Title

Development of Robust Land-use Decisions in Eastern Europe under Technology, Climate, and System Change: The Case of Ukraine

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Abstract

The states of Eastern Europe (Ukraine and all the adjacent European states Belarus, Hungary, Moldova, Poland, Romania, Slovakia) have experienced technology and system change in land use since the 1990s. Their total land area exceeds the land area of Mexico or Indonesia, their total gross domestic product (in current US dollars) is between those products of Mexico and Indonesia, and their total population is higher than population of the Russian Federation or Japan. Some Eastern European states are in the world top-five producers of corn, rye, oat, triticale, buckwheat, potato, carrot, turnip, apple, gooseberry, raspberry, blueberry, plum, currant, milk (sheep), honey, flax, and other agricultural goods. It is found the agricultural production value of Romania, Slovakia, and Ukraine has higher efficiency (in the terms of water and energy use) than that of Belarus, Moldova, Poland, and Hungary. Therefore, it was expected the regions of Ukraine bordering with Romania and Slovakia are of the highest agricultural productivity. This hypothesis is confirmed by the data of capital and labor use as well as the data of agricultural production value. At the lack of energy resources, in Ukraine water appears to be a critical agricultural production factor. Moreover, the regions of Ukraine experiencing a water deficit happened to be the most vulnerable ones substantiating the well-known hypothesis on growing role of water resources for sustainable development. Because a water demand depends on the weather conditions and climate changes, the robust land-use decisions are to be developed in order to contribute to the world food security. For instance, Ukraine is transforming from a global breadbasket to a global foodbasket attracting significant investments to food production and export. The strategic investments and operational land-use decisions are based on such modern systemic risk measures as (conditional) value-at-risk, robust variant of mean or maximum loss.

Development of robust land use decisions in Eastern Europe under technology, climate, and system change: the case of Ukraine

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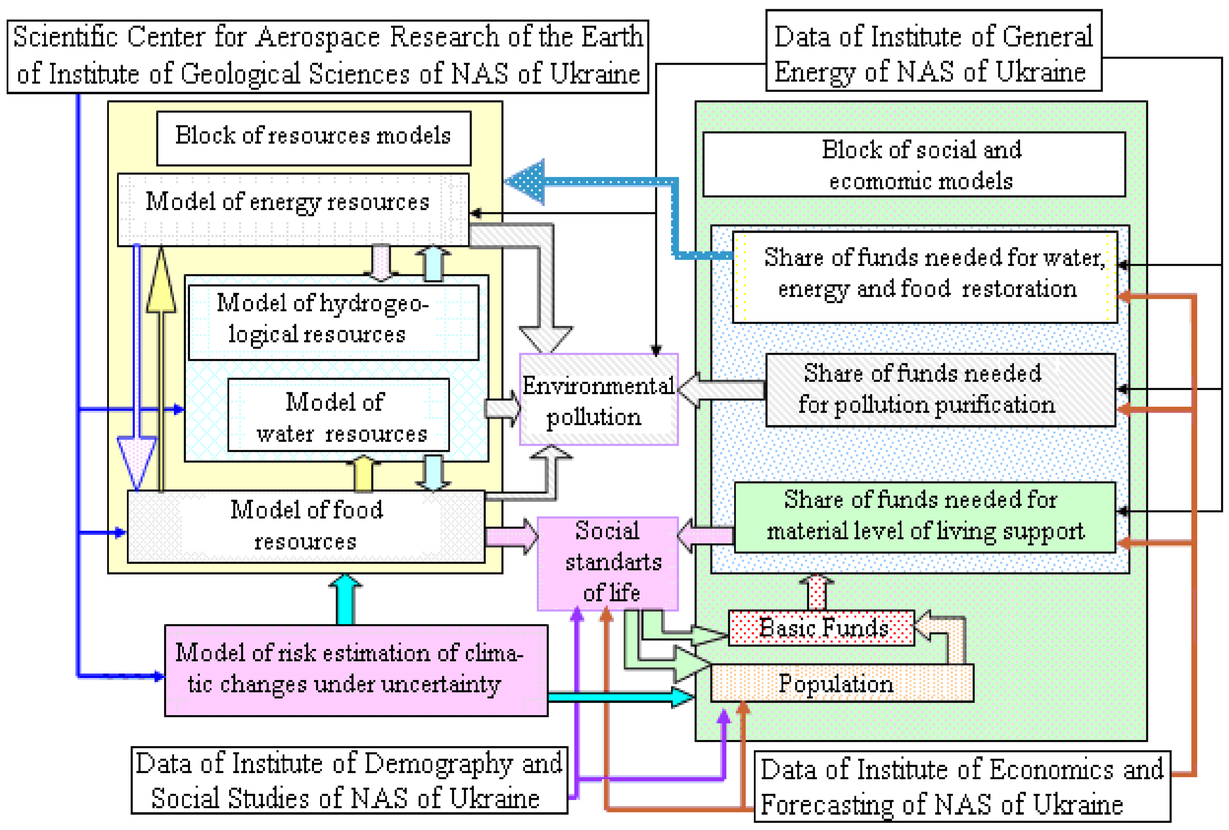
Abstract

- Integrated model for the analysis of food, energy and water resources management under increasing uncertainties and risks has been developed. The model and the underlying data base comprise a decision support system (DSS) for monitoring agricultural resources, investigating variability of yields, assessing vulnerability of agricultural production to global and local changes, optimizing sown areas to maximize production under inevitably increasing uncertainty. Using the DSS, the impact of energy and water factors, as well as the impact of capital and labor factors, on agricultural productivity in Ukraine and the adjacent countries have been studied for the period 2007–2010. It has been analized how the agricultural industry, in particular, the behavior of producers, depends upon natural-climatic conditions. Factors determining regional investment attractiveness have been analyzed and incorporated into the DSS.

