Agnieszka SKOWROŃSKA
Wrocław University of Economics (Poland)

LOGISTICS AS A TOOL FOR SUSTAINABLE DEVELOPMENT

1. Introduction

Logistics is becoming more and more influential, not only in individual companies. Its direct and indirect impact on the economy is being discussed increasingly often in the literature [see Coyle et al., 2002, 58; Skowronek and Sarjusz-Wolski, 2003, 40–75].

The most important relations between logistics and the economy include [Witkowski, 2004, 55]: the influence of improvement in the performance of logistic processes in companies on improvements regarding specialisation and cooperation, leading to expansion of the market; the influence of the improved effectiveness of logistic services on conditions facilitating price reduction, due to the effects of economies of scale and the shortening of delivery times; the influence of the location of public logistic centres on the level of availability of products manufactured in remote places, both in Poland and abroad; the influence of transport and warehousing infrastructure, shaped by the state, on the behaviour of potential industrial and commercial investors.

Therefore, increasing attention is being paid to macroeconomic aspects of logistics and research concerning the relations between production, trade and transport. This field is seen as a starting point for the creation of a new national economic policy, called logistic policy. This covers *the purposeful, direct and indirect influence of the state on improvements in the effectiveness of the processes of product flow and accompanying flow of information between the participants of supply chains* [Witkowski, 2004, 56]. A detailed discussion on the character, types and role of logistic policy in a system of economic policies can be found in Skowrońska [2006].

2. The concept of a logistic environmental imperative as the basis for sustainability of supply chains

The necessity of changes in the functioning of logistic chains is a natural consequence of the transformations occurring in industries, transportation and trade [these changes are described in detail in: Brown, 2003, 97–102; Weizsacker et al., 1999].

Changes in the way that logistic chains function should be aimed at their sustainability, which should ultimately lead to new sustainable meta-logistic chains, in which:

– methods of production, materials, sources of energy, delivery and transport are selected, in order to cause the least harm to the natural and social environment;

– the use of materials, raw materials, semi-finished and finished products is minimised;

– the effectiveness of the use of energy and material is maximised by elongating the life cycles of products;

– the use of renewable energy is maximised and materials are recycled/disposed of according to the principles of the minimisation and segregation of waste, together with the removal of the negative effects of delivery, production, distribution and transport.

Logistic chains that function on these principles will definitely contribute to the widespread implementation of the principles of sustainable development [more information on sustainable development is available in: Reid, 1995; Kozłowski, 1996; Janikowski, 1999; Fiedor, 2000; Zabłocki, 2002; Piontek, 2003; Janikowski, 2004; Borys, 2005].

Actions aimed at the sustainability of supply chains should be based on the **concept of the "logistic environmental imperative".** According to this concept, we should view *logistic chains* as a *system of several interconnected links of a chain of supply and retail. They process matter and/or energy and in this way satisfy the needs of particular links in a logistic chain (and the chain as a whole). The necessity of removing the negative effects of this satisfaction of needs is also an issue here.* It is analogous to the environmental imperative of the customer described in Janikowski [1999].

According to this definition, in a sustainable logistic chain, one should accomplish functions that are connected with: identification of the needs of logistic chains as a whole and the needs of particular links in a chain; determining different (alternative) ways of satisfying needs; selection of methods for satisfying needs; specification of the level at which to satisfy needs; satisfaction of needs; defining methods to eliminate the negative

effects of the satisfaction of needs; selection of methods to eliminate the negative effects of the satisfaction of needs.

These functions can be accomplished in different ways, yet it is crucial to obey the four following principles: selection, minimisation, maximisation and segregation (see Table 1).

Within sustainable logistic chains it is very important to establish close partnership with other participants and also to share technologies that carry out the returning, collecting and recycling of products after use. It is also necessary to accept certain standards and make suppliers conform to them. The selection of suppliers should be based on verification according to specific criteria, including the will, competence and technological ability to cooperate in the process of designing products that are as recycling-friendly as possible. It is also important to use the most up-to-date information and technologies connected with their production. It is vital to create systems of management over the whole range of products and to enable remote monitoring of the flow of goods and marketing process. Such a database should include information regarding returns of spent products, which facilitates their reuse and/or can indicate optimal ways of processing them. Returns of spent products, recycling and reuse should be treated as some of the many dimensions of activity within sustainable meta-logistic systems [Tsoulfas and Pappis, 2001, 207; Grabara, 2003].

