Regional and Business Studies (2016) Vol 8 No 2, 1-14
Kaposvár University, Faculty of Economic Science, Kaposvár

ENVIRONMENTAL AND NATURE CONSERVATION ATTITUDE SURVEY OF BUSINESS DECISION MAKERS ON SOUTH CATCHMENT AREA OF LAKE BALATON

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ABSTRACT

In this paper environmental problem attitude of SME decision-makers will be introduced on South catchment area of Lake Balaton. The main point of this research was a company survey of 100. That means a result introduction of this survey made among managers/owners of local SMEs. Based on the results we can declare that managers consider environment- and nature protection as an important public purpose. SME managers do not see contradictions between CSR and profitability. They usually believe that SME has an important role in CSR, and their profitability could be improved by these kinds of activities. Despite this thought conscious CSR activity is not very typical for these companies, environment awareness activities are mostly ad hoc measures with economic interests.
Keywords: CSR, SMEs, management, environmental conservation.

INTRODUCTION

In this paper environmental problem attitude of SME decision-makers will be introduced on South catchment area of Lake Balaton. The main point of this research was a company survey of 100. That means a result introduction of this survey made among managers/owners of local SMEs. This analysis will help to uncover how local managers consider environmental aspects in their business decisions.

In our company sample micro and small enterprises are over represented: 50% of the sample is micro enterprise and 42% is small enterprise while 6% is medium sized company. From the total (100) 65 company have coastal headquarter and 35 company have headquarter on non-coastal area. Most of the companies (41%) situated on settlements with 2.000- 10.000 population. Companies on settlements under 2.000 population represented by 30% and 29% of the sample consist of companies on settlements over 10.000 population. 65% of the companies were founded before 2000 and from them 28% were established in 1990 or before.

We intended to combine the sample on main business activity like SMEs on South catchment area of Lake Balaton. Overrepresented companies with tourism and environmental activities were chosen by deliberately.

First we shortly introduce the main economic factors of Balaton region. After that we outline the results of the survey and we draw our conclusions.

ECONOMIC ENVIRONMENT FACTORS IN THE REGION

Buday-Sántha (2008) in his comprehensive analysis "Balaton region" gives a detailed outlook from the region's economic. According to him this region is a medium quality agricultural area, but the natural conditions for viticulture and fruit production are better than the average. Industrial production is not common on coastal settlements (apart from some exceptions), it is more typical for non-coastal areas. This study of *Buday-Sántha* point to the fact that a synergic duality of tourism and agricultural production would establish the economic development, but real cooperation can be experienced only in case of vine production. Considering other sectors agriculture could not adapt to seasonal movements. The main economic problem of this region is the coastal advantages of tourism and non-coastal settlements have weak efficiency on tourism benefits.

A publication of *Hungarian Central Statistical Office* (2011) gives a detailed picture from the economy of Lake Balaton Resort Area (LBRA). Here are the main points described below:

- The tourism of the border counties of Balaton mainly concentrated on LBRA settlements.
- Entrepreneurial activity in LBRA is higher than the country average, the entrepreneurial environment is favourable.
- In sectors connected to tourism (provision of accommodation and catering) the rate of active companies is 6% which is double as the Hungarian average.
- In sectors connected to tourism employment rate has grown (contrast with other sectors)
- According to the above capacity utilization of tourism is 50-60% in high season, but it decrease one half in the other part of the year.

Overall these two cited publications both emphasize the priority of tourism in the region's economy. Furthermore Lake Balaton is the most popular destination in the country after the capital city (*Marton, Jónás-Berki*, 2010).

Kabai (2014) reflected the other part of the high significance of tourism. He calls the unified economic-tourism function as a coherent strength of Balaton society, and he emphasizes that tourism was a forming strength which homogenized the society of this area in the last 150 years. *Kabai* also consider natural environment as a coherent strength. This opinion is important for us because companies input usage and product-, waste-, noxious emission effect the nature environment (*Péter et al.*, 2011). Besides mass tourism affects the image of Lake Balaton (*Sulyok*, 2010). Considering this few thoughts above economic environment has not only a direct effect on social cohesion but it also influence social cohesion through the natural environment.

PERCEPTIONS OF BUSINESS MANAGERS AND OWNERS ABOUT SETTLEMENT SPECIFIED ECONOMIC-SOCIAL ENVIRONMENT

It is important to say that in case of SMEs real manager and owner functions are mostly in one hand or maybe in a small family business. Apart from some exceptions owners-managers are residents in the headquarter settlement, in fact "headquarter

choice" (if it is a real choice) is defined by their residence. If this "headquarter choice" still do not attain, the possibility of a strong "daily" relationship between SME managers and everyday life of headquarter is rather high. This means also that beside owner-manager aspects "local resident" aspects are experienced in the identity-, attitudes- and answers of the company responders. Though answers of managers can not consider as similar to responds of resident survey, because entrepreneur attitude and business success play important role in managers' settlement attachment/relation. In the first part of the company survey we intended to reveal what kind of perceptions this complicated interest related responders have about headquarter-settlement specified economic-social environment. Table 1 shows the results of satisfaction about settlements.

Table 1

Headquarter-settlement satisfaction among managers and owners (5-point Likert scale)

As a manger/owner how satisfied are you with …	N	Average	Std. Deviation
Settlement accessibility	100	4.45	0.833
Settlement notoriety	100	4.33	0.877
Natural environment beauty	100	4.29	0.808
Energy supply	99	4.12	0.895
Public (communal) supply	100	4.07	0.891
Internet bandwidth	98	3.60	1.155
Public safety	99	3.58	1.031
Built environment beauty	98	3.53	0.933
Medical treatment	99	3.45	1.072
Municipal environmental policy	95	3.33	1.026
Education and culture opportunities	97	3.23	1.036
Qualification of employees	97	3.22	1.043
Residents environment awareness	97	3.08	0.975
Residents relations	99	3.02	0.880
Business profitability	97	2.86	0.924
Entertainment and recreation facilities	99	2.81	1.175
Overhead expenses	100	2.44	1.192

Overall managers are satisfied with settlements on South catchment area of Lake Balaton. Only three areas got worse than medium, though two from them (business profitability and overhead expenses) are determinant elements of company efficiency. Responders are very satisfied with settlement accessibility and notoriety, natural environment beauty, energy supply, public (communal) supply. However we have to mention that this satisfaction range based on average values is just an indication because standard deviation values are very high. At the same time apart from this information it is meaningful that managers mostly satisfied with "local conditions".

Therefore these are those factors which are/were mostly not a result of the current local society. A settlement accessibility and notoriety, a natural environment beauty are those values that local society owns mostly as a cultural-infrastructural heritage and they only participated in the establishment within narrow bounds. Become aware of the fact that settlement factors endogenously determined (on short-term) by local society participants (municipal environmental policy, education and culture opportunities, qualification of employees, residents environment awareness, residents relations, business profitability, entertainment and recreation facilities) are in the second half of the range. It seems that the biggest attractions of analysed settlements for decision-makers are the given and past inherited conditions. Therefore the local economy can not produce social-economical values that would generate similar high satisfaction. This duality can also be found in chapter 4 (residential survey).

From the analysed satisfaction factors environment awareness and environment activity have a distinguished importance for us. It was mentioned before that managers are very pleased with the natural beauty of their settlement. It is more expressive that 84% of the responders gave minimum score 4 (on Likert-scale) for natural environment satisfaction. At the same time they are less satisfied with resident environment awareness (36% gave minimum 4 and 26%gave worse than 3) and with municipal environmental policy (43% vs. 18%). Parenthetical percentage values show how opinions are divided about these two questions and the rate of "neutral" (score 3) responders are rather high. It is worth to analyse if there is any geographical connection of these expressive satisfaction difference. To be more accurate: would settlement size (in population) and coastal/non-coastal localization affect satisfaction on environment activity? Our research (ANOVA, Welch, and Brown-Forsythe tests) shows that manager responds of coastal and non-coastal settlements have no significant differences between satisfaction average and resident environment awareness or municipal environmental policy. Therefore in this question coastal - non coastal duality can not experienced like in case of many other social-economic questions in Balaton region. However between settlement size and satisfaction averages significant difference was observed, results shown by *Table 2*.

Table 2

Environment awareness and environment activity satisfaction averages by settlement size

Settlement size (population based)	**N**	**Manager satisfaction**	
		resident environment awareness	municipal environmental policy
under 2 000	28	3.07^{ab}	3.59^{a}
2 000 – 10 000	38	3.47^{a}	3.53^{a}
over 10 000	30	2.59^{b}	2.79^{b}

Note: Based on ANOVA, Welch, Brown-Forsythe, and Tukey post-hoc tests significant averages ($p<0.01$) were marked with different letters (a,b) in superscript.

The average value of manager satisfaction about municipal environmental policy was significantly lower in case of settlements over 10.000 population than settlements under 10.000. This outcome becomes interesting if we consider *Varjú's* (2010) results. According to him larger settlements attach more importance to strategic environmental analysis (SEA) in municipal activity planning. He says that the backgrounds of this privileged SEA are the growing development and investment capacity (when settlements are expanding) and the accompanying increasing environmental hazards. We have to add that in *Varjú's* view smaller settlements means villages under 1.000 population. According to his results commitment about SEA is the highest in case of settlements with 5.000-10.000 population, but at the same time settlements over 10.000 believe SEA application in their planning process as rather important. Therefore we have to emphasize that in case of our survey relative dissatisfaction in the largest settlement category does not mean fewer municipal environmental efforts. These unfavourable manager perceptions could come from higher environmental risks and their effects (on larger settlements) in spite of more intensive municipal environmental activity. At the same time on smaller settlements municipal environmental activity is more "visible" and level of environment hazards and their harmful effects are much lower.

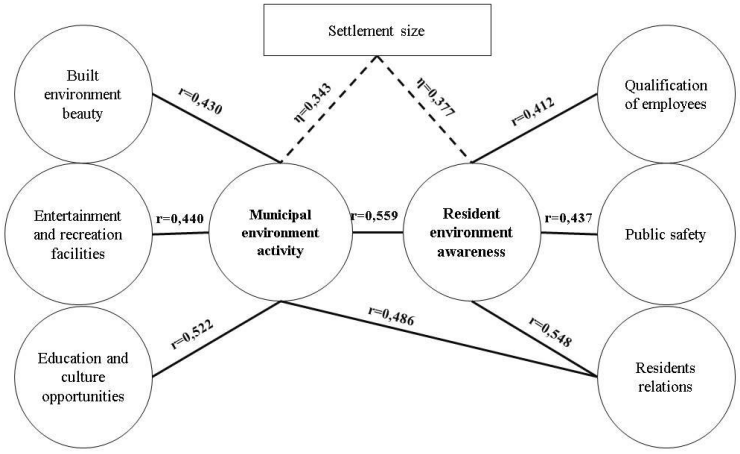
This above mentioned coherency is a partial explanation for differences of resident environmental satisfaction. In this case satisfaction average at settlements with over 10.000 population was the lowest as well. In case of settlements of 2.000-10.000 population satisfaction average was significantly higher. Outstanding satisfaction average in the "medium" settlement category can be explained with the previously mentioned logic. Environmental risks may have already realized remarkably on these settlements, but at the same time resident environmental activities are more efficient and visible than in larger settlements. Satisfaction average value of settlements under 2.000 population place between the two other average value but it had no significance difference. On these settlements environmental hazard is much lower, therefore resident environmental attitude is also less visible. So manager satisfaction average value approached 3 (medium) score. Settlement size effect degree on variables was analysed by Eta. This Eta value was 0.344 in case of municipal environmental activity, while resident environment awareness produced 0.377 Eta value. Both values mean quite weak influence. This means that beside settlement size some other factors have influence on environmental activity- and awareness satisfaction of local social participants.

So we can see that manager satisfaction on municipal environmental activity and resident environmental awareness is weak, but settlement size has a significant effect. What is more in table 1 from the satisfaction areas only environment attitudes and overhead expenses have statistically proved effect. It is surprising that settlement population has no effect on business profitability satisfaction.

We mentioned before that settlement size itself has a weak effect on environmental activity satisfaction of local participants. So here is the question: are there any other factors which have influence on these two satisfaction areas? We looked for the answer with some correlation relation (with other satisfaction areas), therefore we used Pearson correlation coefficient in order to determine which other satisfaction areas significantly correlate with environment satisfaction variables (beside $r>0,4$, $p<0,05$ minimum expectation). These results are shown by *Figure 1*.

Figure 1

Influence factors of manager satisfaction on municipal and local resident environment awareness



Values on *Figure 1* show weak-medium correlational relationship between certain satisfaction areas. Beside this criterion, responder perceptions were:

- Resident environmental awareness is higher on settlements with more active municipal environment activity;
- Entertainment, educational-cultural opportunities are better and built environment is more beautiful on settlements with more active municipal environment activity;
- Employment qualification, public safety and resident environment awareness are areas that strengthening each other;
- The better residential relations could be estimated, the better judgement municipal environment activity and residential environment awareness have.

Based on the above mentioned, (for managers) satisfaction on municipal environment activity can not be completely separated from other service (which responsibility is primary municipal) satisfaction. Similarly to resident environment awareness, it can not be separated from other positive social attitudes (for responders).

Beside current settlement satisfaction we assessed expectations about future settlement economy. Responders could answer with 5-point Likert scale to the following questions:

1. Settlement and the outskirts will not change considerably, current features will remain.
2. Mostly major investment projects will be realized on the settlement and outskirts (hotels, multinational companies).

3. Services based on nature values will develop on the settlement and outskirts.
4. Mostly small (family, small, medium) businesses will expand on the settlement and outskirts.
5. Economic condition will decrease on the settlement and outskirts and even some currently active companies will wind up.

Original answers were collected into three categories: "Agreed, Neutrals, and Refusals". From these only "Agreed" and "Refusals" groups will be introduced by statements in *Table 3*.

Table 3

Rate of "Agreed" and "Refusals" in case of economy vision statements

Statement	N	Agreed (%)	Refusals (%)
No change for current features, they will remain	97	48.4	21.6
Economic condition will decrease, some currently active companies will wind up	97	24.7	45.4
Primarily services based on nature values will develop	98	32.7	40.8
Mostly small (family, small, medium) businesses will expand	98	32.7	36.7
Mostly major investment projects will be realized	99	16.2	63.6

The results show that a quarter of managers rely on local economy condition to fall and on business to wind up. Contrasts with this, half of the responders predict stagnant situation and no major change for current economic features. In case of statements about development "Refusals" are the major responder part. From them fewest responders believe in major investment projects. Apart from the moderate economical expectations three-quarters of the responders would operate in the current headquarter in the future as well. Therefore the majority of managers are committed to headquarter settlements.

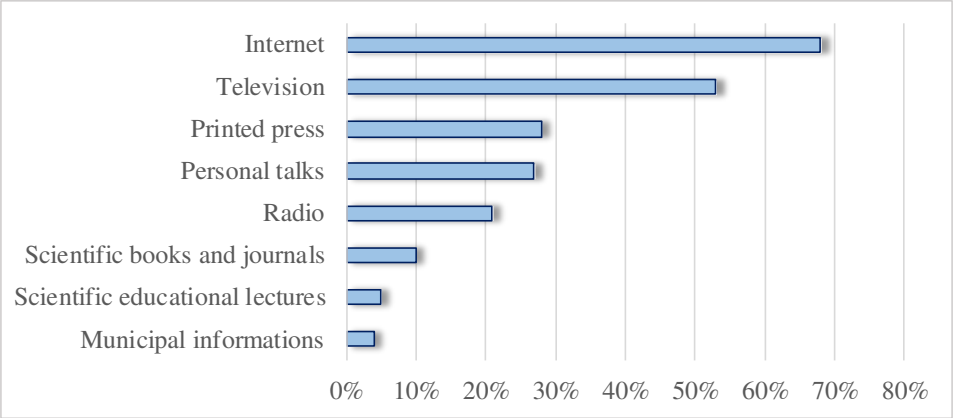
DECISION-MAKER ATTITUDES OF ENVIRONMENTAL PROBLEMS AND ENVIRONMENTAL PROTECTION

In our survey we asked what source they use for environmental knowledge. *Figure 2* shows the rate of source usage.