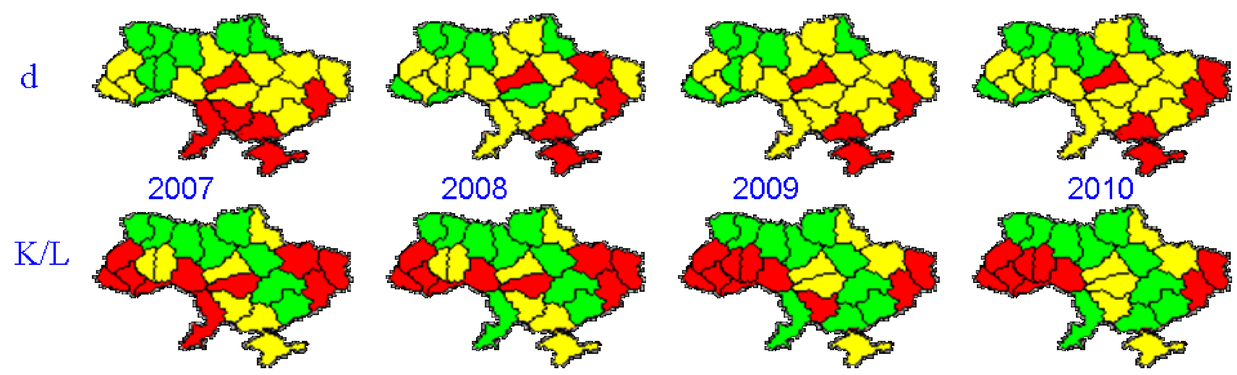
Methodology

- Different large-scale models exist describing separate activities and systems of a real economy and resource management, e.g., energy, agriculture, water, etc.
- The research addresses challenging methodological task of linking the models under inherent uncertainties and risks.
- The models have exogenous variables which describe interactions between the activities and systems. One can consider these variables as endogenous or as decision variables when the submodels are linked together.
- Possible ways to formulate the problem of linkage mathematically and possibilities for applying methods of optimization under uncertainty and risk have been considered.
- The integrated model incorporates quantile-based indicators and factors reflecting intra- and inter-model uncertainties, risks, and security constraints.
- The conceptual framework of hierarchical model for food, energy and water resources management under increased uncertainties and risks is shown in Figure below.

