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Profitability and competitiveness of forestry in European countries

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ABSTRACT: Competitiveness of the forest sector is a necessary prerequisite for the multiple benefits that sustainable forestry provides to society. There is no universal indicator of competitiveness. GDP of the forestry and contribution of forestry to the GDP could be suitable indicators for the forest sector. Competitiveness of forestry may be evaluated by gross and net value added and by the entrepreneurial income as well. The aim of this paper was to compare the competitiveness of forestry in selected European countries based on the results of Economic Accounts for Forestry. On the basis of provided analyses it can be stated: there are great differences in profitability and competitiveness among the particular countries and between the indicators per employee and hectare of forest as well. The state of economy as well as the region has a statistically significant influence on profitability.

Keywords: competitiveness of forestry; contribution of forestry to GDP

Competitiveness of the forest sector is a necessary prerequisite for the multiple benefits that sustainable forestry provides to society. The forest sector has a great potential to further develop high-quality and value-added products and services for diverse and growing demands of society based on a renewable raw material source. Research and technological development, diversification, innovation and investment in human capital are needed to develop a strong and dynamic sector capable of meeting the challenges of global change (EU Forest Action Plan 2006). Competitiveness of forestry means the ability to place the products, material and non-material benefits on market in order to satisfy market demand, allow practical use of their high quality and optimal price. It can be achieved by applying scientific and technological development in practice. Due to economy stability it is necessary to maintain balance in fulfilling economic, ecological and social functions of forests (National Forest Programme of the Slovak Republic 2007).

Ideally, measures of competitiveness should satisfy three basic criteria (Durand, Giorno 1987):

– first, they should cover all the sectors exposed to competition, i.e. represent all goods traded that are subjected to competition and only those goods;
– second, they should encompass all the markets open to competition;
– third, they should be constructed from data that are fully comparable internationally.

In practice, none of the indicators is available to fulfil these three criteria. Data and other limitations mean that compromises have to be made at every stage, so that any measure of competitiveness is in fact only a rough approximation of the ideal (Durand, Giorno 1987).

As was mentioned, there is no universal indicator of competitiveness. The value of gross domestic product (GDP) per capita and its growth may be considered as a relevant indicator of competitiveness. GDP of forestry per employee and contribution of forestry to GDP are suitable indicators for the forest sector. Competitiveness of forestry may be evaluated by gross value added and net value added at basic prices per employee. Another indicator is entrepreneurial income as well. These indicators were chosen based on the indicators used in similar studies (e.g. Durand, Giorno 1987; Marsh, Tokarick 1994; Siggel 2007 and others) on the one hand and on the other hand on available data.

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The aim of this paper was to compare the competitiveness of forestry in selected European countries based on results of the Economic Accounts for Forestry and analysis of differences in profitability and competitiveness of individual countries.

MATERIAL AND METHODS

An overall approach to the analysis of competitiveness is based on an across-country comparison. In total, 18 European countries were included in analyses: Slovakia, Austria, Bulgaria, Switzerland, Germany, Finland, France, Hungary, Italy, Lithuania, Netherlands, Norway, Portugal, Romania, Slovenia, United Kingdom, Poland and Czech republic (only for these countries were data and indicators available). The results of Integrated Environmental and Economic Accounts for Forests (IEEAF 2002) from Eurostat database (2010) were used as a data source. The question is whether all countries applied the rules of IEEAF, or not, therefore the data were transformed according to the rules of Economic Accounts for Forestry (EAF). EAF measure and analyse the generation of income and its distribution through the production account, the account of income generation, the entrepreneurial income account and the capital account. Economic accounts for forestry are an integral part of the national economic accounts and their construction is based on rules, principles and concepts of the ESA 95 methodology (European Commission 2000). The average value for 2006–2007 was calculated for each indicator (except Romania and France, where the values for 2005 or 2004 were used). All data and indicators were corrected by country specific inflation (HICP) before calculating the mean value. The database of Eurostat was used as a data source of GDP of particular countries and HICP.

