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Sustainable Analysis of Small Rivers with a Case Study in Poland

Czarnecki, A. ^α, Ramos-Ribeiro, R.R. ^σ & Lewandowska-Czarnecka, A. ^ρ

Abstract- The present study represents a methodological research of environment factors and anthropic perturbation related with small rivers in the Vistula Mouth in Poland. The aim of this study is to assess the potential of environment services in one study area with a particular environment characterized by the small rivers. The methodology used is based on field expeditions and review of the literature. In this work it was analysed the concept of 'rebuild connections' between small rivers and local society. In particular, this work, relates how to achieve an environment with better interaction with local society, it was performed an analysis of possibilities to carry out actions to maintain, preserve or rehabilitate the small rivers. The results of the study shows the importance of the small rivers, as reported in this paper make some recommendations for further interaction between small rivers and local society.

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I. INTRODUCTION

The link between small rivers is very important for the transport and landforms, is important to understand better these kind of system.

This article presents a literature review and study of case at Vistula Mouth in Poland, for improve the connection of small rivers with local society. The interactions between environment services and social economy are characterized the landscape change in the study area. The issue of urban river revitalisation is complex (REURIS, 2012).

The concept of river renovation involves understand the natural system, looking at the changes that have occurred (JANES et al., 2005).

The study area is the canals of the Vistula River in the North of Poland. The area of the small rivers was characterized before as one efficiently network of canals used most for boat transport of the industry in the region, nowadays this area is characterized by abandoned canals.

II. METHODOLOGY

The data used in this study is result of a qualitative investigation at the Vistula delta river, with situations analyzed information about techniques to

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rebuild connections between canals, carry during the years 2012 and 2013.

It was examined the socio-economic environmental system related with environment services and their social impacts.

This research was conducted under the project 'Wody delty Wisły. Natura i kultura' [Waters of the Vistula delta. Nature and culture], at the Foundation for Development in the University of Gdansk.

III. THE STUDY AREA

The Baltic region of northern Poland has several canal systems. In places, these canals utilize natural glacial lakes, rivers and valleys. In this places, the canals cross upland areas in order to connect different drainage basins. The Fig.1 shows the location of the study area in Poland and the Vistula River.



Figure 1: Location of the study area (red circle) on the delta of the Vistula River in Poland.

The Vistula is one of the biggest European rivers and more or less undisturbed between dikes (PASTUSZAK et al., 2012). It is part of an important ecological corridor for animal and plants, connecting southern and North of Central Europe Lowlands. The system with floodgate allows the transport of boats from one level to another.

The study area is influenced by sea currents and plateau, with altitude around 10m above sea level

(CZARNECKI and LUC, 2001). The environment is unstable due to changing water levels in the Vistula and also because of irregular marine backwaters pushed by stormy wind and flood waters drained moraine plateau.

The Vistula floodplains with its meanders, islands are also a specific habitat for many aquatic and terrestrial species (KEIZERA et al., 2014). One of the reasons for this area be unstable is because of the floods, as result of the low high level of the landscape, with average level 1,5 metres above from the sea. The small rivers are also characterized by minimal decline.

The study area of the delta of the Vistula River is in large part reclaimed artificially by means of dikes, pumps, channels and extensive drainage system. In the past, the water level depended on the state of the Vistula River.

The delta of the Vistula River lost natural features as a result of long-term human interference and during the history became canalized.

The canal in Elblag connects the Vistula estuary with the city of the Ostróda. It starts at the city of Elblag and goes until the southward through the low delta. This canal was constructed under the Old Prussian regime.

The risk of flood at the Vistula Lagoon can reach upstream areas of the Elblag Zulawy and the Great Zulawy, through the river sections such as: Elblag, Nogat, Ciepliówka and Szarpawa. The main rivers formed from the Vistula are: Leniwka, Nogat and Mierzeja.

The Fig.2 illustrates the small rivers on the study area, the Baltic Sea, the Vistula Lagoon, Vistula River and two main cities in the area: Gdansk and Elbalg.

The presence of drains and canals and other infrastructure enables the development of agriculture and depending on their distance from the sea is a growing field and meadow.

