SOCIETY. INTEGRATION. EDUCATION
Proceedings of the International Scientific Conference. Volume VI, May 24th -25th, 2019. 430-440

GLOBAL G.A.P. AND INTEGRATED PLANT PRODUCTION AS A PART OF THE INTERNALIZATION OF AGRICULTURAL FARMS

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Abstract. *Internationalization of farms involved in agricultural production requires ensuring appropriate quality of products, compliant with requirements of specific markets. Consumers from developed countries more and more often draw attention to the origin of food products and confirmation that they were produced in accordance with recognized environmental standards, while simultaneously respecting human rights. The aim of this research study was to assess the extent of changes in production technology and in the management system under conditions of implementing the GLOBAL G.A.P. system on selected fruit and vegetable farms associated in producer groups. The second aim was to evaluate the quantity of sold products along with specific certificates. The research was conducted in 2016; 91 vegetable farms and 71 fruit farms were studied. The results of the conducted research show that implementation of standards required creation of a quality management system on all the studied farms. The implementation of standards required creation of procedures for production management as well as the traceability system. The implementation of standards caused the necessity to change the infrastructure for storage and use of plant protection products and fertilizers, as well as infrastructure improving workers' social conditions. The study results indicate that changes associated with the implementation of the GLOBAL G.A.P. standard applied more to vegetable farms than fruit farms. The implementation of the GLOBAL G.A.P. standard significantly increased producers' chances to introduce products on the market through commercial networks and by selling them to foreign markets.*
Keywords: *Certification, farm internationalization, GLOBAL G.A.P., quality systems, food safety*

http://dx.doi.org/10.17770/sie2019vol6.3902

Introduction

Globalization of the agri-food product market leads to the need to ensure product safety in the entire supply chain (Kocira, Kuboń, & Sporysz 2017). Quality management systems in food processing, as well as at individual stages of the logistic chain, have been being implemented since the beginning of the 1970s. The HACCP system is the basic quality management system in food processing. It ensures execution of a risk analysis for the processes being carried out, as well as identification of the critical control points. The HACCP system is obligatory in food processing, in order to prevent food safety hazards (Regulation (EC) No 852/2004). Development of quality management systems in primary production resulted from the risk of pollution (intentional or unintentional) of products at the stage of crop cultivation, harvest and post-harvest measures (Szeląg-Sikora, Niemiec, Sikora, & Chowaniak, 2017). Optimization of production and logistics processes is very important in order to reduce energy consumption and increase work efficiency (Kuboń & Krasnodębski, 2010; Ivanyshyn et al., 2018). Food safety at the stage of primary production is therefore strategic in production of food, of both plant and animal origin. Farm control systems and systems used to ensure production safety are created at the national level in many countries and so they can vary. This results from the economic, cultural, climatic or political conditions. There is therefore a risk that products generated in compliance with local law will not meet the quality criteria demanded by consumers in target countries (Rajkovic et al., 2017). It applies particularly to issues connected with environmental and social aspects in developing countries. Presently, among environmental aspects, the amount of emission of greenhouse gases is very important, not only at the stage of production but also of distribution of products (Jacyna, Wasiak, Lewczuk, Chamier-Gliszczyński, & Dąbrowski, 2018). Food production consistent with local law in these countries is frequently insufficient to satisfy the aware consumer. Generally, local legislation in the countries that are part of the World Trade Organization is compliant with international standards concerning microbiological safety, content of pesticide residues in products or phytosanitary safety (Zhang, Godefroy, Lyu, Sun, & Fan, 2018; Chaoniruthisai, Punnakitikashem, & Rajchamaha, 2018). However, requirements of commercial networks are very frequently more restrictive than it stems from legislation. It is possible to meet them through formal quality management systems, the most popular of which is GLOBAL G.A.P. (Good Agricultural Practice). The GLOBAL G.A.P. standard was created based on HACCP, Cdex Alimentarius as well as Good Agricultural Practices. Decisions associated with production as well as management of soil and infrastructure should be made based on risk analysis (Kibet, Obare, & Lagat, 2018). Implementation of a quality system at the level of primary production

