

Integration of the Food Supply Chain as a Factor of Sustainable Development

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Abstract: The aim adopted in the paper was to lead the scientific reasoning on sustainable development in context of economic entities and its integration in the supply chain. It is to be noticed that integration of supply chain is one of the factor for using or limiting the functional weaknesses of the market which are related to the three sustainability aspects as *environmental*, *social* and *economic* resources, as assumes the concept of sustainability. In the paper, it was searched for the relationship between these three sustainability aspects and limitation of functional weaknesses of the market through integration of supply chain. It was stated that different forms of integration might contribute to the maintenance and enhancement of *environmental*, *social* and *economic* resources.

Keywords: sustainable development; supply chain management; food supply chains; integration

1. Introduction

The concept of sustainability relates to the maintenance and enhancement of *environmental*, *social* and *economic* resources, in order to meet the needs of current and future generations. Sustainable development covers a broad spectrum of consumption and waste related topics i.e.: food and agriculture use and production, natural resource consumption, population growth, quality of life, flora and fauna diversity, waste generation, air, land and water pollution, recycling and reuse, etc. Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs.

From the other point of view, to sustain long-term growth and profitability in a competitive environment, economic entities must continuously improve their efficiency [Sudit 1995].¹ The search for potential improvement of efficiency has also been spurred on by the realization that not only does single enterprise compete against each other but also entire supply chains [Christopher 1992]. The Authors believe that by taking into account the interactions occurring between the different stages of the food supply chain and the complex structure of activities within and between companies from the agri-food sector the search for potential improvement of efficiency is not the task not only for single enterprises but also for entire supply chains. Therefore the supply chain must be viewed as one entity and any measurement system should span the entire supply chain. Taking into account the interactions occurring between the different stages of the supply chain, the effective management strategy of the entire supply chain, and the structure of activities within and between companies is critical for the integration of the entire supply chain. The forms of integration of the supply chain combine elements of the market and hierarchical organization. These forms of integration might

¹ There are several different concepts of efficiency, its measurement and expressions. Within the framework of efficiency, many terms of similar meaning may be applied. However, these concepts are not identical, and the actual concept of efficiency is derived from the structure of the production function, therefore, is conditioned by changes in the productivity of production factors and their remuneration and refers to the allocation of production factors in the most technically efficient way.

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The aim adopted in the paper was to lead the scientific reasoning on sustainable development in context of efficiency of economic entities and its integration in the supply chain. Within the framework of the paper it was searched for the relationship between these three sustainability aspects and limitation of functional weaknesses of the market through integration of supply chain. It was stated that different forms of integration might contribute to the maintenance and enhancement of *environmental*, *social* and *economic* resources (see the 3rd section). The reasoning was led with the focus on the food supply chains.

2. Supply chains in food economy

The process of food production, that takes place in each national economy within the framework of its subsystem known as food economy, is the point of reference in the agribusiness chains [Grabowski 1998]. According to A. Zalewski, food economy is among the most important and the most complex segments of the national economy. It covers the whole process of material production associated directly and indirectly with food production and distribution. It consists of manufacturing the means of production for agriculture, agriculture and food industry [Zalewski 1989]. According to A. Woś, the concept of the food economy is a term that preceded the development of the theory of agribusiness and was used for the determination of related links of the national economy, which are directly and indirectly involved in food production and distribution [Woś 1998].

The food production and distribution are one of the key conditions for functioning of the agribusiness. The way and principles of food movement from the farmer to consumer are determined by agribusiness links that form the food chain. F. Tomczak states that the food chain provides the food supply from the farm gate to the consumer, transforming agricultural raw materials into products that may be easily purchased, prepared and consumed. The chain includes purchasing, processing, distributing companies as well as food service companies and retail traders, and as a result of the overall transformation and economic needs it is constantly changing and being developed [Tomczak 2004].