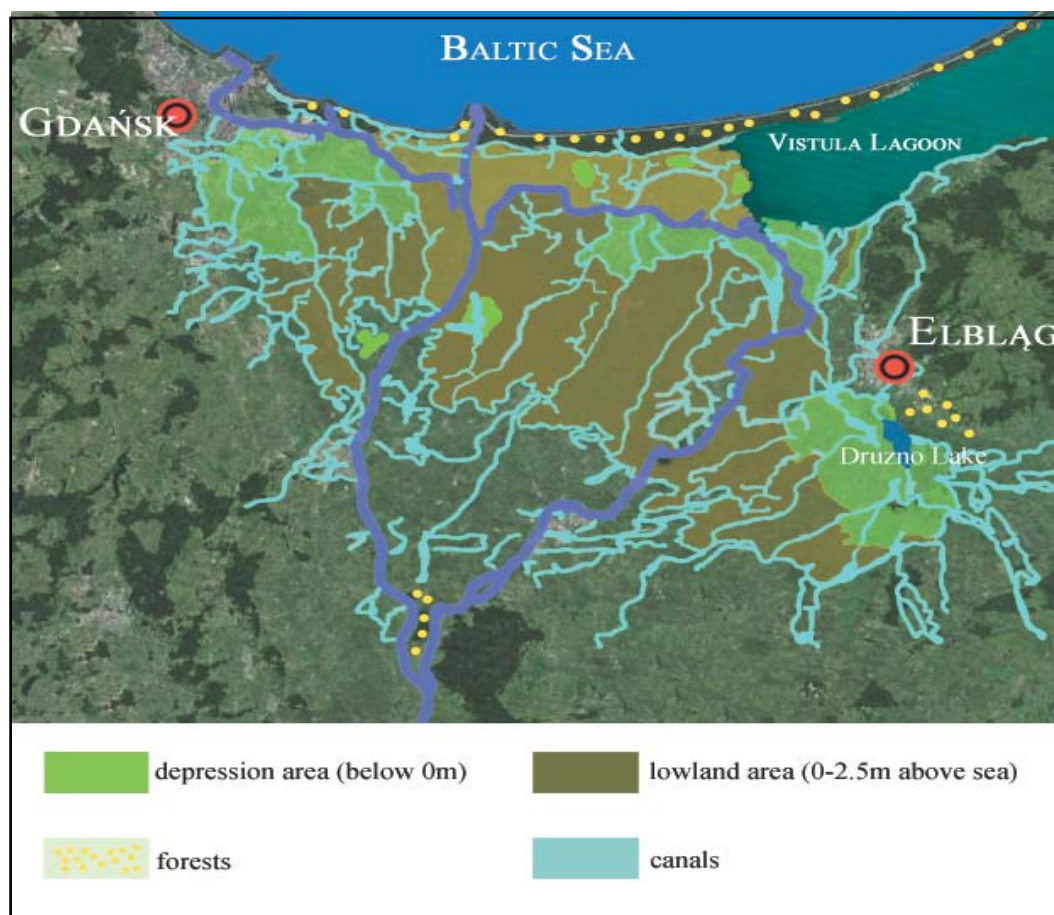


Figure 2 : Illustration of the small rivers and land depression on the study area (Adapt from: CZARNECKI and LUC, 2001).

The flood area around the Vistula Lagoon has an influence of a big area. It can reach not only the polders located alongside of the Lagoon, but also the tributaries. It is of special importance for municipality of Elblag and the Zulawy because the water masses from

the Vistula Lagoon can reach Druzno Lake through the Elblag River.

The Fig.3 illustrates the location to the Zulawy region, where the local authorities of the region recognizes the importance of the tourism for the

development of the region. In the recent years new yachting marinas were build.



Figure 3 : Delta of the Vistula River and the Zulawy region (yellow circle).

The flood is characteristic of this area with depression. For instance, the downfall over the polder area can result in flooding, that is why the effectiveness of flood protection is important. A flood within polder area can result in long-lasting power cuts. The floods within polders do not represent a great threat to society, they can, however, cause heavy economic losses if they occur in some periods of the year.

