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Comparing development sustainability in Belarus, Poland and Ukraine with special respect to rural areas

Abstract. A comparison of environmental sustainability in Belarus, Poland and Ukraine using the Environmental Sustainability Index calculated by the Centre for Environmental Law and Policy of Yale University shows a significant advantage of Belarus over Poland and Ukraine while a slight advantage of Poland over Ukraine. Belarus with ESI score of 52.8 points ranked 47, Ukraine with 44.7 points ranked 108 while Poland with 45.0 points ranked 102 among the 146 classified countries of the world. The state of natural environment in Belarus and Ukraine seems to be much better, while Poland has a distictive advantage with respect to the institutional issues in environmental management. All three countries have roughly similar impact on global environment, of a predominantly negative nature, with Belarus qualifying somewhat better in this respect.
Key words: Environmental Sustainability Index, Belarus, Poland, Ukraine

Introduction

The Centre for Environmental Law and Policy of the renowned Yale University in the USA has recently published a new edition of its calculations of the Environmental Sustainability Index (ESI) which cover 146 countries in the world [2005 ESI... 2006]. The index is supposed to represent an aggregate measure of the sustainability of the country's economic and social development with respect to the environmental quality, stability and perspectives for the future.

At the base level values of 76 variables have been estimated for each country. They are then aggregated into 21 indicators which in turn are summarized into 5 components and finally into one synthetic index.

The comparison between our neighbouring states had in view checking to what extent the ESI indicators confirm the widespread concept of the retardation rent in the environmental impact of economy. A detailed comparison would take much more space than the allowed dimensions, so only the generalized features are discussed.

Comparison

Table 1 presents a comparison between Belarus, Poland and Ukraine with respect to the 76 basic variables, table 2 with respect to the 21 indicators and table 3 with respect to the 5 components.

Values in table 2 are averages of the constituent variables after their normalisation. Variables have been normalised into the form of *z* score which means that the mean has

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been deducted from the original values and the residual has been divided by the standard deviation. In this way 0 means the mean value and, for example, –2 means two standard deviations below the mean while + 0.5 means half standard deviation above the mean. The values in table 3 are percentiles and 100% means the highest possible score in the aggregate index.

Discussion

Out of innumerable concepts of sustainable development its meaning as a social progress combined with economic growth not entailing a rise in entropy of the natural environment can be accepted. In order to measure and compare sustainability of various regions and countries a number of indices have been constructed. Besides ESI the widely used ISEW (*Index of Sustainable Economic Welfare*), EF (*Ecological Footprint*) have been recently calculated for Poland [Wasiak & Lewociuk 2005; Śleszyński 2002]. ISEW has also been separately calculated for an eastern Polish, mostly agricultural, voivodeship (province) of Podlasie. The indices seem to point out to a rather unsustainable development of Poland which is illustrated by the generally falling ISEW numbers in the last decades both for the whole of Poland and the mentioned voivodeship. It is still more visible in the case of a predominantly rural Podlasie vivodeship. Falling ISEW numbers are being observed also in other European countries [Śleszyński 2002].

