Literatúra

BIELIK, P. – RAJČÁNIOVÁ, M. 2008. Determinants of variations in firm-level performance. In: Acta oeconomica et informatica, vol. 11, 2008, no. 1, p. 1–4. ISSN 1335-2571.

BIELIK, P. – SOJKOVÁ, Z. 2006. The evaluation of effects of the subsidiary system on Slovak farms in different regions in the pre- and post- EU accession stage. In: Agricultural Economics: an international journal, vol. 52, 2006, no. 1, p. 12–22. ISSN 0139-570X.

HACHEROVÁ, Ž. – BOJŇANSKÝ, J. – HULÍK, R. 2003. Majetok a kapitál v podnikoch poľnohospodárskej prvovýroby. Nitra : SPU, 2003, 102 s. ISBN 80-8069-296-3

CHRASTINOVÁ, Z. 2008. Ekonomický vývoj poľnohospodárstva v rokoch 2004–2006. In: Ekonomika poľnohospodárstva, roč. 8, 2008, č. 1, s. 3–11. ISSN 1335-6186

GUBOVÁ, M. 2007. Analýza trendov vývoja podnikateľskej štruktúry poľnohospodárskej prvovýrobe s dôrazom na podniky hospodáriace na pôde. Bratislava : VÚEPP, 2007. 34 s. ISBN 978-80-8058-451-1

KIESO, D. E. – WEYGANDT, J. J. – WARFIELD, T. D. 2004. Intermediate Accounting. USA : Wiley, 2004. 1331 p. ISBN 0-471-07208-7.

QUICK, R. – WURL, H. J. 2006. Doppelte Buchführung. Wiesbaden : Verlag Gabler, 2006. 313 s. ISBN 10 3-8349-0388-4.

www.land.gov.sk

http://www.rokovania.sk/sppl/material.nsf

http://www.bmwa.gv.at

http://www.hnonline.sk

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IMPLEMENTATION OF TRIPLE HELIX MODEL FOR DEVELOPMENT OF THE AGRICULTURE-BASED BIOECONOMY ON THE EXAMPLE OF GMO APPLICATIONS

IMPLEMENTÁCIA „TRIPLE HELIX“ MODELU VÝVOJA BIOEKONOMIKY ZALOŽENEJ NA POĽNOHOSPODÁRSTVE (NA PRÍKLADE APLIKÁCIE GMO)

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The cooperation between university, business, and public sectors in development and implementation of biotechnological applications in agriculture and food industry is becoming very important worldwide. Such applications that focus on innovations are of the key factors determining the growth of agriculture-based bio-economy. The paper deals with application of triple helix model as a tool that enables implementation of biotechnology based projects, as well as their management thanks to network relations – a mechanism for cooperation, sharing knowledge and information. The triple helix model is used for the analysis of development and implementation of genetically modified organisms (GMO) in agriculture and food industry under two different strategies represented by the EU and the USA. It shows different compromises reached among the government, industry, scientific, and public sectors with regard to GMO application in order to ensure the development of agriculture-based bio-economy.

Key words: triple helix, GMO, agriculture, bio-economy

Modern biotechnology is seen as one of key technologies of the 21st century. In the field of plant breeding, bio-fuels, or biopharmaceuticals it has been recognized as a unique opportunity to address many emerging needs. Today biotechnology is regarded as a major contributor to achieving economic growth, stimulate job creation, strengthen public health, or increase environment protection. The advances in biotechnology contribute to the significant change towards wider and technologically-sophisticated use of bio-based products and processes. The transformative ability of biotechnology applied to a range of industries could co-deliver profitability, social and environmental gains in near future. Thus biotechnology becomes also one of the key factors of overall development. Moving towards more efficient use of bio-based products and processes biotechnology offers the prospect of developing a new economy of tomorrow – a bio-economy. The bio-economy based on renewable resources and lessening the environmental impact of industrial activities is with its novel products opening up new markets and creating new opportunities for societies.

Agricultural based bio-economy

The bio-economy could be recognized as the aggregate set of economic operations in society (OECD, 2007). It uses the latent value incumbent in biological products and processes to capture new growth and welfare benefits for citizens and nations. It is enabled by recent continuing surge in the scientific knowledge and technical competences that can be directed towards harness biological processes for practical applications. Bio-economy benefits are manifested through productivity gains (agriculture), enhancement effects (health, nutrition), and substitution effects (environmental and industrial uses i.e. energy). Additional benefits can be derived from more eco-efficient use of natural resources to provide ever growing global population with goods and services. It is expected that bio-economy applications will continue to converge with other technologies resulting in potentially large scale changes to global economies. Therefore, strategic interest is growing in the biosciences and development of bio-economy all over the world.