Quantitative analysis of data from the Economic Accounts for Forestry (EAF) was done and the following items of EAF were analysed:

- Item 18000 – output of the forestry "industry" represents total production of forestry;
- Item 20000 – Gross value added (GVA) at basic prices calculated as the Forestry output – Total intermediate consumption;
- Item 22000 – Net value added (NVA) at basic prices calculated as Gross value added – Fixed capital consumption;
- Item 31000 – Entrepreneurial income computed as follows: Net value added – Other taxes on production – Compensation of employees + Other subsidies on production – Rents and other real estate rental charges payable – Interest payable + Interest receivable;
- For the estimation of contribution to Gross Domestic Product (GDP), data on Gross Value Added were used. The relation between GVA and GDP can be defined as: GVA + Other taxes on production – Other subsidies on production = GDP of forestry; the ratio of the value of GDP of forestry to the value of total GDP was calculated to analyse the importance of forestry within national economy;
- There is a problem with data quality for labour input, therefore these indicators were also calculated per hectare of forest available for wood supply (FAWS);
- For each indicator, mean value, standard deviation, variation coefficient, minimum and maximum values are presented in Table 1.

Table 1. Main features of indicators included in the analysis

Variable	Mean	Standard deviation	Variation coefficient (%)	Min	Max
Output of forestry (€·employee^{-1})	75,661	78,868	104	8,254	335,441
GDP of forestry (€·employee^{-1})	42,528	57,139	134	3,505	239,006
Contribution to GDP (%)	0.31	0.34	110	0.01	1.40
Gross value added (€·employee^{-1})	43,196	55,676	129	2,904	233,291
Net value added (€·employee^{-1})	33,925	41,476	122	2,904	169,852
Operating surplus (€·employee^{-1})	18,073	31,142	172	–6,328	105,317
Entrepreneurial income (€·employee^{-1})	17,082	28,831	169	–6,412	91,081
Output of forestry (€·ha^{-1})	264.56	164.03	62	51.68	503.50
GDP of forestry (€·ha^{-1})	128.50	90.52	70	28.34	346.30
Gross value added (€·ha^{-1})	133.51	92.26	69	29.23	348.40
Net value added (€·ha^{-1})	108.31	77.64	72	26.19	292.60
Operating surplus (€·ha^{-1})	46.45	82.63	177	–38.10	254.60
Entrepreneurial income (€·ha^{-1})	44.97	81.30	181	–38.60	248.70

As we can see in Table 1, the data variability of indicators per employee was much higher than per hectare of forest available for wood supply (FAWS), and the assumption of lower quality and consistency of data on labour input was supported.

Testing of the differences in profitability between the groups of countries was carried out by non-parametric statistical tests, because the sample size was smaller than 50 and these tests do not require the normal distribution function. Their disadvantage is the lower power of statistical test and that they are sensitive to extreme values. By excluding one of the variables we can get quite different results of statistic tests. Statistical testing of significance of differences was done by Mann-Whitney *U* test and Kolmogorov-Smirnov test (in the case of two independent interval and binary variables) and by Kruskal-Wallis test and Westenberg-Mood median test (in the case of independent interval and nominal variables). According to the type of variables it is possible to use one-way ANOVA, but for non-normal data it is more suitable to use also non-parametric tests such as Kruskal-Wallis *H* test or its less powerful alternative Westenberg-Mood median test (Rimarčík 2007). Null hypothesis (there are no statistically significant differences among the tested samples) and alternative hypothesis (there are significant differences in profitability and competitiveness of samples) were defined. The significance level was $\alpha = 0.05$. If the *P* value was lower than the chosen significance level, then null hypothesis was rejected and alternative hypothesis was accepted. Statistical tests were done by the programme Statistika CZ, Vers. 9.

RESULTS AND DISCUSSION

The comparison of forestry competitiveness in selected European countries was done by means of the following indicators: output of forestry, gross domestic product of forestry and its contribution to the GDP, gross and net value added and entrepreneurial income.

Output of forestry

Output of forestry includes all goods and services produced during the same accounting period and valuated at current prices. It includes the value of saw logs, value of pulp wood, value of fuel wood, value of other forestry products, value of forestry services and non-forestry secondary activities (IEEAF 2002).