If we compare traditional logistic chains to sustainable ones, we can clearly see similarities and differences. Product recycling systems require collection and transport systems from consumers to recycling centres. After recycling a system is required to deliver recycled goods to consumers. Such chains can be developed from traditional logistic chains by introducing reutilisation systems, which: recycle materials, process them, reuse components, repackage, as well as deal with warranty and commercial returns. Compared with traditional logistic chains, the scope of some links in the chain is broader, as well as the extent and/or goals of cooperation between participants forming links [more in: Grabara, 2004, 288–296].

The concepts of sustainable logistic chains suggest that the participants of logistic chains (including the final user) should be situated as close to each other as possible. This is crucial with respect to the necessity of technological links in the production process enabling the use of waste products from one process as initial material in another. The proximity of the production process to the final user will facilitate deliveries of products to (and returns from) consumers.

The steps that need to be taken in order to ensure the sustainability of logistic chains depend on various micro- and macroeconomic factors; the level of technological innovativeness; availability of resources, raw

Table 1. The environmental imperative of a logistic chain

Principles of sustainability of logistic chains	Features of a principle from the point of view of logistic chains	Function within a logistic chain	Required actions
The selection principle	Participants of a logistic chain select the appropriate raw materials, semi-finished and finished products, methods of production, transport, storage and technology which are the least harmful to the natural and social environment Selection of a service, *i.e.* dematerialisation	Determining and selecting a method to satisfy a need	Shifting from such sources as oil, coal, natural gas to wind power, solar cells and geothermal energy Selection of more eco-friendly means of transport Better use of means of transport (matching vehicle load capacity with the load of goods to be transported; maximisation of the carrying surface of a vehicle Use of logistic services, instead of independent accomplishment of logistic processes Maximisation of the use of logistic services offered by logistic firms Increasing the level of recycling (aimed at closing logistic chains)
The minimisation principle	Entities forming a logistic chain limit the amount of raw materials, semi-finished and finished products and energy consumed by their moderate and economical use	Specification of the level of satisfying needs	Change of habits concerning consumption of water, electricity, thermal energy and gas in logistic processes (delivery, production, distribution) Reducing the amounts of materials in products Shared use of factors of production and supply, *e.g.* of means of transport Quick reaction to individual needs of customers by: searching for new information regarding demand, the introduction of modularised production processes, so that there are common processes for a diverse range of products; maximum shortening of the forecasting horizon Minimisation of storage and stock reserves in any link in the logistic chain (production and delivery of raw materials, materials and products "on time")

Table 1. contd.

Principles of sustainability of logistic chains	Features of a principle from the point of view of logistic chains	Function within a logistic chain	Required actions
The maximisation principle	Links in logistic chains aimed at maximising the effectiveness of the use of energy and/or materials	Process of satisfying needs	Separation of the structural elements of a product from its visible parts Matching vehicle load capacity with goods load Matching the structures of logistic chains with product types (in logistic chains where innovative goods are produced, it is advisable to make their structure more flexible, whereas for functional products the best solution seems to be effective chains) Promotion of eco-friendly vehicles, development of high-quality public transport (including the development of new generation vehicles whose electric engines are connected to thermal engines, or vehicles propelled by natural gas), as well as the promotion of ecologically friendly branches of transport (*e.g.* railway transport) Making sure that parts which are quickly worn out can be easily replaced
The segregation principle	Micro-logistic systems forming logistic chains, focus on renewable sources of energy and recycling/disposing of materials according to the principles of minimising and segregating waste	Determination and selection of methods to eliminate the negative effects of satisfying needs	Ensuring the environmentally friendly utilisation of products as everyday practice Increased amount of recycled parts in products Use of recycled packaging Decreasing the level of pollution emitted by traffic Technological control of the production process in such a way that waste products from one process can be used as initial material in another

Source: based on Janikowski [1999, 165–168], Brown [2003, 97, 151–156, 245–264] and Fiher [1997, 114].

materials, semi-finished and finished products; types and effectiveness of information flow; the effects of the processes of delivery, production, distribution and transport. Consequently, the sustainability of logistic chains is determined by: the market for resources, semi-finished and finished products; decisions and actions of state authorities at all levels; the behaviour of the participants of logistic chains (suppliers, producers, wholesalers, retailers, target customers).