The different types of entities may be distinguished within the structure of the food chain [Lazzarini et al. 2001], namely: agriculture, food industry, wholesale and retail trade. In the literature, one can also find other systematics. On the basis of literature review it was stated that the structure characterizing the food supply chains should include agriculture, purchase and trade of agricultural products, food industry, wholesale and retail trade and other entities, such as: government institutions, local government institutions, service providers including providers of means for agricultural production. They are a network of organizations involved, due to relationships with suppliers and customers, in a variety of processes and activities that create value in a form of products and services delivered to final consumer [Rutkowski 2004]. The supply chain with respect to food products can be defined as "cooperation in different functional areas of agricultural producers, intermediary companies (trade), processing companies, manufacturing, services and their customers, between which flow streams of agri-food products, information, and funds" [Jarzębowski & Klepacki 2013].

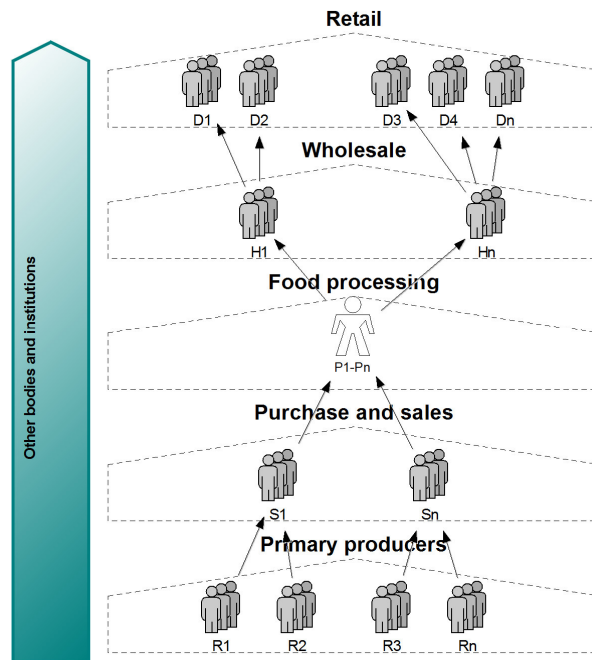


Figure 1. Structure of food supply chains

Source: own work.

The supply chain can be analyzed by the contribution of individual stages while creating added value. Within the framework of the food supply chain, it may be noticed that in the long term the share of agricultural products in consumers' budget shows a continuous downward trend. In this context, the reference to an example of the Dutch market has been made, where more and more value added is generated within the stage of processing, trade and services, and less on the level of agricultural production. This trend intensified in the early nineties. Reducing share of farmers in the overall income of the supply chain need not to be directly related to their performance, which is determined rather by return on investment and labor productivity [Ondersteijn et al. 2006].

The observed phenomenon may be a result of significant changes in food consumption. One can noticed a shift from consumption of fresh products in the direction of processes products and from consumption at homes towards consumption outside homes. Production of processed food requires the involvement of the greater part of value added than in the case of fresh products. This shift in the way of consumption is reflected in food products, in the creation of which processing and trade have the largest share. The main problem of modern agriculture is that societies become wealthier, while farmers in these countries are getting poorer. As stated by A. Czyżewski et al. added value in the market mechanism is distributed in such way that most of the gain goes to those who are closest to the consumer. Market redistributes added value depreciating agriculture [Czyżewski et al. 2006], thus the government should step into the sphere of intermodal flows in order to transfer the created and not realized by farmers value added [Kowalski & Rembisz 2005]. Also capital integration of farmers and processing companies may be a mechanism that counteracts the depreciation (e.g. it takes place in milk processing).

The other feature of the food supply chain is a product that is a subject of specific safety requirements designed to protect the final customer (the consumer). Throughout the food supply chain the adequate level of quality, hygiene and wholesomeness for all intermediate and final products should be provided. Wholesomeness of products should be provided at the beginning of the chain, so on farms, including their suppliers of inputs and services [Bezat & Jarzębowski 2011], through trade and processing (primary and secondary) to the distribution system, including consumer products, as well as final consumers. Thus, a wide variety of standards and rules affects the activities of enterprises in the food chain. Regulations concerning the quality of agricultural products are the important aspect associated with the specificity of food processing. The growing requirements of consumers cause that more and more attention is paid to high quality of these

products. At the same time the quality shows a direct relationship with the price of the product and has a direct relationship with the standards [Makarski 1998].

