7

THE EFFICIENCY OF ECO-LOGISTICS PROCESSES ON THE FOOD MARKET

7.1 INTRODUCTION

Manufacturing enterprises, in particular those operating in the food sector, in view of the character of produced food, may pose a significant threat to the natural environment. Both in the academic discourse as well as in the practical operation of such firms, the need for improvement of the processes of food production by means of actions related to the implementation of optimum solutions in respect of storage, utilization and disposal of various types of waste that is reverse logistics, is stressed. The significance of the concept is particularly important at present times, when the phenomenon of overproduction, resulting from inappropriate adjustment of supply to market demand, has become a frequent problem of large enterprises. Processes of solid planning and monitoring, efficient economic flow of means and goods for the purpose of satisfying customer demands, bearing in mind protection of the eco-sphere, constitute the basis which may guarantee that such issues are solved. That is why the hereby paper discusses the problems of eco-logistics processes on the food market and concentrates on the question of their efficiency.

7.2 HISTORY OF LOGISTICS AND REVERSE LOGISTICS

Logistics has its roots in the military, and its application goes back to the ancient times. It resulted primarily from the constant need to supply the army, and this assumption is valid until now. Logistics constitutes a factor which contributes to military success and is often decisive in respect of the course of battles or even whole wars. Logistics was first mentioned in ancient times during the war between the Roman and Greek Empires, when a group of officers referred to as „Logistics" were responsible for supply and distribution of resources. During World War II, the significance of logistics increased, which resulted in further development of the branch. Perfect organization and planning of the allied forces contributed to the defeat of Germany. The logistics of the United Sates and their allies occurred to be to enormous in comparison with the potential of Germany. The US army assured supply of relevant resources in appropriate places and appropriate time. The primary goal was to supply particularly important positions, while assuming optimum and economic solutions. Such actions resulted in the development of numerous military logistics techniques used until today and constantly improved. This

shows that logistics constituted a significant element of the victory of the Allied Forces during World War II [13].

Reverse logistics has functioned for a fairly long time and its history started during the American Civil War. In 1865, at the end of the war, William T, Sherman realized that supply, mobility, as well the ability to transport resources to battlefields constitute the most difficult elements of war. In 1991, a positive impact of reverse logistics and its effects in various areas of the environment were presented. In 2001 the European Union made a further step by introducing the regulations concerning 50-65% recovery or recycling of packaging materials. Reverse logistics is continuously developed, which translates into numerous positive changes for the environment and people [16].

The Council of Logistics Management Professionals presented the following definition of logistics in 2013: 'logistics is a term describing the processes of planning, implementation and monitoring of economically efficient flow of raw materials, production materials, products as well as information from point of origin to the point of consumption with the purpose of satisfying customer demands' [7].

The definition of reversed logistics is formulated in a similar way. The difference consists in the sequence in which particular action are performed, hence the definition of reverse logistics I as follows: „the processes of planning, implementation and monitoring of economically efficient flow of raw materials, semi-finished products and products as well as related flow of information from the place of consumption to the place of origin with the purpose of recovering value or applying appropriate management" [8].

On the basis of the above definitions of logistics and reverse logistics, it is possible to determine their principle assumption such as: the processes of planning, implementation and monitoring of efficient and economical flow of Raw materials, semi-finished products, and products as well as related information. The sequence in which particular actions are performed depends on the character of logistics and reverse logistics, where [6]:

- in case of logistics: the sequence of actions starts from the moment of production and finishes at the moment of consumption with the intention of satisfying customer demands,
- in case of reverse logistics: the sequence of actions starts at the moment of consumption, and then returns to the moment of production with the intention of recovering value or implementing appropriate instructions concerning the reduction of impact on the environment.

7.3 FROM LOGISTICS TO ECO-LOGISTICS

The increase of the ecological awareness of the society led to the emergence of the term „eco-logistics". This is a new area, often associated with the logistics of recovery, reverse logistics and other related concepts. Yet eco-logistics focuses on the process approach based on the concepts of the management of the flows of waste materials and linked information. The principle assumption of eco-logistics is to decrease the negative impact on the environment from the sphere of logistics. These include all actions conne-

cted with collection and disposal of waste in a way which is not harmful for the environment. The main tasks apply to: collection of waste, segregation, transport, storage in specific places as well as processing. The sphere is subjected to standard and legal requirements concerning environment protection. Eco-logistics covers also product life cycle and LCA (Life Cycle Assessment) allows to determine and assess all factors which may potentially exert impact on the environment in particular phase of product life, from acquisition of raw materials, through the phases of production, transport, use, up to neutralization that is the end of the life cycle connected with waste management or storage. Eco-logistics enables technical and organizational decisions whose aim is to decrease the negative impact on the environment in relation to the realization of particular processes in logistic chains of supply [4].