Decision-makers obtain environmental information from the internet mostly and from television after that. Any other source usage has lagged behind from these two information channels. *Deák's* (2012) general view is harmonizing with these source usage results, because he also emphasizes the high role of internet as a source of environmental information.

Figure 2

Rate of source usage about environmental questions



In the next question section we asked about how responders perceive their own and other social participants' responsibility about emergence of environmental problems in their settlements and Balaton region. Beside responsibility we asked about how they perceive environmental problem solution activity. The involved social participants were the followings: Hungarian Government, local government, holiday home owners, tourists, permanent local residents, and local businesses. In the original assessment list we involved the European Union, but at every question we get a very low average (under grade 2 on 5-point Likert scale). Therefore considering environmental problems of Balaton region and residence responders regard EU responsibility and activity as insignificant. *Table 4* and *Table 5* contain participant average (except EU).

Table 4

Responsibility and activity of some social participants about emergence and solving of local environmental problems (decision-maker responds)

Social participants	Responsibility average	Activity average
Local residents	4.17	3.46
Local government	4.07	3.41
Local businesses	3.98	3.44
Tourists	3.38	2.22
Hungarian Government	3.23	2.59
Holiday home owners	3.21	2.42
Civil organizations	3.03	2.66

Local managers believe that mostly local residents and then local government are responsible for environmental problems. Local companies are in the third place after

them. Tourists are fourth in that range and finally Hungarian Government, holiday home owners and civil organization follow them. It is important to notice that according to this result the main responsible participant for environmental problems are those permanently groups that live/work on the settlement. Temporarily staying tourists and holiday home owners are less responsible compare to them. Range of activity average on environmental problem solving is quite the same as responsibility perception. In case of every participants responders feel rather responsible than active about environmental problems. Rate of activity and responsibility average is the worst in case of tourists (65% while for other groups it is between 75% and 88%). This result shows that according to manager perceptions tourists' – who are the biggest users of nature environment – environmental problem solving is in less proportion to the damage they cause. Activity/responsibility ratio is the best in case of civil organizations.

Table 5

Responsibility and activity of some social participants about emergence and solving of Balaton region environmental problems (decision-maker responds)

Social participants	Responsibility average	Activity average
Local residents	4.40	3.69
Local government	4.18	3.47
Local businesses	4.18	3.57
Tourists	4.12	2.70
Holiday home owners	4.10	3.23
Hungarian Government	3.53	2.65
Civil organizations	3.38	2.93

Almost parallel range was worked out concerning emergence and solving environmental problems in the whole Balaton region as in case of settlement results. The main difference is that responders gave higher responsibility and activity values for each group in case of Balaton region. We made a conclusion of better perception of global problems and environmental activities in overall Balaton region than individual problems in the settlements. Nature environment activities of Balaton can be observed more globally than locally (settlements).

Responsibility and activity averages indicate responder perception of the region's environmental problems; furthermore they can associate these problems with causer groups. It is also true for activities of problem solving. Despite this, the majority of responders do not percept conflicts between social participants in their own settlement about environmental questions. Rates of responder perceptions about conflicts between participants are the following:

- between local residents and holiday home owners: 25%
- between local residents and tourists: 29%
- between different groups of residents: 21%
- between residents on coastal area and other residents: 30%

- between local residents and local government: 30%
- between local residents and environment protectors: 27%
- between local residents and companies: 28%
- between companies with different interests: 20%
- between local entrepreneurs and local government: 25%
- between local entrepreneurs and environment protectors: 21%
- between local government and environment protectors: 18%
- between local governments on different settlements: 22%

Depending on the context fifth-third part of responders' percept conflicts about environmental issues on their settlements. This low rate needs some explanation, because responders could clearly identify the responsible participants of environmental problems and the environment activity of these participants was evaluated lower than their responsibility. For this paradox situation we have two possible explanations. On one hand it is possible that environmental problems do not induce real frustration – in spite of the perceptibility - among social groups. On the other hand another explanation could be that environmental problem inducing and inappropriate environmental activity are causing some frustration, but it do not realized perceptibly therefore it is a latent conflict in settlements' life.

The letter explanation is more confirmed by the fact that management of environmental problems is at the first place concerning problems to solve (by local community) and areas to develop. In our survey the following question was asked: "Let us assume that You have to make a decision on municipal budget! How important do you think the development of the following areas?" 5-point Likert scale was used to mark the importance of areas. *Table 6* contains the average results.

Table 6

Importance of public (municipal) source subsidized development areas (5-point Likert scale average and std. deviation)

Development areas	Average	Std. Deviation
Nature and environment protection	4.36	0.759
Basic infrastructure	4.36	0.798
Medical supply	4.35	0.936
Waste management	4.31	0.907
Tourism issues	4.15	1.058
Social and child well-being services	4.14	0.975
Culture and sport	4.06	0.962
Nursery services and education	4.05	1.298
Drinking water supply	4.02	1.146
Waste water system	4.00	1.181
Public sanitation, insect and rodent control program	3.89	1.254
Public employment	3.66	1.130

Nature and environment protection activity and basic infrastructure stand out from development areas with two aspects: the averages of these two areas are the highest and their std. deviation is the lowest (relative std. deviation is under 20%). Concerning the importance of these questions this means a relative low divide is experienced among responders. Medical supply and waste management have quite high average as well, but their std. deviation values are higher (relative std. deviation is over 20%). Development areas after that have even much higher std. deviation. Based on the results above according to responders environment protection and basic infrastructure development have prime importance compare to other areas.

In the next subchapter we analysed how managers apply social-environmental responsibility in their business decisions.

SOCIAL-ENVIRONMENTAL RESPONSIBILITY APPLICATION IN MANAGER BUSINESS DECISIONS

First of all we will introduce what opinion managers have about the connection of social responsibility and profitability aims. Therefore we asked responders to evaluate two opposite statements. *Table 7* shows the distribution of answers.

Table 7

Social responsibility influence on business profitability according to managers (distribution by evaluation classes, %)

		Profitable business is mostly blocked by social responsibility (N=87)	Profitable business is mostly contributed by social responsibility (N=92)
Agreement value	1	19.5	2.2
	2	18.4	7.6
	3	35.6	34.8
	4	18.4	34.8
	5	8.0	20.7
	Sum total	**100.0**	**100.0**

It is true for both statements that more than third of the responders gave score 3 therefore they do not take a stand on social responsibility (positive or negative) effects. At the same time it is expressive that 55.5% gave at least score 4 for positive statement, while this ratio is only 26.4% for negative statement. 9.9% do not agree (value 1 or value 2) with positive effects of social responsibility and concerning the negative assertion it is 37.9%.

So overall concerning profitability social responsibility is not rejected by responders. The question is how managers regard this area as SMEs' (their own) responsibility. To answer this question we used two other statements for conjunction analysis. Our first statement was: „SMEs do not have important role in global environmental- and social problems, so participation in solving these problems is not expected." Only 23.2%

disagree and 36.1% agree with this statement. 40.7% have no special opinion because they gave score 3 for this question. According to the other statement: "Social responsibility of SMEs is at least as important as large companies' " 18.2% gave score 3 (non-committed). For this statement 63.6% agree and less than 19% gave refusal answer. Therefore decision-makers have a double-approach to SME responsibility. On one hand they do not refuse the thought that solving global social- and environmental problems is a duty of large companies (which actually causing the problems). On the other hand in their own sector they consider social responsibility similar important as in case of large companies. From this observation we suspect that responsibility is considered as a SME sector duty because of its positive influence opportunity of the local environment and not because it is problem causing.

From motivation side attitude to CSR activity is positive. Responders consider CSR as an important activity of SMEs which mostly do not paralyse profitability. In spite of this result only 11% preform CSR activity in their business. We will understand later that this do not mean the lack of voluntary environmental activities among analysed companies at all. It is more likely that these kinds of activities are not part of a conscious CSR strategy and they are not even meant to do as CSR activity. SMEs react ad hoc to opportunities and challenges and they sometimes preform CSR activities without formal CSR conception.

Based on our whole analyses so far it is exciting to ask which are those obstacles (at the analysed companies) that hinder CSR activity extension. In the survey we specified nine factors that need to be evaluated on Likert scale by managers. They had to decide how these factors hinder their own CSR activity and CSR extension. The results are showed by *Table 8*. We can see that CSR "mood" is mostly hindered by additional financial resources (no external subventions are available). The least impeding factor is lack of market expectations. Therefore voluntary CSR activities are either acknowledged/expected by the market or (we suppose this is more likely) despite market "indifference" decision-makers ready to do CSR activity (in case of enough time and resource).

Table 8

Importance of CSR activity hindering factors among analysed companies

Hindering factors	N	Average	Std. deviation
Lack of financial resources and time	89	4.44	.825
Lack of external subventions (government, professional bodies)	90	4.37	.814
Additional CSR expenses	91	4.18	.926
Volatile regulatory environment (laws, standards)	91	4.08	1.088
Lack of employee commitment	90	3.69	1.196
Lack of information.	84	3.61	1.336
Lack of experiences and organization skills	89	3.61	1.134
Market do not allow this kind of commitment	85	3.48	1.269
Business partners do not usually expect from us	89	3.35	1.109

As we mentioned before despite apparent lack of CSR activity most of the analysed companies have some steps to solve or control environmental problems. In our survey we created a nine element list and companies could choose a degree of their activity (1="we do not make any steps on this area", 5="we made significant and determinant steps"). The average values and std. deviation are contained by *Table 9*. In case of these variables standard deviation values are fairly high as well.

Based on preformed non-parametric tests like Wilcoxon-test we can say that compare to other measures companies pay significantly more attention to energy saving than renewable energy. According to Friedman tests no significant differences are experienced among medians of mobility management - waste recycling - and reducing chemicals. The situation is the same concerning greenhouse gas emission reduction – environmental administration system application – environmental friendly product. Use of sustainable/recyclable package is between these homogenous groups.

Table 9

Intensity of certain environmental measures in case of analysed companies

Environmental protection activities	N	Average	Std. deviation
Energy saving	99	4.10	1.074
Mobility management (common car use and share)	95	3.57	1.342
Waste recycle	81	3.54	1.255
Reducing chemicals	91	3.33	1.325
Use of sustainable/recyclable package	66	2.88	1.271
Greenhouse gas emission reduction	83	2.49	1.301
Environmental administration system application	71	2.49	1.217
Environmental friendly product evolution	62	2.47	1.183
Use of renewable energy	86	1.86	1.118

SUMMARY

Based on the results we can declare that managers consider environment- and nature protection as an important public purpose. In public fund usage they deem environment- and nature protection as very significant; moreover they reckon this area among the most important development aims. Mostly a clear and realistic image was formed from the importance of environmental values.

SME managers do not see contradictions between CSR and profitability. They usually believe that SME has an important role in CSR, and their profitability could be improved by these kinds of activities. Despite this thought conscious CSR activity is not very typical for these companies, environment awareness activities are mostly ad hoc measures with economic interests. According to managers lack of resources and subventions are the main obstacles of CSR. Concerning environmental measures resources and subventions of (mostly) voluntary CSR could be incentive for companies.

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Regional and Business Studies (2016) Vol 8 No 2, 15-23
Kaposvár University, Faculty of Economic Science, Kaposvár

POTENTIAL OF ORGANIC FARMING AT THE SOUTHERN WATERSHED OF LAKE BALATON

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ABSTRACT

Previous studies have shown that organic farming is a widely accepted and acknowledged method. The way of farming plays an important role nearby our fresh waters, since – besides influencing the environmental conditions – it affects the local people's and the visitors' judgment, and plays a role in preventing the development of societal conflicts. The aim of our study was to evaluate the potential in organic farming at the Southern Watershed of Lake Balaton. Our hypothesis was that the production of organic food in the studied area could contribute to an increase in the employment, the region's attractiveness (measured in the number of guest nights), as well as in the earnings spent in the region (reproduction). Secondary and primary information collection was performed. A questionnaire-based study was conducted by interviewing the management of local organic and conventional farms (deep interview), as well as local people and the tourists. Results show that consumers considered purchasing organic food as a possibility, however it was accomplished only to a limited extent. According to the management of organic and conventional farms, there is a lack of effective strategy. Critical points were the well-organized local sales activities and communication, which should be improved. Results also revealed that there was no difference in human capital supply, but the environmental conditions were more favorable compared to other regions in the country. Taking advantage of that should be also part of the region's strategy.
Keywords: Local people and tourists, organic foods, consumer behavior, marketing strategy

INTRODUCTION

There is a strong relationship between agriculture and the environment, as the first takes direct and significant event on the latter. However, this also works the other way around, as the components of the environment generally determine the characteristics, success and the buildup of the agricultural activity. We cannot forget about the fact that agriculture is one of the most important and most basic human activities, which – mainly for supporting self-sustaining – generates major changes in the state of the environment by applying its resources. Agricultural activity had always been accompanied by effects forming the environment, but intensity and effects may vary by time and area (*Tar*, 2008).

The traditional and industrialized model of agriculture has led to rapid deterioration of the environment (*Sántha*, 1993). As an alternative for these integrated and ecological was initiated; and we examined the opportunities of the latter in the southern watershed of Lake Balaton. Our strategic aim was to contribute to the increase of

the current production and consumption rates. According to our assumptions the production of eco-products on this area may contribute to increasing employment, growing the attractiveness of the region (may be measured in overnight stays) and the money spent here (reproduction).

We regard the focus of the research especially actual, as the development plan of the region puts emphasis on boosting tourism and health industry and forming the built environment and the minds of the people living in it to be more conscious about healthy, lively environment and *contributing to maintain the natural environment* (*Balaton Fejlesztési Tanács*, 2014). No doubt, there is a need for the contribution of multiple areas, and the focus is on realizing eco-farming and developing the distribution channels in order to increase consumption.

This paper presents part of the results obtained from the questionnaire-based analysis of various actors and stakeholders of the southern catchment area of Lake Balaton, where further aspects and the role of these actors are analysed by researchers (*Horváthné Kovács and Nagy*, 2013; *Torma and Horváthné Kovács*, 2014).

MATERIALS AND METHODS

The research is based on both primary and secondary methods. Our secondary researches included analyzing databases, statistical data collected by self-governments and data of national organizations and previous researches, which are applied for both scientific and social researches.

We carried out empirical research around the agricultural areas in the southern watershed of Lake Balaton, in the form of questioning the leaders of the enterprises (deep interviews). We chose the participants by judgment, we contacted the farmers in the public database of the Hungarian Bioculture Federation and via personal contacts, differentiated by size and area of activity. We included farmers in the research, who already apply the methods of eco-farming, but we also contacted conventional farmers on the spring of 2014. The sketch interview applied – which had been sent to the farmers prior to the interview – contained 9 general and 7 farming-specific questions. Thanks to the unstructured method, in many case further questions were also clarified.

Quantitative primary methods were applied upon questioning the local inhabitants and tourists. We asked 500-500 people among the locals and tourists about the consideration of eco-farming and ecological food and their sales possibilities. The fieldwork of the research was carried out by the Szocio-Gráf Market Research Institute in the first half of 2013 in settlements around Lake Balaton, where the number of urban inhabitants was slightly overrepresented. (Only the sample of local inhabitants was representative.)

