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STOWARZYSZENIE EKONOMISTÓW ROLNICTWA I AGROBIZNESU
Roczniki Naukowe ● tom XVI ● zeszyt 3

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IMPLEMENTING ECO-INNOVATIONS. DETERMINANTS AND EFFECTS

WDRAŻANIE INNOWACJI EKOLOGICZNYCH. PRZESŁANKI I SKUTKI

Key words: eco-innovations, motivations of eco-innovations, effects of eco-innovations
Słowa kluczowe: innowacje ekologiczne, przesłanki wdrożenia, skutki implementacji

Abstract. The article aims to analyze the concept of eco-innovations emphasizing the motivations for implementing them, and effects of the eco-innovation process. The author presents the principal definitions of eco-innovations. Various motivations triggering eco-innovations are presented with a focus on regulatory and market factors. Entrepreneurs should be encouraged to adopt eco-innovations because they contribute to sustainable development which is the only way for a world that is challenged by global population growth, climate change, declining non-renewable resource stock, water shortages, and environmental degradation. The effects of eco-innovations can be both positive and negative. The main aim of eco-innovations is to decrease the environmental burdens of entrepreneurial activity. However, a new attitude towards eco-innovations emphasizes the role of economic returns and supplies security. The types of effects of environmentally friendly innovations discussed in the paper include environmental, technological, economic, social, cultural and managerial.

Introduction

Nowadays, it is crucial for societies to understand innovation processes in terms of environmental effects. There is a demand for a drastic reduction of environmental burdens. Decision makers, business people and consumers should be aware of resource scarcity and environmental degradation. They should look for, support and promote technologies which increase resource efficiency. The discussion about environmental friendly innovations seems to be important because new technologies need quite a long time for invention, adaptation, and for diffusion, respectively. It is important to discuss the motivations and results of environmentally related innovations in order to encourage policy makers, heads of associations, unions and churches, innovators, business people and customers to get involved in "green technologies".

Material and methods

The paper aims to analyze the concept of eco-innovations, emphasize the motivations for implementing them, and discuss the short and long-term effects of the eco-innovation process. The methodology behind the paper is based on a review of recent literature and initiatives concerning eco-innovations taken by the Organization for Economic Cooperation and Development (OECD), Eco-innovation Observatory (EIO), and European Commission.

The concept of eco-innovation

According to *Oxford Advanced Learner's Dictionary of Current English*, innovation is "something new that is introduced", and innovate means "make changes, introduce new things" [Hornby 1980]. Rogers in his book *Diffusion of Innovations*, first published in 1962, defines an innovation as "an idea, practice, or object that is perceived as new by an individual or other unit of adoption" [Rogers 1962]. The concept of innovation has been evolving since its very beginning and, thus the role of innovations has been changing. Innovations have become one of the main sources of competitiveness. The aim of each innovation can be quite different. An enterprise can introduce

an innovation to enlarge current assortment, to enter a new market, to increase a production elasticity, to reduce costs of production, to improve work conditions and so on [Leszczyńska 2011]. Governments, institutions and international organizations are also interested in innovations to benefit from them. Beneficiaries of such innovations, introduced by the wide range of entities, differentiate. The whole society or nation can take advantage of an innovation. A good example of such an innovation is eco-innovation.

The idea of eco-innovation is quite recent. The eco-innovation concept appeared in the 1990s in the book by Claude Fussler and Peter James *Driving Eco-Innovation: A Breakthrough Discipline for Innovation and Sustainability* [Fussler, James 1996]. The authors define eco-innovations as "new products and processes creating value for enterprises and clients and reducing (negative) environmental effects". In a subsequent article, Peter James defines eco-innovation as "new products and processes which provide customer and business value but significantly decrease environmental impacts" [James 1997]. It's worth noticing that to a considerable degree, even companies do not know whether a new product, leading to less environmental burdens, is new to the market or only to them. Therefore the definition of eco-innovation may not distinguish between eco-innovation and technology diffusion or adoption [Rennings, Rexhauser 2010]. According to Fussler and James, eco-innovations equal sustainable innovations because each eco-innovation contributes to sustainable development, applying the commercial application of knowledge to elicit direct or indirect ecological improvements.