The average output of forestry per employee amounted to 76 thousand €. The highest value of production was reached by Norway (335 thousand € per employee). They are many reasons for this fact: high share of private forest owners who manage the

Table 2. Indicators of competitiveness for the particular countries (1,000 €/employee)

Country	Output of forestry	GDP of forestry	Contribution of forestry to GDP	Gross value added	Net value added	Entrepreneurial income
Slovakia	39.74	24.86	0.63	21.10	18.58	3.86
Austria	74.99	54.27	0.44	54.60	45.86	38.98
Bulgaria	24.90	7.35	0.29	7.38	6.61	2.83
Czech Republic	40.90	13.35	0.35	13.52	11.07	3.32
Finland	162.02	119.48	1.42	119.98	98.95	80.17
France	158.31	76.75	0.16	75.54	57.71	32.76
Germany	98.89	39.86	0.09	39.88	35.09	10.50
Great Britain	67.75	28.83	0.02	28.83	19.47	–6.24
Hungary	38.50	13.60	0.14	14.83	10.69	10.76
Italy	12.81	7.02	0.02	10.31	8.25	–0.73
Lithuania	16.09	11.28	0.68	10.58	10.21	4.73
Netherlands	87.68	25.05	0.01	29.64	25.71	–1.90
Norway	335.44	239.01	0.16	233.29	169.85	91.08
Poland	30.77	10.52	0.15	10.52	10.52	–2.83
Portugal	62.04	51.68	0.39	52.51	46.53	39.74
Romania	8.25	3.51	0.20	2.90	2.90	–3.29
Slovenia	25.46	17.74	0.33	18.30	15.46	10.15
Switzerland	77.35	21.37	0.05	33.81	17.19	–6.41

forests by themselves and therefore they are not in records as employees, high proportion of supply services, which on the one hand increases the total output of forestry (transactions among economic entities are recorded) and on the other hand it allows the forest enterprises to manage large forest areas and thus achieve high revenues per employee. Lithuania, Italy and Romania reached the lowest value, which was probably influenced by the nature of forests (Italy), or by overemployment (Lithuania, Romania). Slovakia and the Czech Republic reached similar values of around 40 thousand € per employee, which was the below-average value of the sample (Table 2).

Lower data variability was obtained at their calculation per hectare of forests available for wood supply (FAWS). The average value was around 265 €·ha^{-1} of forest and the highest values were in the Czech Republic, Austria, Switzerland and the lowest ones in Romania, Norway and Italy. Slovakia with 277 €·ha^{-1} was slightly above average (Table 3).

Gross domestic product of forestry and its contribution to GDP

Gross domestic product (GDP) is the value of all traded goods and services which have been produced in a country per year. GDP includes all income earned in the territory of the country, whereby it is irrelevant who owns the means of production. Gross domestic product as an indicator of the economic level was developed during the Depression in the thirties of the 20th century. GDP of forestry per employee or contribution of forestry to GDP is an appropriate indicator for the forestry sector. To calculate this indicator, a simplified approach was used, where the gross value added was adjusted about other taxes on production (+) and other subsidies on production (–). This approach has been used e.g. by Global Forest Resources Assessment (2005).

The average value of GDP per employee in the forestry sector was 42.5 thousand €. The highest value was reached by Norway (239 thousand € per employee). On the other hand, the lowest values were in Bulgaria, Italy and Romania (Table 2). The average value calculated per hectare is about € 91 and the highest values were reached by Austria and Portugal (Table 3).

Regarding the indicator Contribution of forestry to country's GDP, it depends mainly on overall economic development and forest coverage of the country. The average share of forestry in the GDP is 0.31%. Finland had the highest share (1.4%), the lowest one was in Italy and Netherlands, where the forest coverage is relatively low and countries are economically developed. The contribution of

Table 3. Indicators of competitiveness for the particular countries (€/ha FAWS)