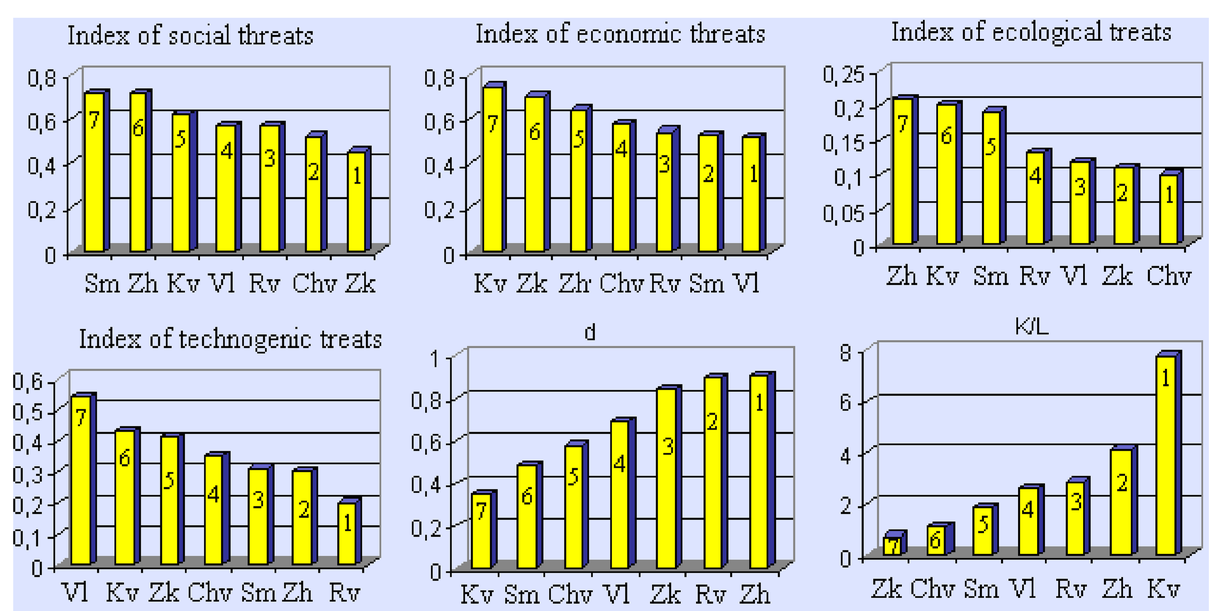


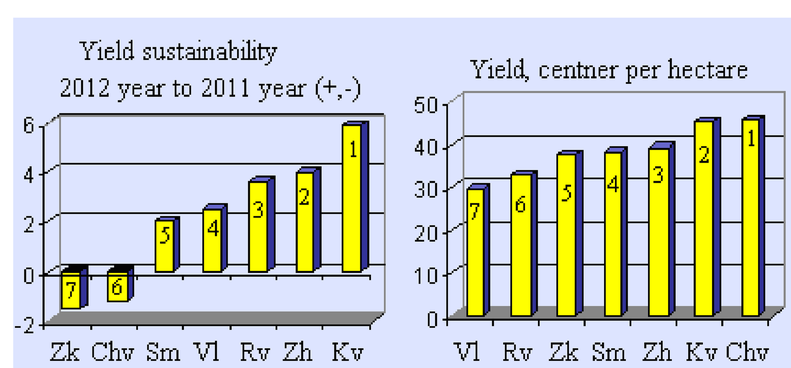
Regional investment attractiveness factor

- Cobb–Douglas type regression model has been developed to estimate investment attractiveness indicators for 27 regions of Ukraine. The estimates include such factors as gross value added by industries (agriculture, forestry, fishing, etc.), the value of fixed assets, the value of labor, and other factors reflecting, e.g., management efficiency, disaster losse, corruption and crime level, etc.



The analysis of results indicates 7 regions (d stands for production value) as the most attractive from the point of view of investing into agricultural sector (based on 2007-2010 data): Zhytomyrshchyna, Rivnenshchyna, Zakarpattya, Volyn, Chernivechchyna, Sumshchyna, and Kyivshchyna. In particular, Kyivshchyna entered this group only in 2010. Zakarpattya and Chernivechchyna have the lowest "kapital to labor K/L" ratio among all the regions within the group.





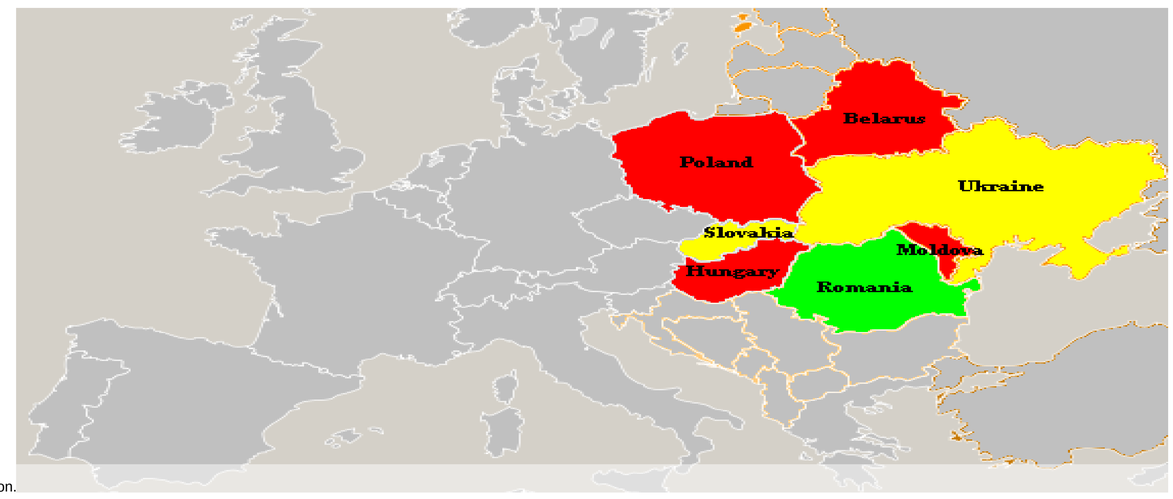
Factors determining the investment attractiveness of agricultural regions of Ukraine.

Most successful regions are Chernivtsi (Chv), Kyivshchyna (Kv), Rivne (Rv), Sumy (Sm), Volyn (VL), Zhitomir (Zh), Zakarpattia (Zk).

Major issue is that Ukraine, becoming a player on the world agricultural market, needs consolidation of its agriculture production indicators with international standards. According to the estimated production efficiency factors, the agriculture of Romania, Slovakia, and Ukraine can be characterized as having higher potential efficiency than that of Belarus, Moldova, Poland, and Hungary

Residual = (Actual value lnV) – (Computed value lnV)

Indicator for 2009 / country	Belarus	Moldova	Poland	Romania	Slovakia	Hungary	Ukraine
Computed value lnV	3,875	2,923	4,226	3,529	3,371	3,639	3,584
Residual	-0,274	-0,259	-0,081	0,496	0,125	-0,08	0,072



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