involves incurring costs of changes in production technology, as well as costs of infrastructure indispensable to ensure compliance with the principles of the standard. Improvement of the position on the goods market as well as increasing the chances of acquiring new markets in other countries are the expected effect of implementing a standard. Vegetable and fruit production in Poland is aimed at export, both to third countries as well as within the European Union (Szeląg-Sikora, Cupiał, & Niemiec, 2015). Apples, carrot, onion and soft fruits are among the most important plants in Poland intended for foreign markets. Being in possession of the GLOBAL G.A.P. certificate is very often a fundamental criterion for the possibility of product sales. GLOBAL G.A.P. is a food quality system that is based on sustainable use of environmental resources, energy, as well as means of production. The purpose of this system is to generate yields of good quality while maintaining production profitability. According to the assumptions of this system, pesticide use should be preceded by results of in-depth monitoring of crops, as well as in the situation when non-chemical protection methods turned out to be ineffective. Fertilization should be preceded by execution of soil tests and adjustment of fertilizer doses to plant nutritional requirements (Niemiec, Cupiał, & Szeląg-Sikora, 2015), whereas tests of water, natural fertilizers and products should result from the risk analysis. Organic materials used for fertilization may contain substances harmful to plants or product safety (Sikora, Niemiec, & Szeląg-Sikora, 2018). The primary purpose of the standard is to assess safety of plant products introduced into the market and to reduce the negative impact of agriculture on the natural environment. An additional purpose is to build a positive image of agriculture.

The aim of this research study was to assess the extent of changes in production technologies and the management system under conditions of implementation of the GLOBAL G.A.P. system on selected fruit and vegetable farms. The second aim was to evaluate the effect of implementing the standard on the potential of selling the products through commercial networks and to foreign markets.

Materials and methods

To achieve the established aim, a survey was conducted in 2016. The survey comprised 91 vegetable farms and 71 fruit farms. Farms associated in producer groups as well as individual farms were selected for the survey. The material for the research was selected using the targeted selection method. The selection criteria concerned the scale of production and the economic significance of the cultivated plants. The farms were located in the following provinces: Małopolskie, Łódzkie, Mazowieckie, Kujawsko-pomorskie, Świętokrzyskie. Material for the survey was purposefully selected. Commercial farms were used

in the survey; those farms use the latest technologies and means in production, and they achieve high yields. Data came from questionnaire surveys based on which it was estimated what kind of technological and infrastructural changes the surveyed farms had to introduce in order to ensure compliance with the introduced quality system management, and to what degree the certificate is useful for selling products. The questions concerned the area of indispensable changes in production and infrastructure. The field of research was divided into ranges according to the GLOBAL G.A.P. checklist and comprised: managing the production site; record keeping; workers' health, safety and welfare; waste and pollution management; environmental protection; protecting food against intentional wrongful acts; traceability and segregation. Questions about the share of sales of certified products and about the sales of certified products to foreign markets constituted another group. In the case of fruit farms, 50 produced apples and 20 produced soft fruits. The surveyed vegetable farms produced carrot, cabbage, cucumber and onion. All the surveyed farms had implemented a quality management system not earlier than five years prior to the survey. The average cultivation area of the surveyed fruit farms was 16.72 ha, whereas of the vegetable farms – 27.52 ha. In the case of the fruit farms, generally all crops were subjected to certification, whereas on vegetable farms only part of the crops were subjected to certification. In the case of vegetable farms, half of them were farms with an area above 20 ha. Farms with an area between 10 and 15 ha (Figure 1) were the largest group among the fruit farms.

