

Green Logistics: Element of the Sustainable Development Concept. Part 1

Zelena logistika: element koncepta održivog razvoja. Dio 1.

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Summary

Nowadays, the reduction of the harmful effect on the environment is one of the essential state-level and international challenges. The solution of this problem lies in a worldwide use of concepts and principles of sustainable development, but also in transport and logistics performance by principles and methods of green logistics. The first part of the paper presents the review of the most authoritative studies in the field of sustainable development and green logistics. The second part of the article reflects the original approach to achieving the goals of sustainable development in the operation of logistics and transport systems based on the harmonisation of economic purposes and principles of logistics with principles of sustainable development that are reached through the systematisation of reviewed methods and instruments of logistics.

KEY WORDS

sustainable development
green logistic
goals

Sažetak

U današnje vrijeme smanjenje štetnog utjecaja na okoliš predstavlja jedan od ključnih izazova na državnoj i svjetskoj razini. Rješenje ovoga problemaleži u primjeni konceptata i principa održivog razvoja diljem svijeta, ali i na organizaciji transporta i logistike u skladu s principima i metodama zelene logistike. U prvom dijelu rada iznosi se pregled najutjecajnijih istraživanja u polju održivog razvoja i zelene logistike. Drugi dio rada sadrži izvorni pristup postizanju ciljeva održivog razvoja u području sustava logistike i transporta na temelju usklađivanja ekonomskih svrha i logističkih principa s principima održivog razvoja, koje se postiže sistematizacijom proučenih metoda i logističkih instrumenata.

KLJUČNE RIJEČI

drživi razvoj
zelena logistika
ciljevi

1. INTRODUCTION / Uvod

More than 1200 Summit participants of the United Nations Global Compact (UN Global Compact) from 75 countries met on 21-23 June 2016 in New-York to discuss the issues of contribution of business communities to the realisation of the goals in the field of sustainable development until 2030 [1, 2]. The executive director of UN Global Compact Lise Kingo, speaking at the Summit, noted: «Many companies start looking at the world through the prism of the goals of sustainable development. Entrepreneurs try to access how their business, goods, and services correspond to the realities of the planet, and how they will meet the demand today and in the long term» [1].

According to World Resources Institute [3] in the period from 2000 to 2014, there were only 20 countries, among them France, Germany, Great Britain and the USA that have reduced the indicators of greenhouse gas emissions' level with rising gross domestic product (GDP). However, it is not enough for achieving the strategic objectives of the Paris Agreement to combat global climate change [4], maintain the growth of global average temperature by the end of XXI century within

the limits of 2°Celsius of beyond pre-industrial indicators and efforts to limit temperature rise to 1,5°Celsius.

Nowadays, the Russian Federation is ranked fourth in the world for CO₂ emission after China, USA, and India [5]. In view of increased traffic volumes as in Russia, also in the global transportation system, the lack of throughput of transport infrastructure and increased negative impact of transport on the environment, the observance of the principles of sustainable development is the highest priority which must be faced by all countries.

2. GOALS AND PRINCIPLES OF SUSTAINABLE DEVELOPMENT CONCEPT / Ciljevi i principi koncepta održivog razvoja

Sustainable Development Goals (SDGs) are new universal sets of goals and objectives that the UN members have approved as guideposts to formulating the policies in the field of ecology and environmental protection up to the year 2030. They have the most critical task of sustainable development,

Table 1 Sustainable Development Goals
 Tablica 1. Ciljevi održivog razvoja

Nº	Designation	Goal content
1		End poverty in all forms everywhere
2		End hunger, achieve food security and improved nutrition and promote sustainable agriculture
3		Ensure healthy lives and promote well-being for all at all ages
4		Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all people
5		Gender equality and empower all women and girls
6		Ensure availability and sustainable management of water and sanitation for all
7		Ensure access to affordable, reliable, sustainable and modern energy for all
8		Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
9		Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation
10		Reduce inequality within and among countries
11		Make cities and human settlements inclusive, safe, resilient and sustainable
12		Ensure sustainable consumption and production patterns
13		Take urgent action to combat climate change and its impacts
14		Conserve and sustainably use the oceans, seas and marine resources for sustainable development
15		Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
16		Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build efficient, accountable and inclusive institutions at all levels
17		Strengthening the means of implementation and revitalising the global partnership for sustainable development

