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INTEGRATION OR DISINTEGRATION OF THE ECOLOGICAL AND URBAN FUNCTIONS OF THE RIVER IN THE CITY? A POLISH PERSPECTIVE*

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Abstract

This article aims to find whether the urbanized area experiences integration or disintegration of the ecological and urban functions of the river. The river has always played an important role in urban areas, although over the centuries, it has come through radical changes. At first, it decided on the location of the city, served as a defense and means of transport, and during the period of industrialization it became the technical base for the city. Currently, the river has again come to be an important element of the urban landscape and it has a number of important functions addressed primarily to city residents and tourists. The study considers the Polish perspective and was carried out on the basis of a case study of the city of Toruń (an example of the post-communist city of medium size) and a part of the River Vistula within it.

Keywords: river, ecological and urban functions of the river, tourism, city management, spatial planning, revitalization.

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1. Introduction

Access to water was one of the primary environmental factors that were decisive in the location and development of cities. First cities on Earth were located precisely near large rivers that served as the main axes of development, with key examples in the form of the most ancient civilizations of Mesopotamia, Egypt and ancient China (Novaresio, 2006; Yassin, Bond and McDonagh, 2012; Cengiz, 2013). At first, rivers were a symbol of life, the main source of drinking water, but also had defensive functions. In the Middle Ages, most fortified settlements were built at riverbanks.

The transport function of rivers was also important, as it was the spread of river transport that vastly contributed to the development of cities which became ports servicing inland navigation. Consequently, cities located at riversides became important trade centers (May, 2006), and river valleys were among the first fragments of nature to be used and transformed by people (Steiner, 2011). Growing river traffic and vessel size required waterways to have sufficient depth. This was manageable only through regulation of rivers consisting in straightening the river bed, narrowing and deepening it and strengthening the riverbanks. Such actions led to changes in water relations, both within the river bed and the whole river valley, which were not always beneficial.

Intensive industrialization and urbanization, started at the turn of the 20th century, led to further degradation of rivers and river valleys, and as a consequence to the loss of rivers' priority in the development of cities. During the economic transformations of the late 19th and early 20th century, rivers supplied industrial plants with water and served as a place of discharge of industrial and municipal waste. Thus, riversides became the technical base for the industrial zone. They had technical facilities in the form of roads, railway sidings, railways and docks. The situation changed radically when other means of transportation gained prominence, as along with the intensive development of the railway, road, and aviation infrastructure the role of the river diminished or even became marginal, as in the case of Poland (Kubiak-Wójcicka, 2014). Neglect over further years led to the degradation of riverside areas both in the technical and infrastructural dimension and in terms of quality and mentality of residents and visitors. The role of rivers in the city was deprecated and it even became visible that most cities in the world, including European cities, turned away from rivers.

We are currently observing changes in the perception of rivers and river valleys in urbanized areas (Everard and Moggridge, 2012). In line with the global trends in planning and management of riverside areas, cities and their residents come back to the river or its proximity (Timur, 2013). The whole world experiences the modernization of riverside areas (Marshall, 2001). However, in terms of leadership, the most prominent examples are the cities in North America (Bryant, 2006; Hagerman, 2007; Cook and Ward, 2012; Airas, Hall and Stern, 2015) and Europe (Gospodini, 2001; Wood and Handley, 1999; Galland and Hansen, 2012; Debrie and Raimbalut, 2016). Although with less intensity, riverside areas are reorganized also in other parts of the globe, e.g. in Asian cities (Marshall, 2001; Gunay and Dokmeci, 2012; Chang and

Huang, 2011). Sairinen and Kumpulainen (2006) indicate that we may even speak about the phenomenon of revival of riverside areas. The revitalization of waterfront areas consists in a partial reconstruction of the river ecosystem, facilitating residents' access to water and creating new attractive public spaces (Hagerman, 2007). These are important actions because the river is capable of creating characteristic places which stand out due to the originality of form, function and content, unusual places which make the city recognizable both by its residents and by its tourists (Bernat, 2010).

In light of the above, this study aims to find whether we are currently experiencing an integration or disintegration of the ecological and urban functions performed by the river in the city. The study concerns the Polish perspective and was carried out on the basis of a case study of the city of Toruń (a typical post-communist medium-sized city) and a section of the River Vistula within it. It will be helpful to answer the following questions:

[1] Which ecological functions are performed by the river in the city?
[2] Which urban functions are performed by the river in the city?
[3] Are ecological and urban functions performed by the river in the city mutually exclusive or complementary?

2. Theoretical background

Issues related to ecological and urban functions of rivers were reflected in the literature on the subject in the end of the 1960s. During that time, papers were issued containing a comprehensive description of the landscape of river valleys. They covered both the economic functions of river valleys and selected elements of the natural environment in urbanized areas. It was noticed that due to their unique natural wealth, large water supplies and the role of main natural ecological corridors, rivers play a key role in the functioning of the whole ecological system of the country, region and city. As ecological corridors, rivers are invaluable in maintaining biodiversity (Gacka-Grzesikiewicz, 1995; Bryant, 2006).