An important feature of sustainable logistic chains that distinguishes them from traditional meta-logistic systems is that they should be in harmony with ecosystems. In order to achieve this, logistic policy should focus on: designing products (cars, computers, household items, etc.) that can be easily decomposed and recycled; redesigning production processes so as to eliminate waste; ceasing the production of disposable items; purchases of goods by the state aimed at expanding the market for recyclable materials; developing and implementing material-saving technologies; closing the supply chain.

In order for a supply chain to conform to the principles of sustainable development, it is necessary to accept an appropriate system for the regulation and alteration of operating procedures [Brown, 2003, 151]. The requirements for sustainable development can only be satisfied if resources are used in the most effective way. This involves the saving of materials, energy, time, while maintaining the level of quality of the items and services produced. The starting point for implementing logistic chains based on the principles of sustainable development should be the creation of an appropriate system of logistic support, both for all the functional areas of a single link and the chain as a whole.

The 'opening' of a logistic chain is a result of demand for essential materials, raw materials, personnel, capital, equipment and machines indispensable for the production of an item and/or service. The 'closing' of a logistic chain is usually expressed by the role of an ideal location, which is a guarantee of access to given goods and/or services at the right time and place, at possibly the lowest price.

A logistic support system is therefore a purposefully organised subsystem of a single link and/or the whole supply chain, which supports the basic process of production by the integration of all actions necessary for the effective and beneficial flow of resources indispensable to the production process. It also supports the process of production by supplying the appropriate equipment, which is both easily available and reliable [Chaberek, 2002, 93].

Logistic processes within logistic chains can only be useful and effective if they are the subject of planning, organisation, supervision and control. It is vital for all these functions to consider logistic principles of

management, while complying with the philosophy of sustainable development.[1]

Sustainable development requires additional processes within logistic chains. These are collecting and/or reclaiming, segregation, processing, and recycling.

Logistic policy, aimed at sustainability of supply chains, should not only concentrate on improving physical and information flows, but also on creating favourable conditions for management of the processes of reclaiming, maintaining, warehousing and storing any resources (materials and information). It is important, though, to make logistic policy facilitate the development of logistic support systems, which are responsible for access to equipment, resources or machines, in accordance with the notion of sustainable development.

3. Concepts and instruments facilitating the sustainability of logistic chains

Logistic chains functioning in accordance with the principles of sustainable development face different environmental, social and economic challenges. For example, the regenerative abilities of the natural environment must be maintained. Non-renewable resources must be wisely managed and substituted by renewable resources. Environmental and social inconveniences must be limited. Conditions for fair competition must be created and followed in relation to access to limited resources. It is also necessary to dispose of waste in an ecologically sustainable manner.

Among the elements forming logistic chains and whole meta-logistic chains, logistic policy should therefore be directed toward shaping responsibility for the environmental effects of activities (the greenhouse effect, destruction of the ozone layer, water pollution, soil pollution, etc.), social effects in relation to the (direct, indirect) influence of such activities on different groups (employees, customers, investors, local communities) and economic effects connected with the creation of market value and profitability of goods and services.

---

[1] The main economic principle of logistics is maintaining the highest possible quality at the lowest possible production costs. This is only possible when resources are used in the most efficient way. However, logistic principles that are in accordance with the notion of sustainable development require striving towards the full exploitation of material and information resources by the minimisation of the amount of unused waste and/or their reuse, reduction of both production stoppages and incomplete utilisation of production time.

In the face of these challenges it is crucial that the state influences the sustainability of meta-logistic systems. This may be carried out using a wide range of instruments that closely correspond to modern concepts of management (see Table 2).