Furthermore, one of the main elements of food safety is assurance of identifying the origin of the product which was described in the EU Regulations No. 178/2002 or 1831/2003. The regulation 178/2002 was remitted to lay down the general principles and requirements of food law, establishing the European Food Safety Authority and lay down procedures in matters of food safety [Regulation 2002]. The requirement 178/2002 should guarantee the full traceability of food demanding from each stage of supply chain collecting data about products. It obliges companies in the food chain to guarantee the traceability of its products as well as to recall of unsafely products (products recall actions). In this way tracking and tracing of food from the producers to industry and from logistic services to final costumers will be possible [Bezat & Jarzębowski 2008]. The Regulation has shown that food processing companies should implement a system that allows the identification of the product from primary production up to final consumers (tracking) and in the opposite direction (tracing). These companies should also, if necessary, share information about their suppliers and recipients of the relevant services [Regulation 2002]. With the concept of traceability it is possible to indicate where in the chain some problems occurred.

The central condition is the chain-wide coordination of the data exchange and the tracking and tracing of the data which should include quantity, type of raw materials, origin (import, country), supplier information, transport and warehousing information. The linking of defined product unities with the accompanying parameters relevant for product and the access possibilities on the suitable information is the basis of the development of traceability systems [Bezat & Jarzębowski 2008]. This is particularly important in supply chains, in which the cargo handling, transport and processing of raw materials (lots of them) are mix with each other frequently. Defining units and size (Traceable Resource Unit) allows tracking goods, clear differentiating of specific parts and forming new parties arising from the combination of the others.

The implementation of solutions supporting food security covering the entire supply chain is voluntary and depends on the market situation and the structure of companies' customers. However, the recipient may, depending on their market power, influence the quality policy of its suppliers which are forced to provide information about the use of manufacturing technologies and their impact on hygiene and quality of the delivered products. Thus, the assurance of products' wholesomeness is dependent on proper communication with customers and consumers, and creation of the quality tracking systems is a challenge for the entire supply chain.

3. Integration and sustainable development in supply chains

The concept of sustainability relates to the maintenance and enhancement of **environmental, social** and **economic** resources, in order to meet the needs of current and future generations. The achieving economic, social, and environmental success in a company is an crucial aspect of finding the way to a sustainable, profitable future in today's daunting era of environmental and social accountability. The issue of sustainability is important since it addresses the legacy we leave to the next generation. Current analyses indicate that human activity may have exceeded the carrying capacity of earth's resources. Remediation efforts through technological advancement, conservation, etc. can extend the overall ability of earth's resource to sustain humanity. However, "business as usual" approaches to the problem will ensure that future generations are less better off than the current generation.

Sustainable development covers a broad spectrum of consumption and waste related topics i.e.: food and agriculture use and production, natural resource consumption, population growth, quality of life, flora and fauna diversity, waste generation, air, land and water pollution, recycling and reuse, etc. Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs.

Nevertheless, the keeping the principles of sustainable development cannot be in contradiction with efficiency of economic entities. There are several different concepts of efficiency, its measurement and expressions. Within the framework of efficiency, many terms of similar meaning may be applied. However, these concepts are not identical, and the actual concept of efficiency is derived from the structure of the production function, therefore, is conditioned by changes in the productivity of production factors and their remuneration and

refers to the allocation of production factors in the most technically efficient way. The search for potential improvement of efficiency has also been spurred on by the realization that not only single enterprise compete against each other but also entire supply chains (Christopher 1992). Taking into account the interactions occurring between the different stages of the supply chain, the effective management strategy of the entire supply chain, and the structure of activities within and between companies is critical for the efficiency of the entire supply chain. Therefore, questions concerning the measurement of efficiency are increasingly important.

