Table 5).

It is important to emphasize that the associative nitrogen-fixing bacteria have a stimulating effect due to their ability to synthesize growth-stimulating substances (such as auxins, gibberellins, cytokinins, etc.) in amounts determined by bio-regulatory mechanisms of plant [Lugtenberg, J. de Weger, Bennett 1991, pp. 457-464; Itakura, Uchida, Akiyama, Hoshino, Shimomura, Morimoto, et al. 2013, pp. 208-212]. This is their big advantage over synthetic growth stimulators.

Table 5. Efficiency of Diazofit in different soil-climatic zones

Country	**Crop**	**Increase in yield (t/ha)**	**Increase in yield (%)**
China	Wheat	1.1	24
Vietnam	Rice	0.75	27
India	Wheat	0.6	22
Russia	Wheat	0.25	11
Ukraine	Wheat	0.36	14

Source: [Patyka, Hnatiuk, Buletsa, Kyrylenko 2015, pp. 12-20].

For example, each year in the USA up to 22 million tons of nitrogen (13 million tons of biological nitrogen, and 9 million tons of mineral) is applied in crop production. Besides, mineral nitrogen is applied in an environmentally safe form. The farm "Agroecology" wisely uses natural factor: every year a certain amount of nitrogen is removed from the soil with the harvest but also a certain amount is returned back to the soil. Moreover, due to microbiological and biological factors returned amount is even bigger than taken one.

Scientists of the department headed by Academician Volodymyr Patyka study phytopathogenic bacteria, i.e., those that cause plant diseases [Hvozdiak, Pasichnyk, Yakovleva, Moroz, Lytvynchuk, Zhytkevych, et al. 2011]. The question is, are there any phytopathogenic bacteria in "Agroecology's" fields? Yes, there are. However, their number is small and environmentally safe. That is, they create diversity. If there is a certain amount of pathogenic bacteria, there are their antagonists fighting harmful organisms and producing biologically active substances. Variety preserves the integrity of the biosphere. Diversity is limited in agriculture. It is not like in nature, where dozens of thousands of species interact simultaneously. At the areas where monocrops were grown, there was such a uniformity created that there no organisms left to fight pests, so it became necessary to apply chemicals. It does not happen in "Agroecology's" fields because natural factors are being successfully used here, namely, microbiological nitrogen enrichment – organic matter returns as green manure that forms humus much easier and faster. Microorganisms decompose straw in the soil.

The powerful aspect of “Agroecology” is usage of organic matter obtained from cows. This matter is kind of a powerful microorganism factory. All the organic residues applied in fields (green manure) are to be enriched with manure (10 t/ha and more). The number of cattle per hectare is optimal at the farm.

At the farm, creative approach to work is exploited. For example, there is sainfoin remained at a field. Roots of leguminous are occupied by bacteria living in symbiosis i.e. plant and microorganisms help each other. And there is growing amaranth too, which contain valuable protein. In pre-root and root zones, there are so-called associative bacteria. Amaranth’s root secretions are very attractive for associative nitrogen-fixing organisms living in soil. Currently this kind of nitrogen fixation is developing in the world. Some microbiological commercial formulation are produced. Moreover, the proportion of nitrogen, which can be produced by these microorganisms is even greater than that of legumes.

If your approach to biosphere excludes violations of the self-regulation and balance mechanisms you can do a lot. For example, after digging potatoes in late July - early August mustard can be sown to grow until the end of October. Mustard is a sanitary plant. If it is incorporated into soil, there are no pathogens causing potato rot for the next 2-3 years; such potato is good at storage. However, undesirable things occur too, particularly in cultivation of rape. So much so, that it returns to the same field in 3-5 years.

The theoretical basis of growing winter and spring rape in rotation is the relationship of plants and soil environment, including microorganisms that living in it. A microbiome in the course of its life creates conditions for the development of other higher forms of life. However, the range of issues associated with the change of microorganisms activity and biochemical processes taking place in the soil as a result of growing plants is complex and in many cases is not yet understood [Patyka, Tykhonovych, Filipiev, Hamaiunova, Andrusenko 1993; Aristovskaya 1972].