When taking the sample from the local inhabitants – within a given settlement – the method of systematic random sampling was applied: the so-called random walking guaranteed complete randomness upon the selection of the respondents. The members of the visited households were still further filtered by the birthday-key method in order to ensure complete randomness (*Malhotra*, 2008). The research carried out on tourists happened on often-visited spots of the settlements of Lake Balaton (beaches, restaurants, markets).

During the creation of the questionnaire we strived for understandability above all, trying to include the possibility of any multiple meanings, and were careful about the sequence of the questions as well.

The analysis of the questionnaires happened by a statistical program matching the needs (SPSS 18.0). During the analysis, first of all we introduce the frequencies in the whole sample. Among the groups made up based on the background variables we analyze only those, which showed significant relationships with 95% confidence level. The analysis contained mainly means and percentages in the case of interval scales; and for other variables we analyzed the data by crosstabs, and in percentages. In the case of percentage distribution we carried out significance analyses with Chi-square tests and in the case of multivariate statistical analyses we checked variance (ANOVA). It is important to mention that there may be ±0.1-0.2% difference from 100% because of the calculation methodology of SPSS.

RESULTS

According to the researches the main advantages of ecological foods are the favorable environmental effects, such as restoring biodiversity and the landscape, decreasing environmental pollution and energy usage, while applying more renewable resources (sun, wind, water) (*Scialabba*, 2003; *Gabriel et al.*, 2009).

During our research we asked about the consideration of environmental effects as well among local inhabitants, tourists and people working in the areas of farming, processing and retail. Our results are introduced in the following.

The possibilities of farmers in the southern watershed of Lake Balaton

The set of activities of the companies asked were broad, we could see some primarily focusing on agricultural activities (growing plants on fields, plantations and animal breeding), fishing and hunting, processing (syrups, honey, wine, meat) and retailers. The activities typically started 20-30 years ago, but there were some, who started about 3-4 years before. The area of the production was just as diversified as the set of activities: it ranged between 1-9000 hectares. The products produced ranged from sunflower, wheat, corn, rape, cherry, peach, grapes, line, triticale, fish, and neat for meat production and breeding animals. Further activities included hunting, fishing and touristic activities (catering and accommodation services). It is favorable that all of our interviewees decided for at least keeping the current production level, but many of them are even planning expansion. Among animal breeders the most popular aims were cutting animals and processing meat (e.g. steak), while for those who grow fruits and vegetables, the directions – besides extending storing capacity – went towards preparing jams, dried fruits, liqueurs, pálinka and wine. The improvement and widening of distribution channels (e.g. web shop, package services) were also listed among the short term plans.

The interviewees are generally satisfied with their production possibilities, but the Balaton-area does not mean any further advantage for them. The general problem in all areas is to find the right number of well-qualified workforce; all the respondents agreed that it is a challenge to find engaged employees. But this is not

a challenge characteristic only in this region, so the solution of it does not mean extra-burden compared to other regions either. Those operating a small business try to solve their problem by involving family members, which however means huge boundaries from economic perspective.

They regard their ecological possibilities as average (except for apiarists, who think it is above average), luckily geographical location does not cause any drawbacks. Generally we can conclude that the respondents do not clearly feel the advantages of being close to Lake Balaton, only the potential in touristic activities is higher. In their production systems they try to adapt to the local circumstances as much as they can. Environmental characteristics influenced the methods of farming a great deal, this is why many started to engage in producing eco-products, which could be a good basis for attracting more farmers to the area..

Concerning sales the responses are rather pessimistic. They do not enjoy the benefits of selling locally, the majority of the products are not purchased in the area of Lake Balaton. The amount of products sold as eco-products is especially low; as for the opinions of the farmers it does not mean real attractiveness for the customers, so they are not hoping for a huge price gap. One example for this is the case of wineries that may only sell their bio-wines on festivals on identical prices as the traditional ones. The real advantage only appeared in the case of those, who are engaged in producing, processing and sales (within the hotel) as well, whose customers justify the acceptance of higher quality, higher value products. The others mostly target the capital and foreign partners with their special products (honey, pálinka, wine, liqueurs and meat products).

Among the necessary changes the improvement of local distribution channels was mentioned on first place; which was supported by all members of the product path. There are good possibilities in the direct communication to the customers as well, but even in spite of being present on multiple festivals they still do not feel this is enough; and they expect more turnover from the yearlong presence in larger stores. They think it is important to improve both horizontal and vertical cooperation. Laws and legal regulations often cause problems: they would welcome more accountable regulations supporting the development of their farms more clearly.

The possibilities of environmentally friendly (ecological) farming from consumer perspective

In this section we highlighted those questions, which tell us details about the attitudes of local inhabitants and tourists concerning environmentally friendly, ecological farming and its products and their willingness to consume them.

First of all we examined the satisfaction of the locals and tourists concerning the natural environment (*Table 1*). They could express their opinions on a scale from 1 to 5 (1=not satisfied at all; 5=completely satisfied).

The general level of satisfaction among the 500 local respondents was 4.44, which shows that they are generally satisfied with the natural environment of Lake Balaton. The same value in the case of tourists was 4.73, which shows that they perceive the natural environment of the area nicer than the locals. It is a positive

phenomenon that over half of the locals (59.8%) is completely satisfied, and further almost one third is rather satisfied. The response of those coming here only for holidays is almost totally homogeneous: they are completely satisfied with the natural environment.

Table 1

Satisfaction with the natural environment among the inhabitants (N=500) and tourists (N=250)

Category	Distribution among inhabitants		Distribution among tourists	
	Person	**%**	**Person**	**%**
Not satisfied at all	2	0.4	0	0
Rather not satisfied	6	1.2	0	0
Neutral	51	10.2	7	2.8
Rather satisfied	139	27.8	53	21.2
Completely satisfied	299	59.8	190	76.0
N/A	3	0.6	0	0

We found significant relationship (p=0.002) between satisfaction and gender in the case of locals only: women (62.4%) are more satisfied with the natural environment of their place of living than men (56.3%).

During our research we examined how much the respondents feel themselves responsible for the environmental problems (*Table 2*). This question was replied rather neutrally both by locals and tourists – represented by marking 3 on the five-level scale. However, it is interesting to observe that among tourists the proportion of the positive replies, marking 4 and 5 was higher: 46.6% of the locals, while 52% of the tourists thought they were responsible for environmental problems.

Table 2

Feeling of responsibility for environmental problems among locals (N=500) and tourists (N=250)

Category	Distribution among inhabitants		Distribution among tourists	
	Person	**%**	**Person**	**%**
I do not agree at all	39	7.8	10	4.0
2	70	14.0	32	12.8
3	**157**	**31.4**	**78**	**31.2**
4	147	29.4	77	30.8
I completely agree	86	17.2	53	21.2
N/A	1	0.2	0	0

Concerning the feeling of responsibility there was a significant relationship (p=0.001) among the local inhabitants concerning qualifications: among those having a university degree 56.6% thought that they are responsible for environmental problems (marking 4 or 5), while among those having less qualification than primary school 31.6% market 4; and there was no one completely agreeing. There was high rate of agreement among those with skilled labor education (51.2%) or specialized schools (49.6%). Among tourists there was no such a relationship visible.

It is important to highlight that the sample of tourists is half as big as that of the local inhabitants, therefore the small sample often made it harder to carry out the analyses. The Chi-square test showed relationship in two cases, concerning family status and current workplace, but unfortunately over 20% of the cells showed expected count less than 5%, so these data are not reliable.

The next question focused on how much the respondents feel they could personally do something for their environment (*Table 3*). As in the case of the previous question, here also the neutral responses dominated, and again it is visible that tourists (42.8%) gave a larger proportion of positive answers that the locals (33.4%).

Table 3

Perception of being able to act actively to solve environmental problems among local inhabitants (N=500) and tourists (N=250)

Category	Distribution among inhabitants		Distribution among tourists	
	Person	**%**	**Person**	**%**
I do not agree at all	56	11.2	9	3.6
2	92	18.4	38	15.2
3	**184**	**36.8**	**96**	**38.4**
4	114	22.8	63	25.2
I completely agree	53	10.6	44	17.6
N/A	1	0.2	0	0

Again there was a relationship concerning the local inhabitants in the case of school qualifications (p=0.000). In this case those with a university degree were the most positive (42.2%), the proportion of positive (4-5) replies of the ones with high school degree (32%) and skilled labor education (38.6%) were again similar, while those with primary school qualification (25.5%), or less (15.8) were again much less positive about the issue than the rest. As before, no such relationship could be seen among tourists.

The Chi-square test showed a relationship among tourists with family status, but because of the small sample size we cannot speak about a trustworthy relationship again.

In the next question we examined how actively do people act in favor of solving environmental problems (*Table 4*). Once again, the vast majority of the responses were neutral concerning the issue, and all in all tourists (36.4%) proved to be more positive than the locals (30.2%). The proportion of those not doing anything to solve environmental problems is higher among the local inhabitants (9.4%); among the tourists this number was just a bit over the half of the previous (5.2%). Compared to the other questions the proportion of people not responding was much higher among the locals, in 15 cases (3%) there was no reply to this question.

Table 4

Acting in favor of solving environmental problems among locals inhabitants (N=500) and tourists (N=250)

Category	Distribution among inhabitants		Distribution among tourists	
	Person	**%**	**Person**	**%**
Nothing	47	9.4	13	5.2
2	110	22	49	19.6
3	**174**	**34.8**	**97**	**38.8**
4	128	25.6	72	28.8
Very much	26	5.2	19	7.6
N/A	15	3	0	0

In the case of this question the samples of local inhabitants and tourists show similarities, as in case of both of them there is a relationship between the responses and school qualification (locals: p=0.007, tourists: p=0.037). In both cases the ones with university degree were the most active against environmental problems (locals: 44.6%, tourists: 41.8%), and no one of the group with less qualification than primary school replied 5 for this question.

Concerning specific activities we also asked if the respondents buy products coming from qualified eco-farms (*Table 5*).

Table 5

Buying products coming from qualified eco-farms among local inhabitants (N=500) and tourists (N=250)

Category	Distribution among inhabitants		Distribution among tourists	
	Person	**%**	**Person**	**%**
Never	**258**	**51.6**	**95**	**38.0**
2	103	20.6	39	15.6
3	81	16.2	69	27.6
4	32	6.4	23	9.2
Always	25	5.0	23	9.2
N/A	1	0.2	1	0.4

In this question neither local inhabitants, nor tourists were neutral: the majority of both samples never buy eco-products, but while among the locals this proportion was 51.6%, among tourists it was only 38%, their responses were more often neutral (27.6%). In this question there was a relationship between gender and buying food from qualified eco-farms ($p=0.089$) in case of tourists; men replied 'Never' more often (45.2%), than women (31.9%). Though it is still a low proportion, 10.4% of women answered 'Always' on contrary to only 7.8% of men. There was no such a relationship visible among the local inhabitants.

CONCLUSIONS AND SUGGESTIONS

As a summary we can conclude that though there is consumer interest towards eco-food in the region, it is still slight. This result is especially unfavorable for those producing and selling eco-products in the area, as it is hard for them to find a market locally. This undesirable tendency is assumedly driven by the high prices and the missing or often wrong information about the products produced by this method.

The solution could be an overall campaign: transmitting information forming consumers' knowledge in the area by significant social support. This could mean opening small and mid-sized eco-farms for those, who are interested, probably complemented by organized programs as well. From the results it is visible that the respondents' feeling of responsibility is significant, so the campaign should be started based on this. The Krishna Valley in Somogyvámos could also be an active member of this campaign, as it is already a well-working community focusing on the sustainability. The Valley is located close to the area examined and provides a wide range of programs as well.

What is missing is a platform where local inhabitants and tourists could be informed about the eco-products produced in the area. This could be solved by an online platform, or what is even better, a mobile application, which provides exact information about the products, prices and availability (with the help if Google Maps). This service could be efficient to fight the problem of high prices as well, since the prices are easily comparable.

ACKNOWLEDGMENT

The project was supported by the EU (TÁMOP-4.2.2.A-11/1/KONV-2012-0038 id. 'Complex analysis of effects of anthropogenic activities and the relating social conflicts on the example of an ecologically sensitive region of shallow lake (Lake Balaton and its water shed)'.

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Regional and Business Studies (2016) Vol 8 No 2, 25-38
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LOCAL HUMAN CAPITAL INDEX IN THE SOUTH TRANSDANUBIAN REGION

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ABSTRACT

The authors addressed the spatial analysis of the human capital of settlements in the South Transdanubian region. It is widely agreed by researchers that especially endogenous regional development relies highly on local assets, among them local human capital. On the other hand there are several indicators in use for measuring spatial allocation of local capital or human capital without a consensus among researchers. Human capital has already been studied from several aspects and reviewing these studies made us confident to work on the topic further. The authors focused on the feasible development of a complex indicator which reflects the spatial allocation of human capital potential in the South Transdanubian region in order to identify the settlements with pulling effect on their surrounding settlements and those areas which are either outliers or negatively affect their neighbourhoods. It was found that local human capital of the Southern Transdanubian settlements had to some extent clear spatial patterns, which is mainly induced by the role of central settlements. Although in some cases the pulling effect of these bigger cities is not unambiguous, not all of their neighbouring settlements benefit. On the other hand, the majority of the settlements does not belong to either positive or negative clusters, and only a few cases were seen as outliers, too.
Keywords: spatial autocorrelation, Hungarian settlements, local human capital index

INTRODUCTION AND AIM OF RESEARCH

The authors focused on the development of a potential indicator which, according to our initial intention, describes the local human capital of settlements in the Southern Transdanubian region.

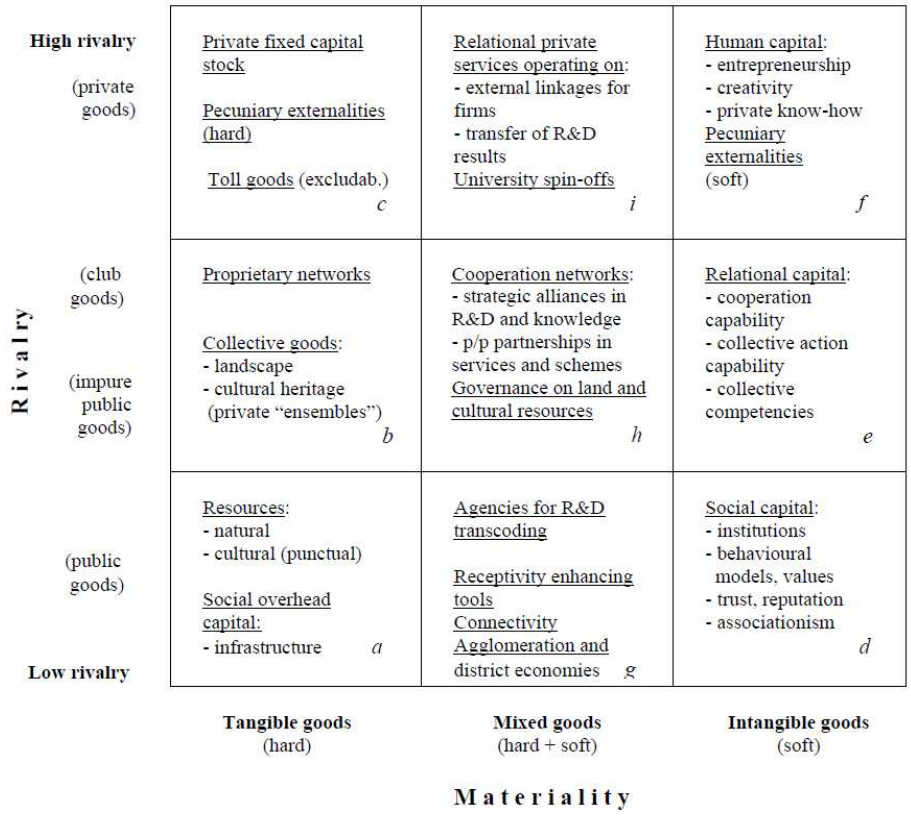
The aim of the research was to compose a complex indicator which contains several pieces of information of the human capital - starting from the population base up to the availability of local jobs.