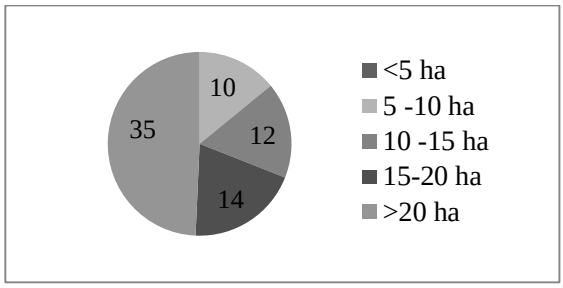

Figure 1 ***Number of vegetable farms in particular groups of cultivated area***

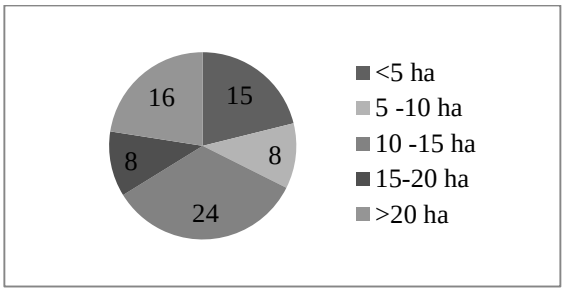

Figure 2 ***Number of fruit farms in particular groups of cultivated area***

Results and discussion

Implementation of quality systems in primary production entails the necessity of incurring high costs, consisting of charges for certification, consultancy, infrastructural changes as well as changes in production technology, which are frequently connected with increasing cost intensity (Gródek-Szostak, Szeląg-Sikora, Sikora, & Korenko, 2017). These factors limit, and sometimes prevent implementation of quality management systems, particularly in countries

where small farms (with a small production scale) are dominant. Kibet, Obare, & Lagat (2018) in the case of farmers producing beans in Kenya, as well as Marschke & Wilkings (2014) in the case of fish producers in Vietnam, also point to that problem. Partzsch & Kemper (2019) draw attention to similar problems in the case of certification of cotton production. Requirements concerning a certificate apply only to commercial network markets. In general, a traditional market does not demand quality certificates, that is why cheaper products on the traditional market can compete with certified products. Producers make a decision regarding certification based on risk analysis. Costs incurred for certification must be transferred onto consumers. That is why it is strategic to build their awareness about the need to increase product safety and to reduce the negative impact of agriculture on the environment (Kuboń, Sporysz, & Kocira, 2017). Carlsson, Khann Nam, Linde-Rahr, & Martinson (2007) draw attention to non-economic aspects of rationalization of production in agriculture. For some producers certification of production for compliance with production systems that take into account environmental and social aspects is of great importance in building the image. Entities implementing the principles of pro-environmental production systems gain a higher social status, and thus have a better position in the market through increased consumer trust (Ibanez & Blackman, 2016). One of the main problems with certification of quality management systems is their inadequacy to the producers' market that is based on small farms (Azhar, Prideaux, & Razi, 2019). High fragmentation of farms is a characteristic feature of vegetable and fruit production in Poland. Functioning of small family farms that produce vegetables is strongly rooted in the tradition of Polish agriculture, that is why development of such production is of great importance – not only economic but also social. Development and implementation of an effective quality management system is difficult and expensive, and thus unattainable for many small farms, as has been pointed out by many researchers of this problem (Walters et al., 2016; Tran & Daisaku, 2018). Azhar, Prideaux, & Razi (2019) draw attention to the high risk of implementing the GLOBAL G.A.P. system, associated with failure to meet quality standards of products despite complying with the principles of this standard. However, Tran & Disaku (2018) stress that despite considerable costs of implementing and administering the quality management systems, producers gain higher financial benefits and a stronger position in the market.

Table 1 ***Number of farms on which changes as a result of implementation of GLOBAL G.A.P. were necessary (%)*** *(own elaboration)*

