LEGAL REGULATION OF AGRICULTURAL LAND USE: CASE OF UKRAINE AND EU COUNTRIES

A series of market transformations in the agricultural sector of the economy contributed into development of the privately run and lease based business, corporatization of the agricultural business and initiation of the agricultural land consolidation process. However, ineffective institutional relations between the owners of capital, i.e. land, and tenant operators, on the other hand, have resulted in the irrational use of the said asset. Such a situation is particularly conditioned by inadequacy of the existing institutions, which provoke irresponsive conduct of tenants and form strong stereotype of villagers, who thereby become indifferent to own property even in terms of the source of revenue. Over the course of past century both unbalanced use of land resources within the agricultural sector and consumer's attitude to land have contributed into rising social and economic, as well as environmental problems of land relations development. Violation of the scientifically substantiated business standards, implementation of one-crop farming system and excessive man-caused environmental impact are typical for the most of manufacturers. Intensification of land use in the market economy environment comes down to promoting of the economic effect of agricultural lands use, however without regard to environmental and social components thereof. Due to expansion of the agricultural production, increasing of demand for the high quality foods and need for the social infrastructure development, the land use optimization issue takes on a particular importance. Despite of the world highest level of land resource introduction into commerce, significant soil fertility and diversity of the land & resource potential, no conditions could be created for effective management, provident attitude and conversion of the domestic agricultural lands into a key factor of the economic advance. Therefore, organization of the agricultural management requires attraction of the new tools, which might help in planning of land use at both national and regional level, as well as monitoring and exercising control over use of the one of the most essential domestic resource, i.e. agricultural lands.

Domestic and foreign scientists paid a due attention to the issues of theory, methods and practice of the land resource management at the regional level, into which the insight is provided in the research papers thereof. The following works are devoted to a range of issues with regard to problems of effective use of the agricultural lands, as well as land use protection and environmentalization: D. Acemoglu [1], D. Ahner [3],

A. Boiko, V. Pastuhov [4], V. Budzyak [5], O. Chaikin [6], B. Danilishyn, S. Doroguntsov, V. Mischenko [8], M. Glady`j [11], V. Gorlachuk, S. Belins`ka [12], J. Swinnen, P.Ciaian, etc. Considerable contribution into theory of the land use economic and mathematical models was made in research papers of: V. Ivanyshyn [14], P. Monkkonen, J. Quigley [16], I. Naumenko [17], U. Nesterchuk [18] and other scientists were engaged in study of issues of modeling based upon geoinformational technologies.

Scientific research and development is of great theoretical and practical importance against the background of intensified land use and land relationship transformation process. However, there is a number of problems still unsolved, in particular with regard to establishing of mechanism for land rational use and protection at the regional level. There is also a need for creation of the forceful tool, whereby the agricultural production shall be forecasted based upon the economic and mathematical models, taking into consideration different criteria of optimal land use, thus providing for availability of a wide field for advanced research and surveys in the said area.

Objective: revealing of main problems and proposing of tools for land use planning and control over the agricultural land utilization status based upon analytical review and results of research of agricultural production specific to the market economy environment in consideration of the modern requirements to the use of lands.

It is stipulated by the above objective to work out a package of mutually agreed economic, process and organizational procedures, as well as managerial decisions for improvement of the agricultural land use economic effect; substantiate the practicability of the economic and mathematical models application for the purpose of land use optimization; determine main concepts of land relationship development at the regional level; and adjust the geoinformational technologies for the purpose of control over use of the agricultural lands.

Research methods are based on traditional economic methods, i.e. monographic (study of the foreign countries experience in application of the modern geoinformational technologies for the agricultural management), system-oriented analysis (comparison of different scenarios of the agricultural land use development), statistical (assessment of the primary indicators of the land resource use effectiveness), graph & table (schematic and tabled display of the research results). The economic and mathematical modeling method has been applied for creation of the simulation models, whereafter modeled results were extrapolated onto the actual working conditions. Application of the said method does enable forecasting and quality assessment of the agricultural production effectiveness based upon modeling of the areas under agricultural crops structure at the regional level, taking into account the different criteria of the optimality thereof.