Analysis of changes in soil biogenic status, which is characterized by the development of major ecological and trophic groups of microorganisms showed that different groups respond differently to winter rape growing under its different saturation percentage in crop rotation (Table 6). Its returning into rotation earlier than in seven years leads to a reduction in the number and biomass of soil bacteria. Thus, bacteria biomass in rotation options increased 1.8 times compared to monocrop, the number of oligonitrophilic bacteria involved in the transformation of residual organic substances increased 2.3 times, streptomycetes 1.4 times. The number of bacteria able to form colonies on soil agar was 2.1 times higher in crop rotation compared to growing monocrop.

Contrary, fungi content increased 1.8 times while growing winter rape as monocrop compared to crop rotation. Among the fungi, the dominant species were Alternaria brassicicola, Alternaria brassicae, Alternaria tenuis, Phoma lingam, Peronospora brassicae, Fusarium oxysporum, Botrytis cinerea, which are pathogenic for plants.

Increase in the number of bacilli and streptomycetes in soil rotation points to more profound degradation of organic matter. These groups of microorganisms metabolize compounds that are often unavailable to bacteria, and they develop on substrates poor in available compounds [Patyka, Kruglov, Berdnikov, Patyka 2008, pp. 59-70; Lykhochvor, Petrychenko, Ivashchuk, Korniichuk 2010]. Cellulose-decomposing microorganisms in soil also point out to mobilization processes in it. According to our data (Table 6), the content of these organisms in rotation was 2.6 times as much compared to permanent growing. In crop rotation, the number of cellulose-decomposing microorganisms in 1 g of dry soil was 35,400, while 13,300 in permanent growing. These data confirm the results of our research for flax and tomatoes that is mobilization processes in the soil occur more rapidly when alternating plants than when permanent growing.

Table 6. Number and biomass of microorganisms in meadow chernozem soil when growing winter rape in crop rotation and permanently (average for 2010–2013)

Variation	Bacteria biomass (t/ha)	Bacteria on nutrition media			Oligo-nitrophilic bacteria	Fungi	Strepto-mycetes	Cellulose-decomposing (thousand/g dry soil)
		MPA	MPA+ SA	SA				
		10^6 CFU/g of dry soil						
Crop rotation (return in 7 years)	8.1	28	4.2	196	283	2.7	98	35.4
Crop rotation (return in 5 years)	6.7	24	5.5	175	242	3.4	88	27.5
Crop rotation (return in 3 years)	5.5	17	6.4	146	181	3.8	71	14.2
Permanent growing	4.5	11	7.4	95	121	4.9	69	13.3
$LSD_{0.5}$	2.0	2.5	1.1	15	30	0.5	15	3.3

Source: own work.

Similar changes were revealed in the dynamics of the microorganisms number, which, apparently, was due to certain processes of income and decomposition of organic matter. The most numerous group of saprophytic microorganisms was bacilli and microscopic fungi dominating the soil in crop rotation in the phase of forming pods in winter rape, while the number of oligonitrophilic bacteria was significantly reduced. For streptomycetes, the difference in experiment variations was insignificant.

Our results on biological activity when growing winter rape in crop rotation and permanently is given in Table 7. It shows that growing winter rape in rotation leads to an increase in the emission of CO_2 2.7 times in comparison with permanent growing. Decomposition of linen fabric for 45 days was 32% in crop rotation, while 21% in permanent growing. These data indicate that when growing crops permanently, less favourable soil conditions are created for microorganisms resulting in reducing their biological activity.

Table 7. Intensity of CO_2-emission from meadow-chernozem soil when growing winter rape in crop rotation and permanently

Variation	**Intensity of CO_2-emission (mcg/g hour)**
Crop rotation (return in 7 years)	5.7
Crop rotation (return in 5 years)	4.9
Crop rotation (return in 3 years)	3.3
Permanent growing	2.1

Note: x/P = 0.05; t_{st} = 2.99
Source: own work

Study on the species composition of bacteria showed that in most cases the same species occurred when growing winter rape both in crop rotation and permanently. However, their occurrence and density of species differed significantly (Table 8).