At the same time, technological and commercial progress in biosciences is outpacing the policy and regulatory frameworks that govern them. There are considerable uncertainties facing science, public and private actors, in terms of technology development, its commercialization, intellectual property or business models. The policy and regulatory frameworks that currently govern bioscience based activities are often unsuited to the economic, social, and environmental issues nowadays emerging.

The differences in development and implementation of genetically modified organisms (GMO) in agriculture and food sector could be taken as examples. However, countries typically follow one of two key strategies in GMO regulation. First group, represented by the United States (US) adopted the principle of substantial equivalence, while the countries from the other group represented by the European Union (EU) adhere to the precautionary principle (Shelton, 2002). Nevertheless, legal, organizational, and economic complexity of food supply chains forms a challenge not only for development of regulatory policies that are based on legal principles – which are of static nature; but also of for dynamic approaches to strategic as well as operational management at the implementation stage. Therefore the innovative processes, such as development and commercialization of GMO products are organized in the way to encompass government, academia, and business. With this regard there is observable growing role of codependences between the dynamics of creating and implementing GMO innovations in the agricultural and food sector and their national regulations.

In the development of bio-economy based on agriculture and perception of biotechnology innovations, such as GMO applications, there can be seen a process in which there is a shift from single projects to a complexity of actions that create new products, models, technologies and services. Innovative processes based on biotechnology in agricultural and food sector run therefore in a specific arrangement of links encompassing business companies, academic research institutions, and nongovernmental institutions, as well as public administration and civic initiatives. Additionally there is a growing role of codependences between the dynamics of creating and developing innovations in the private sector, and organization and development of the science and the public sector.

Triple helix model

In the development of knowledge based economy and perception of innovation, there can be observed a process in which there is a shift from single projects to a complexity of actions that create new products, models, technologies, and services. Innovative processes run in a specific arrangement of links encompassing companies, academic research institutions, nongovernmental institutions, public administration, and civic initiatives. Additionally, there is a growing role of codependences between the dynamics of creating and developing innovations in the private sector, organization and development of the public sector, and availability of dedicated financial instruments.

In 1995 Etzkowitz and Leydesdorff (1995) used a triple helix model to determine the dynamics of relations between universities, business, and government. Under specific conditions, this systematic new order of overlapping communication was presented as an independent organization. In this way, the triple helix model becomes appropriate to show various behaviors in a network. A justification for this model was an innovative regime based on knowledge. The institutional configuration in a knowledge based system has been perceived as an expression of three, functionally connected sub-dynamics of competitive systems: a dynamics of generation of wealth by an economy through exchange, knowledge based dynamics of innovation, and political and managerial need for control over relations. Additionally to that Metha (2002) showed that only a consensus with the fourth element – the public – as a final recipient of innovation could ensure effective implementation and management of knowledge base systems. A benefit of using the triple helix model can be its approach to various research scopes. It can be used to study specific configurations in university – business – administration relations as a form of dynamics of the system based on knowledge. However it should not be treated as a tool for individual relations between business, academic, and administrative sectors. These institutions have to create a new meaning of mutual relations in a network configuration (Leydesdorff, 1999).

Management of biotechnology through network relations

Contradictory aims of the elements constituting triple helix model often lead to the conflicts between the sectors in subject participating in development and commercialization of GMO in agricultural and food sector. Commercially oriented biotechnology companies are interested in the continuous innovation and implementation of solutions with less risk assigned to them. Hence the companies most often seek innovations that will enhance the area that they are already engaged in, and consequently lift them to new business reality. Thus the business sector prefers the projects that allow for fast implementation. Contrary to that the scientific society, however also interested in researching the continuous innovations, prefers more partial to long term researches and very complex attitude. The implementation process is slowed down, which is difficult to be accepted by business. On other hand, the framework preferred by the government often does not cover the areas that are most attractive to scientists or businesses. As a result there arises the conflict between the business and scientific approaches and the needs of administration, which are especially related to the governmental programs orchestrating financing of innovative projects.