The integration with environment (external organizations) of the system is also highlighted (a company is understood as the system). Cooperation is here the main element of the organizational integration of a company with environment (Steffen & Born 1987, pp. 210). Integration is described both in terms of traditional logistics functions (Gustin et al. 1995) and of removing barriers (or boundaries) between organizations (Naylor et al. 1999). The need for integration between an enterprise and its environment increases with the degree of intensification of global competition. In this context, the concept of integration, considered as a key factor in achieving better results by an enterprise, is one of the most important topics in the scientific literature.

The interaction among market participants is connected to the market equilibrium theory (Kreps 1990). This interaction is coordinated through the price mechanism – depending on relative prices market, participants (households and enterprises) take individual decisions on supply and demand, so that benefits (or profits) and number of available goods are maximized. The theory passes over analysis of institutional circumstances. However, considering the existence of institutions and organizations makes sense, when the central assumptions of the equilibrium theory are not met, since then one deals with functional weaknesses of the market (i.e. market outcomes are not Pareto-efficient). Elements undermining the market equilibrium theory's assumptions are: **information asymmetry** and emerging on its basis **transaction costs** (including **property rights** and **external effects**), as well as **increasing economies of scale**. These elements may cause an incentive for market participants to seek together a solution in a form of institutions or organizations that would compensate functional weaknesses of the market (or eventually use them). In this sense, institutions and organizations may be interpreted as a kind of compensation mechanism.

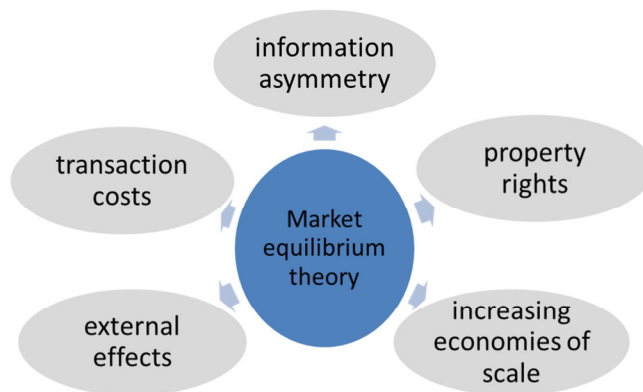


Figure 2. Elements undermining the market equilibrium theory's assumptions

Source: own work.

Economies of scale, transaction costs, information asymmetry and uncertainty of the transaction may be pointed out as weaknesses of the market indicating the need for integration. In order to reduce the impact of weaknesses of the market or to take advantage of these weaknesses various forms of cooperation between market participants are used. Such unselfish cooperative forms, as presented by Nash basing on game theory, are necessary to achieve the optimal state of the economy (Noga 2009, pp. 67). These activities are referred to as connections with external partners, integration forms or organizations, outsourcing, hierarchical strengthening within long-term contracts, symbiotic partnerships, cooperation with external partners. These forms are a wide range of intermediate solutions between the market and hierarchy. At the same time, the forms combine elements of the market and hierarchical organization. These forms of integration might also contribute to the maintenance and enhancement of **environmental**, **social** and **economic** resources - in order to meet the needs of current and future generations, as assume the concept of sustainability.

One of the elements of creating various forms of integration is the market failure that is reflected in **transaction costs**, **uncertainty**, **increasing revenues in terms of scale**, **opportunism and lack of confidence**, **external effects**, **specificity of capital**, **social inequality and information (knowledge) flow**. Organizational solutions as integration are referred in this context as opportunities to use or limit market weaknesses.

The limitation of functional weaknesses of the market through integration of supply chain can be related to the three sustainability aspects. The relationships occurring in each group base on the previous work of the authors and indicated the following relations:

- **Environmental aspects**
 - Reduction of **information asymmetry** (regarding the products and processes). In consequence of reduction of information asymmetry more responsible exploring of natural resources (like water, land, air) can be achieved.
 - Reduction of **external effects** (regarding the products and processes). In consequence reduction of emissions to environment (sewage to water, fertilizers to the soil, gases emission into the air) is possible to achieve.
- **Economic aspects**
 - Reduction of **transaction costs** (between participant of supply chain). As a result of shorting of Long Chains creating value. Through better coordination reduction of resources involved in products and processes is possible to achieve.
 - Reduction of **uncertainty, opportunism and lack of confidence** (between participant of supply chain). As a result of better coordination and communication between the market participants the reduction of resources involved in control and risk assessment can be achieved.
- **Social aspects**
 - Reduction of **social inequality and information (knowledge) flow** (between supply chain participant creating value and customers – society). As a result of better exchange of information about the products and processes, including resources involved to its creation reduction of social inequality and information can be achieved.