Source: [7]

which needs an integrated solution by all countries [6]. SDGs are incorporated into the global strategic programme «Transformation of our world: the sustainable development agenda to 2030», which was adopted at the 70th session of United Nations General Assembly that was held in September 2015. This programme includes the Declaration, 17 goals, and 169 objectives, the achievement of which is intended to ensure sustainable development by improving the social and economic sphere of society while at the same time protecting the environment (Table 1).

An essential aspect of an agenda is the complex and indivisible nature of SDGs balancing all three components of sustainable development: economic, social and environmental. The success in achieving SDGs is much dependent on the activities of international and regional organisations that promote sustainable development and coherence of national,

local and foreign policies regarding enshrined priorities and implementation of sustainable development principles.

Nowadays, strengthening and developing the principles of sustainable development concept are being implemented through two approaches – legal and regulatory, scientific and methodological approaches.

Legal and regulatory approaches imply the interpretation of sustainable development principles in various legal and regulatory acts of international and national legislation. Hence, the primary document containing sustainable development principles is the Declaration on Environment and Development [8], adopted at the UN Conference on Environment and Development, Rio de Janeiro in 1992. The declaration contains 27 sustainable development principles. UN Framework Convention on Climate Change (adopted 09 May 1992) has five principles and aims to achieve the goal of

stabilising greenhouse gas concentrations in the atmosphere at the level that would prevent dangerous anthropogenic interference with the climate system [9].

The basis for developing sustainable development concept in Russian legislation contained two decrees of the President of the Russian Federation – «About the governmental strategy of the Russian Federation of environmental protection and sustainable development» [10] and «On the concept of the Russian Federation for the transition to sustainable development» [11]. Furthermore, 24 main principles of environmental protection in the Russian Federation have been formulated in article 3 of the federal law «On Environmental Protection». Moreover, seven principles of state management in the field of atmospheric air protection and waste management have been formulated in federal laws «On Air Protection» [13] and «Waste products resulting from the productive process and consumption» [14]. The same seven principles have reflected in the Decree of Russian Government «On the environmental doctrine of Russian Federation» [15], as well as eight principles in public policy in the field of the environment. However, only 16 principles have been presented in «Provisions of Government policy in the field of environmental development of Russia up to the year 2030» [16].

The analysis of scientific-methodical literature in the field of applying the principles of sustainable development in various areas indicated that there has recently been the growing interest in concepts of sustainability, viability, sustainable development and sustainable transport [17]. Furthermore, the same situation observed in implementing the principles of sustainable development [18], [19].

Laws, rules, principles, and hypotheses of modern ecology have most fully considered by Reymers, F. M. [20]. He has formulated general principles of environmental policy. It highlights that humanity is at the crossroads of ecological and socioeconomic eras and it requires the development of clear environmental policies, and the need to «fit» in the natural biogeochemical cycles and change the ways of natural resources use. Rozenberg G.S. et al. have presented a systematic approach to studying ecosystems and the basic concepts of modern ecology. This paper emphasized the challenges of sustainable development of ecosystems of different scales and seven principles were proposed [21].

Melnik L.G. identifies five groups of principles to achieve the goals of sustainable development [22], [23]: 9 principles to organize the socioeconomic system; 7 principles of environmental succession of generations; 14 principles of ecosystems' sustainability; 6 principles to establish «environmental goals» that form the environmental focus of sustainable development processes; 6 principles of «environmentally oriented motivation».

Paper [24] contains the principles underpinning the different models of corporative environmental management, among them the requirement of sustainable development; the principles of the stakeholders, circularity, cooperation; environmental risks management.

The «Club of Rome» report of E. Vaytszeker, E. Lovins, L. Levine played an important role in the formation of attitudes of sustainable development [25]. Authors are sceptical about the possibilities of greening the lifestyle due to market

mechanisms and strongly believe that it is essential to regulate the market by the government and meet the challenges of environmental conservation. They have proposed eight principles of Eco-capitalism [26].