It can be seen that due to the selective pattern of regional growth various development paths of single regions are emerging even worldwide. Definition of possible growth strategies for each territorial unit must necessarily rely on local assets (*MTA*, 2001) and potentials and their full exploitation: in short, on what is called 'territorial capital'. (*OECD*, 1999; *OECD*, 2010) The literature of endogenous development is wider than what is possible to overview in this article, but it can be agreed that increasing attention is paid to „intangible, atmosphere-type, local synergy and governance factors". In the last few years these theories were re-interpreted as social capital, relational capital or knowledge assets (*Camagni*, 2008; *Camagni and Capello*, 2008).

Camagni in his work attempting to incorporate the elements of territorial capital (*Figure 1*) into a materiality – rivalry matrix – rates human capital as a factor with private and intangible goods.

Figure 1

Camagni's classification of Local Capital elements



Source: *Camagni* (2008) p. 6

Human and social capitals are defined more deeply in a research focusing on the identification of patterns of economic growth and territorial capital growth (*Jóna*, 2015). The author formulated available variables in the two forms of capital among others in order to find out the interrelationship of stable and rapid growth of regions with local capital forms. The author underlines that in many cases interactions for policy objectives are contradictory to stable growth and it is seen from his work that human local capital and more over social local capital serves stable growth better than rush economic growth.

After having already spoken about the regional context of territorial capital, we want to refer here to *Bodnár's* point of view (*Lengyel and Vas* (eds), 2013). The special approach of endogenous development and its concept for rural regions is important because these are unique territorial spaces in terms of economic abilities,

social features and the settlement structure. We agree *Bodnár* that the meaningful changes have taken place, having created functions other than agrarian production for rural regions, they highlight the role of territorial capital in the development of rural areas such as the Southern Transdanubian Region.

Despite the fact that human factor is an important element of local capital and it can be seen in many aspects of it – social, human, infrastructural, relational, cultural, etc. – there is not any agreement or common way to measure it. *T. Kiss* (2012) classifies various indicators that are more or less widely used to measure the embodied knowledge and skills of individuals but at the end she emphasises that such indicators are always tailor-made for individual research objectives, but still rely on the most important factor of it, namely the schooling, the educational level of the population.

Among the methods and complex indicators developed for measuring local human capital the most inspiring for us was the Local Human Development Index of *Szendi* (2015). The author made attempts to develop a complex indicator for local territorial units in order to see centre – periphery relations and to identify the 'pulling' regions with the means of spatial autocorrelation method. In her work she adopted the UNDP methodology (*UNDP*, 2013 38-44. p.) for the indicators available at regional level. The author found that the education level besides life expectancy had a significant effect in the two Central Eastern European countries analysed.

Further studies dealt with the education level and its spatial imbalances (just to mention the most known research groups, *Forray and Híves* 2013; *Nemes Nagy* 2003; *Rechnitzer* 2009; *Rechnitzer–Smahó* 2005; *Kertesi–Varga* 2005; *Obádovics-Kulcsár*, 2003). Most importantly we refer here to the paper of *Sánta et al.* (2015), because they regard qualified human capital as one of the most important economic development theories, especially those with endogenous trend (*Gál et al*, 2010; *Stimson et al.*, 2006; *Todaro and Smith* 2009; *Varga* 2009; *Romer*, 1994). Other authors also used the simplification that human capital of a given region is best described by the education level of the population, but agreed with the phenomenon that the educational level is in close relationship with better jobs, at the end with higher employment (*Ambrus and Varsányi* 2011, *Kézdi*, 2004) among other benefits.

As we have seen above, imbalances of educational level lead to disparities in the local human capital on one side. It made us interested in whether the local population's availability and employment indicators in a complex way are influenced by a spatial pattern, too.

The authors of the current paper have been committed to that the analysis should focus on the settlement level and we chose our wider region for the study. The focus on the settlement level for studying imbalances was not only a continuation of earlier researches (*Sarudi et al.*, 2011; *Honfi and Horváthné Kovács*, 2008) but was justified by the extremely detailed and wide review of methods for the classification of regional units in the work of *Pénzes* (2014) reviewed by *Nagy* (2015), too. In his work *Pénzes* warns that micro regional level of analysis is not easy if the researcher wants to see chronological changes due to the continuous changes of the administrative units.

It was not a question to use a complex or composite indicator for the objectives of our study. The literature and development strategies, papers (e.g. OECD, WHO,

Worldbank, etc.) developed and applied various complex indicators with the intention to incorporate a number of important pieces of information in a single, interpretable indicator for policy uses (*Horváthné Kovács and Nagy*, 2015). *Pénzes* also introduces and compares the benefits of various methods for complex indicator development and he regards standardization method as most ideal. We agree that in case of high number of original variables factor reduction is necessary to eliminate autocorrelation of factors. After having studied the settlement level data (T-STAR) of Hungarian Central Statistical Office (*HCSO*, 2014) and due to the limited range of variables we decided on a reasonable selection of those variables which we wanted to test against spatial autocorrelation in the Southern Transdanubian region. We agree with *Pénzes* that the spatial autocorrelation results may reveal deeper relationships and believe also that it contributes to the understanding if and how certain regional centres influence their surroundings in terms of their local human capital, which - as we have seen previously - in the end is an important factor of the regions' endogenous development from several points of view.

MATERIALS AND METHODS

The territory of the research was analysed on the basis of the settlement data available in Dissemination Database of the Hungarian Central Statistical Office (*HCSO*, 2014). It covered the settlements of the Southern Transdanubian region and included a set of panel data regarding population, population movements and employment figures for year 2014 (*Table 1*).

Table 1

List of variables, n=612

Geographic area T-Star 2014
Area of the settlement
Resident population at the end of the year (data calculated further from finalized data of the population census) (capita)
Number of live births (capita)
Number of arrivals due to migration (permanent and temporary together) (treatments)
Number of departures due to migration (permanent and temporary together) (treatments)
Number of children and children that have come of age, found to be disadvantaged
Number of registered enterprises - GFO'14
Number of registered limited liability companies (pieces)
Number of registered job-seekers, total (capita)
Number of job-seekers registered over 180 days, total (capita)
Number of registered job-seekers, manual workers (capita)
Number of registered job-seekers, non-manual workers (capita)

Source: Filtered from HCSO online database

The database was aligned in the following structure (*Table 2*).

Table 2

Structure of initial database

	Area	Variable 1	Variable 2	...	Variable 612
1	Settlement 1				
2	Settlement 2				
...	...				
612	Settlement 612				

The methodology of data processing consisted of two steps: in Step 1 the variables were composed into a joint index. The Index composition followed a standardi-zation process of the initial variables; then a composite indicators of the so called Population Power and Employment Power were created, which two indicators were used in the Composite Index of Local Human Capital (LHCI). In Step 2 the LHCI variable of settlements were used in GIS based analysis (*Anselin and Bera*, 1998) (spatial autocorrelation), where we wanted to point out the clusters of settlements with stronger human capital power and whether there is a relationship (*Dusek*, 2004; *Varga*, 2002) between the geographical location of settlements and their human capital supply. On the other hand, this tool enables us to identify the areas lagging behind, where both the settlement and its surrounding suffer from low LHCI. Further results of the applied spatial autocorrelation method were expected to highlight the outlier settlements of the region.

RESULTS

Index composition for local human capital

The aim of index composition was to compose various pieces of information into one single indicator that is easy to interpret and illustrate, also appropriate for further numeric methods. The method index composition is widely spread from field-to-field (e.g. environment, innovation capacity, *Bajmóczy et al*, 2010.) and institution-to-institution, but all of them have a concern to create a single variable (key variable, head variable) which carries several pieces of various information at the same time. We followed basically the methodology described by *Szendi et al.* (2015), mainly because the similar topic of interest (human indicator).

By calculating the standardized variables we created a dimensionless variable set taking on values between 0 and 1 (1).

$$x_{norm} = \frac{x_i - x_{min}}{x_{max} - x_{min}} \quad (1)$$

In the further steps we incorporated the standardized variables into composite indicators. The method used in the formula was the weighted average (*Molnár*, 2015). In order to make our standardized variables applicable in the formula they had to be transformed in a way to take on values between 1 and 2 (in order to avoid multiplying with a zero value).

The initial set of indicators were either individually used in the standardized variables (ratio kind variables) or two or three of the individual initial variables were jointly used (*Table 3*) in order to compose the information content into one-one indicator (index).

Table 3

The composition of indicators

Composite index	Sub index	Standardised variables	Initial variables
Composite index of LHCI	Sub index for Population Power	Population Index	• Population at the end of the year (data calculated further from finalized data of the population census) (capita)
		Birth Ratio	• Number of live births (capita)
		Migration Balance	• Number of arrivals due to migration (permanent and temporary together) (treatments) • Number of departures due to migration (permanent and temporary together) (treatments)
	Sub index for Employment Power	Disadvantaged Child Ratio	• Number of children and children that have come of age, found to be disadvantaged
		Local Employment Power Index	• Number of registered enterprises - GFO'14 • Number of registered limited liability companies (pieces)
		Unemployment Ratio	• Number of registered job-seekers, total (capita) • Number of registered job-seekers, manual workers (capita) • Number of registered job-seekers, non-manual workers (capita)
		Long Unemploy-ment Ratio	• Number of job-seekers registered over 180 days, total (capita)

Finally we created 7 kinds of derived variables and these were used in the composition of sub-indices for Population Power (1, 2, 3, 4, 5) and for Employment Power (6, 7, 8, 9, 10).

The formulas used in the creation of standardized variables as well as of the sub indices are shown respectively in the following session.

Formulas used in composition of sub index for Population power (PPI)

In the first step the population sub index (2) was calculated:

$$P_I = 1 + 99 * \frac{pop_i - pop_{min}}{pop_{max} - pop_{min}} \quad (2)$$

In calculating the birth ratio index, first the ratio of number of live births and population was calculated. After it the birth ratio index (3) was used according to the formula below.

$$BR_I = 1 + \frac{br_i - br_{min}}{br_{max} - br_{min}} \quad (3)$$

The migration balance index (4) used the immigration and migration values as its ratio.

$$MB_I = 1 + \frac{mb_i - mb_{min}}{mb_{max} - mb_{min}} \quad (4)$$

The *complex index of population power* (5) was then the geometric average of the three indicators derived above.

$$PPI = \sqrt[3]{P_I * BR_I * MB_I} \quad (5)$$

Formulas used in composition of sub index for Employment power (EPI)

Prior to calculating the disadvantaged child index (6), the ratio of disadvantaged child and population was calculated.

$$D_I = 1 + \frac{dcr_i - dcr_{min}}{dcr_{max} - dcr_{min}} \quad (6)$$

In a similar way, the unemployment index (7) and the long unemployment index (8) were calculated.

$$UE_I = 1 + \frac{uer_i - uer_{min}}{uer_{max} - uer_{min}} \quad (7)$$

$$LUE_I = 1 + \frac{lr_i - lr_{min}}{lr_{max} - lr_{min}} \quad (8)$$

As the number of local companies and the number of private companies were separately available, we first added the two numbers, and the ratio of the total companies and population gave the local employment power index (9).

$$LE_I = 1 + 9 * \frac{le_i - le_{min}}{le_{max} - le_{min}} \quad (9)$$

The complex index of employment power (10) was then the geometric average of the four indicators derived above, where the reciprocal values of the disadvantaged child index and the indexes of unemployment were put in the calculation.

$$EPI = \sqrt[4]{\frac{1}{D_I} * \frac{1}{UE_I} * \frac{1}{LUE_I} * LE_I} \quad (10)$$

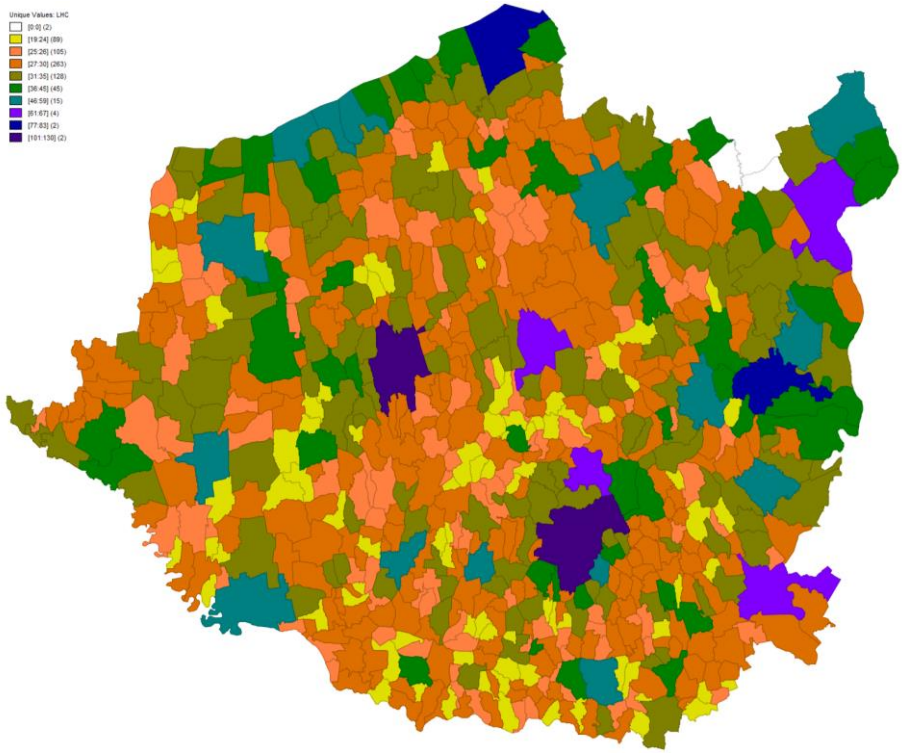
In the final step the Composite index of Local Human Capital (LHC) was calculated (11).

$$LHC = {}^1/_3\, EPI * {}^2/_3\, PPI \quad (11)$$

In the end of the process all settlements in the initial database were assigned with the LHC indicator (*Figure 2*).

Figure 2

Individual values of Local Human Capital of the settlements of the South Transdanubian Region



Source: Based on HCSO data

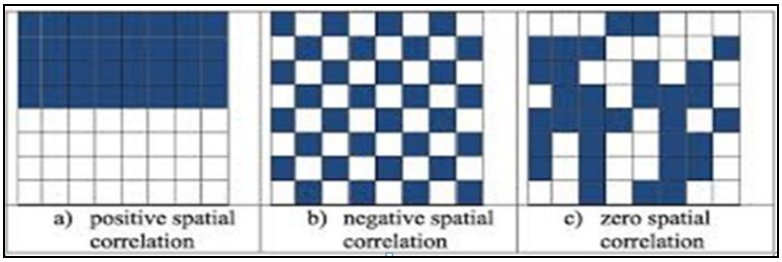
Spatial autocorrelation of local human capital of settlements in the Southern Transdanubian Region

In *Figure 2* the reader may recognize groups of settlements with substantially darker or lighter colours, which raises the issue of spatial autocorrelation. Originally, autocorrelation is detected in time series but later spatial analysis overtook the tool in order to reveal geographic patterns in socio-economic indicators (*O'Sullivan and Unwin*, 2003).