The next research stage dates back to the turn of the 21st century. Papers of that time not only identified the high natural value of rivers and river valleys, but also acknowledged their high 'urban' or 'urbogenic' value. Literature regarding that subject contained numerous publications regarding exclusively the urban function of the river. As pointed out by Francis (2012), urban rivers perform crucial ecological and social roles within broader urban systems. Therefore, in order to understand the functions of rivers in urban systems we need to analyze explicit interactions and endogenous and exogenous relations between the society, i.e. residents of cities and the natural environment (Rogatka and Ramos Ribeiro, 2015). Education and participation of the society are an inextricable element here, and it consists in building public awareness regarding riverside areas, for instance (Polajnar, 2008), and in determining the role of riverside areas as important elements of the urban landscape or even ecosystem (Guntenspergen and Dunn, 1998).

The latest trends applied to the studies of river functions in urbanized areas are shown in an interdisciplinary research approach based on the cooperation of spe-

cialists in different fields, especially in the scope of urbanization processes and environmental issues (Bunce and Desfor, 2007; Yue, 2012; Francis, 2012; Fumagalli *et al.*, 2013; Dyson and Yokom, 2015). The observable effects of the conducted studies and research and development projects take the form of a renewal of waterfronts and their recreational use in connection with preserving the ecological function of the river (Beatley and Newman 2013; de Groot, Wilson and Boumans, 2002; Francis and Lorimer 2011). It is a consequence of the concept of 'opening the city to the river' which is currently gaining prominence, and is implemented through the processes of revitalization and restoration of rivers and river valleys. During the first stage, these actions are technical and they eliminate obstacles which hamper the natural fluvial process, and in the second phase the restoration process is driven by the forces of nature (Andersson, 2006). Going even further, Carmon and Shamir (2010) propose to create open spaces available to the society along rivers in cities. Such approach to the management of waterside areas helps preserve the role of rivers in flood protection while strengthening social and ecological functions (Kenwick, Shammin and Sullivan, 2009; Kostopoulou, 2013; Baker, Eckerberg and Zachrisson, 2014; Hall and Stern, 2014). In light of the above, the role of local authorities seems important as they are responsible for implementing the development policy, including spatial policy, which is of key significance to the organization of space in cities, including in riverside areas (Rogatka *et al.*, 2015).

3. Study area

The issue of coexistence of ecological and urban functions of the river in urbanized areas was considered in the case of Toruń, a city located in central Poland on the banks of the largest river in Poland – the River Vistula. Toruń is an example of the problem of coexistence between the river and the city, i.e. the urbanized and non-urbanized riverside areas in the city, and therefore is a representative case for Poland.

The study area was selected on the basis of the following premises:

[1] In the perception of the Polish society, the River Vistula is one of the most important symbols of the country, it has an intangible value which impacts its position in the minds of the people (Angiel and Angiel, 2015). According to Bernat (2010), the river is the symbol of national identity.

[2] Toruń is located on the River Vistula in its lower section, on both banks. The length of the river within the administrative limits of the city is around 20 km, and the river bed inside the city is 355 to 440 m wide.

[3] The River Vistula valley is an ecological corridor of international significance. According to Gacka-Grzesikiwicz (1995), from the viewpoint of valorization of ecological corridors, the lower Vistula valley was defined as an area with very high natural value. Waterside areas function as ecological corridors and provide shelter for many animal and plant species.

[4] There are legally protected areas within the city and the river. Legally protected forms include the special protection area for birds – Lower Vistula Val-

ley (PLB040003) within the framework of the Natura 2000 network (Katalog obszarów Natura 2000) and the natural reserve – 'Kępa Bazarowa' covering the riparian poplar and willow forest on the left bank of the River Vistula.

[5] Toruń is a city which has served different functions since as early as the 13th century. Its current functions are: administrative (it is the seat of the marshal's office of the Kujawsko-Pomorskie Voivodship), scientific (it hosts one of the largest universities in Poland – the Nicolaus Copernicus University), cultural (Toruń boasts a rich cultural and architectonic heritage – in 1997 the Toruń medieval conurbation, the Old Town, was included in the UNESCO World Heritage List), tourist (thriving urban tourism) and others.

When analyzing the administrative role of Toruń, we should note that the city is one of the two capitals of the Kujawsko-Pomorskie Voivodship (NUTS 2 – Nomenclature of territorial units for statistics, European basic regions for the application of regional policies) located in central Poland. Toruń is a city with *poviat* rights (LAU 1 – European Local Administrative Units of the 1st order). The city area is 115.7 sq km which represents 14% of the total area of urban areas in the Kujawsko-Pomorskie Voivodship. It has 203,158 residents, which makes 1,756 persons/sq km. After Bydgoszcz, Toruń is the second most inhabited city in the Kujawsko-Pomorskie Voivodship. It is home to 9.7% of the residents of the voivodship and 16.2% of the total number of residents of all cities in the Kujawsko-Pomorskie Voivodship (Główny Urząd Statystyczny, 2014). Like other large cities in Poland, Toruń is experiencing a decrease in population resulting from the developing suburbanization processes (Szymańska, Chodkowska-Miszczuk and Biegańska, 2013). It should be noted that in terms of transportation, Toruń is located at the crossing of important international and national communication routes, including: A1 motorway (meridional direction) and express road S-10 (latitudinal direction).