According to the OECD, eco-innovation is an innovation that reflects the concept's explicit emphasis on a reduction of environmental impact, whether such an effect is intended or not. It is not limited to innovation in products, processes, marketing methods and organizational methods, but also includes innovation in social and institutional structures [Rennings 2000]. Eco-innovation and its environmental benefits go beyond the conventional organizational boundaries of the innovator to enter the broader societal context through changes in social norms, cultural values and institutional structures. Eco-innovation can be understood and analyzed in terms of an innovation's target (products, processes, marketing methods, organizations and institutions), mechanism (modification, re-design, alternatives and creation), and impact [*Sustainable manufacturing*... 2009]. Impact refers to the eco-innovation's effect on the environment. Potential environmental impacts stem from the eco-innovation's target and mechanism and their interplay with its sociotechnical surroundings [*Sustainable manufacturing*... 2009].

Horbach, Rammer and Rennings define environmental innovations as product, process, marketing and organizational innovations leading to noticeable reduction of environmental burdens. Positive environmental effects can be explicit goals or side effects of innovations. They can occur within the respective firms or by using products or services by the customers [Horbach et al. 2010].

The definition of eco-innovation formulated on the basis of the newest strategic documents and research studies say that it is an innovation that improves natural resources' efficiency, reduces environmental burdens of human's entrepreneurial activities or strengthens the economy's resistance to environmental pressures [Szpor, Śniegocki 2012, *Better policies*… 2011, *Towards green*... 2011, *Sustainable manufacturing*... 2011, *Fostering innovation*… 2011, *The eco-innovation*... 2011, *Innowacja na rzecz*... 2011]. This up-to-date eco-innovation approach emphasizes three major aims of environmental innovations: reduction of environmental burdens, resource efficiency and cost reduction, and it supplies security.

Environmental technologies (process or product technologies) may be divided into integrated technologies (preventive) and additive technologies (end-of-pipe). End-of-pipe technologies reduce or eliminate environmental burdens but do not avoid new pollutions. Integrated technologies prevent the formation of pollutants and are designed to decrease both the amount and the quality of pollution during the production process [Leszczyńska 2011, Kijek 2013].

Governments and EU legislations define technical eco-innovation as installations. In the European Union directive 96/61/EC concerning integrated pollution prevention and control, emission limit values should be based on the best available techniques (BAT). "Best" shall mean most effective in achieving a high general level of protection to the environment as a whole.

Determinants

It is common to use a simple framework for separating four groups of factors that have been found as main determinants of eco-innovations in the literature: company strategies, technology, market and regulation. However, most studies concentrate on regulation and market forces.

There are various motivations triggering eco-innovations. For sure, there is an important role of regulations and cost-savings for environmental innovations. However, a set of supply and demand factors also motivate eco-innovations. These factors include: availability of technological resources, company specific factors (e.g. knowledge transfer mechanisms and involvement in networks), organizational innovations, competition conditions, policy variables and customer demand. There is some empirical analysis based on the German part of the Community Innovation Survey conducted in 2009 that shows which factors are significant for each environmental area (air, water or soil pollution, noise emissions, energy consumption, recycling, dangerous substances etc.) [Horbach et al. 2010]. Horbach, Rammer and Rennings confirmed in their analysis that regulations seem to be important for almost all environmental areas (except the field "reduced material and energy use"). Their results of research show that different areas of environmental impact need different policy approaches. Some fields do not need strict regulatory approaches (e.g. material or energy savings), and other fields still need strict environmental regulation measures (e.g. the replacement of dangerous substances or noise reduction). It turns out that cost savings are the main motivations for energy saving. Environmental Management Systems (EMS) seem to be especially important tools to trigger cost saving cleaner technologies because they help to overcome incomplete information within an enterprise. Subsides are very important for CO^2 emissions, a relatively young innovation area which still highly depends on public funds. Self-commitments are relevant for all environmental innovation areas, but especially important for recycling [Horbach et al. 2010].

Overall, decisions taken by enterprises about implementing eco-innovations may be considered as an aspect of interaction between two groups of external factors, economic-market and administrative-warrant factors [Leszczyńska 2011, Kijek 2013]. There is a survey described in the literature conducted in 2011 by Gallup Hungary at the request of the European Commission which proves that an implementation of environmentally-friendly innovations is strongly stimulated by such external factors as: expected future increases in energy prices, current high energy prices and current high material prices. The same research shows that existing regulations rarely are significant determinants of the process of eco-innovation absorption [Gallup 2011]. The analysis of Kijek show that the factors significantly positively affecting eco-innovation implementation include: an increase in market demand for "green" products, current high prices of materials and access to subsidies and fiscal incentives [Kijek 2013].