Abovementioned conflicts can be reduced through interactions and better understanding of the interdependencies between the governmental agencies, scientific, and business sectors. Preoccupied with the tasks on different stages of development and implementation of GMO application they often destroy the possibility to build strong and enhancing adherence. Lack of proper communication hampers transfer of knowledge and does not allow for sharing experiences. In effect this leads to reduction of the possibility to transform the conceptions of biotechnology project into commercialized innovations. If there is insufficient interaction within business and science, and furthermore among possible users and regulators of GMO application, the moment when their work is presented is very often the time when the product is finished, the resistance of the unprepared future users and regulators may put at risk the implementation of the project effects.

Development of biotech based agriculture

In 2006, the first year of the second decade of commercialization of biotech crops, the global area of biotech crops continued to climb for the tenth consecutive year at a sustained double-digit growth rate of 13 %, or 12 million hectares reaching 102 million hectares. It is notable that the year-to-year increase of 12 million hectares in 2006 is the second highest in the last 5 years in absolute area, despite the fact that the adoption rates in the US, the principal grower of biotech crops (~60 % of world cultivation area), are already over 80 % for soybean and cotton. In 2006, the 22 countries growing biotech crops comprised 11 developing countries and 11 industrial countries. They were, in order of hectarage: USA, Argentina, Brazil, Canada, India, China, Paraguay, South Africa, Uruguay, Philippines, Australia, Romania, Mexico, Spain, Colombia, France, Iran, Honduras, Czech Republic, Portugal, Germany, and Slovakia. Notably, the first eight of these countries grew more than 1 million hectares each. On this list there are 6 countries being members of the European Union. In 2006, the global market value of biotech crops was $ 6.15 billion representing 16 % of the $ 38.5 billion global crop protection market in 2006 and 21 % of the ~$ 30 billion 2006 global commercial seed market. The market value of the global biotech crop market is based on the sale price of biotech seed plus any technology fees that apply. The global value of the biotech crop market is projected at over $ 6.8 billion for 2007 (Jamies, 2007).

Strategies for application of biotechnology in agriculture

Countries' positions on GMO application in agriculture depend on many factors, such as their policy awareness, the level of risk they are willing to accept, their capacity to carry out risk assessments in the sector and implement adequate legislation, their perception of the benefits they could gain from biotechnology, their dependence on agricultural exports, their reliance on food aid, and the investments they have already made in the sector (Zarrill, 2005). However, at present there is a sharp contrast between the widespread acceptance of benefits of biotechnology in pharmaceuticals and industrial products, and the rapidly growing concerns about its possible dangers in agricultural and food production (Eurobarometer, 2006).

Assessments of the risks and benefits related to biotechnology in agriculture and food sector vary substantially between countries and regions, and so do the regulatory approaches (rules on GMO approval, marketing, import, labeling, and documentation).

GMO regulations are based on the assessment of the actual or potential risks that those products may bring about. Such assessment can be a "conventional" risk assessment or a risk assessment based on the precautionary approach. The former is about relevant scientific evidence, which means that there is sufficient scientific evidence for the perceived risks underlying the measure. Conversely, the "precautionary approach" to risk assessment is concerned with scientific uncertainty whether there is adequate theoretical or empirical basis for assigning possibilities to a possible set of outcomes. Three basic conditions may thus trigger application of protective measures: uncertainty, risk, and lack of proof of direct causal link (Christoforou, 2003). With respect to GMO, the problem of defining the relationship between business, science, and policy in risk regulation is by and large a matter of regulatory culture deeply embedded in underlying socio-economic settings. As an example the United States has substantially applied the conventional risk assessment approach, and has widely authorized most GM products for production and consumption. The GMO development and commercialization is based on close relations and cooperation between the science and business sector with good information exchange with administration. Opposite to that, the regulators i.e. in the European Union have taken up a more cautious approach based on guaranteeing a very low level of risk to human health and the environment. They have therefore imposed strict control measures on approval and marketing of GMO. As an effect the cooperation between business, science, and administration is limited to fulfilling legal obligations, without additional communication.

The differences between the US and the EU strategies of GMO development, commercialization and regulation show the divergence of management of relationships between business--science and government. As a result the EU dynamics of innovations' implementation through GMO products is slower comparing to the US. The higher US dynamics of generating economic benefits thought implementation of GM is accompanied with lower governmental control over relations comparing to the EU. Thus the compromise among the governmental, industrial, scientific and public sectors in the US and the EU is reached due to different intensiveness of dynamics of creating and developing innovations and management of their implementations.