Other advantages of the city include natural values, such as woodlands and the natural reserve. 'Kępa Bazarowa' is a unique area of special natural and historical importance. It is a River Vistula island located in the center of Toruń, near the left bank of the Vistula. The island covers an area of 70 ha and is 2.5 km long, with a maximum width of 400 m. Half of the island's area is taken up by the 'Kępa Bazarowa' natural reserve which serves to protect a fragment of the riparian forest with preserved natural features. The Natura 2000 area, Lower Vistula Valley (PLB040003), is among other forms of protected landscape present within the city of Toruń (Kubiak-Wójcicka and Adamska, 2013).

Therefore, the study area, i.e., the city of Toruń, in particular in its central part determined by the location of the Old Town, is a combination, unique for Poland and Europe, of urban and ecological ecosystems which function within a relatively small area. The dual nature of the area covers the developed, urbanized Bulwar Filadelfijski on the right bank of the river, and the 'Kępa Bazarowa' natural reserve exactly opposite the boulevard on the left bank. In this respect, the River Vistula is a characteristic link between the developed and undeveloped riverside zone (Figure 1; Table

1) (Kubiak-Wójcicka and Adamska, 2013). The analyzed section is a fragment of the Vistula valley with a length of 1.4 km, located between the railway bridge to the East and the road bridge to the West. In this section, the width of the Vistula varies from 355 m (Brama Mostowa) to 440 m near the railway bridge.

Moreover, Bulwar Filadelfijski, which comprises the urbanized part of the research area, due to its central location and functions that it performs, is one of the top priority areas for the city authorities. The local authorities have undertaken extensive projects aiming at implementing a coherent concept of urban-architectural management of Bulwar Filadelfijski. The first stage, intended to select a contractor, has finished in 2015. The on-site construction work conducted as a part of the multi-stage revitalization of the waterfronts in Toruń has started in 2017.

Furthermore, the city authorities, being aware that the medieval city center together with the river embankment comprise one of the advantages, which determine (among others) the city's image, have started activities with a goal to create a local town planning scheme for the Old Town district together with its surroundings (City Council of Toruń Resolution no. 321/12 from June 28, 2012). Currently, there is a planning work underway, which eventually will create a document that will define urban-architectural and legal frames for all the activities, initiatives and investments in the above mentioned area.

Note: A-B: cross-section of the study area

Figure 1: Study area – urbanized area (Bulwar Filadelfijski) and non-urbanized area (Kępa Bazarowa) located on the River Vistula

Source: Authors, based on resources of the Urban Planning Office in Toruń

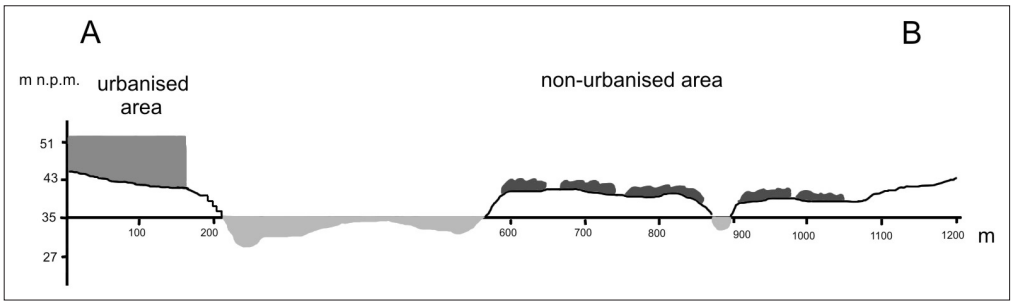

Figure 2: Cross-section of the Vistula valley in Toruń

Source: Authors

4. Research methods

Due to the multifaceted nature of the issue, the authors have decided to apply a multistage research procedure. This study uses the following research methods: desk research, comparative studies, case study of integration/ disintegration of ecological and urban functions of the River Vistula in Toruń, SWOT analysis.

On the basis of general trends in riverside space development and the functions performed by that space in the global approach, the authors studied local conditions of the city of Toruń. The documents analyzed in this stage included various cartographic materials, e.g. historical and current topographic maps, aerial and satellite photographs and planning documents such as, for instance: Development Strategy for the City of Toruń until 2020, Study of Conditions and Directions of Spatial Development of the City of Toruń, The Local Revitalization Plan for the City of Toruń, and Master Plans for the City of Toruń prepared by the City Urban Planning Office. The next step covered comparative studies which consisted in identifying and determining the most representative elements distinctive for the two waterfronts – the urbanized area of the right Vistula riverbank (Bulwar Filadelfijski) and the non-urbanized left riverbank (Kępa Bazarowa).

In order to fully understand the mutual relations of ecological and urban functions of the river on the example of Toruń, the authors performed a SWOT analysis which helped show the:

- S (Strengths), i.e. the integration of ecological and urban function of the river;
- W (Weaknesses), i.e. the disintegration of ecological and urban function of the river;
- O (Opportunities) for the integration of ecological and urban function of the river;
- T (Threats) consisting in the disintegration of ecological and urban function of the river.

The choice of the SWOT analysis was motivated by the fact that it is a complex method of strategical analysis which allows identifying the key advantages and disadvantages related to the coexistence of ecological and urban functions of the river in urbanized areas and current and future opportunities and threats related thereto.