Regulations, subsides, fees and taxes drive some eco-innovation processes; however, national tools are much more significant for the process than international ones. It is important to integrate innovation and environmental policies to promote eco-innovations efficaciously. It's a matter because innovation policy in most countries has been the responsibility of ministries for trade and industry and science and technology, while environmental policy has usually been developed by environment ministries, and usually not too much effort has been made to integrate these two policies [*Sustainable manufacturing*... 2009].

Market determinants of eco-innovations implementation cannot be neglected either because they are also of high importance. However, it is difficult to generalize their influence on the implementation of environmentally friendly innovations because local market conditions vary and are crucial for innovators. Positive attitude of innovators towards environment and their willingness to contribute to "green technologies, processes and products" seem to be weighty for eco-innovations.

It is worth mentioning the main obstacles of eco-innovation implementations. First of all, an eco-innovation's receiver will probably not be able to evaluate benefits of such an innovation because of lack of competences in this field. Secondly, a lot of eco-innovations projects are uncertain in terms of economic returns and they are usually long-lasting. What is more, there are not to many qualified people with green skills. Other problems are financial limits of enterprises and old infrastructure incompatible with new projects [Szpor, Śniegocki 2012].

Effects

First of all, eco-innovations lead to noticeable reduction of environmental burdens, caused by manufactures, households, farms, research institutes and so on. Such innovations may improve energy, resource and material efficiency, recycling and waste management, water management etc. Thus, eco-innovations contribute to sustainable development and green growth [www.greengrowthknowledge.org]. The effects of eco-innovations are noticeable not only for an innovator but for much more consumers, even the whole society or nation. Thanks to eco-innovations, consumers' quality of life should improve. In the long run, eco-innovations change social norms, cultural values and institutional structures. What is more, technical eco-innovations stimulate a creation of new innovations.

While implementing an eco-innovation, business people usually hope for an economic success of such a change. However, benefits from the absorption of environmentally-friendly innovations are quite often not sufficient enough in relation to expenditures. It is a result of an easy access to the knowledge and technology connected witch such an innovation, and a character of environmental benefits which are common goods [Leszczyńska 2011].

Nevertheless, there are some empirical studies conducted by Horbach, Rammer and Rennings which say that the majority of eco-innovations implementations surveyed lead to lower or constant cost, and one third of them are connected with a higher turnover so that they are also economically successful [Horbach et al. 2010]. When looking at the returns of innovations in terms of productivity, it can be observed that eco-innovations exhibit a generally lower return relative to other innovations, at least in the short run. In the medium-long run, the positive effects of eco-innovations on competitiveness should be noticed more frequently. The returns of such innovations depend a lot on the creation of new markets for "green" technologies [Marin, Lotti 2013]. In the short run, eco-innovations may increase an energy efficiency and profitability of an enterprise. But in the long run, same eco-innovations may cause higher energy prices so that operation costs grow and profits drop.

In general, by implementing ecoinnovation, businesses may increase their ability to access various markets, enhance the company's technical capacity and increase profitability through more efficient use of resources. Businesses should learn how to use eco-innovation as a strategic business tool that will enable them to meet customer needs and gain competitive advantage in the long run. Eco-innovations can positively influence the competitiveness and growth of firms, but the primary effect of environmental innovation activity is aimed at reducing negative externalities of entrepreneurial activity. Reducing negative externalities may entail higher costs at the side of producers without generating additional income for them [Rennings, Rammer 2010]. Environmental innovations can have both positive and negative effects. The results of eco-innovations depend a lot on a field of the innovation. The analysis of Rennings and Rammer show that innovators in the vehicle sector have achieved above average sales shares. However, the adopters of these innovations in the transport industry had to pay the costs, and may have in fact experienced a loss of competitiveness. In waste and recycling field it may have been easier to pass through the additional cost to the customer, and in the field of resource efficiency some cost savings may have offset the costs [Rennings, Rammer 2010].