Principles of environmental management activities in transport have detailed considered in the paper [27], the principles of monitoring and evaluating the state of the environment and environmental safety in rail transport presented in papers [28], [29]. Nine principles of the transport operation, as part of the technosphere, taking into account its impact on the environment have presented in paper [30].

Thus, the analysis of legislative framework and studies in the field of sustainable development, environmental protection and ecology showed that currently, these are well-established academic areas with its laws, principles, theories. However, modern science has not been developed yet the universally accepted definition of «sustainability» and «sustainable development» about socioeconomic systems [31]. It reflects both the complexity of meanings, and the complexity of the object of a study as a way could be both national economics and individual industrial enterprises, transport organisations, supply chains.

3. GREEN LOGISTICS AS THE ELEMENT OF SUSTAINABLE DEVELOPMENT CONCEPT / *Zelena logistika kao element konceptual održivog razvoja*

The application of logistics to solve the environmental problem and implementation of the principles sustainable development began in the 1980s. Many academics pointed out [32 - 35] that logistics has significant potential for the environmental monitoring of transport systems, processes of products' recycling, control and minimisation of environmental pollution, energy and resource-saving processes. Actively developing research and possible directions during the final 20 years based on principles of sustainable development that are the green logistics and green supply chain management have reached a high level of maturity in Europe, the USA, and some Asian countries [33], [36].

It should be emphasized that the introduction of the principles of green logistics is particularly important for large megacities, for which the environmental problems are particularly acute [37]. These principles are close to both individual logistics or transportation companies that successfully use this as their advertising, and for global solutions. For example, article [38] introduces the idea of «Green Customs», but paper [39] considers the idea of global green transport corridors.

Authors propose a new approach to achieving the goals of sustainable development in the operation of logistics and transport systems [40] based on the harmonization of economic goals and principles of logistics with goals and principles of sustainable development that could be achieved as a result of systematizing methods and instruments of logistics.

The comparison of sustainable development goals (Table 1) and goals of logistics systems' operation show the existing contradictions. If the operation of logistics system is oriented to achieve economic purposes (improvement of the quality of services, profit, costs saving), the main role of sustainable development is the achieving the balance between economic,