Country	Output of forestry	GDP of forestry	Contribution of forestry to GDP	Gross value added	Net value added	Entrepreneurial income
Slovakia	276.86	173.19	0.63	147.00	129.46	26.90
Austria	478.47	346.26	0.44	348.36	292.61	248.73
Bulgaria	98.70	29.13	0.29	29.23	26.19	11.20
Czech Republic	503.55	164.29	0.35	166.48	136.34	40.87
Finland	164.42	121.25	1.42	121.76	100.41	81.35
France	375.83	182.21	0.16	179.33	137.01	77.78
Germany	443.83	178.92	0.09	179.00	157.50	47.11
Great Britain	328.07	139.58	0.02	139.58	94.26	–30.21
Hungary	200.04	70.65	0.14	77.06	55.55	55.89
Italy	51.68	28.34	0.02	41.58	33.30	–2.94
Lithuania	122.74	86.09	0.68	80.72	77.89	36.09
Netherlands	460.70	131.63	0.01	155.75	135.07	–9.96
Norway	64.32	45.83	0.16	44.73	32.57	17.47
Poland	135.46	46.30	0.15	46.30	46.30	–12.46
Portugal	376.76	313.82	0.39	318.9	282.53	241.34
Romania	83.82	35.60	0.20	29.49	29.49	–33.44
Slovenia	131.16	91.38	0.33	94.29	79.66	52.26
Switzerland	465.61	128.62	0.05	203.54	103.48	–38.60

forestry to the GDP of Slovakia according to this methodology was 0.63% (Table 2). In this analysis those entities belong to the forestry sector that have the main economic activity according to the industrial classification of economic activities [classification of industries (NACE classification)] that was in force by 31.12.2007 as follows: code 02 "Forestry, logging and related activities" and code 20 "Manufacture of wood products without manufacture of pulp, paper and furniture"), 02 "Forestry and logging". In some countries (e.g. Finland, Norway) the "Manufacture of wood and wood products, except furniture (code 16)" was understood as the forestry sector as well and therefore the reported share of forestry in the GDP may be higher.

Gross value added

Added value is a key indicator to express the performance of a sector throughout the national economy. Gross value added can be calculated as the value of production minus the value of intermediate consumption.

The highest gross value added was reached by Norway and Finland, the lowest by Bulgaria and Romania (Table 2). Average value was 43 thousand €. In comparison per hectare, Austria and Portugal were the best countries (Table 3). Average value was 133.5 €·ha^{-1} available for wood supply.

Net value added

Net value added is the gross value added adjusted by the value of fixed capital formation. There are no significant differences among the countries in the comparison of this indicator. The highest value per employee was reached by Norway and Finland (Table 2), and/or by Austria and Portugal in comparison per hectare of forest available for wood supply (Table 3) and the lowest ones by Bulgaria and Romania in both cases.

Entrepreneurial income

Entrepreneurial income generates the income which has been obtained by the owner of financial assets for the provision of these assets to another economic entity. The entrepreneurial income is calculated in the following way: received interests are added to mixed income and paid interests and rents are subtracted.

Norway and Finland were the best countries in comparing this indicator per employee. Great Britain and Switzerland showed negative values of this indicator (Table 2). The average value of entrepreneurial income per employee was 17 thousand €. When comparing countries according to the entrepreneurial income per hectare of forests available for wood supply, the highest values were reached

Table 4. Analysis of profitability based on the state of economy (average value)

State of economy/Indicator	*n*	Output of forestry	GDP of forestrye	Contribution to GDP (%)	GVA	NVA	Entrepreneurial income
		(€·employee^{-1})			(€·employee^{-1})		
Countries in transition	8	28,077	12,774	0.34	12,392	10,756	3,690
Advanced countries	10	113,728	66,332	0.30	67,839	52,460	27,795
H_o: $(x_a = x_b)$ > p, H_A: $(x_a \neq x_b) \leq P$, (Mann-Whitney *U* Test)		$P = 0.004$	$P = 0.005$	$P = 0.169$	$P = 0.003$	$P = 0.004$	$P = 0.351$
H_o: $(x_a = x_b) > P$, H_A: $(x_a \neq x_b) \leq P$, (Kolmogorov-Smirnov Test)		$P < 0.005$	$P < 0.01$	$P > 0.1$	$P < 0.005$	$P < 0.01$	$P > 0.1$
State of economy/Indicator	*n*	Output of forestry	GDP of forestry	Contribution to GDP (%)	GVA	NVA	Entrepreneurial income
		(€·ha^{-1} FAWS)			(€·ha^{-1} FAWS)		
Countries in transition	8	194.04	87.08	0.34	83.82	72.61	22.16
Advanced countries	10	321.00	161.60	0.30	173.30	136.90	63.20
H_o: $(x_a = x_b) > P$, H_A: $(x_a \neq x_b) \leq P$, (Mann-Whitney *U* Test)		$P = 0.23$	$P = 0.12$	$P = 0.169$	$P = 0.046$	$P = 0.069$	$P = 0.625$
H_o: $(x_a = x_b) > P$, H_A: $(x_a \neq x_b) \leq P$, (Kolmogorov-Smirnov Test)		$P > 0.1$	$P > 0.1$	$P > 0.1$	$P > 0.1$	$P > 0.1$	$P > 0.1$