5. Analysis and results

In an attempt to answer the questions presented in the introduction to this paper, the authors began with determining the functions served by the river in urbanized areas. On the basis of theoretical considerations backed by an in-depth review of literature and on-site inquiry, it was determined that the river performs various functions, primarily for cities and their residents. Focusing on the main ecosystem elements of the river and the city, the authors made a general division into ecological and urban functions of the river. It was followed by a detailed classification of individual functions taking into account the relation between the city and the river and their recipients. The most important ecological functions of the river include (based on results of literature review and field studies):

a) the hydrological function:
   - it gathers water in the Vistula valley and river bed, which has a positive effect on water retention and leads to the increase of water resources;
   - it is the recipient of the surface runoff and drainage from the city area;
   - it is an element of the sewerage system;
   - it regulates the water level in the river bed depending on the supply; and
   - it impacts the level of groundwater;

b) the biological function:
   - it is the natural habitat for numerous plant and animal species; and
   - it serves as an ecological corridor and facilitates the passage of different plant and animal species between isolated habitats and a free exchange of genes between populations. Moreover, the corridors provide conditions for the formation of local vegetation;

c) the meteorological function:
   - it improves the microclimate of the city of Toruń by decreasing the amplitude of fluctuations in temperature and increasing air humidity; and
   - it impacts wind direction – ventilation of the city.

The river defines the character of the city, determines its topography, impacts urban planning and architecture, life quality and social relations. Thus, it performs many important urban functions which may be grouped as follows (based on results of literature review and field studies):

a) socio-educational function:
   - it is a meeting place, and primarily a place integrating the local community; and
   - the banks of River Vistula serve as places for nature trails and 'green science rooms';

b) urban planning and aesthetic function:
   - it creates new public spaces;
   - it makes the urban landscape more attractive;
   - it is the exposure frontline in the panorama of the city of Toruń;
   - it is the dominant element in the urban landscape; and
   - it forms the main compositional axis;

c) reservoir or investment areas (e.g., the so-called floating houses, parks on floating platforms);
d) recreational function:
   – it is a place where sporting and recreational activities may be performed;
e) culture-forming function:
   – it is a cultural heritage (former port buildings, water infrastructure elements);
   – it creates the *genius loci* of Toruń and forms the identity of the place;
   – it impacts the city's image – it is an element of Toruń's branding, marketing; and
   – it serves a representative role – boulevards, riverside areas are the lounges of the city;
f) utilitarian function:
   – it is a reservoir of drinking water (supply for the population and animals, surface water intakes), water for commercial purposes;
   – it is used for fire protection purposes; and
   – it serves for communication and transportation (freight and passenger inland navigation).

As follows from the above, rivers are a litmus test for all ecological, social and economic changes because they form a system of intertwined environmental, social, economic and cultural relations. The most important role in the integration of ecological and urban functions of the river is played by the waterfront, i.e. the sphere of contact between water and land. There are significant differences between the left bank (Kępa Bazarowa in the analyzed case) and the right bank (Bulwar Filadelfijski) of the River Vistula, arising from the different nature of development and the resulting purpose of the Vistula waterfront in the center of Toruń (Figure 1; Figure 2). With the use of the comparative method, Table 1 recognizes and defines the most representative elements of the waterfront development and physiognomy covering the urbanized area of the right bank of the Vistula represented by Bulwar Filadelfijski and the non-urbanized left bank of the Vistula – Kępa Bazarowa.

The presented examples prove on the one hand that the River Vistula in the section passing through the central part of Toruń performs both ecological and urban functions, and on the other hand that to a large extent their execution is partially separated. Ecological functions (including: natural habitat for numerous plant and animal species, ecological corridor, microclimate improvement) are characteristic of the non-urbanized left Vistula waterfront with the natural reserve. In turn, urban functions (primarily integration of local communities, protection of cultural heritage, city image) pertain mostly to the right waterfront related to the urbanized, historical part of Toruń.

The identification of ecological and urban functions of the River Vistula in Toruń in connection with the development and purpose of the waterfront gives rise to the question of their coexistence. When analyzing the issue, the authors applied the SWOT analysis. Based on previous results, they analyzed endogenous (strengths and weaknesses) (Table 2) and exogenous factors (opportunities and threats) (Table 3) of the (dis)integration of ecological and urban functions of the river. During the research

procedure, the authors determined the strengths and weaknesses in the performance of ecological and urban functions of the River Vistula in Toruń and assigned weights to them. Strengths include six elements, and from the viewpoint of residents and tourists the most important of them are: a meeting place and place integrating the local community. Among the five weaknesses established, the bad state of the water engineering structures was named as the most burdensome.