	Vegetable farms	Fruit farms
Managing the production site		
Creation of a decision-making system based on risk analysis	100.0	100.0
Creation of a production data archiving system	71.4	53.5
Workers' health, safety and welfare		
Implementation of formal hygiene procedures	100.0	83.1
Introduction of a system of employee training	75.8	62.0
Implementation of the use of personal protection means	44.0	32.4
Extension of the social part (workers' rest areas, accommodation conditions)	89.0	76.1
Changes in waste management on the farm	29.7	15.5
Changes in management of non-production areas on the farm	9.9	5.6
Changes in water acquisition and use	29.7	45.1
Changes in the hygiene of harvest and size reduction processing	80.2	64.8
Changes in quality control of water used for production	100.0	70.4
Changes in cleaning and storage of product packaging	94.5	70.4
Changes in product protection against wrongful acts and against animals	80.2	53.5
Using fertilizers and plant protection products		
Modernization of warehouses for fertilizers and plant protection products	80.2	62.0
Changes in the technique of using plant protection products and devices for their application	9.9	0.0
Changes in soil management	39.6	9.9
Actions related to product traceability and segregation	90.1	74.6

Implementation of the GLOBAL G.A.P. system requires a number of actions connected with organizational, infrastructural and technological aspects at the farm level. In Poland, the importance of quality systems at the level of primary production has been increasing in recent years due to the necessity of searching for new markets. On all the surveyed farms (both vegetable and fruit farms), implementation of the GLOBAL G.A.P. standard was associated with development of a system of decision-making based on risk analysis. Prior to GLOBAL G.A.P. standard implementation, approximately 70% vegetable farms and 50% fruit farms had not had a system for archiving production-related data (Table 1). The fundamental principle of effective quality management systems is to take into account the risk analysis results when making decisions as well as to archive actions and effects of these actions so as to be more efficient in perfecting the system (Chemweno, Pintelon, Muchiri, & Van Horenbeek, 2018). Development of risk analysis for individual stages of production entailed the need to purchase the service, which involved additional costs. Effective use of risk analysis in decision-making processes is one identified problem. Kibet, Obare, & Lagat (2018) as well as Tran & Daisaku (2018) draw attention to this problem among farmers who cultivate on small farms in different parts of the world. On

all the vegetable farms and on 80% fruit farms, implementation of the GLOBAL G.A.P. standard required introduction of formal hygiene procedures. Before certification started, a series of trainings was conducted on about 25% vegetable farms and 33% fruit farms (Table 1). In the case of using personal protection measures (protective gloves, gas masks), less than half of the surveyed farms required changes. Almost all the farms required extending the social zone where workers could rest, as well as providing workers with accommodation. Social issues are one of the biggest problems with certification on small farms. It is very frequently the case that low earnings associated with the scale of production make it impossible to create social infrastructure compliant with the requirements of the standard (Ibanez & Blackman, 2016; Glasbergen, 2018). Adapting to the GLOBAL G.A.P. standard involved changing waste management on 30% vegetable farms and 15% fruit farms (Table 1). Waste management in modern agriculture should involve waste disposal and re-introducing it to the agroecosystem (Sikora et al., 2017; Niemiec, Mudryk, Sikora, Szeląg-Sikora, & Komorowska, 2018). A comparable number of farms introduced changes in management of non-production areas in the context of environmental protection. Issues associated with waste management are regulated by Polish legislation. That is why the implementation of this standard did not require any additional actions from the producers. The GLOBAL G.A.P. standard places great importance on acquisition and rational use of water resources. Moreover, water is one of the most important risk factors for food safety (Allende et al., 2018). Agriculture is regarded as an activity that has the most negative effect on water resources, both in the quantitative and qualitative context. Most of the surveyed farms have irrigation, therefore this aspect is very important. Changes in the issue of managing water resources concerned 30% vegetable farms and 45 fruit farms. These changes focused mainly on regulating the issues connected with legal permit for drawing water or with introducing optimization of water use for irrigation. On all the vegetable farms and on 80% fruit farms it was necessary to introduce a system of quality control of water for irrigation, for the use of plant protection products, and for postharvest actions (Table 1). On 80% vegetable farms and 64% fruit farms, implementation of the GLOBAL G.A.P. standard required making changes in the harvest hygiene. The biggest problems were connected with providing toilets and ensuring the possibility to wash hands at the cultivation site, as well as with maintaining the proper hygiene condition of product packaging and of vehicles used for transportation. Almost on all the farms it was necessary to regulate the issues connected with storing empty product packaging, which, according to the principles of the standard, should not be exposed to contact with animals. Within the scope of techniques of using fertilizers and plant protection products, introduction of the standard did not require any changes. However, on the most farms it was necessary to modernize