It is worth to add that eco-innovations seem to be especially important in food production. People buy and consume food every day and they are usually very sensitive about what they eat and what they offer the members of their family. New models of food production and consumption are needed to secure food supplies while reducing the environmental impact of existing patterns. On the supply front, businesses need to adopt innovative business models and actively involve employees in plans to increase resource efficiency and cut waste. On the demand side, more efforts appear necessary to encourage more sustainable consumption patterns. Thanks to eco-innovations, environmental conditions, the quality of food and the quality of life could improve significantly.

While looking at Eco-Innovation Scoreboard 2013 developed by Eco-Innovation Observatory, Poland is last but one out of all European Union countries. However, Poland has problems with

innovations in general. Low R&D expenditures, both public and private, and few patent applications every year are the main reasons of Poland's weakness in innovation field. Nevertheless, there are more eco-innovations than other innovations in Poland. To promote eco-innovations in polish economy it is crucial to increase an overall innovatory potential of Poland and to inform entrepreneurs about advantages of eco-innovations implementation and environmental regulations. Other necessary points are: effective activities of public administration, proper financing and compatible infrastructure [Szpor, Śniegocki 2012].

Conclusions

Nowadays, innovation has become one of the main sources of competitiveness. It is important for current and future societies to adjust innovation processes to challenges of the future, such as: global population growth, climate change, declining non-renewable resource stock, water shortages, and environmental degradation. Eco-innovations, also called sustainable innovations, rise to this challenge. There are many types of eco-innovations (reducing air, water or soil pollution, noise emissions, energy consumption, emission of dangerous substances etc.), but all of them decrease environmental burdens of entrepreneurial activity, intentionally or not. This is the main aim of each eco-innovation; however, there is a wide range of effects of environmentally friendly eco-innovations. The newest definition of eco-innovation emphasizes both environmental and economic aims of such an innovation. While implementing an eco-innovation, business people usually hope for an economic success of such a change. Unfortunately, eco-innovations exhibit a generally lower return relative to other innovations, at least in the short run. It is a result of an easy access to the knowledge and technology connected witch such an innovation, and a character of environmental benefits which are common goods. However, there are some international surveys conducted which show that a significant part of eco-innovations lead to lower or constant cost, higher turnover, increase competitiveness and are the source of growth of firms. Nevertheless, in the long run, eco-innovations which give energy savings may lead to an increase in energy prices.

To promote an involvement in eco-innovation processes, the motivations triggering environmentally related innovations are worth knowing. Both the determinants and the results of eco-innovations depend on the environmental field of such innovations. In general, there are four groups of determinants of eco-innovations: company strategies, technology, market and regulation. Numerous studies confirm that regulations seem to be important for almost all environmental areas, especially national regulations. Same studies prove that eco-innovations are strongly stimulated by such factors as high energy and material prices, and an increase in market demand for "green" products. Eco-innovations also require governmental support, well-informed entrepreneurs, financial resources, and compatible infrastructure.

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Streszczenie

W pierwszej części pracy przedstawiono pojęcie ekoinnowacji. Analiza problemu dotyczyła głównie przesłanek i skutków wdrażania innowacji przyjaznych środowisku. Główne determinanty wdrażania innowacji ekologicznych w przedsiębiorstwach to regulacje formalno-prawne oraz czynniki o charakterze rynkowym. Warto zachęcać przedsiębiorców do innowacji ekologicznych, gdyż wpisują się one w zasady rozwoju zrównoważonego, który jest jedynym wyjściem w obecnym świecie, w którym szybko wzrasta liczba ludności, nieodwracalnie zmienia się klimat, kurczą się nieodnawialne zasoby, brakuje wody, a środowisko naturalne jest coraz bardziej zdegradowane. Skutki wdrażania ekoinnowacji mogą być zarówno pozytywne, jak i negatywne. Celem innowacji ekologicznych jest przede wszystkim zmniejszenie negatywnych skutków działalności gospodarczej na środowisko naturalne, choć zgodnie z nowym podejściem, cele ekologiczne mają współgrać z celami ekonomicznymi. Inne konsekwencje wdrażania ekoinnowacji, to m.in.: zmniejszenie lub zwiększenie kosztów produkcji, zmiany wewnątrz organizacji o charakterze kulturowym, społecznym, organizacyjnym, pobudzenie kolejnych innowacji, wzrost konkurencyjności przedsiębiorstw, wejście na nowe rynki, wzrost sprzedaży i poprawa jakości życia konsumentów.

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