The domestic agricultural sector of the economy underwent a rather difficult period of rise and development, which has been lasting for now. For the time of getting transited to the industrial system the agricultural industry has gained the features inherent to leading industrial sectors of the economy. Due to advancement in mechanical engineering, chemistry, biology and genetics the qualitative modifications have taken place, thus assisting in solving of the food problems, in particular through achievement of positive response in agricultural crop yield and increased productiveness of livestock framing [10, 15]. However, a significant number of problems has been simultaneously raised with regard to production extensification, climatic changes, environmental system exhaustion, decrease in stocks of the natural resources suitable for effective agricultural performance.

According to figures of the Governmental agency Soils Protection Institute of Ukraine (Derzhhruntokhorona), the weighed mean content of humus in soil has been decreased for last 20 years by 0.5 (%) percent and its losses are 0.5–0.6 T/hectare per annum; mobile phosphor and potassium concentration in soil has been decreased by 6.1 and 6.3 mg/kg accordingly. Annual nutrient removal rate (for the yield formation) is five times more than the reverse process. Millions of hectares of the domestic agriculturally used areas are subject to water (over 13) and wind (1.7) erosion, of which near 11 and 1.5 million hectares accordingly are the plowing lands. Agricultural industry has become known for frequent breaches of the agri-environmental principles, whereby implementation of the scientifically substantiated crops rotation, organic and mineral fertilizer treatment, application of the environmentally friendly technologies of natural resource preservation, as well as creation of mechanisms for biological conservation thereof, are envisaged. The said situation is caused, inter alia, by the lack of due control over the land use status and appropriate tools for monitoring of the agricultural land utilization.

With reference to the above, the national strategy of land relationship development shall be dependable upon simultaneous solving of a few controversial tasks: growth of the agricultural product output; reduction of the environmental pollution level; maintenance of the high productiveness of lands for the benefit of today and tomorrow generations; subsidization for the purpose of soil protective activity stimulation; intensification of the agriculturally used areas utilization. As it is stipulated by the above tasks, land use optimization at the regional level assumes following a target process of implementation of a package of mutually agreed economic, process and organizational procedures, as well as managerial decisions for improvement of the agricultural land use economic effect, provided that environmental balance violation is prevented.

Proposals with regard to the land use optimization taking into consideration the economic, environmental and social aspects, as well as forecasting of the appropriate scenarios for the cropping patterns have been worked out based upon the case of Zhytomyr Region. The trend of growth of primary (raw) production of the energy intensive agricultural crops being in good demand in the global market has been emerging for the last 5 years in the region under assessment. At the same time no adverse factors affecting soil fertility, contaminating environment and resulting in downfall of the traditional branches in the said region (i.e. sugar, flax cultivation and fodder production industries) have not been considered hereby. According to statistical data for 2010-2016, grain corn production in the region under assessment has been grown by 23 (%) percent, thus making up to 30 (%) percent of the total plant crop products output; soy and sunflower production – by 19 (%) and 17 (%) percent accordingly. It shall be stated herewith that appr. 80 (%) percent of export are not processed products.

Significant growth of the energy intensive crop share within the cropping pattern does cause their planting on a single-crop basis, thus resulting in negative yield response and need for use of the additional plant protection products. Moreover, much more nutrients are removed by the said crops out of soil and more organic humus is destroyed thereby. Breach of crop husbandry branch specific proportions has adverse effect on the processing industry through, e.g. liquidation and disassembly of a great number of compound fodder and flax mills, sugar and starch factories, distilling plants, etc.; termination of employment of able-bodied population and no state budget revenues required for the social welfare maintenance and development of the rural areas. Therefore, Zhytomyr Region requires optimization of the manufacturers' production structure, in particular areas under agricultural crops balance, taking into account not only economic, but also environmental and social criteria.