7.4 EFFICIENCY OF ECO-LOGISTICS PROCESSES

Development of any concepts of logistics undertakings requires consideration of major components of logistics processes that is people, goods, information and financial means. The main task of management in logistics is to plan logistics processes and coordinate them with other processes, while taking into account one's own goals as well as those of the partners'. Obviously the flow of goods and related information constitute basic logistics processes. The most important branches covering all logistics processes are: logistics of supply, logistics of production and logistics of distribution. The above mentioned processes have to be supplemented by the process of waste utilization, which constitutes the area of logistics of utilization processes, and gradually gains in significance in most economies. Considering eco-logistics processes, the questions of waste and packaging are of primary importance. Already in the phase of production, waste generation should be avoided, and then at the end of product's life cycle the negative impact of utilization on the environment should be minimized. Packaging plays a particularly significant role, as it is expected to perform its protective and marketing functions and do contribute to the pollution in the environment, when they are no longer used. Some results can be achieved if reusable packaging, made from materials which enable recycling, is used. Since however, every processing cycle finishes, materials used for packaging should have properties which guarantee that they do not exert influence on the degradation of the environment [12](Tab. 7.1).

The problem of the efficiency of logistics processes gains increasingly more significance in the aspect of the requirements and the need to look for new options for the growth of market and economic efficiency of enterprises, their competitiveness and ability to cooperate. Hence identification of the possibility of complex and long-term shaping of new potentials and the ability to create value and benefits, assuring permanents growth of efficiency and success of enterprises on the market, is becoming increasingly more significant.

The category of efficiency can be analyzed in two important dimensions. The first can be described as the market dimension of the efficiency, and is manifested by shaping the optimum structure of the added value for the customer, i.e. such values (of useful-

ness), which satisfy the needs and solve problems related to them and the specific character of given segment of the market on the side of the customer. The second dimension in the presented structure of the categories of efficiency can be described as economic dimension of efficiency. It is manifested by shaping the optimum structure of actions and costs of the assumption of actions in the process of creating added value and the determination to achieve rational economic links between such costs and desired structure of effects (the structure of value) [2].

Tab. 7.1 Examples of logistics measures of customer service

Measures elements	Logistics customer service
Promptness of supply	Probability of observing agreed delivery lead times
Quality of the delivery	The ratio between the volume of delivery without natural loss, transport damage to the total volume of delivery
Delivery time	The period between order acceptance and realization of the delivery
Delivery reliability	Compliance of the delivery with time specification
Completeness of delivery	Compliance of the received delivery with assortment specification
Flexibility of delivery	Susceptibility to customer (technological, seasonal, assortment) demands
Readiness of delivery	The share of ordered foods which can be dispatched immediately
Formalism of delivery	The approved procedure of order placement and realization, re action to complaints
Convenience of delivery	The extent to which placing orders is convenient for customers

Source: own elaboration based on: [12].

Each process is related to specific attributes, which making planning and monitoring actions easier. In relation to these processes, the concept includes a set of parameters which characterize a given process. They are used for the purposes of identification of the process as well as changes in its status one limit values have been exceeded. The basic attributes of the logistic process are as follows:

- process duration – that is the average time of process completion,
- prompt process completion – specifies the compliance of process completion with the planned deadline,
- quality of the process – synthetic or partial measure of the course of the project, manifested by the satisfaction of the customers with process effects,
- cost of the process – covers all costs connected with the performance of actions of the process.

Customer satisfaction, which answers not only the question whether process products meet customer expectations, but also whether services related to the process were provided in accordance with the expectations, has become the most important attribute of logistics process in contemporary economy. For the purpose of evaluation, the following measures of the level of customer satisfaction are used: percentage of the orders delivered in full or reliability and flexibility. The attributes constitute the basis for the for-

mulation of process measures. These include values by means of which it is possible to determine whether a given process is efficient. The following measures can be distinguished:

- supply, characterizing information and input resources;
- resources, describing the consumption of resources in the process realization;
- results specifying information of final results of the process.