Table 2. Concepts of management facilitating the sustainability of logistic chains

Concepts of management	Characteristic features of the concept from the point of view of its impact on sustainability of logistic chains
Lean Management	Reduction in complexity, *i.e.* simplification of all processes and flows in order to avoid mistakes, wasting resources, semi-finished products, materials or opportunities. It is also crucial to intensify the exchange of information and feedback between functional spheres of a company and links of the external logistic chain, which may facilitate the transfer of so-called clean technologies
Clean Delivery/ Clean production/ Clean Distribution/ Clean Transport	Delivery/production/distribution/transport that considers and guarantees a responsible approach to the methods and scope of using natural resources; self-limitation; constant efforts to improve the technologies of delivery, production and distribution, which ensure the accomplishment of goals within individual links, in accordance with the concept of sustainable development
Just in Time	The essence of this concept is to avoid either producing goods for warehouses or creating reserves of resources, materials or raw materials. Realisation of this concept allows managers to plan how to eliminate a producer's losses, delays and waste using appropriate schedules for delivery to assembly lines
Quick Response	Such a system consists of technologies involving databases, automatic order placing, bar codes, data exchange, all of which enable information and product flows along the whole logistic chain. Quick responses are aimed at maximising the efficiency of the chain via reduced expenditure on reserves, which reduces waste and facilitates economical management of limited resources
Efficient Consumer Response	This concept is based on cooperation, partnership and full integration of all the companies in the various links of a logistic chain. It is aimed at coordination of physical and informational flows. The concept encompasses stimulating demand (optimisation of product range, promotion, introduction of new products, information about demand); supply (integration of suppliers of raw materials and packaging; higher reliability of processes in order to reduce reserves, wastage of resources and time in the various chain links; synchronisation of production and real demand for a product; substitution of warehousing by cross-docking; introduction of the principle of constant completion in response to information from points of sale; systems of automatic order placing); supporting technologies (standardisation of product labelling, mass packages, transport packages, sites, partners and their automatic identification; electronic data exchange)

Table 2. contd.

Total Quality Environmental Management	This concept integrates environmental management systems with social management systems. It involves planning, implementation of principles and procedures crucial to accomplish environment-oriented and social-oriented objectives. It uses tools such as: environmental market analyses, scenario analyses, voluntary agreements among companies, audits, sustainable development indices, calculations of costs and social benefits
Sustainable Development Results Chart	This is a concept of the strategic management of sustainable development in various links of logistic chains. The strategic results chart: shows interrelations between different factors assessing the realisation of strategies; allows us to improve the efficiency of logistic processes; enables the identification and management of environmental and social aspects of success, depending on their strategic importance
Green Supply Chain Management	This concept considers the needs of environmental protection and customers' preferences in all links of the logistic chain
Re-engineering of Logistic Processes	This concept is based on the verification of supply chains from the point of view of generating added value by the implementation of the processes of reverse logistics in accordance with the '5 R's': recognise and report (recognise and report all physical and informational flows, taking into account reverse logistics); recover and return (recover and return reclaimed materials to their suppliers); recycle and reuse (recycle and internally reuse materials to the greatest possible extent, in order to maximally reduce waste); retire (remove scrap metal and waste for redistribution); review, re-engineer or renew (monitor activities, in order to rapidly re-design and/or udpate the system of return logistics, including its infrastructure and elements)

Source: based on Fechner [1998, 215–227], Borys [1999, 247], Graczyk [1999, 171], Kaplan and Norton [2001], Borys [2004, 130–140], Grabara [2004, 279] and Karwacka [2005,169–175].

Instruments of logistic policy that create and improve logistic chains, while conforming to the principles of sustainable development, may be divided into [see Barde, 1996; Górka et al., 1996; Fiedor, 2003, 74–90; Poskrobko et al., 2004, 62–84]:

– direct instruments (any legal and administrative regulations; obligatory standards; administrative decisions; local legal regulations, including local spatial plans);
– indirect instruments that may be further divided into:
  • legal instruments,
  • market instruments:
    • economic and fiscal (environmental fees, fines for exceeding the maximum level of emissions allowed, product fees and taxes, deposit-refund fees, trading emission limits, subsidies, etc.),

- voluntary agreements, sharing, pooling, public sector purchases, product responsibility, eco-leasing,
- horizontal supporting instruments:
- information (eco-labelling, information labels, advertising and marketing campaigns, description of contents),
- education (scientific research, environmental counselling centres, etc.),
- financial instruments (special financial support mechanisms outside budget financing).

The description of these instruments clearly implies the necessity of the integration of different policies. The choice of an appropriate instrument should be made on the basis of the following criteria [Janikowski, 1999, 111–112]:

1. The extent of integration of policies that indirectly influence the environment through their implementation and the instruments used.