GDP – gross domestic product; GVA – gross value added; NVA – net value added

by Austria and Portugal and the lowest ones by Romania and Switzerland (Table 3). Slovakia had the values markedly below the average in both cases. It is to remember that the value of unpaid work of forest owners is included in this indicator and also for these reasons significant differences among countries are to be analysed.

Analysis of results

As we have seen, there are significant differences among the countries. It is also interesting to analyse to what extent these differences are influenced by other factors such as the state of economy or region.

Analysis of results based on the state of economy. A very important factor affecting the competitiveness of economy is its state (country with advanced market economy, country in transition or developing country). Therefore the countries were divided into two groups: advanced countries and countries with economy in transition and then the statistical characteristics were compared between these groups.

When comparing the value of indicators per employee, they are on average 5 to 10 times higher in countries with developed market economy than in countries in transition (Table 4). If we compare the value of indicators per hectare of forest available for wood supply, the differences between these two groups are much lower (on average 2 to 3 times higher in countries with developed market economy). The reason is the already mentioned quality of data per employee. The main causes of differences in profitability and competitiveness of these two groups should be sought in the use of obsolete technologies and machines, lower use of harvester technology, and the resulting lower labour productivity. Statistically significant differences were observed just in all indicators per employee (except the indicator Entrepreneurial income) and in the

Table 5. Analysis of profitability based on regions (average value)

Region/Indicator	*n*	Output of forestry	GDP of forestry	Contribution to GDP (%)	GVA	NVA	Entrepreneurial income
		(€·employee^{-1})			(€·employee^{-1})		
Countries with forestry in transition	8	28,077	12,774	0.34	12,392	10,756	3,690
Countries with low management intensity	2	37.425	29,351	0.20	31,410	27,389	19,506
Countries with multifunctional forestry	4	102,384	48,063	0.18	50,958	38,964	18,957
Pulp and paper industry-oriented countries	4	163,224	103,091	0.40	102,935	78,493	40,778
H_o: ($m_a = m_b = m_c = m_d$) > P, H_A: ($m_a \neq m_b \neq m_c \neq m_d$) ≤ P, (Kruskal-Wallis H test), H (3, n = 18)		P = 0.005	P = 0.018	P = 0.560	P = 0.013	P = 0.018	P = 0.809
H_o: ($m_a = m_b = m_c = m_d$) > P, H_A: ($m_a \neq m_b \neq m_c \neq m_d$) ≤ P, (Westenberg-Mood median test), df = 3		P = 0.001	P = 0.023	P = 0.262	P = 0.001	P = 0.023	P = 0.682
Region/Indicator	*n*	Output of forestry	GDP of forestry	Contribution to GDP (%)	GVA	NVA	Entrepreneurial income
		(€·ha^{-1})			(€·ha^{-1})		
Countries with forestry in transition	8	194.04	87.08	0.34	83.82	72.61	22.16
Countries with low management intensity	2	214.22	171.08	0.20	180.24	157.91	119.20
Countries with multifunctional forestry	4	440.94	209.00	0.18	227.56	172.65	83.75
Pulp and paper industry-oriented countries	4	254.38	109.57	0.40	115.45	90.58	14.66
H_o: ($m_a = m_b = m_c = m_d$) > P, H_A: ($m_a \neq m_b \neq m_c \neq m_d$) ≤ P, (Kruskal-Wallis H test), H (3, n = 18)		P = 0.158	P = 0.148	P = 0.560	P = 0.048	P = 0.097	P = 0.725
H_o: ($m_a = m_b = m_c = m_d$) > P, H_A: ($m_a \neq m_b \neq m_c \neq m_d$) ≤ P, (Westenberg-Mood median test), df = 3		P = 0.112	P = 0.112	P = 0.262	P = 0.112	P = 0.112	P = 0.572

GDP – gross domestic product; GVA – gross value added; NVA – net value added

indicator gross value added per hectare of forests available for wood supply.