Conclusions

The cooperation between university, business, and public sectors in the development and implementation of biotechnological applications in agriculture and food industry is becoming important worldwide at the beginning of 21^{st} century. Such applications that focus on innovations are of key factors determining growth of bio-economy based on agriculture. In the development of agriculture-based bio-economy on the example of biotechnology innovations, such as GMO applications, there can be seen a process in which there is a shift from single projects to a complexity of actions that create new products, models, technologies, and services. Innovative processes based on biotechnology in agricultural and food sector run therefore in a specific arrangement of links encompassing business companies, academic research institutions, and public administration. There is a growing role of codependences between the dynamics of creating and developing innovations, such as GMO applications in the science and the private sector, and organization and development of the public sector while these innovations are being implemented.

The triple helix model used for studies of specific configurations in university – business – administration relations with regard to GMO showed different forms of dynamics of development of a system based on knowledge.

This dynamics is not based on individual relations between business, academic, or administrative sectors. The development is achieved by mutual relations in the network configuration of these sectors. Applying different strategies for GMO development and commercialization the United States adopted the principle of substantial equivalence, while the European Union adhered to the precautionary principle. As a result the EU dynamics of implementation innovations through GMO products is slower comparing to the US. Higher US dynamics of generating economic benefits thought implementation of GMO is accompanied by lower governmental control over relations, and higher information exchange comparing to the EU.

Súhrn

Spolupráca medzi akademickým, hospodárskym a verejným sektorom pri vývoji a implementácii biotechnologických aplikácií v poľnohospodárstve a potravinárskom priemysle sa v celosvetovom meradle stáva čoraz dôležitejšou. Aplikácie, ktoré sa zameriavajú na inovácie, patria ku kľúčovým faktorom determinujúcim rast bio-ekonomiky založenej na poľnohospodárstve. Článok sa zaoberá aplikáciou „triple helix“ modelu (model trojitej špirály) ako nástroja, ktorý umožňuje implementáciu a manažovanie projektov založených na biotechnológiách, a to vďaka sieťovej forme vzťahov, využitej ako mechanizmus kooperácie a zdieľania vedomostí a informácií. „Triple helix“ model je tu využitý na analýzu vývoja a implementácie geneticky modifikovaných organizmov (GMO) v poľnohospodárstve a potravinárstve, a to podľa dvoch rozdielnych stratégií uplatňovaných v Európskej únii a USA. V článku sú uvedené kompromisy týkajúce sa využitia GMO, ktoré boli dosiahnuté predstaviteľmi vlády, priemyslu, vedeckého a verejného sektora s cieľom zabezpečiť vývoj bioekonomiky založenej na poľnohospodárstve.

Kľúčové slová: model trojitej špirály (triple helix), poľnohospodárstvo, GMO, bioekonomika

References

CHRISTOFOROU, Th. 2003. The Precautionary principle in European Community Law and Science”. In: Tickner J.A. (ed.) “Precaution, Environmental Science, and Preventive Public Policy”. Island Press : Washington, DC

EUROBAROMETER. 2006. Europeans and Biotechnology 2005. Patterns and Trade. Brussels

ETZKOWITZ, H. – LEYDESDORFF, L. 1995. The Triple Helix – University – Industry – Government Relations: A Laboratory for Knowledge Based Economic Development. EASST Review, no. 14.

JAMES, C. 2006. Global Status of Commercialized Biotech/GM Crops: 2006. ISAAA Brief No. 35. ISAAA : Ithaca, New York.

LEYDESDORFF, L. 1999. The Mutual Information of University – Industry – Government Relations: An Indication of Triple Helix Dynamics. ASCoR.

MEHTA, M. 2002. Regulating Biotechnology and Nanotechnology in Canada: A Post – Normal Science Approach for Inclusion of the Fourth Helix. Presented at the International Workshop on Science, Technology and Society: Lessons and Challenges. National University of Singapore.

Organisation for Economic Co-operation and Development. 2007. Survey on Managing the Transition to a Bio-based Economy. Paris

SHELTON, I. M. 2002. Regulation of biotechnology: will we ever “freely” trade GMOs?. In: European Review of Agricultural Economics, Oxford : Oxford University Press, vol. 29, 2002, no. 1.

ZARRILLI, S. 2005. International trade in GMOs and GM products: national and multilateral legal frameworks. Policy issues in international trade and commodities, study series no. 29. UNCTAD United Nations, New York and Geneva

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