Measurement and evaluation enable the solution of two basic problems resulting from the scope of engineering of logistics processes:

- how to develop a model which makes the choice of elements improving the process easier (critical points),
- what measure should be used for a given process and how feedback, which creates the mechanism of process improvement (system of measures and indexes), can be constructed on the basis of this measure.

The selection of the criteria of efficiency constitutes the basic action in the evaluation of the process. The measures of the efficiency of processes can qualitative or quantitative, quantitative measures are better, since they can be expressed in numbers. This applies to the following measures [10] (Fig. 7.1):

- based on shapes (trend – minimization of costs),
- based on customer service (trend – maximization of satisfaction).

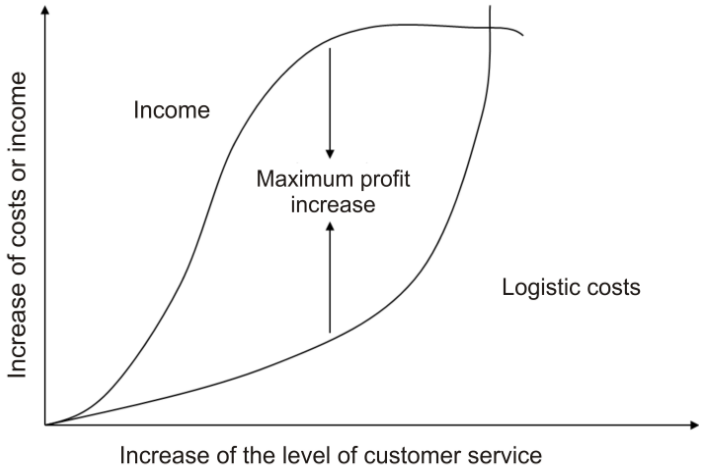

Fig. 7.1 The impact of the increase of the level of customer service on income, costs and logistic profits

Source: own elaboration based on: [10]

7.5 EFFICIENCY OF ECO-LOGISTICS ON THE FOOD MARKET

Food market constitutes a significant element of the economy of all countries, including Poland. There are good reasons for that. Economic activity of enterprises producing food contributes significantly the growth of GDP, but also offers workplaces and satisfies numerous and changing demands of customers and consumer [18]. Agriculture, whose main assumption throughout the history was to supply food products, which are the effect of purposeful plant cultivation and animal breeding, is definitely an important element of the food market. Over the years human activity on the food market has been

subjected to permanent changes [3]. This results from the fact that the food sector is one of the most important and dynamic industrial sectors in Europe. It is referred to as one of the pillars of the economy of the European Union. EU has the highest share in the food and drink export in the world, which total at almost 20%. EU member states maintain significant advantage over remaining exporters, whose share is much lower. The United States with the share of almost 12% occupy the second positions, whereas Brazil, whose share in the export of food and drinks total at almost 8%, has the third position [5]. Over the last 20 years food sector Poland has undergone significant changes. After the crisis connected with the political transformation, it became one of the most quickly developing branches. At the same time it operated as an import ant stimulant of the economic growth, which translated into quicker development of the entire country. Permanent technological and organizational development contributed to export success of Polish enterprises.

Poland joined the group of top modern and innovative food producers in Europe. Accession to the European Union in 2004 was also an important factor. It was connected with a wide stream of grants and subsidies, both before and after the accession, which enabled the adaptation of manufacturing enterprises to standards required by EU. More than triple increase of the export of food was caused by opening access to the European markets [11]. Food market was covered by formal and legal regulations in view of its influence on human health. Regulations and conditions of food productions in Poland are to a large extent created by the law of the European Union. This is an important factor since almost 80% of Polish export is directed to the EU market. Food products must meet rigorous sanitary standards, which exert direct impact on investment that has to me made before business activity in this sector is started. Environment protection standards as well as quality standards are increasingly more rigorous, which translates into high barriers to entering food market [17].

Food market in Europe and in the world is characterized by high fragmentation and spatial concentration. Vast majority of all producers in the food sector are small and medium enterprises. There are few international companies [9]. Subjects from food sector are classified into two categories, i.e. production of food and production of drinks. At the next stage, more detailed segmentation depending on the type processed raw materials and manufactured products, is used [17].