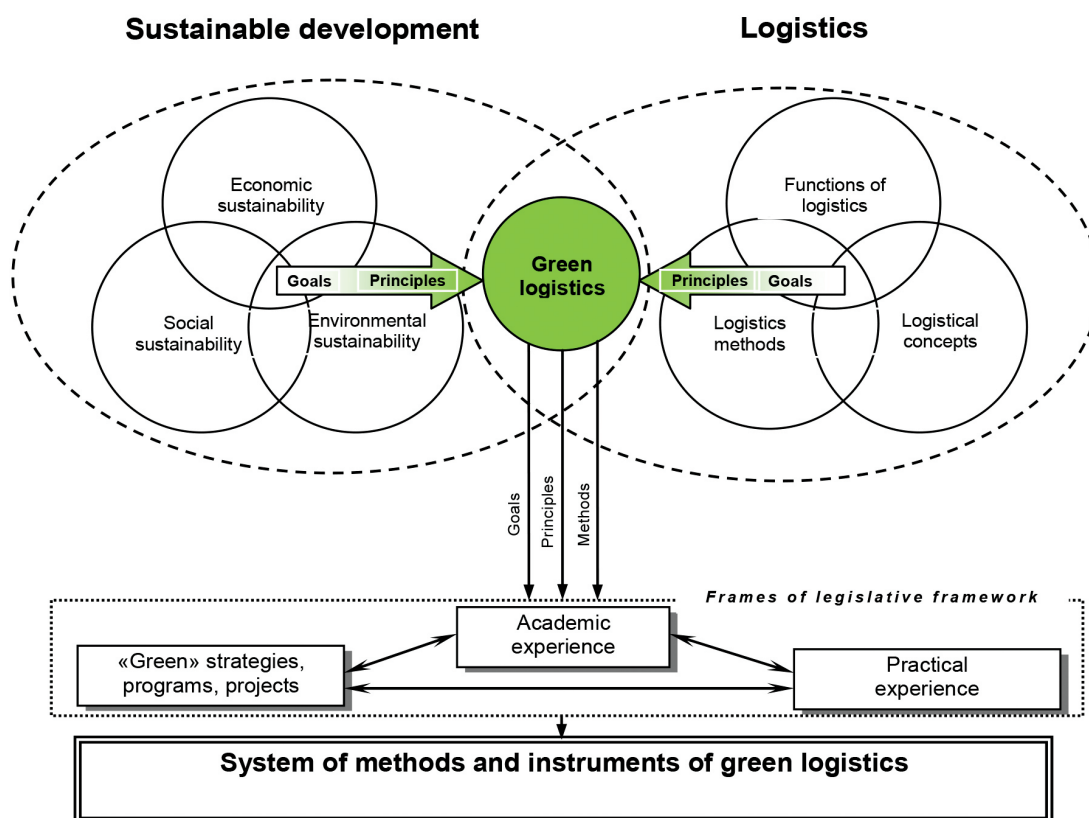


Figure 1 The scheme of proposed approach to achieving the goals of sustainable development in the operation of logistics and transport systems

Slika 1. Shema predloženog pristupa postizanju ciljeva održivog razvoja u radu sustava logistike i transporta

Source: authors' elaboration

social and environmental needs of society. From the perspective of green logistics, it is necessary look for ways to harmonise the goals of sustainable development and logistics. The main hypothesis of this harmonisation is that the implementation of logistics methods, concepts and functions principally reduces the expenditure of resources that potentially contributed to reducing the adverse impact on the environment. Effective utilisation of resources with logistics methods' application improves the logistics processes, and as a result, implement social and environmental needs of society. However, that requires the systematisation of functions, methods and concepts of logistics for developing «synthetic» principles of green logistics. It will provide the achievement with the goals of logistics and sustainable development.

Figure 1 shows the scheme of the proposed approach. Creation of a system of methods and instruments of green logistics consistent with the goals and principles of sustainable development should be carried out under the following conditions:

1. *The description of logistics systems from the perspective of structural, functional and system approach.*

Each logistics element performs the specific set of functions affected by logistics flows. The performance of these functions is essential to achieve the goals of logistics elements for passing and processing logistics flows.

Concerning logistics systems, it is necessary to highlight two types of functions [41]:

- basic functions that affected the logistics flows. These

include supply (input of flows onto a system); production (qualitative change of flows); transportation (flows' promotion); warehousing (accumulation and deceleration of flows); distribution (output of flows from the system with transformation of material flows into flows of services and financial flows);

- key functions for managing logistics flows and logistics system as a whole.

The selection of logistics functions by structural and functional approaches systematise the logistics flows and instruments for achieving sustainable development goals. Furthermore, it could group well-known methods and instruments into two core topics. The first topic belongs to logistics element, implementing one of the basic logistics functions. The second one belongs to the reason of method's impact on logistics flows based on the implementation of key management functions of logistics flows. It will exclude the duplication of green methods at different stages of logistics processes and allow to define and apply perspective methods and instruments.

The author's system of methods is detailed considered in the second part of the paper (Green Logistics: A System of Methods and Instruments. Part 2).

2. *Logistics principles' consistency with principles of sustainable development concept.*

Logistics concept is the idea forming the basis for building the specific logistics system. The logistics concept is the way to connect (interact) the logistics elements. According to two key