Basically three kinds of spatial autocorrelation exist. Autocorrelation is positive when similar values cluster together and negative when dissimilar objects form groups. The third case is when there is not autocorrelation or it is very low (close to zero), which means that the objects analysed taking on values randomly, without any geographically significant pattern. The three types of spatial autocorrelation are schematically shown in *Figure 3*.

Figure 3

Schemes of spatial autocorrelation cases



Source: *O'Sullivan and Unwin*, 2003

The fundamental issue of the analysis is that the autocorrelation measure is a 'regression' type of measure, where the explanatory variable is the Initial variable of the spatial units and the result variable is the so called 'lagged' variable calculated from the Initial variable of the neighbouring spatial units. The method applied is the weights matrices, in this process we need to define the weights referring to the neighbourhood. The design of neighbours may follow a bishop, queen or rook contiguity or *k* nearest neighbours or by considering the distance of spatial units.

The measure indicator for spatial autocorrelation can be the Moran's statistics. Local Moran's I indicate the slope of the regression line fitted in the Initial variables and the lagged variables, in case of strong autocorrelation the statistics is close to 1 or -1.

Various pieces of software exist for the analyses of geographic information systems. We chose the free download open source software GeoDa for our aims. In the first step a shape file was created for Southern Transdanubia by using administrative shape file for Hungarian settlements (*data2.openstreetmap.hu*). After the merging of the shape file of settlements with the database of LHC indicator (see Chapter *Index Composition for Local Human Capital*) we created and used a weights file (.gal extension) with the method of Queen Contiguity.

We used Moran's statistics as the measure indicator for spatial autocorrelation. Local Moran's I indicates the slope of the regression line fitted in the initial variables and the lagged variables (derived from the weights and Initial LHC). The following diagram (*Figure 4*) indicates the relationship of initial and lagged LHC and the Local Moran's statistics on a Moran scatter plot.

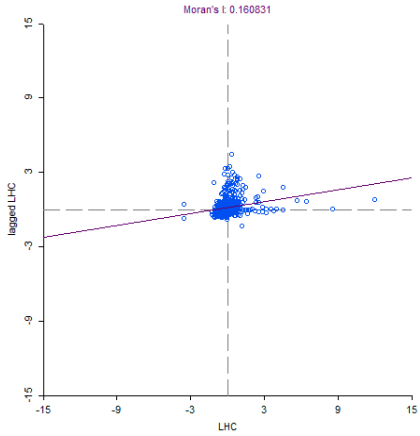
The variable of our interest is on the *x*-axis, while the spatial 'lag' on the *y*-axis. The slope of the regression line (0.16) is the Moran's I statistics for LHC using a queen contiguity weights definition.

We can state that the Southern Transdanubian settlements have very little clustering features regarding their local human capital and neither there are many outliers.

Figure 5 illustrates the further results of the spatial autocorrelation analysis of the Local Human Capital of South Transdanubian settlements. Basically, there was not any autocorrelation found for the majority of the 612 settlements.

Figure 4

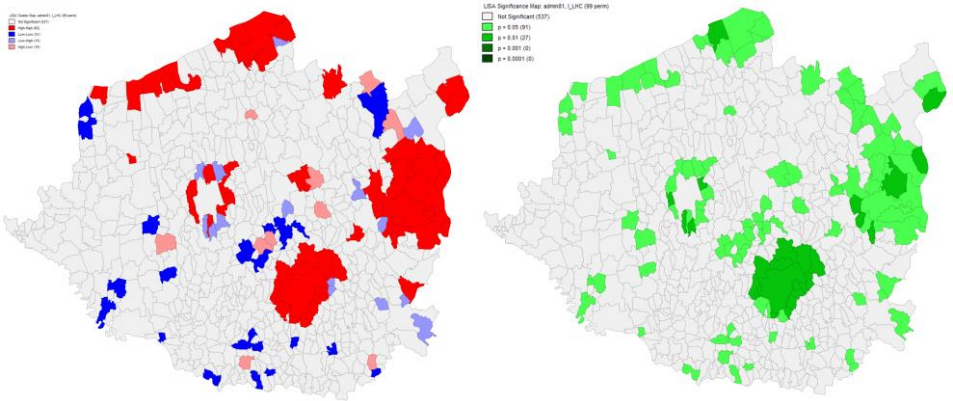
Local Moran's scatter plot on spatial autocorrelation of local human capital of settlements



Source: Based on HCSO data

Figure 5

LISA Cluster Map and Significance Map of LHC



Source: Based on HCSO data

Our results – although on a different regional level – are only little in line with the results of *Szendi* already mentioned above. In her work she found that the spatial autocorrelation LHDI (Local Human Development Index, built on the health, education and well-being dimensions) is basically not significant in the micro regions of Southern Transdanubia. However *Szendi's* analysis was not sensitive enough to clarify the role of central settlements and reflects only that Pécs micro region is a positive outlier.

We found that there are clear but smaller clusters of settlements with higher human capital potential – basically these are micro regional centres and the capital cities of the three counties. Szekszárd together with 12 settlements forms the hot spot of the region, as well as Pécs plays a pivotal role in the life of the surrounding settlements. Surprisingly, some of the shore settlements of Lake Balaton (Zamárdi, Balatonboglár, Fonyód) and their neighbours also have higher potentials, but Siófok as the 'capital' of the southern lake shore has not got a significant role in grabbing upwards its neighbours regarding their local human capital. Another surprise in this term was Kaposvár that was found to have no significant effect on its surrounding settlements as a few of its neighbours were found with lower while another ones with significantly higher LHC potential. It can be explained in a way that the proximity of a town on its own does not provide an adequate pulling effect, another factors play a role in the diverse potential of the neighbouring settlements.

In the future our LHC indicator can be tested for the whole of Hungary and it is reasonable to develop it further in terms of complexity in order to incorporate further dimensions of human capital.

CONCLUSIONS

It can be seen that, due to the selective pattern of regional growth, various development paths of single regions are emerging even worldwide. The definition of possible growth strategies for each territorial unit must necessarily rely on local assets (*MTA*, 2001) and potentials and their full exploitation: in short, on what is called 'territorial capital'. (*OECD*, 1999; *OECD*, 2010). It is widely agreed by researchers that especially endogenous regional development highly relies on local assets, among them on local human capital. On the other hand, there are several indicators in use for measuring spatial allocation of local capital or human capital without a consensus among researchers. Human capital has already been studied from many aspects and reviewing these studies made us confident to work on the topic further. The authors focused on the development of a potential indicator which, according to our initial intention, describes the local human capital of the settlements in the Southern Transdanubian region. The aim of the research was to compose a complex indicator which contains several pieces of information of the human capital - starting from the population base up to the availability of local jobs. It was found that the local human capital of the Southern Transdanubian settlements has to some extent clear spatial patterns, which is induced mainly by the role of central settlements. Although in some cases the pulling effect of these bigger cities is not unambiguous, not all of their neighbouring settlements benefit. On the other hand, the majority of the settlements does not belong to either positive or negative clusters, and only a few cases were seen as outliers, too. In the future our LHC indicator can be tested for the whole of Hungary and it is reasonable to develop it further in terms of complexity in order to incorporate further dimensions of human capital.

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Regional and Business Studies (2016) Vol 8 No 2, 39-63
Kaposvár University, Faculty of Economic Science, Kaposvár

ROLE OF HUMAN IMPACTS ON DRASTIC CHANGES OF INFLOW TO LAKE BALATON – POTENTIAL HYDROLOGICAL AND ECONOMIC CONSEQUENCES – COMPREHENSIVE HYDROLOGICAL STUDY OF LAKE BALATON WATERSHED – ROLE OF HUMAN IMPACTS ON DRASTIC CHANGES OF INFLOW*

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ABSTRACT

Lake Balaton is an important natural and economic asset of Hungary. In the past, similarly to other large lakes, it provided habitat for wild life as well as livelihood and drinking water for the people living in its neighbourhood. In the second part of the last century, water related tourism developed a great deal and Lake Balaton became an important economic factor of the national economy. A necessary condition to maintain or develop the tourism industry in the Lake Balaton Resort Area it is enough to have good quality water in Lake Balaton and a pleasant and rich natural environment in the region. The extended drought period from 2000 to 2004 underlined the vulnerability of the water resources of Lake Balaton to changing hydro-meteorological conditions. It is well known that the water balance of the lake was changing to the worse in the last 3 decades. In this study, human activities affecting the water balance of the lake were investigated. It was found that annually 210 to 230 lake mm of water was deterred from the lake due to human impacts such as the construction/restoration of the Balaton Minor Water Protection System, reservoirs and fish ponds constructed in the watershed, disturbance of the main karstic reservoir by bauxite mining, direct water use from the lake, changes in the land use pattern in the watershed, and already manifested impacts of climate change through decreasing discharges of the tributaries of Lake Balaton. Based on the findings of the study, recommendations were made such as launching a complex water resource preservation program for the whole watershed including rain water management and utilization, land use planning giving priority to water resource management, elimination of illegal water withdrawal, banning the construction of further shallow reservoirs and fish ponds and the improvement of the hydro-meteorological monitoring system.

Keywords: Lake Balaton, human impacts, water balance, climate change

* This article is based on the presentation held at the Conference "100 Year of the Hungarian Hydrological Society - National Wandering Meeting" 6-8 July 2016, Debrecen, [online] <URL: https://www.researchgate.net/publication/312121204_A_Balaton_es_teljes_vizgyujto-teruletenek_atfogo_hidrologiai_vizsgalata_kulonos_tekintettel_a_lefolyasi_viszonyok_drasztikus_valtozasara_es_a_hozza_folyas_csokkenesere

INTRODUCTION

Lake Balaton is a natural asset of Hungary. It is a multiple-use water body: drinking and irrigation and industrial water resource, food resource, a navigation medium, and last but not least, supporter of tourism industry in the region. Lake Balaton region („official" name: Lake Balaton Resort Area, LBRA) is a legal entity consisting of 180 municipalities and the lake surface itself. With more than 6 million commercial guest nights recorded annually, LBRA is the second most important tourist destination after Budapest, both in terms of guest nights and tourism-related income. However, when non-commercial guest nights spent in the more than 70 thousand holiday-houses are counted, LBRA well exceeds the figures of Budapest. For at least two months in summer, Lake Balaton is „the second largest city" in Hungary with an estimated population exceeding 500 thousand.

Tourism related income of LBRA may be estimated at 283,000 million HUF/year (a share of 25% of the national figure) (estimated based on *HCSO*, 2016a and *HCSO*, 2016b). It may be interesting to know what the potential value of the whole Lake Balaton would be as a drinking water resource. The regional price of drinking water is around 500 Ft/m^3. Lake Balaton volume at 100 cm water level is 2,130 million m^3. Therefore, the potential value is 1,065,000 million HUF. It is almost 4 times larger than the tourism income per year. Such calculations can be performed in case of other hypothetical uses, such as irrigation water, fisheries water, and even the case of draining the lake and using as an agricultural area can be (and was!) imagined. All these other uses would provide only a small fraction of the tourism related income.

The good environmental status of Lake Balaton is a necessary condition for the tourism industry to thrive and provide livelihood for the permanent population as well as significant revenues for the local governments.

Lake Balaton is an extremely shallow lake with 3.5 m average depth. Such lakes are very sensitive to environmental changes both in terms of water quantity and quality. Sensitivity of water level to water quantity is caused by natural variability of water budget elements together with changes caused by human interventions to them. Water budget related processes of the last one and a half decades provided several premonitory signs. Mostly due to the more and more extreme meteorological events the extreme water budget condition increase occurs.

In order to track the changes in the water level of Lake Balaton (or any lake) it is essential to have reliable and comprehensive knowledge about the factors affecting water budget.

The water balance of a lake for a certain period of time reads as follows:

$$\Delta B = (PR+IF) - (EV+OF+WU) \quad (1)$$

where

- PR direct precipitation to the lake surface,
- IF inflow from the watershed,
- EV evaporation from the lake surface,
- OF outflow (in case of Lake Balaton controlled outflow through the Sió canal sluice),
- WU water use from the lake,

ΔB change in water budget,
ΔB_N natural change of water budget $\Delta B_N = (PR+IF) – EV.$

In case of Lake Balaton, reliable and verified monitoring data on water budget elements have been available since 1921, resulting in a 94 year long time series (1921-2014).

In *Table 1*, mean, minimum and maximum values of water budget elements are summarized for the entire period.

Table 1

Characteristic values of water budget elements of Lake Balaton

Water budget element	Minimum	Mean	Maximum
	Lake mm/year*		
Direct precipitation (PR)	309	618	929
Inflow (IF)	293	858	1974
Evaporation from the lake (EV)	723	898	1073
Change in natural water budget (ΔB_T)	-281	578	2031
Outflow (OF)	0	558	1791
Water use (WU)**	15	28	51

** 1 Lake mm ~ 600,000 m³ water volume; ** values refer to the 1971-2014period*
It can be concluded that evaporation (EV) shows the least variability while inflow (IF) shows the greatest one.

Long term averages show that Lake Balaton has outflow, i.e. it is an exorheic lake. The annual outflow is approximately equal to the volume of direct precipitation. Outflow from the lake has been controlled since 1863. Discharge and period of outflow are determined by actual demands and the water level control regulations in force.

Changes in the natural water budget mean the algebraic sum of natural water budget elements, i.e. precipitation + inflow – evaporation. This calculated amount (ΔB_N) indicates the impact of natural pressure on the water budget.

Figure 1 shows the time series of the annual values of ΔB_N. It should be stressed that it was positive in every year for the period between 1921 and 1999. However, there were 7 years between 2000 and 2014 when the value of ΔB_N became negative.

In order to explain the changes in the value of ΔB_N in time 30-year averages of precipitation, inflow and evaporation were analysed (in accordance with the recommendations by the World Meteorological Organization, *WMO*, 1983). Results are shown in *Figure 2*.

As it is shown in *Figure 2* the inflow is the budget element that shows strong declines starting from the 1970s. Therefore, it can be concluded that the inflow is the dominant factor controlling the changes in the natural water budget. Based on this finding, inflow to Lake Balaton has been analysed to reveal the causes of the decline in inflow.