The influence of the functioning of the food market on the natural environment is highly diversified depending on particular branches of the industry. Limited negative impact on the environment is characteristic of corn and milling industry as well as production of food concentrates. At the same the following branches exert significant influence on the environment: sugar, dairy, drink, meet, fruit and vegetable industries. Food production is connected with the emission of gas and dust pollution. Sugar factories, which emit combustion gases, are the main source of pollution on the food market. Dairy industry constitutes another instance of strong influence on the environment. It uses large amount of water in production processes and emits sewage, which is characterized by high BOD5 (biochemical demand for oxygen), COD (chemical demand for oxy-

gen), variable pH, large amount of total suspension, nitrogen, phosphorus, protein, fat etc. It is worth observing however, than in recent years the level of emission of pollution in food industry has been gradually reduced. There are several factors which influence such reductions, among others rigorous quality and environmental standards as well as technological development. Yet, the issue of waste management remains the major problem. This results from the problems connected with utilization and physical as well as chemical diversity of particular categories of waste [11].

It is estimated that in 25 EU countries, food products, in the entire chain of food production and distribution, are responsible for 20-30% of impact of consumption on the environment. The problem of waste management increasingly more often occurs in the background literature, has it is reflected in constantly developing Eco-logistics, which deals with levelling the negative impact of enterprises on the natural environment. Eco-logistics searches for optimum solutions in respect of collection, storage, removal, utilization or neutralization of waste which is not disturbing to the environment and society [14]. It was observed that in 2012 the amount of waste generated by food market enterprises was reduced by half (46.5%) in comparison with 2000. Vast majority of food industry waste is subjected to the processes of recovery; some of the waste is stored or neutralized. Reduction of emission was possible thanks to the application of production technologies which are less harmful for the environment, increasing ecological awareness of the society, but also in result of bankruptcy or closure of enterprises which emitted high level of pollution to the environment [11]. All manufacturers are obliged to neutralize their waste in the way which safe for the environment and in accordance with regulations. The obligation contributes to high costs borne by producers and waste generators [14]. In view of the enormous significance of the industry both in respect of its size, as well as impact on human health, eco-logistics has become indispensable in reduction of the impact of the enterprises of the food production sector on the environment [18].

Transport is used at almost every stage of food production and distribution. Increasing more often, companies use plastic pallets, which are fighter than the wooden ones by 70%, or card-board rather than wooden boxes. Such solutions have positive impact on the environment as they lead to reduction of fuel consumption, and hence lower emission of combustion gases. DB Schenker, a logistics company, offers their customers a programmer which compiles reports on the emission of basic of pollution to the environment during transport of consignment in specific time and on various destinations in Europe. Increased interest in the problem of the negative impact on the natural environment has contributed to numerous positive changes whose assumption is to reduce this negative influence. In turn, increased interest on the part of entrepreneurs on the food market has contributed to the emergence of a new category of ecological products. Eco-food is gradually becoming more popular, and its impact on the natural environment is much smaller than in case of the use of conventional methods. Awareness among consumers as well as popularization of healthy food encourages the purchase of ecological products, which gradually become more available [1].

In background literature, the concept of efficiency is usually understood as a result of undertaken actions, described by the relation between the results obtained and the incurred outlay. The concept is a subject of many discussions and analyses since despite attempts, efficiency is not defined precisely and explicitly enough in background literature. In relation to reverse logistics and the process approach to eco-logistics, special attention needs to be paid to definite pressure put on developing the optimum structure of processes and increase of their efficiency. The measurement can be made with the aid of partial and synthetic indexes of the use of resources or on the basis of such criteria as: quality, usefulness, cost-effectiveness and many others. Thus efficiency of eco-logistics processes is characterized by their reliability, flexibility and completeness. It has to be stressed that the assumptions of each of the dimension of efficiency, concerning reverse logistics or broadly understood eco-logistics, evolve in time in response to developments in theory and practice as well as changing expectations or systems of values [2]. The efficiency of eco-logistics processes reflects the relation between the obtained results and incurred outlay, in order to obtain the best parameters of the ecological evaluation of the process.