Further to assessment of manufacturers' specific commercial activities, study of the soil and environmental status of lands in Zhytomyr Region, as well as region specific natural and climatic conditions, main methodological principles of the economic and mathematical modeling have been formed with regard to development of the land relations at the regional level, in particular: adaptation of the land use practice for the actual social and economic conditions, as well as market situation; working out of the crop rotation schedule for manufacturers of whatever types and ownership form; compliance of land use with the environmental requirements and getting environmentally friendly agricultural products;

consideration of the logistical base available and financial soundness of the farming companies. The economic and mathematical tools developed hereby are essentially required for improvement of the economic, environmental and social effectiveness of land use within the existing areas under crops and/or modification thereof by consistent transformation of the agricultural lands.

It is assumed at opening phase of modeling procedure to proceed with agri-environmental grouping of lands, whereby the areas for certain crops and their territorial placement shall be determined. Therefore, boundaries of the plowing lands, hayfields, woodlands, etc. shall be the same as of appropriate agri-environmental groups. Each plant group shall occupy such areas of the optimized agricultural landscape, which soil conditions have positive effect on the productiveness thereof. Soils in Zhytomyr Region were divided into 8 (eight) agri-environmental groups through its classification by ascending biological properties of plant groups, taking into consideration appropriate specific commercial use thereof.

The interim modeling phase assumes design calculation of areas suitable for use as plowing, grazing lands and hayfields. The environmentally substantiated structure of lands within specific land mass is determined thereby. There are four groups (I, II, III and IV) were divided after research done from agriculturally used areas of Zhytomyr Region, which are suitable for use as plowing lands. Next three (V, VI and VII) are suitable for use as forage lands and one (VIII) – as tree-planting lands. Environmentally substantiated cropping pattern of Zhytomyr Region shall be as much as possible as follows: plowing lands 375, hayfields 447 and grazing lands 166 thousand hectares (table 3.5.1).

The final phase of the economic and mathematical modeling of the intensive land use at the regional level assumes creation of the simulation models of the areas under agricultural crops in consideration of the agri-environmental soil grouping. Forecast is done based upon developed and implemented crop rotation system for the plowing lands and methods of plant group formation – for the forage lands. Calculation of the total area of a land suitable for certain crop is performed based upon area of plowing land, which ground coating complies with requirements to the said crop. Term of its return back to the previous location shall be determined based upon crop disease and insect pest resistance. Design area of either crop planting may be subject to adjustment due to commercial needs; however it may not exceed the threshold value thereof. Should the crop planting area be increased over threshold value, a degradation process in the agricultural landscape might be apparent, especially in the eroded, waterlogged and contaminated territories.

Table 3.5.1

Environmentally Adapted Plowing Lands for Agricultural Crops in Zhytomyr Region, Thousand Hectares

Crop	Total area suitable for crop planting	of which by agri-environmental groups				Rotation period, year	Threshold cropping area
		I	II	III	IV		
Winter Wheat	201.7	178.8	18.8	0	4.1	4	50
Winter Rye	201.7	178.8	18.8	0	4.1	3	67
Winter Cereal Crops	201.7	178.8	18.8	0	4.1	4	50
Oats	375	178.8	18.8	173.3	4.1	3	125
Buckwheat	180.8	93.1	2.7	85	0	4	45
Millet	26.9	19.8	2.7	0	0	4	7
Leguminous Crops	375	178.8	18.8	173.3	4.1	4	125
Flax (fibre)	178.8	178.8	0	0	0	6	30
Flax (linseed)	26.9	19.8	2.7	0	0	5	5
Potatoes	197.6	178.8	18.8	0	0	4	50
Feeding Root Crops	370.9	178.8	18.8	173.3	0	3	93
Rape (seeds)	26.9	19.8	2.7	0	0	5	5
Trifolium	201.7	178.8	18.8	0	4.1	4	50
Perennial grass	375	178.8	18.8	173.3	4.1	3	125
Annual grass	375	178.8	18.8	173.3	4.1	3	125
Grain Corn	197.6	178.8	18.8	0	0	4	66
Silage Corn	201.7	178.8	18.8	0	4.1	4	50
Sunflower	197.6	178.8	18.8	0	0	4	66
Soy	375	178.8	18.8	173.3	4.1	4	125

Source: own research results.