Figure 1

Time series of the natural water budget values of Lake Balaton

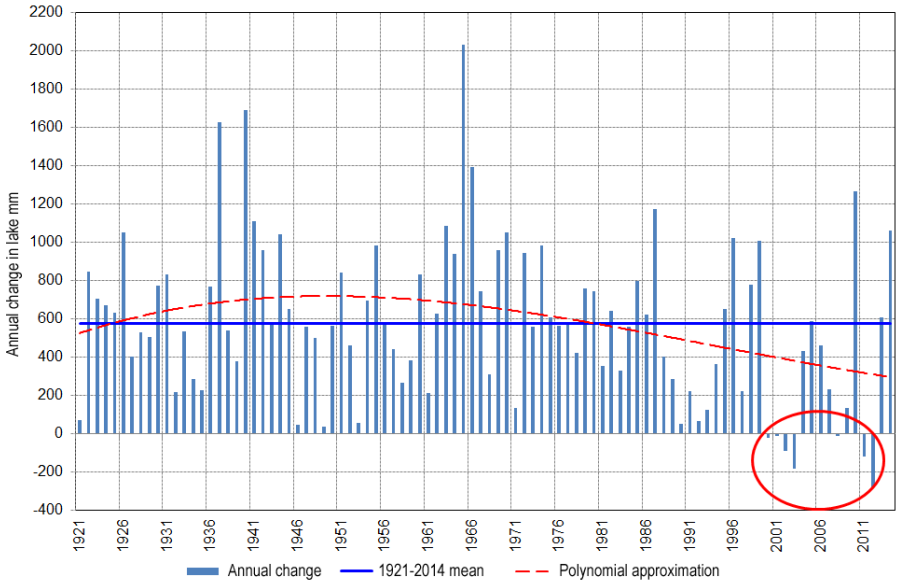
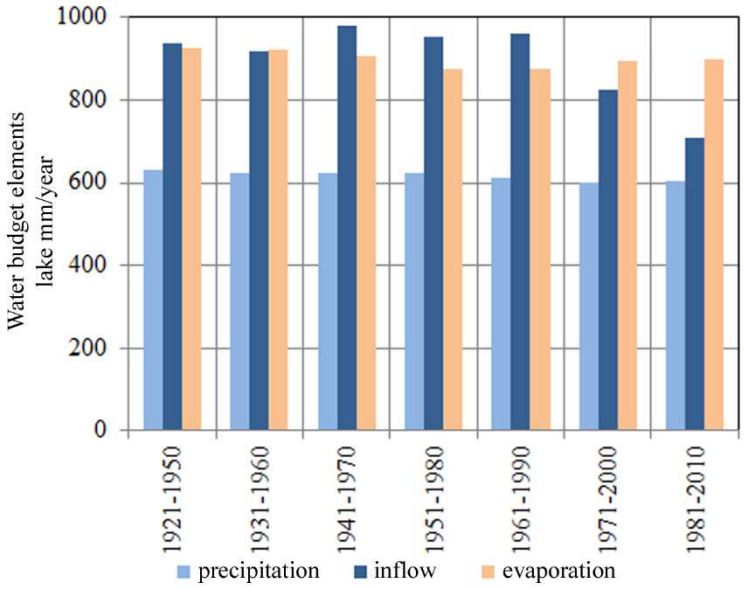


Figure 2

30-year averages of natural elements of the water budget of Lake Balaton



ANALYSIS OF DISCHARGES OF THE TRIBUTARIES OF LAKE BALATON AND BALATON MINOR

Regular hydrological monitoring of the tributaries of Lake Balaton and Balaton Minor („Kis-Balaton" in Hungarian) started in the 1950s. The longest time series of daily mean discharges are available for the Zalapáti section of River Zala. In the second half of the 20th century, more and more tributaries were included in the level/discharge monitoring system. Data used for analysis are shown in *Table 2*.

Table 2

Available discharge data used for the analysis

No.	Tributary/station	Period	Missing data	No. of years
1	Lesence reed field western outflow, Balatonederics	2003-2014		12
2	Lesence reed field eastern outflow, Balatonederics	2003-2014		12
3	Tapolcacreek, Hegymagas	1986-2014		29
4	Eger creek, Nemesgulács	1986-2014		29
5	Burnót creek, Ábrahámhegy	1970-2014		45
6	Örvényesi creek, Örvényes	1970-2014		45
7	Kéki creek, Balatonfüred	1983-2014	1986	31
8	Western belt canal, Balatonkeresztúr*	1992-2014	2011-2012	21
9	Határkülvíz canal, Csömend	1985-2014	1998	29
10	Kőröshegyi creek, Kőröshegy	1979-2014	1983, 1985-86, 1989-91, 2003, 2005, 2007	27
11	Tetves creek, Visz	1964-2014	2000, 2004, 2009	48
12	Keleti Bozót canal, Pamuk	1988-2014		27
13	Büdösgáti creek, Szólád	1967-2014	1980, 1994, 2010	45
14	Boronkai creek, Boronka	1986-2014	1989, 1991-92, 2003, 2010	29
15	Zala river, Zalalövő	1980-2014		35
16	Zala river, Zalaegerszeg	1970-2014		45
17	Zala river, Zalabér	1962-2014	1975	52
18	Zala river, Zalaapáti	1952-2014		63
19	Zala river, Balatonhídvég	1985-2014		30
20	Zala river, Fenékpuszta	1976-2014		39
21	Egyesített-övcsatorna, Fenékpuszta	2005-2014	2014	9
22	Esztergályi creek, Esztergályhorváti	1999-2014		16
23	Orosztonyi creek, Garabonc	2003-2014		12
24	Kiskomáromi creek, Zalakomár	1970-2014	1977	44
25	Zala-Somogyi border ditch, Szőkedencs	1996-2014		19
26	Marótvölgyi canal, Főnyed	1996-2014	2003-2004	17

** For Nyugati övcsatorna, only monthly average discharges are available therefore, only mean discharges could be determined.*

Analysis of the discharge time series

For all tributaries and years shown in table 2 daily average, minimum and maximum discharges were determined for a given year and respective hydrological half years (summer half year (November 1 to April 30) and winter half year (May 1 to October 31). In this way, 228 time series were produced. For all-time series, the linear correlation equation and the respective coefficient of correlation were determined. Pearson's test was performed for the correlation coefficients at three levels of statistical significance (90, 95 and 99%, or p values of .1, 0.05 and 0.01). In addition, signs of the slopes of the correlation equations (or trends of changes) were also analysed. Examples of the results are shown in *Table 3* for River Zala and tributaries of Balaton Minor.

Table 3

Statistical indicators of the discharge monitoring stations of Zala river watershed based on annual medium discharges

Water course/station	N	R^2	R	Changes	Significance level (%)		
				+/-	90	95	99
Zala river, Zalalövő	35	0.1093	0.3306	-	+	-	-
Zala river, Zalaegerszeg	45	0.0191	0.1382	-	-	-	-
Zala river, Zalabér	52	0.2086	0.4567	-	+	+	+
Zala river, Zalaapáti	63	0.1251	0.3537	-	+	+	+
Zala river, Balatonhídvég	30	0.0835	0.2890	-	-	-	-
Zala river, Fenékpuszta	39	0.0194	0.1393	-	-	-	-
Egyesített-övcsatorna, Fenékpuszta	9	0.0078	0.0883	-	-	-	-
Esztergályi creek, Esztergályhorváti	16	0.0211	0.1453	-	-	-	-
Orosztonyi creek, Garabonc	12	0.0300	0.1732	-	-	-	-
Kiskomáromi creek, Zalakomár	44	0.1293	0.3596	-	+	+	-
Zala-Somogyi border ditch, Szőkedencs	19	0.0472	0.2173	-	-	-	-
Marótvölgyi canal, Főnyed	17	0.0659	0.2567	-	-	-	-

Statistics were prepared for all discharge indicators of the watershed. Summarizing the results it can be stated that negative (decreasing) trends in the discharges were found in 166 cases out of 228, i.e. in 73.1% of the cases. Positive trends were found only in 61 cases and no change in 1 case.

When statistically significant trends are considered (at least 90% significance level), negative trends dominate even more: 71 (or 84.5%) out of 84 significant trends and as few as 13 trends were positive.

Results of statistical analyses are summarized in *Table 4* and *Table 5*.

Table 4

Number of statistically significant decreasing discharges

Water course/station	LKQ*			KÖQ**			LNQ***		
	winter half year	summer half year	full year	winter half year	summer half year	full year	winter half year	summer half year	full year
Lesence reed field western outflow, Balatonederics	1	1	1						
Lesence reed field eastern outflow, Balatonederics									
Tapolcacreek, Hegymagas				1	1	**1**	1		
Eger creek, Nemesgulács									
Burnót creek, Ábrahámhegy	1	1	1	1	1	**1**	1	1	1
Örvényesi creek, Örvényes	1		1	1			1		
Kéki creek, Balatonfüred									
Western belt canal, Balatonkeresztúr									
Határkülvíz canal, Csömend		1							
Kőröshegyi creek, Kőröshegy		1		1	1	**1**			
Tetves creek, Visz		1	1						
Keleti Bozót canal, Pamuk	1								
Büdösgáti creek, Szólád		1			1	**1**			
Boronkai creek, Boronka	1								1
Zala river, Zalalövő	1	1	1	1		**1**			
Zala river, Zalaegerszeg		1	1						
Zala river, Zalabér	1			1	1	**1**	1	1	1
Zala river, Zalaapáti				1	1	**1**	1	1	1
Zala river, Balatonhídvég	1			1					
Zala river, Fenékpuszta	1	1	1						
Egyesített-övcsatorna, Fenékpuszta			1						
Esztergályi creek, Esztergályhorváti	1								1
Orosztonyi creek, Garabonc									
Kiskomáromi creek, Zalakomár	1	1	1	1	1	**1**			
Zala-Somogyi border ditch, Szőkedencs	1								
Marótvölgyi canal, Főnyed	1	1	1						
Total	*13*	*11*	*10*	*9*	*7*	***8***	*5*	*3*	*5*

* LKQ: smallest discharge, ** KÖQ: mean discharge, *** LNQ: largest discharge

Table 5

Number of statistically significant increasing discharges

Water course/station	LKQ*			KÖQ**			LNQ***		
	winter half year	summer half year	full year	winter half year	summer half year	full year	winter half year	summer half year	full year
Lesence reed field western outflow, Balatonederics									
Lesence reed field eastern outflow, Balatonederics									
Tapolcacreek, Hegymagas			1						
Eger creek, Nemesgulács	1	1	1		1	**1**			
Burnót creek, Ábrahámhegy									
Örvényesi creek, Örvényes									
Kéki creek, Balatonfüred									
Western belt canal, Balatonkeresztúr									
Határkülvíz canal, Csömend									
Kőröshegyi creek, Kőröshegy									
Tetves creek, Visz									
Keleti Bozót canal, Pamuk					1		1	1	1
Büdösgáti creek, Szólád									
Boronkai creek, Boronka									
Zala river, Zalalövő									
Zala river, Zalaegerszeg									
Zala river, Zalabér									
Zala river, Zalaapáti		1	1						
Zala river, Balatonhídvég									
Zala river, Fenékpuszta									
Egyesített-övcsatorna, Fenékpuszta									
Esztergályi creek, Esztergályhorváti									
Orosztonyi creek, Garabonc	1								
Kiskomáromi creek, Zalakomár									
Zala-Somogyi border ditch, Szőkedencs									
Marótvölgyi canal, Főnyed									
Total	*2*	*2*	*3*	*0*	*2*	***1***	*1*	*1*	*1*

* LKQ: smallest discharge, ** KÖQ: mean discharge, *** LNQ: largest discharge

Based on the discharge monitoring data of several decades, it was found that negative trends dominate in the changes of discharges of watercourses in Lake Balaton watershed.

There are two discharge monitoring points on Lake Balaton watershed that have suitably long time series of daily mean discharge values: one on river Zala at the village of Zalaapáti (63 years long) and another on Kiskomáromi canal at the village of Zalakomár (45 years). When these time series were divided into two (approximately) equal periods, and means as well as trends of change were determined, the results shown in *Table 6* were obtained. The linear correlation equations are statistically significant. Discharges for the ends of the periods were also estimated by these equations. For both watercourses, the discharges show significant decrease. The difference for the two periods in case of River Zala is 1.06 m^3/s corresponding to a decrease of 56 lake mm/year.

Table 6

Long term changes in the discharges of River Zala and Kiskomáromi Canal

Zala, Zalaapáti		Kiskomáromi-csatorna, Zalakomár	
Period	**KÖQ* mean, m^3/s**	**Period**	**KÖQ* mean, m^3/s**
From measured data		From measured data	
1952-1983	5.56	1970-1992	0.369
1984-2014	4.48	1993-2014	0.325
Change, %	-19.4	Change, %	-11.9
From trendline equation		From trendline equation	
1952	6.01	1970	0.466
2014	3.95	2014	0.325
Change, %	-34.2	Change, %	-30.2

* KÖQ: mean discharge

ANALYSIS OF THE EFFECT OF BALATON MINOR ON THE CHANGES IN THE WATER BUDGET OF LAKE BALATON

Analysis of time series based on hydrological analogy

The Balaton Minor Water Protection System (BMWPS) is a kind of restoration of former wetlands that extended to several tens of square kilometres near the mouth section of River Zala (*Figure 3*). The primary purpose of the restoration was the eutrophication control of Lake Balaton. Stage I. of BMWPS (The 19.6 km^2 surface area Lake Hídvég) was inundated in July 1985. Part of Stage II (Ingó swamp with 16 km^2 area) was inundated in October 1992. Finally, Stage II was finished at the end of 2014 with the construction and inundation of the Lake Fenéki with a surface area of 35.5 km^2. Total surface area of BMWPS is 71.1 km^2, i.e. some 12% of the surface area of Lake Balaton.

BMWPS is situated in the downstream section of River Zala, between the village of Zalapáti and the river mouth. The sub-watershed area of BMWPS is 1094 km^2, belonging entirely to the Lake Balaton watershed.

(Re)construction of BMWPS significantly modified the hydrological processes of the affected area. The open water surfaces created evaporate more water than that (evapotranspiration) of the mostly dry land that had existed there before the inundations.

According to annual water balances calculated for BMWPS evaporation is about 900 mm/year (source: WTDWMA) while, according to literature data (*Nováky*, 1984), evapotranspiration was only 550 to 600 mm/year. This means that the evaporation excess is 300 to 350 mm/year.

In addition to evaporation excess, seepage from the lakes (that are actually reservoirs) to the ground water on the eastern, peaty side of BMWPS may also be important. The seepage may affect (practically increase) the evapotranspiration of the area around BMWPS.

More detailed analysis of the modification effects of BMWPS on the hydrological processes and water budget of Lake Balaton were carried out by two methods described below.

Annual specific runoff of the sub-watershed of River Zala between the Zalapáti water gauge and the river mouth was determined using hydrological analogy based on the discharge data of Kiskomáromi canal (one of the largest tributaries) measured at the Zalakomár water gauge. Processed data of the Hungarian Hydrological Database (MAHAB) were used. Annual runoffs for the sub-watershed (assuming that BMWPS does not exist) were estimated as the products of annual specific runoffs and the area of the sub-watershed.

Results showed that in 23 out of 29 years the difference of measured and estimated discharges for the mouth section of River Zala were negative. The multiannual average is -34 lake mm/year, indicating that BMWPS has a negative impact on the water balance of Lake Balaton. It should be mentioned that there is a great year-to-year variability in the value. The largest deficit is -108 lake mm/year, occurring in 2004.

The negative effect of BMWPS on the water balance of Lake Balaton is most obvious when dry periods with below-average annual precipitation are considered.

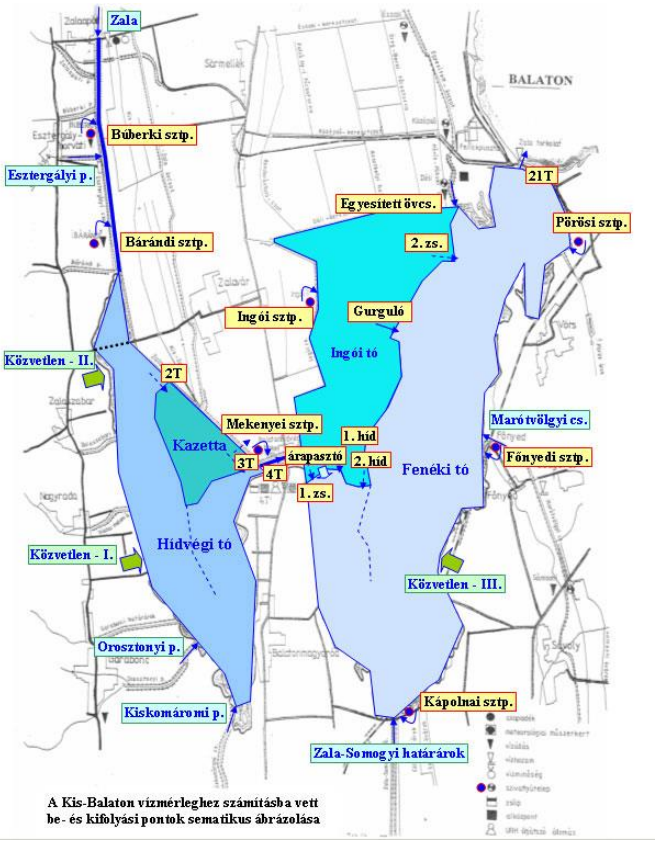
E.g. in the period from 2000 to 2003, the four-year average of annual precipitation was 521 mm/year as compared to the average (660 mm/year) of the whole period examined (29 years from 1986 to 2014). Although in year 2004 there was 6% more precipitation than the average, the water abstraction effect was twice of the average (-67 lake mm/year) for the 4 years.