2. Minimisation of negative effects on the distribution of wealth. The actions of some instruments may be regressive, *e.g.* due to rises in the prices of certain products. Such negative influences on the distribution of wealth should be limited and compensated for using other policies.

3. Implementation costs. All the elements of implementation costs must be taken into account: monitoring, licensing, execution, etc.

4. Simplicity. Complicated regulations and economic instruments are poorly executed, they lead to fraud and excessive administration and adaptation costs.

5. Flexibility. Participants in a logistic chain (producers, suppliers, etc.) or whole chains must be allowed to choose their own methods of adapting to environmental requirements (a free choice of techniques for reducing pollution and adaptation strategies).

6. Motivation. There should be constant motivation to reduce pollution and seek technological innovations.

7. Economic efficiency. Instruments should accomplish their goals at minimal social costs.

8. Effectiveness in achieving sustainable development. Some instruments are more appropriate than others (*e.g.* banning the production of hazardous substances will be more effective than taxing them).

9. Political acceptability. This depends on different factors (costs, simplicity, clarity, social participation). Some types of regulations or taxes may be acceptable in certain circumstances and unacceptable in others.

10. Conformity to international agreements, conventions (protocols, negotiated principles).

Table 3 presents examples of instruments that may facilitate the sustainability of logistic chains from the point of view of sustainable development.

Since the need to coordinate different kinds of policies is fundamental to the development of the state's logistic policy, it is necessary to integrate the use of various instruments which influence sustainability.

Table 3. Examples of instruments that may facilitate the sustainability of logistic chains

Types of the state's instruments
Rises in tax rates concerning: carbon and sulphur emissions, diesel oil, power and water supply, burning and dumping waste, purchase of new cars, sale of petrol, industrial carbon emissions, sale of pesticides, chlorinated solvents, solid waste accumulators, air and water pollution
Tax allowances for investors in the wind power industry
Tax allowances used for supporting investments in energy saving
Eco-labeling of products that are produced in accordance with the requirements of environmental protection
Production limits
Elimination of regulatory and infrastructural barriers to access to railways, sea and air transport services
Economic and financial support of combined transport, improving safety and environmental protection
Promoting the sustainability of particular branches of transportation
Systems of fees for users of city centre infrastructure
Mechanisms of differentiating taxes on means of transport, depending on eco-friendliness criteria
Promotion of integrated transportation
Planning, public and private partnerships in the field of infrastructure development
Promotion of EDI standards
Building and modernisation of sea and air ports, as well as reloading terminals
Advice regarding and promotion of logistic services
Banning the production of disposable goods
Subsidies encouraging the effective use of water and wind power
Directives concerning vehicles and oils
Standards regulating the level of traffic fumes
Standards regulating fuel quality
Creation of legal regulation concerning alternative fuels which emit less pollution
Reform of the railway system (separation of services from infrastructure management, restructuring)
Developing organisational structures for industrial cooperation systems
Developing the system of credit guarantees for companies forming links in the logistic chain

Source: author's own elaboration.

Taxation instruments, administrative regulations, eco-labels and production limits could be helpful in this area. However, while striving to improve physical and information flows between participants of logistic chains in accordance with the idea of sustainable development, restructuring the taxation system seems to be crucial. Taxation policy is an exceptionally effective tool, since it works at the level of a system as a whole.

Some of the state's activities aimed at improving physical and information flows in accordance with the idea of sustainable development, should be directed toward subsidies promoting *e.g.* the system of railway transport in cities and the use of recyclable materials, which do not destabilise the climate or deplete sources of energy.

4. Concluding remarks

Logistic policy is undoubtedly facing challenges concerning the creation and structuring of stimuli which facilitate efficiency and the effectiveness of flow in supply chains. Nevertheless, decision makers responsible for logistic policy should not forget about reverse relations between the effective flow of materials, semi-finished and finished products in logistic chains and sustainable development.

The state's actions should therefore focus on changing the structure of stimuli. They should resign from historically shaped stimuli, *i.e.* those orientated towards prosperity, technological progress and/or military strength, and instead promote innovation and effective exploitation of natural resources.