Analysis of results based on the region. The particular countries have different conditions concerning production characteristics (forest characteristics, forest types, intensity of production regimes, technology and so on), consumption characteristics (type and size of industry), general regional characteristics and other political, environmental, and social factors. Rametsteiner et al. (2006) introduced 7 regional types: globalized regions (Nordic-Baltic region), wood production oriented regions (Central Europe), plantation-oriented regions (Western Europe), broader, multifunctional forestry oriented regions (Western Europe), urban society service influenced regions (North-western Europe), countries in transition (Eastern Europe), low forest management intensity regions (Southern Europe). For the purposes of this analysis, the regional types were integrated and slightly modified. Four groups were created based on this typology and the countries were assigned to: (1) regions dominated by restitution issues, "countries in transition" (Slovakia, Hungary, Romania, Bulgaria, Slovenia, Poland, Czech Republic, Lithuania), regions dominated by low forest management intensity and with high importance of non-wood forest products (Italy, Portugal), regions with multifunctional forestry (France, Germany, Austria, Switzerland), production regions based on plantations and globalized pulp and paper industry-orientated countries (United Kingdom, Netherlands, Finland, Norway).

The regions oriented at the pulp and paper industry reached the highest values of the indicators per employee, whereas the highest values of indicators per hectare of forest available for wood supply (excluding entrepreneurial income) were obtained by countries with multifunctional forest (Table 5). The highest entrepreneurial income per hectare was in countries with low-intensity forest management, which can be explained by low costs of forest management and a relatively high level of support from public resources for this kind of forest management. Regions with forestry in transition (and also economy in transition) reached the lowest value of indicators in both cases (per employee and per hectare). Differences between these groups were statistically significant only in values per employee (Table 5).

CONCLUSIONS

The aim of this article was a comparison of profitability and competitiveness of forestry in selected European countries based on the results of Integrated Environmental and Economic Accounts for Forests and Economic Accounts for Forestry. Based on these analyses these conclusions can be drawn:

- There are great differences in profitability and competitiveness among particular countries; it could be caused by the share of public ownership, providing of forest services to the public, support of forestry, policy goals and other realities;
- There are great differences between indicators per employee and per hectare of forest; data variability was much higher in indicators per employee than in indicators per hectare of forest available for wood supply (FAWS). The assumption of lower quality and consistency of data on labour input was supported and therefore it is appropriate to compare and analyse the data per hectare of forest;
- The state of economy (advanced countries and countries with economy in transition) has a statistically significant influence on profitability; indicators in countries with developed market economy were much higher than in countries in transition;
- There are also differences in profitability and competitiveness of the groups based on regional classification and they are statistically significant; the regions oriented at the pulp and paper industry reached the highest values of indicators per employee, whereas the highest values of indicators per hectare of forest available for wood supply (excluding entrepreneurial income) were obtained by countries with multifunctional forest, regions with forestry in transition have reached the lowest value of indicators in both cases;
- Slovak forestry reached less than average profitability and competitiveness in the framework of the evaluated European countries; main causes are probably as follows: lower support from public resources, environmental and natural conditions, policy goals, obsolete technologies, machines and tools used in forestry and others;
- The limited validity and consistency of the data may restrict significance of results and it is also questionable to what extent the national methodologies are consistent in applying the Economic Accounts for Forestry and its practical rules. All conclusions are based on simplified analyses and are valid on the basis of results of this sample. The results can be different for another sample size.

There are many possibilities to increase profitability and competitiveness. Diversification of activities is also a possibility to increase profitability and competitiveness of forestry under the present

global financial and economic crisis. Forestry in Slovakia acquires over 80% of sales for wood and only about 20% for other production. The average level of diversification of activities in European countries is around 25% (Sarvašová, Kovalčík 2010; Svitok, Tutka 2010). Another possibility is the implementation of forest externalities into the market mechanism (Moravčík et al. 2010). Innovations and intersectoral cooperation in providing various services may contribute to an increase in competitiveness (Sarvašová et al. 2010). In addition to the impact of the global financial and economic crisis, forestry will have to face the impacts of climate change (change of tree species composition, increasing risk of various natural disasters), which can result in impairment of the forest property value. The introduction of adaptation measures can reduce these impacts (Tutka, Svitok 2010).

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