CONCLUSIONS

In conclusion, again a question should be asked concerning the need to introduce logistics management in manufacturing enterprises. At present, when enormous pressure is put on the issues related to environment protection, this option must not be abandoned. Production control generates positive impact not only on the enterprise itself, but also on the natural environment. Pro-ecological manufacturing encourages minimization of waste or their conscious utilization, which is extremely promising. As the food market is one of the most profitable areas of economy, the problem requires a lot of attention. At the same time increasingly more rigorous criteria and standards enforce the pro-ecological aspect of production. Increased awareness among entrepreneurs is also more widespread. Thus there occurred the need for the emergence of eco-logistics as such, with the purpose of more efficient collection, removal and storage of waste as well managing utilization processes.

ACKNOWLEDGEMENTS

ZIELONA GÓRA

This paper is co-financed by the city of Zielona Góra
Zrealizowano przy pomocy finansowej Miasta Zielona Góra

REFERENCES

1 S. Abt. *Zarządzanie logistyczne*. Poznań: Wielkopolski Odział Towarzystwa Naukowego Organizacji i Kierownictwa, 1996.

2 P. Blaik. Logistyka. Koncepcja zintegrowanego zarządzania, Warszawa: PWE, 2012.

3 K. Bojko, M. Burda, M. Gawron, M. Smyk, J. Zborowska. „Perspektywy rozwoju ekologicznej produkcji rolnej w województwie lubuskim." *Management Systems in Production Engineering*, No 3(19), 2015.

4 D. Burchart-Korol, P. Śląski. „Analiza eko-efektywności w logistyce produkcji." *Logistyka,* No 5, 2011.

5 J. Brzozowski. „Rynek rolno-spożywczy w UE." [Online]. Available: http://www.-een.org.pl/ [Accessed: Apr. 2, 2016].

6 C.R. Craig, L.M. Ellram. „Reverse Logistics: A review of the literature and framework for future investigation." *Journal of Business Logistics*, Vol. 19, No. 1, 1998, p. 85-102.

7 „Council of Logistics Management Professionals", *Supply Chain Management Definitions and Glossary*, 2013.

8 S. Dale, R. Tibben-Lembke, R.S. Tibben-Lembke. G*oing Backwards: Reverse Logistics Trends and Practices,* Pittsburgh, PA: RLEC Press 1999.

9 M. Dąbkowska, K.Gutta, M. Jażdżewska-Gutta N. Mucha, M. Sadło. *Analiza sytuacji rynkowej dla działalności gospodarczej na obszarze województwa zachodniopomorskiego dla branży spożywcze*. Gdańsk: PWN 2011.

10 J. Frąś. *Normalizacja i Zarządzanie jakością w Logistyce*. Poznań: Politechnika Poznańska, 2015, p. 157-159.

11 A. Kasztelan, M. Kierepka. „Oddziaływanie przemysłu spożywczego na środowisko w Polsce." [Online]. Available: http://ageconsearch.umn.edu [Accessed: Apr., 2016]

12 S. Krawczyk. *Zarządzanie procesami logistycznym.* Warszawa: PWE, 2001, p. 52-70.

13 „Logistics History – Logistics." [Online]. Available: http://www.bestlogisticsguide.com/ [Accessed: Apr. 22, 2016].

14 M.M. Nowak. „Wykorzystanie odpadów z przemysłu mleczarskiego, jako element ekologistyki." *Logistyka,* No 6, 2014.

15 C. O'Shaughnessy. „Wstępne badanie określające branże przemysłu spożywczego oraz podsumowujące wyniki badań krajowych i międzynarodowych, a także efekt synergii z wcześniejszymi i bieżącymi projektami inicjatywami." Projekt „GREEN-FOODS", No 5, 2013. [Online]. Available: http://www.green-foods.eu/ [Accessed: Mar. 12, 2016].

16 A. Robinson. „History of Reverse Logistics is at the Core of The Stories of War, Retail, eCommerce, and Automotive Aftermarket." [Online]. Available: http://cerasis.com/ [Accessed: Mar. 23, 2016].

17 Sektor spożywczy w Polsce, Profil sektorowy, Warszawa: Departament Informacji Gospodarczej, Polska Agencja Informacji i Inwestycji Zagranicznych S.A., 2013.