the warehouses for plant protection products (Table 1). In most cases, modernization of the warehouses involved closing the warehouse, installing lighting and technological barriers that would prevent spillage of a plant protection product in case of damaged packaging. In several cases producers had to exchange those sprayers that did not meet legal standards. In Poland, principles of integrated plant protection have been in force since 2014. That is why when it came to the use of plant protection products, only small changes in the studied group of farms were necessary. The need for changes with respect to soil management concerned 40% vegetable farms and 10% fruit farms. The introduced changes concerned the use of crop rotation and techniques that reduce soil erosion. Almost all the farms required introduction of an effective system of product traceability and segregation, which is the base for all quality systems in production and distribution of agri-food products (Hu, Zhang, Mog, & Neculita, 2013; Badia-Melis, Mishra, & Ruiz-García, 2015). Functioning in the traditional fruit and vegetables market does not require effective traceability. Creating an effective system was a major problem associated with adapting the farms in this respect to the requirement of the GLOBAL G.A.P. standard. Changes in producers' mentality with regard to the issue of a system approach to creating records and labelling products in relation to the harvest date or the date of post-harvest processing were the most important ones. Despite the fact that creating a traceability system does not involve incurring costs for technical infrastructure, actions in this area turned out to be the most difficult to implement.

Table 2 ***Changes in directions of product sales as a result of implementation of the GLOBAL G.A.P. standard on the surveyed farms (%)*** *(own elaboration)*

Parameter	Vegetable farms		Fruit farms	
	Before certification	After certification	Before certification	After certification
Sales of products to commercial networks	9.9	45.1	28.2	71.8
Sales of products to the international market	7.7	30.1	16.9	53.5

The results of the conducted research indicate that implementation of the GLOBAL G.A.P. standard in farms producing vegetables increased product sales in the commercial networks market by 35%, whereas in the case of fruit producers the increase amounted to approximately 44%. Prior to the commencement of the certification, almost three times fewer farms introduced products in the market through commercial networks (Table 2). Approximately 23% vegetable farms started product sales in foreign markets thanks to certification in primary production. In the case of fruit farms, that value amounted to 36%. Prior to

certification commencement, approximately 8% vegetable farms and 17% fruit farms had been selling their products to foreign markets. In the case of farms that had been selling their products to commercial networks and to foreign markets before the certification process started, implementation of the GLOBAL G.A.P. standard was dictated by the loss of the possibility of selling their products under the existing rules.

Conclusions

The conducted research indicates that implementation of quality management systems in primary production on Polish farms required significant changes, both in the area of infrastructure as well as producers' mentality. Based on the results of the conducted research it was established that implementation of the GLOBAL G.A.P. system on the surveyed farms improved product safety. Improvement of safety applied particularly to quality control of water used for irrigation, pesticide use, as well as of washing products and creation of a formal traceability system. Extension and modernization of the social infrastructure allowed creating better conditions for employees, and protection of the warehouses for plant protection products and rationalization of water consumption allows for a considerable reduction in the impact of production processes on the environment. From the point of view of the technology used so far as well as costs incurred for the adaptation of farms to the requirements of the standard, issues associated with providing social infrastructure, adapting the drawing of water to be in compliance with the law, as well as changes in the hygiene of harvest are the most severe. This is because they are enforced by law to a lesser extent and they have not been implemented earlier. In the case of small farms, adaptation of production conditions to the requirements of the standard is problematic from the economic point of view. Nevertheless, the results of the conducted research unambiguously indicate that implementation of the GLOBAL G.A.P. standard allows to increase the possibility of selling your products to commercial networks, as well as strengthening their position in the market of products intended for export. However, most of the surveyed producers stated that higher prices of the certified products did not compensate the costs connected with certification and adaptation of the farm to the requirements of the standard.

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