Analysis of runoff based on multiannual averages and area delineation

After the inundation of Phase I (19.6 km^2) of the BMWPS in 1985, its water surface changed in three steps. The total water surface increased to 35.6 km^2 in 1992 and to 71.1 km^2 in 2014. Water balances have been done for Balaton Minor (BM) every year since 1986, though with changing methodology that resulted in inconsistent results and made year-to-year comparison difficult. Therefore, these annual water balances are not used in this study. Instead, we used a new approach of area delineation to deal with the whole BM area.

Figure 3

A schematic map of Balaton Minor Water Protection System with the objects used for the calculation of water balance



Source: http://www.nyuduvizig.hu/upload/kb_be-kifolyasok-e.jpg

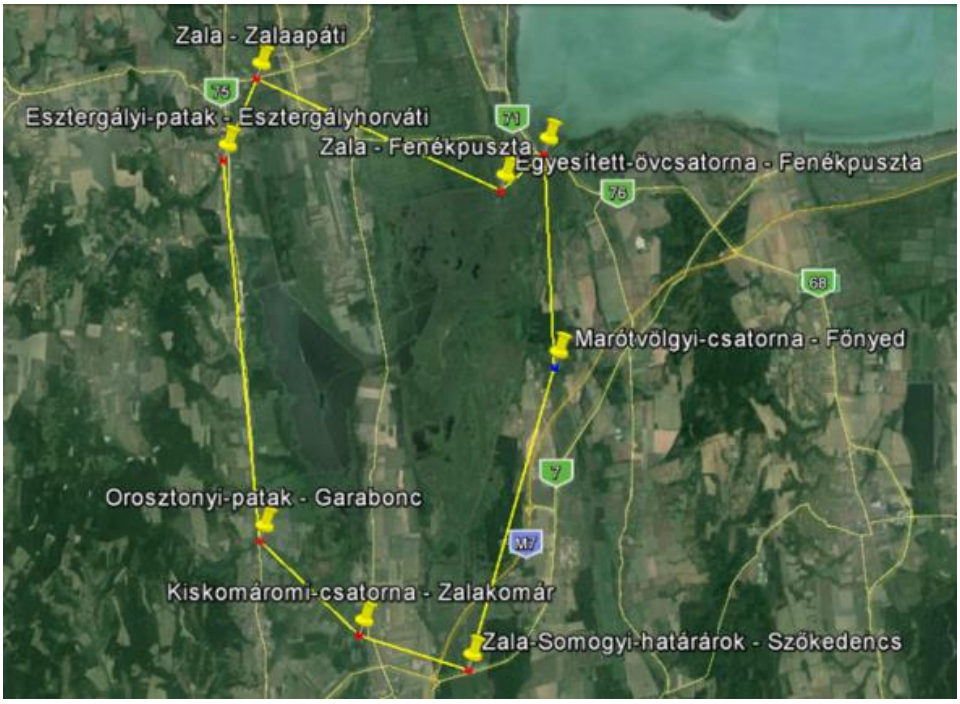
There are 8 discharge monitoring points around the whole area of BM (*Figure 4*). The polygon determined by these 8 points encloses an area being considerably larger than the area of the BMWPS. Therefore, natural internal flows between Phase I and Phase II as well as discharges of pumping stations inside the polygon did not have to be dealt with. Steps of the method are as follows:

1. The polygon enclosing the area was determined based on the geo-coordinates of the discharge monitoring stations.
2. Direct watersheds as well as watersheds of small watercourses located outside the polygon were determined (altogether 8 "outlying" areas).
3. The average specific runoff was calculated for 7 sub-watersheds based on the inflow discharge data of the monitoring stations for the 1986-2014 period.
4. For the "outlying areas, the average specific runoff was calculated as the weighted average of the two neighbouring sub-watersheds.

5. The average specific runoff for the polygon was determined as the weighted average of the known data of the 7 sub-watersheds.
6. The predicted discharge of river Zala at the mouth of river Zala (outflow of the polygon, and inflow to Lake Balaton) was calculated using the specific runoff data of the 7 known sub-watersheds and the 8 "outlying" areas, and the predicted figure was compared to the monitoring data of the station at the river Zala mouth.

Figure 4

The polygon enclosing Balaton Minor
(tips are the discharge monitoring points)



This estimate of the discharge of River Zala is considered as a "conservative" one since the specific runoff data of River Zala (calculated from the data of the Zalaapáti monitoring station) were also included in the estimation of the runoff of the polygon. Since the runoff figure of Zalaapáti is smaller than that of the smaller tributaries of BM, the calculated "theoretical" discharge at River Zala mouth is smaller than it would be by the omission of the Zalaapáti data.

In order to study the sensitivity of the estimated discharge to the method used, two estimations were carried out with slightly modified methods. As one modification, the runoff of the polygon was estimated as the weighted average of 4 medium watercourses (Kiskomáromi Canal, Zala-Somogyi Border Ditch,

Marótvölgyi Canal és Egyesített Belt Canal). This is considered to be the "maximum" scenario in terms of the discharge estimate at Zala mouth. The other modification was based on the specific runoff of Kiskomáromi Canal, a medium sized watercourse. The runoff of this watercourse is smaller than the other medium sized watercourses, so this estimate was considered as "minimum" (*Table 7*).

Table 7

Estimation of the effect of Balaton Minor on the discharge of River Zala and on the water balance of Balaton Minor and Lake Balaton

Quantity	Conservative	Maximum	Minimum
Calculated discharge, m^3/s	8.00	8.10	7.81
Measured at Zala mouth, m^3/s	7.04	7.04	7.04
Deficit, m^3/s	-0.96	-1.06	-0.77
Deficit as BM water level (71.1 km^2) lake mm/year	-428	-469	-342
Deficit as Lake Balaton water level (600 km^2) lake mm/year	**-50.7**	**-55.6**	**-40.6**

Based on the estimations by these methods, it can be concluded for the 29 year period studied that the annual average deficit caused in the water balance of Lake Balaton by Balaton Minor is some 40 to 60 mm /year in terms of Lake Balaton water level.

The two different methods (annual analysis based on hydrological similarity as well as multiannual analysis based on territorial delineation and hydrological similarity) resulted in estimates of 34 to 51 mm/year as deficits in terms of Lake Balaton water level.

EFFECT OF RESERVOIRS AND FISH PONDS ON THE LAKE BALATON WATERSHED ON THE WATER BUDGET OF LAKE BALATON

Reservoirs and fish ponds in the watershed

Based on data of year 2015, the number of reservoirs and fish ponds exceeding the 1,000 m^2 area is 405 with a total water surface area of 37.2 km^2. The distributions of these water bodies by size and number are shown in *Figure 5*.

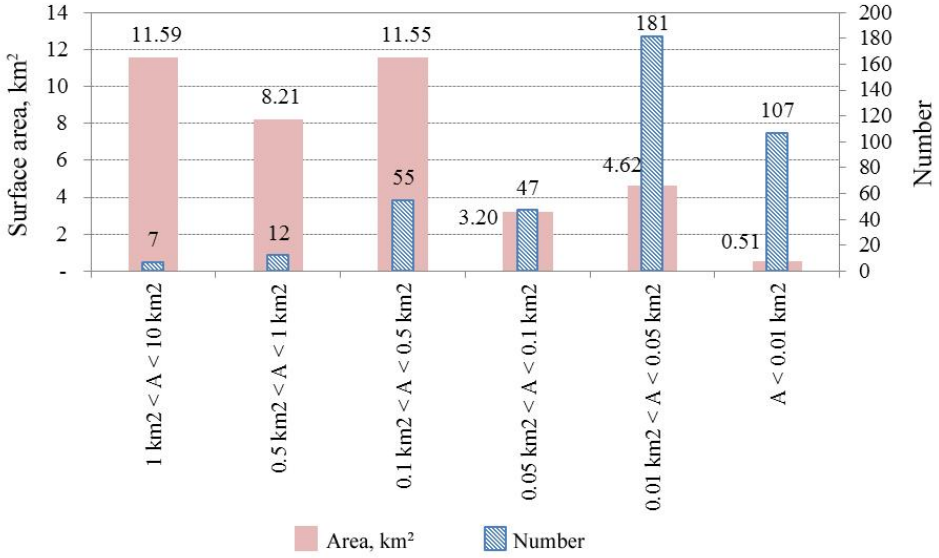
These free water surfaces constructed on the water courses of the watershed are extremely shallow and they increase evaporation (water temperatures exceeding 30 °C are not rare in summer) as compared to the evaporation of small rivers and creeks. The excessive evaporation appears as deficit in the water budget of Lake Balaton.

The excess in evaporation of these water bodies was estimated as the difference in the evaporation of free water surfaces and that of grass covered (meadow, pasture) areas. The long term multiannual (from 1951 to 2014) average was 8

mm/year in terms of Lake Balaton water level. When the period of the existence of BMWPS is considered (from 1986 to 2014), the deficit caused by these water bodies is 10 mm/year. The year-to-year figures show great variability (e.g. 1 mm in 1996 and 21 mm in 2000).

Figure 5

Distribution of number and surface area of reservoirs and fish ponds in the Lake Balaton watershed (without Balaton Minor)



The average water deficit caused by the BMWPS and all the other stagnant surface water bodies is estimated as some 44 to 61 mm/year.

During the extended drought period from 2000 to 2004 the stagnant surface waters alone (including the BMWPS) caused as much as 406 mm deficit in the water budget of Lake Balaton. This figure compares to the 3500 mm average depth of Lake Balaton.

Climate change scenarios referring to Lake Balaton predict increasing temperatures and evaporation (both from the lake and the watershed). In multi-decade lookout, it is probable that the frequency and length of periods with water deficit increase. These findings suggest that the creation of new stagnant water surfaces in the watershed is definitely not recommended.

ANALYSIS OF WATER USE FROM LAKE BALATON

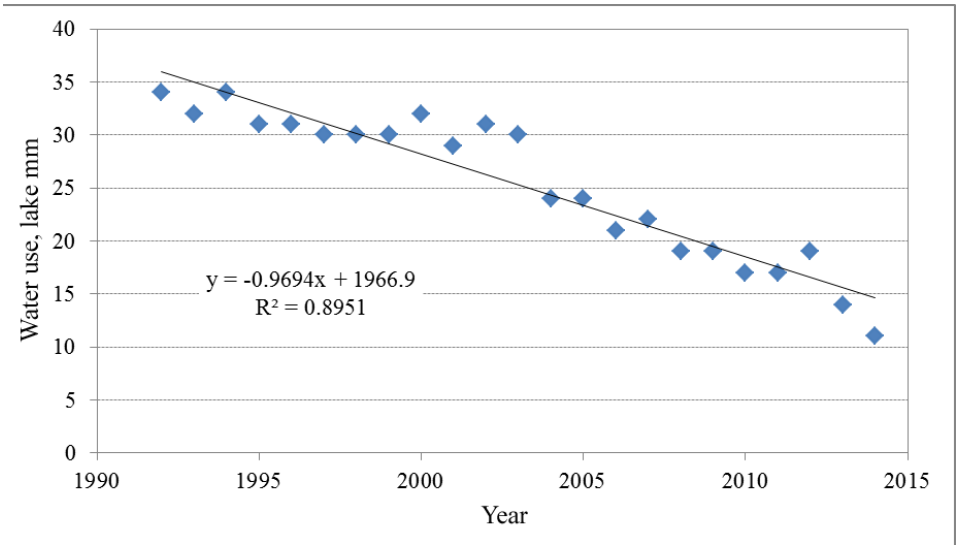
Water withdrawal now and its expected future change

Water use is the difference of withdrawn (drinking, irrigation, industrial, cooling water) and returned (treated effluents, used cooling water, etc.) water volume.

Reliable data for water use from Lake Balaton have been available since 1971. The greatest figure was 51 mm/y in 1989 while the smallest one was 11 mm/y in 2014. Trend of water use in the last 23 years is shown in *Figure 6*.

Figure 6

Trend of water use from Lake Balaton



An important reason for the decreasing trend is that while the consumer price index increased "only" 7.3 times during the period (*HCSO*, 2016c), the drinking water and sewer prices increased 16 times. The high water service price is a strong incentive to water saving. At the same time, environmental awareness may also play some part in the reduction of water use. While water use in the Lake Balaton watershed was 180 litre/person/day in 1997-1999 (in JICA project), it decreased to less than 100 litre/person/day by 2014.

The installed water withdrawal capacity of the Transdanubian Regional Water Works (DRV) corresponds to 41 lake mm/year, but it uses only a fraction of it, i.e. 9 to 11 lake mm. The company plans to switch its water base from Lake Balaton to karstic water wells.

The Water Framework Directive of the European Union states that the principle of the recovery of water service costs should be taken into consideration. Therefore, it is not expected that water prices would decrease in the future, and as a consequence, water use would not increase either. The dissemination of environmental and climate awareness as well as the corresponding programs of municipal governments also have an effect to reduce water use.

Act CXII. of 2000 on the Regional Development Plan of Lake Balaton Resort Area (so called "Lake Balaton Act") prefers environmental and nature protection to

industrial development, so it is not expected that industrial water withdrawal would increase to any significant level.

The lack of funds in agriculture at the beginning of 1990 resulted in radical drops in the use of irrigation water and fertilizers. However, in the last decade, fertilizer use increased moderately (*Kutics*, 2015). It is expected that irrigation water demand would slightly increase in the next decades.

In summary, water withdrawal is not expected to increase, and it probably stays in the 10 to 20 mm range.

Water returned into Lake Balaton in the form of treated sewage effluent is 19,098 m^3/day (2014) corresponding to 11.6 lake mm.

The total water withdrawal hardly exceeds the amount of returned water, so water use from the Lake results in a mere 6 to 7 mm deficit in the water budget of Lake Balaton.

EVALUATION OF THE EFFECT OF THE INTRODUCTION OF WATER WITHDRAWN FROM MINES

The most important subsurface water storage formation of Lake Balaton region is the main karstic water reservoir of the Transdanubian Mountain Range. Of the anthropogenic impacts on the reservoir bauxite mining is the most influential one. Most of the bauxite deposits at the north-western edge of Bakony Mountains were positioned below the original (natural) karst water level constituting a threat to the mining activities. Since 1963, the mining company applied the active water level reduction technique in the mining area around the villages of Nyirád and Nagytárkány. Water withdrawal from the main karstic water reservoir affected the water level in a wide area at the north-western part of the northern sub-watershed of Lake Balaton. Karstic water level dropped significantly (in some areas as much as 150 m) and the subsurface flow direction of karstic water changed (*Lorberer et al.* 1980). Several springs dried up or their discharges were reduced radically. Some smaller water courses dried up seasonally or even for longer periods (Világos creek, Lesence creek, Eger creek) so the mining activities fundamentally modified the surface water runoff as well (*Kravinszkaja*, 1986). The water withdrawal from the mines around Nyirád village exceeded as much as 5 m^3/s (i.e. some 70% of the discharge of River Zala, the largest tributary of Lake Balaton. Most of the withdrawn water was discharged into another watershed (River Marcal), but a still significant part (in the order of 1 m^3/s) was discharged into the Kétöles creek, a small tributary of Lake Balaton.