Three simulation scenarios of adapted cropping pattern for Zhytomyr Region have been modeled in the course of study: 1) *Unregulated 'wild' market*, 2) *Scientifically substantiated crop balance*, and 3) *Manufacture* *of value-added products*. Each of scenarios has a common target function, whereby maximization of profit is envisaged to be gained per unit of ground area taking into account different restrictions thereon.

$$Z_{max} = \sum P_{i,j} X_{i,j} \tag{3.5.1}$$

were, i = agricultural crop;

j = land use agri-environmental group;

$X_{i,j}$ = area occupied by the agricultural crop within the agri-environmental group, thousand hectares;

$P_{i,j}$ = profit earned from planting of crop i within the land use agri-environmental group j;

It is assumed by the first scenario – *Unregulated 'wild' market* to use to the maximum possible extent the agricultural lands for commercial manufacturing, perform crop placement with no consideration of crop rotation schedules and agri-environmental classification of lands, reduce as much as possible operational costs, use high performance wide-cut machines and provide for automation of the entire commercial cycle. Production is then focused on consideration to much possible extent of domestic and global pricing environment with regard to agricultural products, as well as adjustment of production facilities insofar as it concerns changes of the above (table 3.5.2).

Table 3.5.2

Anticipated Agricultural Cropping Pattern for Zhytomyr Region, Thousand Hectares Case (Scenario): *Unregulated 'Wild' Market*

Crop	Total area suitable for crop planting	of which by agri-environmental groups				Thresh old cropp-ing area	Actual cropp-ing area	Profit earned from crop
		I	II	III	IV			
Rape (seeds)	26.9	19.8	5	0	0	5	30.2	259.91
Grain Corn	197.6	178.8	66	0	0	178.8	178.8	2,912.20
Sunflower	197.6	178.8	66	0	0	66	86.0	1,552.60
Soy	375	178.8	125	173.3	4.1	125	80.0	853.33

Source: own research results.

Restrictions considered for the scenario concerned are as follows:

1) Total cropping area shall not be in excess of the total ground area of the region:

$$\sum x_{i,j} \leq S \tag{3.5.2}$$

2) Cropping area within the agri-environmental group shall not be in excess of the ground area of the regional agri-environmental group *j*:

$$\sum x_{j} \leq S_{j} \tag{3.5.3}$$

3) Cropping area of the agricultural crop *i* within the agri-environmental group shall not be in excess of admissible agricultural crop planting area within the agri-environmental group *j*:

$$\sum x_{i,j} \leq S \tag{3.5.4}$$

4) All values determinable shall be always positive:

$$x_{i,j} \geq 0 \tag{3.5.5}$$

The above scenario has been being implemented during recent 10 years by the majority of corporate type farming companies in the region under assessment. It is evidenced through prevalence of the following crops in the cropping pattern: *Sunflower, Soy, Rape* and *Grain Corn*, which are not typical for the region concerned according to agri-environmental classification of lands, and planted on a single-crop basis. Cropping pattern transformation and increase of the energy intensive crop share with simultaneous reduction of feeding crops one are mainly caused by change of global prices for crop products, downfall of the livestock breeding industry, as well as bio energy branch development. Implementation of this scenario enables maximization of manufacturers' profits, however provides for adverse environmental (soil fertility degradation) and social (promotion of fly-in and fly-out economic activities, reduction of employment among local residents) impacts.

The second scenario – Scientifically substantiated crop balance – assumes working out of the simulation model of the agricultural production planning in accordance with the Cabinet of Ministers of Ukraine Decree *On Approval of Standards of Crop Rotation Balance in Different Natural and Agricultural Regions*, of 2010, No. 164, whereby crop placement proportions are set forth. In case of Polissian region, rape crops are allowed for placement on the same field not earlier than in three years after. Cereal crop share shall not be in excess of 60 (%) percent of the cropping pattern, while forage crops shall occupy at least 25 (%) of cropping area, of which at least 10 (%) percent – for perennial grasses [6]. Due balance between nutrients removed out of the soil and those returned with fertilizer treatment is the essential condition of this scenario (table 3.5.3).