IV. LANDSCAPE ANALYSIS

In the 60th and 70th century as result of the intensification of agricultural production, it increased the doses of artificial fertilizers and pesticides, on the small rivers (NERUDA et al., 2012). Some of these inputs is not used by plants and results in eutrophication, as response of the ecosystem for these substances. The presence of high concentrations of nutrients and lack of shading on the banks by trees, results in a high biological productivity, threatening the small rivers.

Several rivers of Europe including the Vistula, experience floods and risk right waters. The Fig.4 shows on situations with two landscapes changed in two sides: 'a' and 'b,' separated by one dike. The areas are not exposed for the floods are used by agriculture.



Figure 4 : Two sides of the landscape separated by one dike (yellow set) (Photograph: A. Czarnecki).



Figure 5 : Bigger canal used for transport (Photograph: A. Czarnecki).

With the development of new roads for transport on the study area, the small rivers are no so used for transport. The result is of lack of funds for maintenance of the canals, following by many situations as for example the erosion. However the Vistula delta waterways serves as passage to the Lake District.

The main problem is the inexistence, up to now, of management of the canals of the delta in the Vistula River. So far, this unstable area could be used for environment services and tourism attraction in order to develop the local economy.



Figure 6 : Sluice system used for navigation at the canal (Photograph: A. Czarnecki).

It had been create systems on the delta of the Vistula River, mainly the lowlands, to protect the area of the cities Gdansk, as result of the importance for the economy, with the purpose to create conditions for develop the area.



Figure 7 : Small river changed by canalization and close remains of companies situated on the border (red set) (Photograph: A. Czarnecki).

Nowadays the study area support many traditional industries, such as shipbuilding, metallurgy and, textile. These new marinas are located for example on Szkarpa River and Nogat River. The Fig.8 presents one example of renovated waterfront, part naturalized in Poland at the town of Stobrawa on the Brda River.



Figure 8 : Small river in Poland (Photograph: A. Czarnecki).

The area is part of a complex ecosystem. The small rivers and floodplain were converted for a many purposes, including water supply, drainage, transportation, sewage, flood control, recreation, aesthetic values, and lately for the creation of habitats of plants and animals.

Successful completion of the renaturalization projects can increase the attractiveness of the areas and thus attract more users and uses (BOER and BRESSERS, 2011).

V. CONCLUSIONS

This paper present aspects of the small rivers on the Vistula Mouth and illustrate the canals. The main condition on the study area is that the canals of the delta of the Vistula River are nowadays relatively abandoned.

A good system of small rivers can become to be tourist attraction needs to be navigated, in order to be another economical source for the small cities on the area.

One new relation with the canals can be used to develop tourism. The positive impact of the tourism includes of economic development of the region. Due to the development, new workplaces should be created. This kind of tourism develops the attention to landscape, ecological awareness and nature preservation.

The Mouth of Vistula is an area rebuilt regarding natural system, with a big area of prevailing wetlands with unstable water level that could be flooded from three sources as drainage of water surplus from 90 meters above sea situated on the Moraine Plateau (GORZEL and KORNIJÓW, 2007). During a regular year, the level of Vistula River water can increases 7 meters.

It is a very clever technical infrastructure, which stabilizes an enlarged area and allows the development of cities industry and agriculture.

It is common that industry in similar condition be replaced by tourism development, where the boating is a key element. The described area it is a clever system maintaining the conditions for the development of biodiversity and providing the possibility of economic development.

For nature protection and development of tourism is need to improve structure and functions of ecosystem. It is important recognise it can be achieved by naturalization of small rivers.

One of the conclusion is the possibility of improve the environment services provided by using the small rivers with a relative small effort compared with the benefits from the results for the society and nature. The system analyzed can to improve the relation between the society and nature. These article describes a connection with small rives and cities, by the history and their natural change.

To achieve an environment with better interaction with local society, it was performed an analysis of possibilities to carry out actions to maintain, preserve or rehabilitate the small rivers. In the past the small rivers were characterized as a useful way for transport with no big environment problems on the area. Nowadays, the small rivers are abandoned and with pollutions as result of the agriculture activity in the zone.

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