Improvement in flows within logistic chains must definitely be accompanied by: the conscious promotion of efficiency in utilising resources; persuading players within logistic chains to obey the rules of sustainable development; building strategic partnerships between participants of supply chains regarding the use of available resources and capital in accordance with the principles of the eco-efficiency code; creating conditions for the competitiveness of sustainable technologies; orientation towards the concept of material productivity.

Logistic policy, while improving physical and information flows and facilitating the implementation of the assumptions of sustainable development, should also aim to create stimuli that encourage participants of supply chains to play a role in sustainable development by: prolonging the lives of products (which contributes to limiting the consumption of materials consumption); reusing durable containers for materials, semi-finished and finished products; using recycled packaging.

The implementation of logistic policy should not only be directed towards improving existing supply chains, but also towards creating new sustainable logistic chains, which: *select* the methods of implementation and/or kinds of materials and energy, choosing such methods of delivery, production, distribution and transport which are the least harmful to the natural and social environment; *minimise* the amount of used raw materials, semi-finished and finished products; *maximise* the effectiveness of the use of renewable sources of energy, time, space, energy and/or materials; *segregate* used materials by minimising and segregating waste, as well as eliminating the negative effects of delivery, production, distribution and transport on sustainability.

All in all, logistic policy should create conditions facilitating the profitability, development and implementation of concepts favouring the sustainability of logistic chains. With the use of these concepts, the management of logistic systems in individual companies, as well as entire meta-logistic systems, leads to more efficient implementation of the processes connected with delivery, production and distribution. All the decisions made within logistic chains following these concepts will not only improve physical and information flows, but also result in economical and effective use of time, space, materials and energy.

Literature

Barde, J.P., „Polityka ochrony środowiska i jej instrument", in: Folmer, H., Gabel, L., Opschoor, H. (eds.), *Ekonomia środowiska i zasobów naturalnych*, pp. 18–34. Warszawa: Wydawnictwo Krupski i S-ka, 1996.

Borys, G., „Koncepcje i instrumenty zrównoważonego rozwoju przedsiębiorstw", *Ekonomia i Środowisko*, 2, pp.130–140, 2004.

Borys, T., „Spory wokół pojęcia zrównoważonego rozwoju", in: Czaja, S. (ed.), *Zrównoważony rozwój – doświadczenia polskie i europejskie*, pp. 35–51. Wrocław: Wydawnictwo I-BiS, 2005.

Borys, T., *Wskaźniki ekorozwoju*. Białystok: Wydawnictwo Ekonomia i Środowisko, 1999.

Brown, L.R. *Gospodarka ekologiczna na miarę ziemi*. Warszawa: Książka i Wiedza, 2003.

Chaberek, M., *Makro- i mikroekonomiczne aspekty wsparcia logistycznego*. Gdańsk: Wydawnictwo Uniwersytetu Gdańskiego, 2002.

Cost and Benefit of Enlargment study for Phare MCTP. Halcrow/NEI, 1999.

Coyle, J.J., Bardi, E.J., Langley, J.J., *Zarządzanie logistyczne*. Warszawa: PWE, 2002.

Fechner, I., „Strategia ECR w łańcuchu dostaw – integracja dla wzrostu konkurencyjności", in: *Zarządzanie łańcuchem dostaw*. materiały konferencyjne, pp. 215–227. Poznań: PTL, 1998.

Fiedor, B. (ed.), *Problemy trwałego rozwoju (Sustainable Development)*. Wrocław: Wydawnictwo I-BiS, 2000.

Fiedor, B., „Instrumenty ekonomiczne i rynkowe w realizacji koncepcji zrównoważonego rozwoju", in: Borys, T., (ed.), *Zarządzanie zrównoważonym rozwojem – Agenda 21 w Polsce – 10 lat po Rio*, pp. 74–90. Białystok: Wydawnictwo Ekonomia i Środowisko, 2003.

Fisher, M.L., "What is the right upply chain for yor product?", *Harvard Business Review*, March–April, pp.114–121, 1997.

Górka, K., Poskrobko, B., Radecki, W., *Ochrona środowiska. Problemy społeczne, ekonomiczne i prawne.* Warszawa: PWE, 1996.