See below restrictions applied to the scenario concerned:

1) Total cropping area shall not be in excess of the total ground area of the region:

$$\sum x_{i,j} \leq S \tag{3.5.6}$$

2) Cropping area within the agri-environmental group shall not be in excess of the ground area of the regional agri-environmental group *j*:

$$\sum x_{j} \leq S_{j} \tag{3.5.7}$$

3) Cropping area of the agricultural crop *i* within the agri-environmental group shall not be in excess of threshold agricultural crop planting area within the agri-environmental group *j*:

$$\sum x_{i,j} \leq S_{cr} \tag{3.5.8}$$

4) Nutrient balance $b_{rj} x_{ij} + k_{ijr}^{ä} z_{ijr} \leq p_{ir} k_{ijr}^{ã}$ and fertilizer treatment standards $l_{ij}^{\min} \leq k_{ijr}^{g} z_{ijr} \leq l_{ij}^{\max}$ shall be followed, (3.5.9)

where x_{ij} = crop *j* yield response in the field *i*;

z_{ijr} = quantity of *r*-type fertilizer(s), whereby crop *j* in the field *i* shall be treated.

i = land parcels, *i = n,* where *n* = land parcel number;

j = agricultural crops, *j = m,* where *m* = crop number;

r = nutrient typ, *r = κ,* where *κ* = nutrient type number;

b_{rj} = standard of nutrient removal by crop *j* from fertilizer *r*;

$k_{ijr}^{ä}$, $k_{ijr}^{ã}$ = nutrient *r* conversion ratio of crop *j* in the field *i* depending upon fertilizer and soil type;

$l_{ij}^{\min}, l_{ij}^{\max}$ = minimum and maximum fertilizer treatment rate for crop *j* in the field *i*;

p_{ir} = availability of nutrient *r* in soil of the field *i*;

s_{i} = field *i* area;

f_{r} = *r*-type fertilizer effect duration;

w_j = planned volume of *j*-type product output;

c_j = unit price of *j*-type product;

c_r = price of *r*-type fertilizer primary nutrient, per 1 kg.

5) All values determinable shall be always positive:

$$x_{i,j} \geq 0 \tag{3.5.10}$$

Table 3.5.3

Anticipated Agricultural Cropping Pattern for Zhytomyr Region, Thousand Hectares Case (Scenario): *Optimal Crop Balance for Rotation Mode*

Crop	Total area suitable for crop planting	of which by agri-environmental groups				Threshold cropp-ing area	Actual cropp-ing area	Profit earned from crop
		I		III	IV			
Winter Wheat	201.7	178.8	50	0	4.1	50	44.7	359.39
Winter Rye	201.7	178.8	67	0	4.1	67	11.9	19.53
Spring Cereal Crops	201.7	178.8	50	0	4.1	50	44.7	106.99
Oats	375	178.8	125	173.3	4.1	125	59.6	128.34
Leguminous Crops	375	178.8	125	173.3	4.1	125	44.7	260.02
Trifolium	201.7	178.8	50	0	4.1	50	44.7	246.25
Perennial grass	375	178.8	125	173.3	4.1	125	26.3	182.81
Grain Corn	197.6	178.8	66	0	0	66	44.7	728.05
Sunflower	197.6	178.8	66	0	0	66	26.2	403.37
Soy	375	178.8	125	173.3	4.1	125	27.5	233.33

Source: own research results.