Table 1: Differences between the urbanized riverside area (Bulwar Filadelfijski) and the non-urbanized area (Kępa Bazarowa)

	Urbanised area (Bulwar Filadelfijski)	Non-urbanised area (Kępa Bazarowa)
Panoramic view		
Entrance, the so-called 'gate' to the place		
Characteristic greenery present in the area		
Dominating road surface type		

	Urbanised area (Bulwar Filadelfijski)	Non-urbanised area (Kępa Bazarowa)
Small architectural elements		
Liaison zone: land-water (buffer zone)		

Source: Authors, 2016

Table 2: Endogenous factors of (dis)integration of ecological and urban functions of the river on the example of Toruń on the basis of the SWOT method

Weight		Endogenous factors
1,0	**S**	**Strengths**
0,2	**S1**	a distinct element of the urban structure of the city
0,1	**S2**	convenient location in terms of urban planning and transportation
0,1	**S3**	microclimate improvement
0,1	**S4**	reservoir of investment, sporting and recreational areas
0,2	**S5**	ecological corridor (biodiversity)
0,3	**S6**	meeting place and place integrating local communities
1,0	**W**	**Weaknesses**
0,2	**W1**	neglected public space
0,2	**W2**	lack of sporting and recreational infrastructure
0,3	**W3**	bad state of the water engineering structures
0,1	**W4**	traffic noise near bridges (road and railway)
0,1	**W5**	bad communication between the right and left bank of the river (no ports and river docks, lack of modern naval fleet servicing passenger traffic, including: water trams, houseboats, floating hotels)
0,1	**W5**	bad physical and chemical state of the water

Source: Authors

The functioning of the river in the urbanized area may (and does) undergo changes as a result of anthropogenic activities performed within its valley and drainage basin and as a result of natural changes in the climate, i.e. in an area exceeding city limits. Moreover, changes introduced in the urban area of the river impact hydrological conditions not only locally, but also at the regional or national level. According to the suggestion of Baschak and Brown (1995) and Silva *et al.* (2012), complete integration of the river-city system should be considered not only in the local scale, but also in the scales of the region and country. Therefore, beside endogenous premises, a good recognition of exogenous factors helps properly answer the question of performance of the ecological and urban functions of the River Vistula in Toruń. While considering the endogenous factors of (dis)integration of ecological and urban functions of the Vistula River in Toruń, the authors determined the most important opportunities and threats. The most important among the three established opportunities is the existence of boulevards which are the showpiece of the city and determine the development of recreation and tourism. Material threats to the integration of ecological and urban functions include the destruction of the river ecosystem caused by strong anthropopressure.

Table 3: Exogenous factors of (dis)integration of ecological and urban functions of the river on the example of Toruń on the basis of the SWOT method

Weight		Exogenous factors
1,0	**O**	**Opportunities**
0,4	**O1**	boulevards as the showpiece of the city creating city branding
0,4	**O2**	development of tourism and recreation
0,2	**O3**	development of inland navigation
1,0	**T**	**Threats**
0,2	**T1**	risk of overinvesting in riverside areas (over-revitalization)
0,6	**T2**	destruction of the river ecosystem through anthropopressure, municipal and industrial pollution, and pollution resulting from transport
0,2	**T3**	reduction of biodiversity and fragmentation of biologically active areas

Source: Authors.

Both the endogenous and exogenous factors included in the SWOT analysis are mutually correlated. For instance, the bad state of the water engineering structures (W3) determines the development of inland navigation (O3). What is more, the lack of adequate infrastructure in the form of marinas, wharves, harbor master's offices, parking spaces, etc. (W5) translates into scarce interest in transportation (passenger and freight) using inland navigation. From the viewpoint of the residents of Toruń and tourists, the River Vistula is a barrier in the free movement between the right and left riverbank. The interest of tourists and residents focuses exclusively on the right bank of the river due to the relatively easy access to the waterfront. When considering

tourist and recreational undertakings as an opportunity for the integration of ecological and urban functions of the river Vistula (O2), we should note that Toruń, similar to other Polish cities, is only starting to implement changes to that end. Municipal authorities recognize the potential, which is reflected e.g. in the promotion of the Vistula waterfront as a meeting place and place integrating local communities (S6). On the other hand, there is a problem in the lack of sporting and recreational infrastructure (W2) or the still neglected public space (W1).

The most important threats include the destruction of the river ecosystem through anthropopressure, in particular municipal and industrial pollution, and pollution resulting from transport (T2). Increased pollution of the river ecosystem will lead to the decrease in biodiversity of species (T3). Pollution of the River Vistula in the analyzed section may result from local pollutants coming from within the city and pollutants released into the river in its upper reaches, as water quality in the river depends not only on local, but also on regional conditions.

Table 4: Results of the SWOT analysis regarding the (dis)integration of ecological and urban functions of the river on the example of Toruń

Results	Results of the SWOT analysis	
	Sum of interactions	*Sum of products*
Strengths/ opportunities	18.0	4.7
Strengths/ threats	14.0	3.2
Weaknesses/ opportunities	24.0	6.5
Weaknesses/ threats	4.0	2.2

Source: Authors.