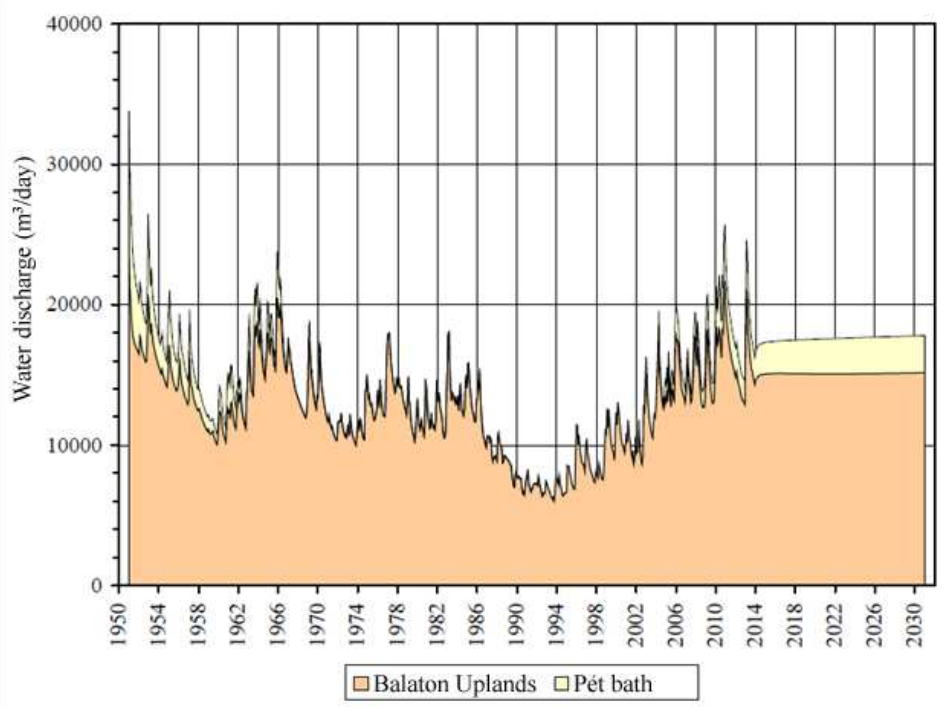
Bauxite mining and water withdrawal from the mines came to an end in 1990, and introduction to the withdrawn water to the tributary of Lake Balaton was radically reduced, though some fractional amount from the wells around the mines were introduced to Kétöles creek up to 2009. The introduction of mining water into Lake Balaton was completely stopped in that year.

After ending water withdrawal from the main karstic water reservoir, a natural regeneration process started and this process has been going on since then in front of our eyes. In some areas the karstic water reached the level that was typical before

the human interventions, but the regeneration process has not been finished yet (*Figure 7*). However, the depletion and recharge processes differ in terms of duration, intensity and amount.

Figure 7

Calculated and predicted karstic discharges of the Transdanubian Mountain Range from 1951 to 2030



Source: *Hidrosys,* 2014

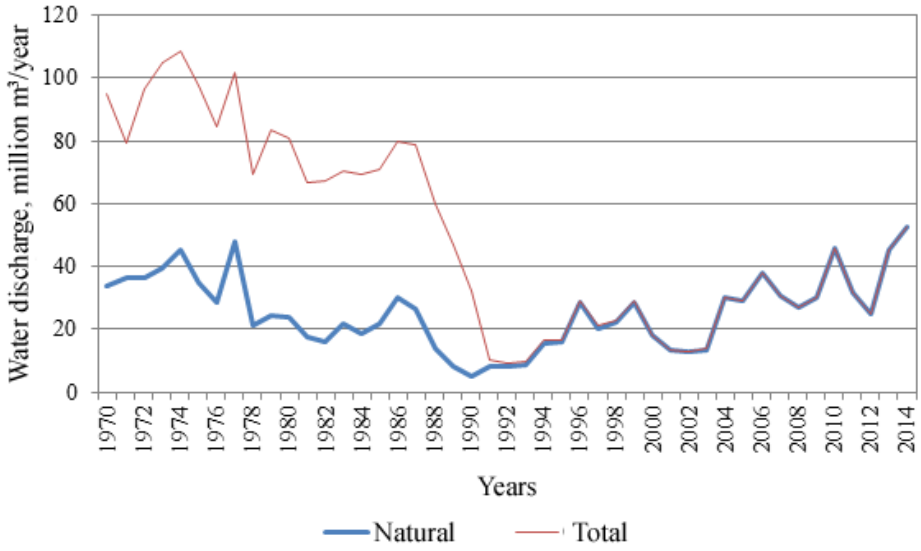
Mining activities influenced mostly the water courses and springs of the Tapolca Basin (NW of Lake Balaton). "Natural" (i.e. free from the effects of mining) runoff time series of the Tapolca Basin were estimated for the 1970 to 1990 time period, as well as for the 1991-2014 time period (actual monitoring data). The results are shown in *Figure 8*.

The two separate natural runoff time series were analysed statistically and average rates of decrease and increase of runoffs were determined. The rate of decrease was found to be -1.44 million m^3/year, while that of the increase was 1.38 m^3/year.

The increasing natural runoff reached the 40 million m^3/year value in 2014, equalling to the figure of 1970. However, in 1970 some 60 million m3/year water withdrawn from the mines added to this figure. This latter amount, corresponding to about 100 lake mm is missing from Lake Balaton's water budget at present.

Figure 8

Total and natural runoff of Tapolca Basin



IMPACTS OF CHANGES ON LAND USE

The most significant changes in land use in the Lake Balaton watershed was the increase of the area of forests in the last 4 decades. The reasons of change are erosion control and abandoned tillage and vineyard following political changes in 1990 and subsequent reprivatisation of land confiscated during the communist period. Since forests retain precipitation and increase evapotranspiration, excessive forestation may have a negative impact on the water balance of the Lake. Effect of land use change was analysed by the DIWA hydrological simulation package (*Szabó*, 2015). Results showed that the impacts of changes in land use on runoff were almost negligible. The deficit caused is some 3 to 4 mm/year in Lake level, close to the uncertainties of the figures of meteorological and hydrological monitoring stations (*Table 8*).

Table 8

Change of land use in the watershed of Lake Balaton (data in per cent)

Category	1977	2006	Change
Tillage	38.0	36.0	-2.0
Forest	23.4	28.3	5.0
Meadow, pasture	15.1	12.3	-2.8
Vineyard, orchard	6.1	3.9	-2.2
Water surface	10.5	11.1	0.5
Other	6.9	8.4	1.5
Total	100.00	100.00	0.00

CLIMATE CHANGE IMPACTS ON THE WATER BUDGET OF LAKE BALATON

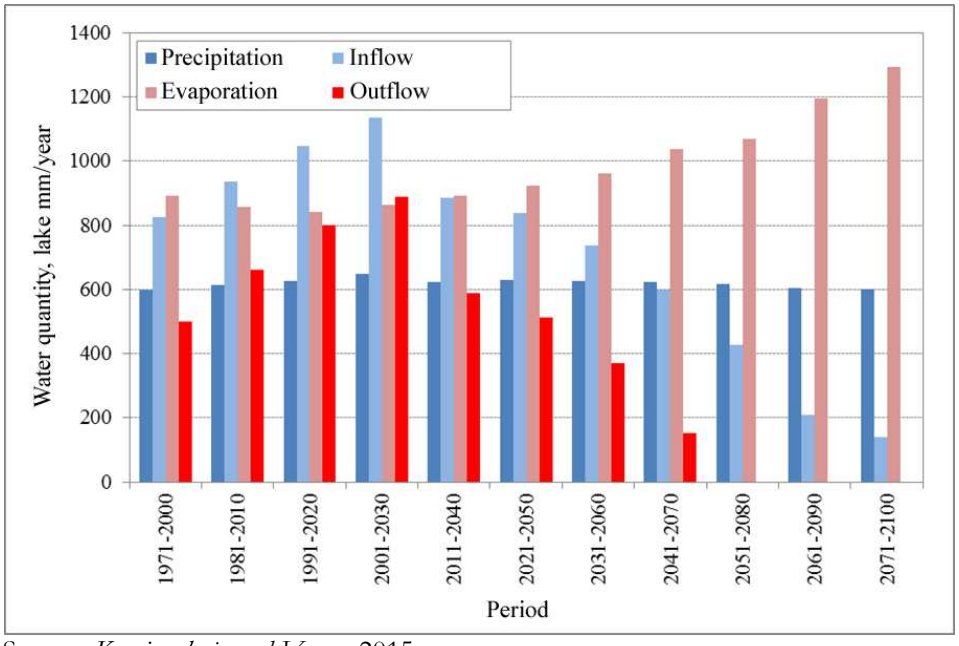
Lake Balaton Development Coordination Agency, the operative arm of Lake Balaton Development Council dealt with the problem of climate change and its impact on Lake Balaton (Lake Balaton Adaptation Project, UNDP-GEF, 2006-2008, EU-Lakes Project "010-2012, Lake Admin Project, 2011-2014).

The objective of the EU-Lakes Project was to study the impacts of climate change on European lakes. A high resolution regional climate change model was developed by one of the project partners (*Züger and Knoflacher*, 2011, 2012) that provided meteorological data for the 21st century for the Lake Balaton watershed. Data of this model were used to predict changes in the water budget of Lake Balaton.

Results of the predictions on the elements of the water budget are shown in *Figure 9*. The graph indicates that inflow is expected to be greatly reduced and Lake Balaton may become an endorheic lake in the second part of the century. It should be stressed that such modelling carries a great deal of uncertainties, but the results suggest that precautionary measures should be planned on the long term.

Figure 9

Changes of water budget elements of Lake Balaton in the 21st century. Results of climate change simulations based on scenario A1b



Source: *Kravinszkaja and Varga*, 2015

Results of climate change impact predictions are not included in the evaluation of human impacts, since the objective of this study was to uncover the human impacts that have already been manifested.

In summary, recognized effects of human influence on the water budget of Lake Balaton are shown in *Table 9*.

Table 9

Effects of human activities on the water budget of Lake Balaton

Human activities	Water resources reduction Lake mm/year
Restoration/Creation of the Balaton Minor Water Protection System	- (34-51)
Formation and operation of fishponds	-10
Changes in land use (forestation)	-(3-4)
Diversion of STP effluents to other watersheds	-(6-7)
Discontinuation of the introduction of water extracted from mines	-100
Significant reduction of the discharges of River Zala and Kiskomáromi Canal	-59
Total	**-(212-231)**

SUMMARY AND RECOMMENDATIONS

Long time series of discharges for whole years as well as summer and winter hydrological half years were produced and trends of changes were analysed for the tributaries of Lake Balaton. Trend of change was found to be decreasing in 73.1%, increasing in 26.5% of the cases. There was no change in 0.4% of the cases. Pearsons tests were performed and it was found that out of the statistically significant ($p < 0.05$) trends, 84.5 % were decreasing ones. In case of River Zala discharge monitoring stations (River Zala carries some 60% of all discharges into Lake Balaton), as much as 93.8 % were decreasing and a mere 6.2% were increasing trends at $p < 0.01$ level. For the two monitoring stations (River Zala at Zalaapáti and Kiskomáromi Canal at Zalakomár) having the longest time series of daily discharge monitoring data, the time series were divided into two, approximately equal length, series and it was found that in the last 31 years the annual mean discharge of River Zala at Zalapáti was 19.4% smaller than in the preceding 32 years. In case of Kiskomáromi Canal, the time series was only 45 years long, and it was found that in the last 23 years the annual mean discharge was 11.9% less than in the preceding 22 years.

The water budget elements of Lake Balaton were analysed for the 1921 to 2014 period (94 years). No statistically significant trend was found in direct precipitation onto the lake surface. However, it should be mentioned that both the greatest and

smallest annual precipitation sums occurred in the last 5 years. In the water budget, decrease of inflow is the most serious negative factor. As far as the output side of water budget concerned, statistically significant trend was not found in evaporation time series. Changes in the water budget of the Lake show warning signals. On one hand, frequency of unusual/extreme meteorological conditions has increased. On the other hand, in 7 of the last 15 years the natural water budget (direct precipitation + inflow – evaporation) was negative, while such figure never occurred in the previous 79 year period from 1921 to 1999.

The effect of the Balaton Minor Water Protection System on the water budget of Lake Balaton was analysed by two methods. It was found that the BMWPS reduced the inflow into the Lake. The long term average figure is -34 to -51 mm/year in terms of Lake Balaton level. Consecutive years with drought conditions may result in several times higher values than the averages.

Artificial stagnant surface water bodies (reservoirs and fish ponds) result in 8 lake mm/year deficit for the whole period that could be analysed while the figure is 10 mm/year for the 1986 to 2014 period.

Water use from the Lake, defined as the difference of withdrawn and returned water volume, is not significant as compared to other elements of the water budget. The figure is 6 to 7 lake mm/year, and it is not expected to increase in the future.

The introduction of water withdrawn from bauxite mines into Lake Balaton had a serious influence of the water budget of Lake Balaton. Both introduction and stoppage were abruptly decided and carried out. Reliable discharge data for the water courses and springs affected by mining are not available for the period before mining (and water withdrawal) activities started, therefore a genuine background value for runoff of the affected area is not known. It can be concluded, however, that the natural runoff of the area was 40 million m^3/year in 1970. It was reduced to about 8 million m^3/year by 1990 (when mining was stopped), and increased again to 40 m^3/year by 2014. However, some 60 million m^3/year (100 lake mm/year) of "mining water" (in fact, drinking water quality karstic water) was introduced into the Lake during the 1970 -1990 period that is missing from the water budget at present.

The found impacts on the water budget of Lake Balaton either directly originate from human activities or the manifestations of the global climate change. The deficit caused by human activities in the water budget of Lake Balaton is roughly 210 to 230 mm/year in terms of Lake Balaton level, or 126 to 138 million m^3/year (for comparison, Hungary's total potable water production is 600 million m^3/year). Based on the results of this study our recommendations are as follows:

1. Discharge monitoring on the whole watershed should be developed both quantitatively (more stations) and qualitatively (telemetric, continuous monitoring) in order to increase reliability of the elements of water budget.
2. Construction of artificial shallow surface water bodies (i.e. reservoirs and fish ponds) should not be allowed in the watershed. Expired licences should be revised, extensions should either be refused or strict water management conditions should be required.

3. Manifested direct human impacts and the expected future impacts of climate change indicate that a complex water resources preservation program should be started in the Lake Balaton watershed. The elements of the program are: development of rain water management/utilization on individual and municipality level; improvement of the technical and safety conditions of water storage in the Lake (i.e. maintaining higher water level to alleviate the impacts of droughts); increase the level and efficiency of the activities of water authorities; elimination of illegal water withdrawals; regulation of land use giving priority to water resources management considerations.

ABBREVIATIONS

BM	Balaton Minor
BMWPS	Balaton Minor Water Protection System
DIWA	Distributed Watershed
DRV	Trans-Danubian Regional Water Works
EULAKES	Project - European Lakes under Environmental Stressors
HCSO	Hungarian Central Statistical Office
IPCC	Intergovernmental Panel on Climate Change
JICA	Japan International Cooperation Agency
KDT VIZIG	Central Trans-Danubian Water management Authority
STP	Sewage Treatment Plant
UNDP-GEF	United Nations Development Programme – Global Environmental Facility
US-EPA	United States Environmental Protection Agency
VITUKI	Research Centre for Water Sciences
WMO	World Meteorological Organization
WTDWMA	West Trans-Danubian Water Management Authority

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