Implementation of this scenario shall provide for due balance of cropping pattern and contribute into natural recovery of the soil fertility. At the same time it may be implemented only if method of land use organization is changed from linear to contour & environmental in terms of land tenure and allocation system. Should it be implemented the cropping pattern is then configured according to the agricultural landscape in consideration of the following components: plowing to stabilizing lands ratio; threshold cropping areas; spatial placement of crops within the boundaries of the agri-environmental groups of lands suitable for cropping; subsurface soil tillage system; and environmentally optimized fertilizing system. However implementation of this scenario is challenged by absence of a mechanism for imposing penalties on the manufacturers for violation of the scientifically substantiated requirements to business conduct. Because of modern level of the institutional support farming companies have no enough stimuli for making capital investments into land protection and recovery as: 1) the most part of agriculturally used areas is not in ownership of such farming companies; 2) farming companies are generally unprofitable or earn profit, which is not enough for making long-term investments; 3) there is no easy-term loan system available for business entities willing to get money and invest them into the environmental projects.

According to the third scenario – Manufacture of value-added products – the agricultural lands shall be to the maximum possible extent used for getting raw materials to be processed in local factories. By this scenario the model of anticipated transformation of crop products into feeds and fodders to be used in livestock farming industry and further sales of finished products is created (table 3.5.4). The simulation scenario of creation of forage base for livestock farming industry was worked out in consideration of specific features of the region under assessment. Estimates suggest that production and sale of 100 thousand T of grain in the domestic market will provide for added value of UAH 69 million, while use of grain as fodder for livestock farming industry will provide so far for getting added value of UAH 202 million, thus allowing to employ extra 930 people.

See below restrictions applied to the scenario concerned:

1) Total cropping area shall not be in excess of the total ground area of the region:

$$\sum x_{i,j} \leq S \tag{3.5.11}$$

2) Cropping area within the agri-environmental group shall not be in excess of the ground area of the regional agri-environmental group *j*:

$$\sum x_j \leq S_j \tag{3.5.12}$$

3) Cropping area of the agricultural crop *i* within the agri-environmental group shall not be in excess of threshold agricultural crop planting area within the agri-environmental group *j*:

$$\sum x_{i,j} \leq S_{cr} \tag{3.5.13}$$

4) Limited demand in feeds and fodders $\sum_{J=1}^{n} s_j q_{ij} a_{ij} \geq x_j$; (3.5.14)

where: x_j = demand in *j*-type feed or fodder;

s_j = forage crop *j* cropping area;

a_{ij} = nutrient *i* content per individual *j*-type feed or fodder;

q_{ij} = main crop yield response.

5) All values determinable shall be always positive:

$$x_{i,j} \geq 0 \quad (3.5.15)$$

Table 3.5.4

Anticipated Agricultural Cropping Pattern for Zhytomyr Region, Thousand Hectares Case (Scenario): *Manufacture of Value-Added Products*

Crop	Total area suitable for crop planting	of which by agri-environmental groups				Threshold cropping area	Actual cropping area	Profit earned from crop
		I	II	III	IV			
Winter Wheat	201.7	178.8	18.8	0	4.1	50	95.0	724.1
Winter Rye	201.7	178.8	18.8	0	4.1	67	7.8	4.6
Spring Cereal Crops	201.7	178.8	18.8	0	4.1	50	7.8	6.8
Oats	375	178.8	18.8	173.3	4.1	125	10.4	6.0
Leguminous Crops	375	178.8	18.8	173.3	4.1	125	10.4	16.2
Potatoes	197.6	178.8	18.8	0	0	50	15.0	2.0
Feeding Root Crops	370.9	178.8	18.8	173.3	0	93	7.2	1.6
Trifolium	201.7	178.8	18.8	0	4.1	50	7.2	14.5
Perennial grass	375	178.8	18.8	173.3	4.1	125	67.2	521.0
Annual grasses	375	178.8	18.8	173.3	4.1	125	9.6	4.1
Grain Corn	197.6	178.8	18.8	0	0	66	62.8	1,022.7
Silage Corn	201.7	178.8	18.8	0	4.1	50	7.2	1.3
Sunflower	197.6	178.8	18.8	0	0	66	1.9	33.8
Soy	375	178.8	18.8	173.3	4.1	125	65.7	700.6

Source: own research results.