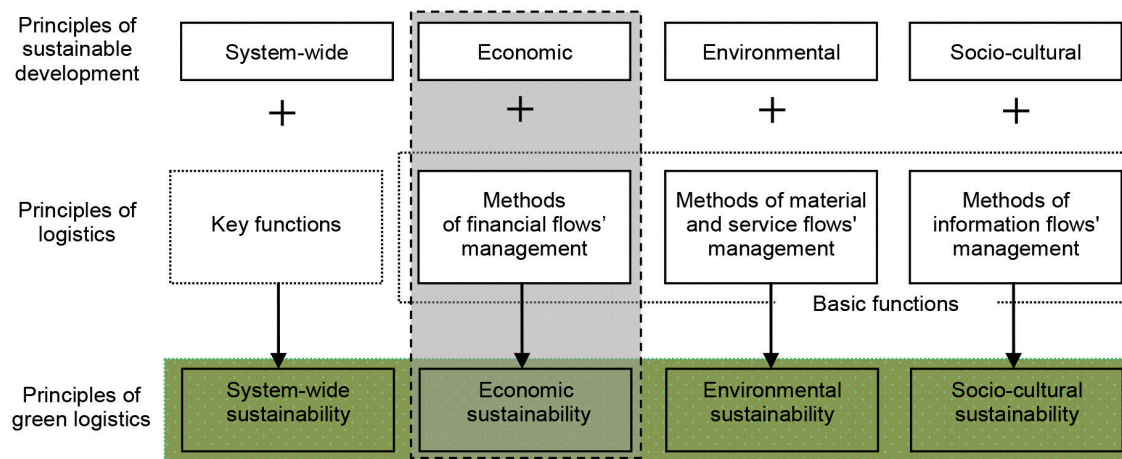


Figure 2 Scheme of forming the principles of green logistics
 Slika 2. Shema formiranja principa zelene logistike

Source: authors' elaboration

concepts, these connections could be horizontal (JIT), emerging as a result of self-organisation process, as well as vertical (ERP), specifically formed in the process of logistics systems designing.

Implementation of sustainable development concept could also be applied given self-organisation processes in society in two ways, the formation of environmental awareness, development of the ecological movement, public environmental monitoring or through centralized management, based on enforcement of legal and regulatory framework in the field of ecology and of environmental protection.

The first way implies the inclusion of social mechanisms in the practice of supply chain management, i.e. the development corporate social responsibility, environmental management, implementation of audit programme according to environmental requirements and reliance on logistics systems on social needs of society. The second way is based on the application of economic and legal instruments of governmental regulation of logistical activities.

Therefore, the consistency of logistics principles with principles of sustainable development concept is based on the establishment of new targets of management flow of logistics system, i.e. implementation of «green» key functions. On the one hand, regarding practical activity of logistics companies, it involves the compliance of the mandatory requirements and restrictions in the field of ecology. On the other hand, there is the availability to achieving economic profit, competitive advantage, improvement of the image and public popularity of the company through the use of green technologies.

3. *Achieving and maintaining the balance between economic, environmental and socio-cultural sustainability of logistics systems.*

The basis of logistics principles consists of seven rules of logistics that could be formulated as «a company within the logistical systems should provide the availability of right product with the required quality in the right place at the appropriate time for a specific consumer with minimal costs». However, the compliance with these regulations primarily focuses on increasing the economic efficiency of the logistics system. Moreover, it does not adequately implement principles of sustainable development based on achieving a reasonable balance between economic, social, cultural and environmental

development and need people's needs.

Comparative analysis of the economic aspects of logistics and sustainable development makes it possible to formulate general «synthetic» principles of green logistics through the combination logistical rules (principles) and environmental requirements (principles of economic sustainability) (figure 2).

Therefore, the system of green logistics principles has formed as a result of the synthesis of principles of sustainable development and logistics principles. The main idea of this system is the achieving the balance between economic, environmental and socio-cultural sustainability of logistics system. Authors propose to highlight system-wide and specific principles of green logistics. System-wide principles are the general management principles that applied to all the elements of the green logistic system. Particular principles are related to individual aspects of sustainable development of the green logistic system.

Table 2 presents the results of systematization of green logistics principles and its characteristics.