Grabara, J.K., „Ewolucyjny charakter systemów informacyjnych na przykładzie informatycznego wspomagania logistyki odwrotnej", in: Kisielnicki, J., Grabara, J.K., Nowak, J. (eds.), *Informatyka w gospodarce globalnej*, pp. 28–41. Warszawa: WNT, 2003.

Grabara, J.K., „Logistyka odwrotna jako element zwiększenia konkurencyjności rynkowej przedsiębiorstw", in: Bukowski, L. (ed.), *Wybrane zagadnienia logistyki stosowanej*, pp. 279–291. Kraków: Oficyna Wydawnicza TEXT, 2004.

Grabara, J.K., „Zamknięte pętle łańcuchów dostaw. Wyznaczanie zasad", in: Sołtysik M. (ed.), *Kierunki rozwoju logistyki w Polsce w świetle tendencji światowych*, pp. 288–296. Katowice: Wydawnictwo Akademii Ekonomicznej im. K.Adamieckiego, 2004.

Graczyk, M., *Zarządzanie proekologiczne.* Zielona Góra: Wydawnictwo Politechniki Zielonogórskiej, 1999.

http://www.psm.pl.

Janikowski, R., *Zarządzanie ekologiczne.* Warszawa: Akademicka Oficyna Wydawnicza PLJ, 1999.

Janikowski, R., *Zarządzanie antropopresją – w kierunku zrównoważonego rozwoju społeczeństwa i gospodarki.* Warszawa: Difin, 2004.

Kaplan, R.S., Norton, D.P., *Strategiczna Karta Wyników. Jak przełożyć strategię na działanie.* Warszawa: PWN, 2001.

Karwacka, G., „Regulacyjna funkcja logistyki w równoważeniu rozwoju przedsiębiorstwa", in: Brdulak, H., Gołębiowski, T. (ed.), *Wspólna Europa. Zrównoważony rozwój przedsiębiorstwa a relacje z interesariuszami*, pp. 169–176. Warszawa: Szkoła Główna Handlowa, 2005.

Kozarowicz, H., Skowrońska, A., *Polityka przemysłowa.* Wrocław: Wydawnictwo Akademii Ekonomicznej im. O. Langego, 2005.

Kozłowski, S., „Zrównoważony rozwój – wyzwanie przyszłości", *Człowiek i Przyroda*, 5, pp. 6–12, 1996.

Piontek, F., „Globalizacja a rozwój zrównoważony i trwały", *Problemy Ekologii*, 1, pp. 13–18, 2003.

Poskrobko, B., Bukowska, J., Ejdys, J., Sidorczuk, E., „Propozycje modyfikacji wybranych instrumentów ekonomicznych ochrony środowiska w Polsce", *Ekonomia i Środowisko*, 6, pp.62–84, 2004.

Reid, D., *Sustainable Development. An introductory guide.* London: Earthscan, 1995.

Skowronek, Cz., Sarjusz- Wolski, Z., *Logistyka w przedsiębiorstwie.* Warszawa: PWE, 2003.

Skowrońska, A., „Logistyka w polityce gospodarczej państwa", *Ekonomika i Organizacja Przedsiębiorstwa*, 11, pp. 35–42, 2006.

The UE Sustainable Development Strategy. A framework for indicators. Pascal Wolf – Eurostat E5. Seventh Meeting of the ESS Task Force on Mathodological Issues for SDI. Stockholm: SDI Workshop February 2004.

Tsoulfas, G.T., Pappis, C.P., *Application of Environmental Principles to Reverse Supply Chains.* Tinos: Aegean Conferene, 2001.

Weizsacker, E.U., Lovins, A.B., Lovins, L.H., *Mnożnik cztery – podwojony dobrobyt – dwukrotnie mniejsze zużycie zasobów naturalnych.* Toruń: Polskie Towarzystwo Współpracy z Klubem Rzymskim, Wydawnictwo Rolewski, 1999.

Witkowski, J., „Polityka logistyczna nowym rodzajem polityki gospodarczej państwa", in: Sołtysik, M. (ed.), *Kierunki rozwoju logistyki w Polsce w świetle tendencji światowych*, pp. 54–62. Katowice: Wydawnictwo Akademii Ekonomicznej, 2004.

Zabłocki, G., *Rozwój zrównoważony. Idee, efekty, kontrowersje.* Toruń: Uniwersytet M. Kopernika, 2002.