The EU member states experience in land use and operational business results have proven the economic and mathematical modeling to be a forceful tool enabling commercial activity planning and working out scenarios for development of the agricultural sector of the economy. At the same time attempts to arrange effective and meaningful management are faced with numerous challenges. To begin with, there is a lack of true information on both locality and type of land use, as well as mode thereof. Soil and vegetation properties within certain portions of cropping fields are subject to consistent changes induced by the different operational, environmental and administrative processes. Moreover, such data shall be on one hand available to professionals in charge of yield response forecasting and assessment, and on the second hand be taken as basis for agro-engineering plans with regard to each specific field or portion thereof.

In the EU Member States, the state regulates the maximum amount of land ownership per family (Czech Republic), controls compliance with the designated purpose of a land parcel and maintains its level of fertility (Lithuania), establishes rules for obtaining a permit for the purchase of agricultural land (France), regulates the transformation of land from one category to another (Bulgaria). The creation of specialized agencies for the management of state-owned land was a prerequisite for functioning of the agricultural land market in the EU Member States. Such agencies include the Slovak Land Fund (Slovakia), the Agricultural Property Agency (Poland), the National Land Service (Lithuania), the State Land Service (Latvia), the Department of Land Consolidation (Denmark), Government Service for Land and Water Management (The Netherlands), National Company Land (Bulgaria).

The EU Member States (Bulgaria, Estonia, Latvia, Lithuania, Poland, Romania), which had a model of agricultural sector development similar to Ukrainian one, which was based on collectivization or state-owned production, carried out land reform in the early 1990's of the last century. It is based on restitution – the return of land to former owners and the auction distribution of land with subsequent phased liberalization of foreign capital access to them. Private property and the agricultural land market in each of the EU Member States were formed with the stated objectives to ensure a high level of efficiency of agricultural production (Latvia, Lithuania, Bulgaria), to develop a mechanism for social protection of the population living in rural areas (Poland, Hungary).

Extensive use of land resources, transformational processes in the agricultural industry and corporatization of the agricultural business have resulted in significant deterioration of the agricultural areas environmental condition. Adverse effects of the land use shall require substantial determination and taking of a series of land protection actions, i.e. environmental monitoring of soils, improvement of organizational methods for land use and protection, which would provide maximum environment-landscape and social & economic effect. In doing so, the land use forecasting issues shall be based upon application of the modern mathematical modeling methods and information systems enabling automated collection, processing and assessment of the spatial and coordinate reference information, as well as be fundamental for drawing up of any and all land surveying documents. Modeling method provides for creation of the adequate economic and mathematical models and further extrapolation of modeled results onto the actual working conditions. Implementation of the said method enables summarizing and performing proper analysis of the information based upon in-depth quantitative study, as well as improvement of production management and planning.

The economic and mathematical model of the land use optimization as worked out and adapted for region specific natural and climatic conditions has been tested based upon the case of Zhytomyr Region. Three simulation scenarios of the cropping pattern against the background of intensified production have been modeled: 1) *Unregulated 'wild' market*, 2) *Scientifically substantiated crop balance*, and 3) *Manufacture of value-added products*. In the course of strengths and weaknesses analysis with regard to implementation of the said transformations for agriculturally used areas, the reasonability of the forage areas extension for the purpose of livestock farming production growth has been substantiated. Proposed economic and mathematical model of the land use optimization against the background of intensified production is adaptive not only in terms of improvement of adequacy of description of the existing structural and functional particulars of activities undertaken and feasibility of the proposed managerial decisions, but also options for consideration of the environmental and social factors.

Study performed with help of Cropio geoinformational system has made it possible to monitor the status of use of the agricultural areas in the region under assessment and find idle reserves therein. Calculations show that engagement of such areas in commercial use would enable getting additional UAH 90 million required for the social and economic development of the rural areas. The economic and mathematical modeling approach combined with implementation of the geoinformational technologies shall provide for creation of the forceful comprehensive tooling for the agricultural land use management.