4. *Development of the system of methods and instruments of green logistics by best practices in the field of implementing the environmental programs and projects in the activity of public and state institutions, business structures, research institutions and international associations.* Nowadays, many logistics companies, for example, DHL, Schenker AG, Green Cargo Kuehne Nagel, UPS, COSCO Group and etc. have been applying the principles of green technologies in the implementation of its activities. They define the green logistics as the effective approach to managing technological processes, resource and energy flow to reduce environmental and economic damage. Moreover, in authors opinion that approach could provide social development of workers and efficient, innovative expansion of production. The process of accumulation and selection of particular solutions for reducing harmful effects of transport and logistics systems on the environment is still going in the world. These solutions are reflected in green programs, strategies and projects. The formation of the system of methods and instruments of green logistics should be based on this experience. The author's variant of such systematisation based on presented methodology in this

Table 2 Systematization of green logistics' principles
Tablica 2. Sistematizacija principa zelene logistike

Aspect of sustainability	Name of principles	Characteristics
System-wide sustainability	Principle of consistency	consideration of environmental, economic and socio-cultural aspects of sustainable development of the logistics system and relationships between them as a unified system
	Principle of adaptability	property of adaptation to the effects of external factors on logistics system (changes of the environment) for maintaining the sustainability of the market and useful application of advanced technologies
	Principle of development	constant and purposeful improvement of the structure and functions of the logistics system, the methods, techniques and instruments of green logistics in a competitive environment to ensure the sustainable market position
	Principle of self-organisation	change of principles of operation of social and economic systems to consolidate the found optimal ecological and economic solutions
	Principle of competency	formation and presence of competencies of all supply chain's actors needed for sustainable development
Economic sustainability	Principle «polluter pays»	compensation of environmental damages related to the provision of logistics services at all stages of material flow's promotion
	Equity principle	total benefit from the acquisition of the goods by the consumer in supply chains should be proportionately aligned between manufactures, sellers and carriers
	The principle of efficiency and safety	solutions in the field of logistics system development should be evaluated concerning both economic efficiency and safety and negative impact of system on environment
	Principle of optimality	development of optimal solutions in logistics system's management is carried out through environmental costs as a part of total logistics costs
	Principle of non-waste and resource saving	maximum use of the waste product, packaging and packing as a secondary material or its environmentally sound recycling, as well as minimal utilisation of raw materials and packaging that couldn't be re-used or safely utilised.
Environmental sustainability	Principle of minimal impact	reducing the negative impact on nature through the whole cycle of production, transportation, direct use and recycling
	Principle of innovation	the introduction of innovative technologies to reduce the environmental pressure on the environment
	Principle of rationality	rational use of natural resources and potential of enterprises
	Principle of hierarchy	prioritisation of solutions for sustainable development conditioned by the hierarchy of aspects of sustainable development: environment → economy → society → culture
Socio-cultural development	Principle of responsibility	the increased environmental responsibility of staff and formation of corporative environmental ecology
	Principle of transparency	improving the relationships with clients and stakeholders by interactivity, information and financial transparency
	Principle of reasonable consumption	commitment to reducing transport social needs and government that do not violate the rights of free movement and trade as well

Source: authors' elaboration

paper is described in the second part of the paper Green Logistics: A System of Methods and Instruments. Part 2.

4. CONCLUSION / *Zaključak*

The analysis of reviewed studies in the field of sustainable development of transport systems, green logistics and integration of environmental factors into the practice of logistics management shows that currently, approaches and principles of sustainable development have already been formulated, the legal framework for its implementation has been created. However, well-known, accepted principles of green logistics have not been expressed yet, there is no unified system of methods and instruments for implementing these policies. We have a situation when there are numerous theoretical studies in the field of sustainable development of transport systems, however, general results of its research are weakly used for

systematising the massive number of private technical and technological solutions for reducing the harmful impact of transport on the environment.

The insufficient system in the implementation of methods and instruments of green logistics in practice often leads to decrease in efficiency of these methods and instruments separately, does not contribute to the green synergistic effect in supply chains.

A new approach to achieving the goals of sustainable development based on the harmonisation of economic purposes and principles of logistics with goals and principles of sustainable development is presented in the paper.

On one hand, this approach systemises famous and widely used logistics methods in practice, accesses the effectiveness according to the criterion for achieving sustainable development goals, but on the other hand, it determines the

goals of sustainable development, achievement of which is not provided by existing logistics methods and identifies areas where these methods could be improved.

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