Figure 3. presents the relationship between three sustainability aspects and limitation of functional weaknesses of the market through integration of supply chain.

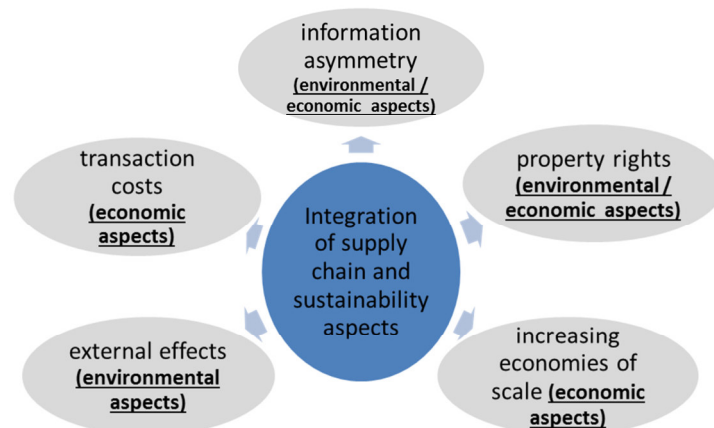


Figure 3. Maintenance and enhancement of environmental, social and economic resources through supply chain integration

Source: own work.

To clarifying the strength of influence of the food supply chain integration on sustainable development the further research should be conducted. The main point of the future research will be to develop the measure clarifying the influence of the food supply chain integration on sustainable development.

In the context of this within previous research, a measure showing the supply chain integration's degree was constructed. The *SIDM* was developed and evaluated by the authors within the framework of previous publications [Jarzebowski 2013]. The variable – *SCIDM* (Supply Chain Integration Degree Measure) includes integration with both suppliers and customers. The construction of *SCIDM* is presented below.

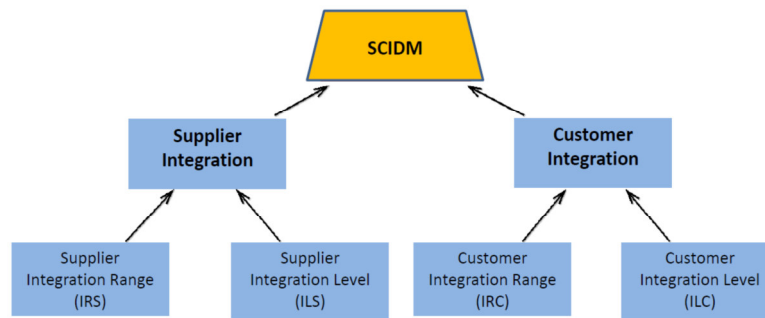


Figure 4. The structure of the SCIDM measure

Source: own work.

For the integration measurement the *SCIDM* will be used. In the next step the sustainability aspects will be included in the model to evaluate the contribution of supply chain integration to the sustainable development. The relation will be examined by using statistical and econometrical methods. The question how the overcoming of several functional market weaknesses (through integration) influences / improve sustainability will be answered. So the impact of supply chain integration on the sustainable development will be clarify.

4. Conclusions

The concept of sustainability relates to the maintenance and enhancement of environmental, social and economic resources, in order to meet the needs of current and future generations. Thus, the clarifying the strength of influence of the food supply chain integration on sustainable development will have a positive impact on the development of society.

Within the framework of the paper, it was searched for the relationship between the three sustainability aspects (environmental, social and economic) and limitation of functional weaknesses of the market through integration of supply chain. It was stated that different forms of integration might contribute to the maintenance and enhancement of environmental, social and economic resources.