The practice of EU Member States proved that a well-developed and well-institutionalized land market ensures the distribution of land ownership rights in such a way that sound use of land resources and related economic assets is achieved. The analytical review and the results of the study of the evolutionary characteristics of the process of land governance transformation in Bulgaria, Estonia, Latvia, Lithuania, Poland and Romania allowed highlighting the main elements of the formation of a full-fledged agricultural land market. They include a cadaster, specialized land agencies, a market mechanism for land valuation, lease relations and state regulation. The availability of market infrastructure and proper institutional provision for purchase and sale of agricultural land enabled the countries under investigation to liberalize and make the market free from regulatory restrictions.

REFERENCES

1. *Acemoglu, D. 2004. Institutions as the Fundamental Cause of Long-Run Growth. NBER Working Paper. №: 10481: 11 p.*
2. *Acemoglu, D., Robinson, J. 2012. Why Nations Fail: the Origins of Power, Prosperity, and Poverty. – New York: Crown Business.*
3. *Ahner, D. 2004. Rural Development policy in an enlarged European Union. Proposals of the European Commission for the period 2007–2013. Halle, Germany.*
4. *Boiko, A., Pastuhov, V. Optimal Composition of MTF Complex for the Crops Production Selection [Vybir optymal`nogo skladu kompleksu MTA dlya vyrobnycztva sil`gospkultur]. Tehnika APK. № 3: 6–9.*
5. *Budzyak, V. 2008. Agricultural Land Market Formation [Formuvannya rinku zemel sIlskogospodarskogo priznachennya]. EkonomIka APK., № 8: 118–122.*
6. *Chaikin, O. 2014. Corporate responsibility, ecological certification aspect. Management Theory and Studies for Rural Business and Infrastructure Development. Scientific Journal. Vol.: 36., № 3: 463–470.*
7. *Ciaian, P., Kancs d`A., Swinnen, J., and others. 2012. Institutional Factors Affecting Agricultural Land Markets. Brussels: Centre for European Policy Studies.*
8. *Danilishyn, B., Doroguntsov, S., Mischenko, V. et. al. 1999. Ukraine Sustainable Development Natural Resource Potential [Pryrodno-resursnyy potentsial stalogo rozvytku Ukrayiny]. Kyiv: RVPSU NANU.*
9. *Dankevych, V. 2013. The Utilization of Farm Lands in High-commodity Production. The advanced science journal, № 7: 33–37.*
10. *Dankevych, Y., Dankevych, V., Chaikin, O. 2017. Ukraine agricultural land market formation preconditions. Acta Univ. Agric. Silvic. Mendelianae No. 65: 259–271.*
11. *Glady`j, M. 2007. I Don`t Think that Any Political Forse Could Froze the Land Market Opening This Year. Biznes. № 5(29): 31.*

12. *Gorlachuk, V., Belins`ka, S. 2007. The Land Market Implementation Prerequisites for the Agricultural Commodity Production in Ukraine. EkonomIka APK. № 7: 18–20.*
13. *Ihlanfeldtt, K. 2007. The Effect of Land Use Regulation on Housing and Land Prices. Journal of Urban Economics. №:61: 420–435.*
14. *Ivanyshyn, V. 2011. Organizational and Economic Principles of Agricultural Production Technical Potential Reproduction and Effective Use, Kyiv: NNTSIAE.*
15. *Maly`j, I. 2008. About Private Land Ownership Romanticization. Ekonomichna teoriya. № 3: 11–20.*
16. *Monkkonen, P., and QUIGLEY, J., and others. 2010. Economic Geography, Jobs, and Regulations: The Value of Land and Housing. Working Paper №: W10-005. University of California. USA.*
17. *Naumenko, I. 2013. The Economic Essence and Content of Agricultural Production Material Support. AgroInKom, № 10: 53–57.*
18. *Nesterchuk, U. 2014. Innovation and Technological Aspects of Ukraine Modern and Competitive Agricultural Sector (Collective monograph), Uman`: Vizavi.*