18 O. Stefko. „Czynniki warunkujące rozwój przedsiębiorstw przemysłu spożywczego w Polsce." *Zeszyty Naukowe Szkoły Głównej Gospodarstwa Wiejskiego w Warszawie*, *Problemy Rolnictwa Światowego*, 2013.

THE EFFICIENCY OF ECO-LOGISTICS PROCESSES ON THE FOOD MARKET

Abstract: *The paper discusses the question of the efficiency of eco-logistics on the food market. The aim of the article is to present major problems related to the impact of food production processes, packaging, distribution and transport on the environment. It presents the origins of eco-logistics in relation to the concepts of logistics and reverse logistics. It analyses the characteristics and general assumptions of the efficiency of eco-logistics processes and describes food market as well as its impact on the natural environment. Furthermore it discusses the issue of waste generation and presents business entities operating on the food market in the aspect of their further development. The question of sanitary standards for products of the food sector is analyzed as well as the dynamics of the development of technologies used in the processes of reverse logistics, changing exogenic expectations and systems of values.*

Key words: *eco-logistics, reverse logistics, food market*

EFEKTYWNOŚĆ PROCESÓW EKO-LOGISTYCZNYCH NA RYNKU PRODUKTÓW ŻYWNOŚCIOWYCH

Streszczenie: *Artykuł podejmuje problematykę efektywności eko-logistyki na rynku produktów żywnościowych. Celem artykułu jest przedstawienie głównych problemów oddziaływania procesów wytwórczych produktów żywnościowych, opakowań, dystrybucji oraz transportu na środowisko. Przedstawiono w nim genezę eko-logistyki w nawiązaniu do pojęcia logistyka i logistyka zwrotna. Została przedstawiona charakterystyka oraz ogólne założenia efektywności procesów eko-logistycznych, jednocześnie opisano rynek produktów żywnościowych oraz jego wpływ na środowisko naturalne. Ponadto określono w nim problematykę generowania odpadów przez podmioty gospodarcze działające na rynku żywnościowym w aspekcie ich dalszego zagospodarowania. Poruszono, także temat norm sanitarnych dla produktów z sektora gospodarki żywnościowej oraz dynamikę rozwoju technologii wykorzystywanych w procesach logistyki zwrotnej, zmieniających się oczekiwań egzogenicznych i systemów wartości.*

Słowa kluczowe: *eko-logistyka, środowisko, logistyka zwrotna, rynek produktów żywnościowych*

Weronika DOROZIŃSKA
University of Zielona Góra
Scientific Association Eco-Management
Faculty of Economics and Management
ul. Licealna 9, 65-417 Zielona Góra
e-mail: Weronika-Dorozinska@wp.pl

La Minh HOANG
University of Zielona Góra
Scientific Association Eco-Management
Faculty of Economics and Management
ul. Licealna 9, 65-417 Zielona Góra
e-mail: Machinelearningguys@gmail.com

Maciej KWIATKOWSKI
University of Zielona Góra
Scientific Association Eco-Management
Faculty of Economics and Management
ul. Licealna 9, 65-417 Zielona Góra
e-mail: Maciek.Kwiatkowski12@wp.pl

Manh Duc NGUYEN
University of Zielona Góra
Scientific Association Eco-Management
Faculty of Economics and Management
ul. Licealna 9, 65-417 Zielona Góra
e-mail: ndManh2307@gmail.com

Daria NOWICKA
University of Zielona Góra
Scientific Association Eco-Management
Faculty of Economics and Management
ul. Licealna 9, 65-417 Zielona Góra
e-mail: DariaNowicka10@wp.pl

Marcin SIKORA
University of Zielona Góra
Scientific Association Eco-Management
Faculty of Economics and Management
ul. Licealna 9, 65-417 Zielona Góra
e-mail: MarcinSikora4@tlen.pl

Paulina STAŃKO
University of Zielona Góra
Scientific Association Eco-Management
Faculty of Economics and Management
ul. Licealna 9, 65-417 Zielona Góra
e-mail: Pakii@o2.pl

Le Minh QUAN
Vietnamese-German University
6th Floor, 307A Nguyen Trong Tuyen,
Ward 10, Phu Nhuan District,
Ho Chi Minh City, Vietnam
e-mail: lunardrik@gmail.com

Date of submission of the article to the Editor: *05/11/2016*
Date of acceptance of the article by the Editor: *06/30/2016*