Table 8. Typical and dominant species of asporous bacteria in rizosphere of winter rape when growing winter rape in crop rotation and permanently

Species	**Crop rotation**		**Permanent growing**	
	I	**II**	**I**	**II**
Agrobacterium radiobacter	–	–	21	6
Agrobacterium radiobacter pv. *rhizogenes*	4	–	12	3
Agrobacterium tumefaciens	–	–	19	6
Arhtrobacter globiforvis	65	11	43	7
Arhtrobacter pascens	87	9	6	1
Arhtrobacter simplex	88	7	–	–
Arhtrobacter tumescens	57	3	83	9
Arhtrobacter ureafaciens	2	–	52	2
Brevibacterium fuscum	44	3	8	–
Flavobacterium diffusum	45	3	27	3
Flavobacterium suaveolens	–	–	64	2
Mycobacterium lacticum	57	4	11	1
Nocardia rubropertincta	–	–	54	3
Pectobacterium carotovorum subsp. *carotovorum*	3	–	31	4
Pseudomonas cichorii	–	–	27	2
Pseudomonas fluorescens	54	7	76	8
Pseudomonas marginalis pv. *marginalis*	4	1	35	3
Pseudomonas rathonis	68	8	4	–
Pseudomonas syringae pv. *maculicola*	3	–	41	5
Pseudomonas viridiflava	4	–	32	4
Xanthomonas campestris pv. *campestris*	3	–	41	4

Note: I - the frequency of species occurrence (%); II- species density (%).
Source: own work:

In rhizosphere of winter rape that was grown permanently occurred Arhtrobacter globiforvis, A. tumescens, Flavobacterium suaveolens, Pseudomonas fluorescens, P. syringae pv. maculicola, Xanthomonas campestris pv. sampestris. It should be noted that Pectobacterium, Pseudomonas and Xanthomonas prevailed in permanent growing, while Arhtrobacter, Brevibacterium, Nocardia, etc. (that feature high biochemical activity) predominated in crop rotation.

Previously, we have shown that the population of pathogens of rape bacterial diseases in nature is heterogeneous, namely, that is 78% of high and 11% of low aggressive strains [Zakharova, Melnychuk, Dankevych, Patyka 2012, pp. 46-52]. It should be noted that the most aggressive pathogen appeared to be Pectobacterium carotovorum subsp. carotovorum, and the least aggressive - polyphage Pseudomonas fluorescens. All strains studied by us in rape were quite aggressive. According to their major morphological, cultural and biochemical properties they are related to pathogens of root bacteriosis Xanthomonas campestris pv. campestris, mucosal bacteriosis Pectobacterium carotovorum subsp. sarotovorum and Pseudomonas fluorescens.

Permanent growing of winter rape steady leads to lower yields (Table 9). The data shows that the reduction in yield when permanent growing was 60% compared to growing in rotation. Significant yield reduction was observed in the variation with returning winter rape to the same field after 3 years (24%).

Thus, permanent growing of winter rape significantly influences formation of soil microbiota, with its biomass in soil reducing. The number of bacilli, oligonitrophilic and cellulose-decomposing microorganisms is decreasing, so is biological activity of soil.

Table 9. Yield of winter rape when growing winter rape in crop rotation and permanently

Variation	**Grain yield (t/ha)**	**Increase in yield (to control)**	
		(t/ha)	**%**
Permanent growing (control)	1.33	–	–
Crop rotation (return in 3 years)	1.65	0.32	24
Crop rotation (return in 5 years)	1.97	0.64	48
Crop rotation (return in 7 years)	2.67	1.34	100.7
$LSD_{0.5}$	0.30		

Source: [Patyka, Zakharova 2015, pp. 15-19].

Certain changes are observed in the dynamics of the microorganisms number due to specifics of income and decomposition of organic matter in crop rotation. These data indicate that mobilization processes in soil in crop rotation occur more intensively than when growing rape permanently. In addition, accumulation of rape bacteriosis pathogens, such as Xanthomonas campestris pv. campestris, mucosal bacteriosis Pectobacterium carotovorum subsp. carotovorum, Pseudomonas fluorescens, and microscopic fungi increased 1.8 times when growing winter rape permanently compared with crop rotation, including fungi Alternaria brassicicola, Alternaria brassicae, Alternaria tenuis, Phoma lingam, Peronospora brassicae, Fusarium oxysporum, Botrytis cinerea, which indicates about rape having lost its phytosanitary properties. Failure to comply with the basic requirements of rape growing technology, especially its high saturation percentage in rotation observed in recent years does not improve, but worsens phytosanitary condition in soils.