Results of the SWOT analysis (Table 4) regarding the (dis)integration of ecological and urban functions indicate that the sum of interactions is largest in the relation between weaknesses and opportunities (24.0), which means that Toruń has a large potential for development. The materiality of weaknesses of the study area and the related opportunities clearly point to the competitive strategy. This strategy is implemented on the basis of elimination of weaknesses and the simultaneous use of existing opportunities. In the analyzed example, the largest problems are generated through the lack of adequate recreational and tourist infrastructure in the area (W2); this is a barrier to development of all tourist and recreational activities (O2), the biggest opportunity for the development of riverside areas in Toruń, a city opening to the River Vistula in line with European and global trends. However, it should be noted that the role and development of the discussed area, including the abovementioned opening to the River Vistula, is a priority in the urban policy – municipal urban planners began works to create a Master Plan (the primary tool for implementing spatial policy) for the area of the Old Town together with Bulwar Filadelfijski. A dual approach was proposed here. The Study of Conditions and Directions of Spatial Development of the City of Toruń prepared according to the spatial policy is protective,

sanctioning the existing condition (Kępa Bazarowa), and pro-development, providing for a supplement to land development and allowing certain investments boosting the attractiveness of riverside areas (Bulwar Filadelfijski).

6. Conclusions

In response to the fundamental question included in the title of the paper it should be stated that we are dealing with integration, or even synergy, of ecological and urban functions of the River Vistula within the city of Toruń. Despite different development of both banks of the River Vistula, the integration of urban and ecological functions is particularly visible in the riverside area of the city. The level of integration is not full because outdated technical infrastructure and/or the lack thereof hamper access to the waterfronts, and as a consequence suppress the development of urban functions for recreational, tourist and socio-economic activities.

The conducted analysis shows that full integration requires eliminating weaknesses and making use of existing opportunities. The most important among elements which would significantly improve the integration of both banks and facilitate the performance of ecological and urban functions of the river is the investment in modern and functional marinas and wharves. They will help revive passenger transport on inland waterways, both within city limits and at a larger scale (local, regional, national, international) and will expand the tourist offer of the city by qualified water tourism and water sports. They will also cause tourists and residents to stay in the waterfront area longer than before. What is more, the improvement of the city's riverside area will undoubtedly impact Toruń's image as a city open to water.

In order that the riverside area may serve urban and ecological functions to the same extent, local communities should be included in the works on the development of the riverside space. Moreover, a properly implemented urban policy with an integral element of social participation will help include the river into the urban tissue anew. Success in the revitalization of riverside areas depends on the coordination and integration of works at the stages of planning, designing and managing. It may be achieved only through establishing teams of experts with relevant experience and commonly accepted principles in order to facilitate the performance of works. Such works are performed by the municipal authorities of Toruń, what foreshadows a rapid improvement in the quality of the riverside area and leads to the conclusion that the area located on the river is again becoming an important matter in the management of the city and impacts its development. Such state may be achieved also by honest and comprehensive familiarization of the public with issues related to the functions performed by the river (ecological and urban) and the resulting challenges (investments).

Due to the fact that this research has focused on the plane of contact between ecological and urban functions of a river in the city, the analysis has a large utilitarian potential. It is because it may comprise a starting point for further analyses and work on waterfronts revitalization in many towns in Poland and other post-communist countries. As indicated by research results, the topics related to return of cities to

rivers are an important part of urban policies in many post-communist countries because local authorities noticed opportunities for development through popularizing the new functions, including the touristic one, creating city brands or building a social climate.

When observing global trends related to the development of cities, e.g. the urban sprawl, suburbanization, shrinking cities, we should note that the management of the city consisting in creating new, interesting spaces in the city, also covering waterside areas, which improve life quality, should be a priority. Only a well-managed city with interestingly designed public spaces integrating ecological and urban elements is attractive for residents, tourists and investors. The example of the River Vistula in Toruń shows that the river should not be treated as a barrier in the settlement and socio-economic development of the city, but as an integral element of the urban space.

Ecological and urban functions performed by the river in the city are complementary because of spatial separation of location of those functions: ecological function of the river – natural area of the city, and urban function of the river – urbanized area.

References:

1. Airas, A., Hall, P.V. and Stern, P., 'Asserting Historical "Distinctiveness" in Industrial Waterfront Transformation', 2015, *Cities*, vol. 44, pp. 86-93.
2. Andersson, E., 'Urban Landscapes and Sustainable Cities', 2006, *Ecology and Society*, vol. 11, no. 1, art. 34, [Online] available at www.ecologyandsociety.org/vol11/iss1/art34/, accessed on August 30, 2017.
3. Angiel, J. and Angiel, P.J., 'Perception of River Value in Education for Sustainable Development (The Vistula River, Poland)', 2015, *Sustainable Development*, vol. 23, no. 3, pp. 188-201.
4. Baker, S., Eckerberg, K. and Zachrisson A., 'Political Science and Ecological Restoration', 2014, *Environmental Politics*, vol. 23, no. 3, pp. 509-524.
5. Baschak, L.A. and Brown, R.D., 'An Ecological Framework for the Planning, Design and Management of Urban River Greenways', 1995, *Landscape and Urban Planning*, vol. 33, no. 1-3, pp. 211-225.
6. Beatley, T. and Newman, P., 'Biophilic Cities Are Sustainable, Resilient Cities', 2013, *Sustainability*, vol. 5, no. 8, pp. 3328-3345.
7. Bernat, S., 'Doliny rzeczne i ich percepcja' [The River Valleys and Perception], 2010, *Krajobrazy Kulturowe Dolin rzecznych. Potencjał i wykorzystanie. Prace Komisji Krajobrazu Kulturowego* [River Valley Cultural Landscape. Potential and Use. Works of the Cultural Landscape Commission], no. 13, pp. 167-178.
8. Bryant, M.M., 'Urban Landscape Conservation and the Role of Ecological Greenways at Local and Metropolitan Scales', 2006, *Landscape and Urban Planning*, vol. 76, no. 1-4, pp. 23-44.
9. Bunce, S. and Desfor, G., 'Introduction to "Political Ecologies of Urban Waterfront Transformations"', 2007, *Cities*, vol. 24, no. 4, pp. 251-258.
10. Carmon, N. and Shamir, U., 'Water-Sensitive Planning: Integrating Water Considerations into Urban and Regional Planning', 2010, *Water and Environment Journal*, vol. 24, no. 3, pp. 181-191.