To clarifying the strength of influence of the food supply chain integration on sustainable development the further research will be conducted. The main point of the future research will be to develop the measure clarifying the influence of the food supply chain integration on sustainable development.

The connecting of integration of the food supply chain and the sustainability is a new direction of scientific interests and hasn't been searched yet. Thus, the research outcomes will have an impact on the scientific field and scientific community in Europe.

References

- BEZAT, A., JARZĘBOWSKI, S., *The effective traceability on the example of Polish supply chain*. [in:] ed. Glauben, T., Hanf, J., Kopsidis, M., Pieniadz, A., Reinsberg, K., *Agri-food business: global challenges – innovative solutions*, Halle: IAMO, 2008. p. 47-57.
- BEZAT, A., JARZĘBOWSKI, S., Traceability w łańcuchu dostaw przetwórstwa spożywczego. *Logistyka*, 2, 2011, p. 75-84
- CHRISTOPHER, M., *Logistics and Supply Chain Management - Strategies for Reducing Costs and Improving Services*. London: Pitman Publishing, 1992, 288 p.
- CZYŻEWSKI, A., POCZTA, A., WAWRZYŃIAK, Ł., Interesy europejskiego rolnictwa w świetle globalnych uwarunkowań polityki gospodarczej. *Ekonomista*, nr 3, 2006, p. 350-351.
- JARZĘBOWSKI, S., *Integracja łańcucha dostaw jako element kształtowania efektywności sektora przetwórstwa rolno-spożywczego*. Warsaw: Wydawnictwo SGGW, 2013.
- JARZĘBOWSKI, S., KLEPACKI, B., Łańcuchy dostaw w gospodarce żywnościowej. *Zeszyty Naukowe SGGW w Warszawie, Ekonomiki i Organizacja Gospodarki Żywnościowej*, nr 102, 2013, s. 107-117.

- KOWALSKI, A., REMBISZ, W., Rynek rolny i interwencjonizm a efektywność i sprawiedliwość społeczna, Warsaw: Wyd. IERiGŻ-PIB, 2005.
- LAZZARINI, S., CHADDAD, F., COOK, M., Integrating supply chain and network analysis: the study of net chains. *Journal on Chain and Network Science*, 1 (1), 2001, p. 7-22.
- MAKARSKI, S., Funkcjonowanie rynku rolno-żywnościowego, Lublin: Wyd. UMCS, 1998.
- NAYLOR, J.B., NAIM, M.M., BERRY, D., Leagality: Integrating the lean and agile manufacturing paradigms in the total supply chain. *International Journal of Production Economics*, Vol. 62, No. 1-2, 1999, s. 107-118.
- ONDERSTEIJN, Ch., WIJNANDS, J., HURINE, R., KOOTEN, O., *Quantifying the agri-food supply chain*. Dordrecht: Springer, 2006.
- REGULATION, Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety, 2002, available at: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2002:031:0001:0024:en:PDF>
- RUTKOWSKI, K., Zarządzanie łańcuchem dostaw – próba sprecyzowania terminu i określenia związków z logistyką. *GMiL*, nr 12, 2004.
- STEFFEN, G., BORN, D., *Prowadzenie gospodarstw i przedsiębiorstw w rolnictwie [Betriebs- und Unternehmensführung in der Landwirtschaft]*. Warsaw: Książka i Wiedza, 1995.
- SUDIT, E.F., Productivity management in industrial operations. *European Journal of Operational Research*, 1995, 85(3), p. 435-543.
- TOMCZAK, F., *Od rolnictwa do Agrobiznesu. Transformacja gospodarki rolniczo-żywnościowej Stanów Zjednoczonych Ameryki Północnej*. Warsaw: SGH w Warszawie, 2004.
- WOŚ, A., *Gospodarka żywnościowa. Kompleks gospodarki żywnościowej*. [w:] Encyklopedia agrobiznesu, Warsaw: Fundacja Innowacja, 1998.
- ZALEWSKI, A., *Problemy gospodarki żywnościowej w Polsce*, Warsaw: PWN, 1989.