Rape intensively exhausts soil, and pathogens spread in crops. That is why it is impossible to obtain good harvest after one, two, or three years [Patyka, Zakharova 2015, pp. 15-19]. Therefore, rape must not be returned into the same field sooner than in 7-8 years. Scientists constantly warn about the danger of intensive approach in agriculture, but, unfortunately, nobody listens to them.

One can understand a farmer sowing rape to get financial benefits today, but we must think of the years to come. At the farm "Agroecology", people are aware that we must take care of soil fertility to be used by their children, grandchildren and great-grandchildren in the future. A little over ten years ago, they rented land of the neighbour farm, which contained only 3% humus, and now it increased to more than 4%. It witnesses about the farm owner being a patriot, a man who cares about earth.

And one more important detail. Ravines here have not been ploughed. They are sources of useful microorganisms that are natural antagonists of pests. They are developing there and then distributed by the carriers.

In Ukraine, there is a good concept of sustainable development of agro-ecosystems developed by specialists of the Institute of Agroecology in 2002-2004. It was reviewed and approved by the Ministry of Agriculture, and a special joint executive order was issued by the Ministry of Agriculture, Ministry of Environment and the National Academy of Agricultural Sciences. Then this concept was brought up to the Cabinet of Ministries. After that, breaks were put on it. If we implemented it, as farm "Agroecology" did, we would not talk today about quality wheat of other states, because we would have our own quality wheat.

That plenty of seeds, which we try to harvest today, is not any kind of salvation, but disaster, because it is produced with the use of chemicals. To obtain ecologically safe natural harvest, it is necessary to introduce farming practice similar to "Agroecology's" one.

Thus, the basic principles of organic (natural) farming in "Agroecology" are as follows: soil preserving technologies, that is, seed bed is processed to depth of 5 cm for all the crops while surface is mulched with harvest residues; soil fertility is restored with the aid of organic fertilizers (manure - at least 24-26 t/ha, non-tradable crop residues and green manure crops); synthetic fertilizers are not applied (nitrogen is supplied through entering legumes into crop rotation (more than 20% saturation); agro-technical measures to protect crops from weeds and stubble crops (cruciferous green manure sown after harvesting, which has allelopathic effect on weeds); crop protection from pests and diseases with the aid of agricultural practices, prevention and biological methods; correction of land use patterns and optimal crop structure modelling.

This research based on the example of “Agroecology” is used for environmental education in rural schools in Poltava region, as well as in higher education establishment, particularly Poltava State Agrarian Academy, in specialized education centres, and non-formal education institutions.

Increasing environmental awareness in agricultural sector is an urgent problem nowadays. It is necessary to ensure improvements among both young and mature population [Sobchyk 2004, 2013].

Environmental education is a task for many institutional, social, political and cultural organizations. Educational institutions play a special role in its implementation. This is due to the fact that they have a long and significant impact on young people. That is why environmental education will result in improving living conditions and raising environmental awareness of the younger generation, first of all, in rising natural culture among people. Quality environmental education results from choosing appropriate forms and methods, as well as from using original and interesting teaching tools. For example, there are all the necessary conditions for training Poltava Agrarian Academy’s students at the farm, including social issues.

The idea of balanced management stems from the concept of sustainable development [Sobczyk 2013; Sobchyk 2004]. Development of crop production is possible as long as agro-ecosystems and biological diversity of natural resources maintained for future generations. Well-balanced crop production (sustainable agriculture) should perfectly realize the following goals:

– to produce high quality livestock (environmentally safe) at affordable prices and in quantity necessary for the needs of the country;
– to ensure such an income of producer of agricultural products, which would be adequate in respect of other sectors of the economy;
– to make it possible to maintain natural balance [Sobczyk 2004, 2013; Biliavski 2002, pp. 18-28; Sob 2004, pp. 150-153; Szewczuk, Biliavski 2002].

The program on residential areas should always take into account human activities and problems, natural feature and value of the environment (i.e., to be in harmony with nature), cultural and historical heritage of rural areas.

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TRANSFORMATION MANAGEMENT OF ECONOMIC AT RURAL AREAS

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