11. Cengiz, B., 'Urban River Landscapes', in Özyavuz, M. (ed.), *Advances in Landscape Architecture*, InTech, 2013, pp. 551-586.
12. Chang, T.C. and Huang, S., 'Reclaiming the City: Waterfront Development in Singapore', 2011, *Urban Studies*, vol. 48, no. 10, pp. 2085-2100.
13. City Council of Toruń, Resolution no. 321/12 from June 28, 2012.
14. Cook, I.R. and Ward, K., 'Relational Comparisons: The Assembling of Cleveland's Waterfront Plan', 2012, *Urban Geography*, vol. 33, no. 6, pp. 774-795.
15. de Groot, R.S., Wilson, M.A. and Boumans, R.M.J., 'A Typology for the Classification, Description and Valuation of Ecosystem Functions, Goods and Services', 2002, *Ecological Economics*, vol. 41, no. 3, pp. 393-408.
16. Debrie, J. and Raimbalut, N., 'The Port–City Relationships in Two European Inland Ports: A Geographical Perspective on Urban Governance', 2016, *Cities*, vol. 50, pp. 180-187.
17. Development Strategy for the City of Toruń until 2020, [Online] available at www.torun.pl/pl/rozwoj/miejskie-programy-rozwojowe/strategia-rozwoju-miasta-toruniado-roku-2020, accessed on August 30, 2017.
18. Dyson, K. and Yocom, K., 'Ecological Design for Urban Waterfronts', 2015, *Urban Ecosystems*, vol. 18, no. 1, pp. 189-208.
19. Everard, M. and Moggridge, H.L., 'Rediscovering the Value of Urban Rivers', 2012, *Urban Ecosystems*, vol. 15, no. 2, pp. 293-314.
20. Francis, R.A. and Lorimer, J., 'Urban Reconciliation Ecology: The Potential of Living Roofs and Walls', 2011, *Journal of Environmental Management*, vol. 92, no. 6, pp. 1429-1437.
21. Francis, R.A., 'Positioning Urban Rivers within Urban Ecology', 2012, *Urban Ecosystems*, vol. 15, no. 2, pp. 285-291.
22. Fumagalli, N., Colombo, C., Ferrario, P.S., Senes, G. and Toccolini, A., 'Suburban Waterfront with Ecological and Recreational Function: Planning Based and Network Analysis', 2013, *Journal of Agricultural Engineering*, vol. XLIV, no. 183, pp. 141-152.
23. Gacka-Grzesikiewicz, E. (ed.), 'Korytarz ekologiczny doliny Wisły. Stan-Funkcjonowanie – Zagrożenia' [Vistula as an Ecological Corridor. State-Functioning – Threats], Warszawa: Fundacja IUCN Poland, 1995.
24. Galland, D. and Hansen, C.J., 'The Roles of Planning in Waterfront Redevelopment: From Plan-led and Market-driven Styles to Hybrid Planning?', 2012, *Planning Practice and Research*, vol. 27, no. 2, pp. 203-225.
25. Główny Urząd Statystyczny [Central Statistical Office], Bank Danych Lokalnych [Local Data Bank], 2014, [Online] available at http://stat.gov.pl/bdl/app/strona.html?p_name=indeks, accessed on August 30, 2017.
26. Gospodini, A., 'Urban Waterfront Redevelopment in Greek Cities A Framework for Redesigning Space', 2001, *Cities*, vol. 18, no. 5, pp. 285-295.
27. Gunay, Z. and Dokmeci, V., 'Culture-led Regeneration of Istanbul Waterfront: Golden Horn Cultural Valley Project', 2012, *Cities*, vol. 29, no. 4, pp. 213-222.
28. Guntenspergen, G.R. and Dunn, C.P., 'Introduction: Long-term Ecological Sustainability of Wetlands in Urbanizing Landscapes', 1998, *Urban Ecosystems*, vol. 2, no. 4, pp. 187-188.
29. Hagerman, C., 'Shaping Neighborhoods and Nature: Urban Political Ecologies of Urban Waterfront Transformations in Portland, Oregon', 2007, *Cities*, vol. 24, no. 4, pp. 285-297.

30. Hall, P.V. and Stern, P.R., 'Implicating Waterfronts in Regional Sustainability', 2014, *Local Environment*, vol. 19, no. 6, pp. 591-604.
31. Katalog Obszarów Natura 2000 [Catalogue of the Nature 2000 Areas], [Online] available at http://obszary.natura2000.org.pl/, accessed on August 30, 2017.
32. Kenwick, R.A., Shammin, M.R. and Sullivan, W.C., 'Preferences for Riparian Buffers', 2009, *Landscape and Urban Planning*, vol. 91, no. 2, pp. 88-96.
33. Kostopoulou, S., 'On the Revitalized Waterfront: Creative Milieu for Creative Tourism', 2013, *Sustainability*, vol. 5, no. 11, pp. 4578-4593.
34. Kubiak-Wójcicka, K. and Adamska, E., 'Funkcjonowanie i zagrożenia rezerwatu przyrody w warunkach miejskich na przykładzie „Kępy Bazarowej" w Toruniu' [The functioning and threats of nature reserve "Kępa Bazarowa" in Toruń in urban conditions], 2013, *Zeszyty Naukowe*, vol. 26, no. Wydawnictwo Naukowe Wyższej Szkoły Handlu i Usług, pp. 159-171.
35. Kubiak-Wójcicka, K., 'Stopień wykorzystania infrastruktury liniowej w żegludze śródlądowej na przykładzie bydgoskiego odcinka międzynarodowej drogi wodnej E-70' [Present State and Usage of the Hydrotechnical Infrastructure in Inland Navigation based on the Example of Bydgoszcz's Part of the International Water Way (E-70)], 2014, *Logistyka*, no. 6, pp. 12820-12832.
36. Marshall, R. (ed.), *Waterfronts in Post-Industrial Cities*, London and New York: Spon Press Taylor & Francis Group, 2001.
37. Master Plans for the City of Toruń prepared by the City Urban Planning Office, [Online] available at www.mpu-torun.pl/index.php?lang=pl&m=tab, accessed on August 30, 2017.
38. May, R., '"Connectivity" in Urban Rivers: Conflict and Convergence between Ecology and Design', 2006, *Technology in Society*, vol. 28, no. 4, pp. 477-488.
39. Novaresio, P., *Great Rivers of the World*, New York: Barnes & Noble, 2006.
40. Polajnar, K., 'Public Awareness of Wetlands and Their Conservation', 2008, *Acta geographica Slovenica*, vol. 48, no. 1, pp. 121-146.
41. Rogatka, K. and Ramos Ribeiro, R.R., 'A Compact City and Its Social Perception: A Case Study', 2015, *Urbani izziv*, vol. 26, no. 1, pp. 121-131.
42. Rogatka, K., Biegańska, J., Grzelak-Kostulska, E., Cieślik, E., Chodkowska-Miszczuk, J. and Środa-Murawska, S., 'Revitalization as a Part of the EU Cohesion Policy', in *XVIII. Mezinárodní kolokvium o regionálních vědách, Sborník příspěvků* [18th International Colloquium on Regional Sciences. Conference Proceedings], Hustopeče, June 17-19, 2015, Brno: Masaryk University, 2015, pp. 293-299.
43. Sairinen, R. and Kumpulainen, S., 'Assessing Social Impacts in Urban Waterfront Regeneration', 2006, *Environmental Impact Assessment Review*, vol. 26, no. 1, pp. 120-135.
44. Silva, J.B., Saraiva, M.G., Ramos, I.L. and Bernardo, F., 'Improving Visual Attractiveness to Enhance City–River Integration – A Methodological Approach for Ongoing Evaluation', 2013, *Planning Practice and Research*, vol. 28, no. 2, pp. 163-185.
45. Steiner, F., 'Landscape Ecological Urbanism: Origins and Trajectories', 2011, *Landscape and Urban Planning*, vol. 100, no. 4, pp. 333-337.
46. Study of Conditions and Directions of Spatial Development of the City of Toruń, [Online] available at www.torun.pl/pl/rozwoj/miejskie-programy-rozwojowe/strategia-rozwoju-miasta-torunia-do-roku-2020, accessed on August 30, 2017.

47. Szymańska, D., Chodkowska-Miszczuk, J. and Biegańska, J., 'Bydgosko-Toruński Obszar Funkcjonalny (Metropolitalny) w świetle wybranych wskaźników'. [Bydgoszcz-Toruń Functional (Metropolitan) Area in the Light of the Selected Aspects], 2013, *Acta Universitatis Nicolai Copernici*, *Ekonomia XLIV*, no 2, pp. 319-332.
48. The Local Revitalization Plan for the City of Toruń. 2007-2015, [Online] available at www.torun.pl/sites/default/files/pictures/zeszyt_glowny_lpr-t.pdf, accessed on August 30, 2017.
49. Timur, U.P., 'Urban Waterfront Regenerations', in Özyavuz, M. (ed.), *Advances in Landscape Architecture*, InTech, 2013, pp. 169-206.
50. Wood, R. and Handley, J., 'Urban Waterfront Regeneration in the Mersey Basin, North West England', 1999, *Journal of Environmental Planning and Management*, vol. 42, no. 4, pp. 565-580.
51. Yassin, A.B.M., Bond, S. and McDonagh, J., 'Principles for Sustainable Riverfront Development for Malaysia', 2012, *Journal of Techno-Social*, vol. 4, no. 1, pp. 21-36.
52. Yue, J., 'Urban Rivers: A Landscape Ecological Perspective', 2012, *Hydrology: Current Research*, vol. 3, no. 1, pp. 1-6.