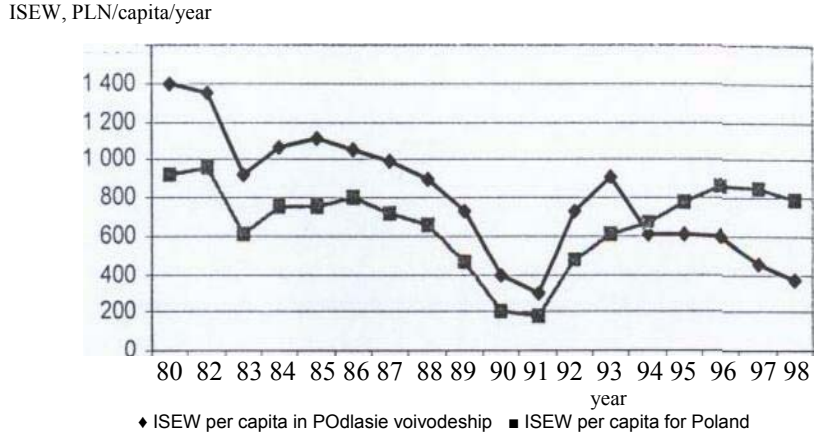

Fig.1 ISEW for Podlasie voivodeship and Poland after Wasiak & Lewociuk [2005],

An upsetting regressive tendency can be observed in Poland with regard to the social welfare and fairness. While in 1996 only 4.3% of the total population got the income below the subsistence level, in 2004 income below this level received 12% of the population [Warunki... 2005]. It applies first of all to the village inhabitants, of whom 18.5% had in 2004 to live upon an income below this level. Income below the social minimum was received in 1996 by 47.9% of the country population and in 2004 this percentage reached 57% [Instytut... 2005]. So the zero percentage for the undernourished population in Poland (variable UND_NO in table 1) is surely false. There have been estimates that 40% of children in the rural areas come to school hungry.

Table 1. Values of variables included by the Centre of Environmental Law and Policy in the indicator estimations for Belarus, Poland and Ukraine

code	Variable description	Units	Belarus	Poland	Ukraine	146 countries mean	146 countries median
NO2	Urban population weighted NO_2 concentration in the air	$\mu g/m^3$	42.6	8.2	0.04	39.22	35.56
SO_2	Urban population weighted SO_2 concentration in the air	$\mu g/m^3$	0.01	20.56	0,06	19.35	.32
TSP	Urban population weighted Total Suspended Solids concentration in the air	$\mu g/m^3$	18.40	40.85	0.15	80.76	42.92
INDOOR	Indoor air pollution from solid fuel use, adjusted for ventilation (percentage of households using solid fuels)	%	2.0	7.0	11.0	45.17	40.0
ECORISK	Percentage of country's territory in threatened ecoregions	%	100	100	100	43.62	36.09
PRTBRD	Threatened bird species as percentage of known breeding bird species in the country	%	1.36	1.76	3.04	4.6	2.62
PRTMAM	Threatened mammal species as percentage of known mammal species in the country	%	9.46	16.67	14.81	14.91	11.19
PRTAMPH	Threatened amphibian species as percentage of known amphibian species in the country	%	0.0	0.0	0.0	13.08	4.22
NBI	National biodiversity index	score 0 to 1	0.37	0.37	0.42	0.55	0.55
ANTH10	Percentage of area (including inland waters) having very low (less than 9 points in 58-point Human Impact Index scale) anthropogenic impact	%	0.01	0.03	0.36	20.56	3.51
ANTH40	Percentage of total land area (including inland waters) having very high (more than 36 points in 58-point Human Impact Index scale) anthropogenic impact	%	4.43	9.22	6.64	8.38	1.53
WQ_DO	Dissolved oxygen concentration in surface waters	µg/l	6.81	10.12	6.78	8.67	9.17
WQ_EC	Electrical conductivity of surface waters	µSiemens/cm	547.8	969.12	1190.9	573.1	457.1
WQ_PH	Phosphorus concentration in surface waters	µg/l	0.12	0.24	0.12	0.16	0.12
WQ_SS	Suspended solids in surface waters	µg/l	not av.	3.33	not av.	3,74	3,92
WATAVL	Freshwater availability per capita (surface runoff and groundwater recharge)	thous. m^3/ person/year	4.81	1.75	1.93	26.99	7.51
GRDAVL	Internal groundwater availability per capita	thousand m^3/ person	1.84	0.33	0,42	4.24	0.82
COALKM	Coal energy consumption per populated land area (at 5 or more persons per square km)	TJ/km^2	0.00	6.89	2.97	2.43	0.0
NOXKM	Anthropogenic NO_X emissions per populated land area (at 5 or more persons per km^2)	$tons/km^2$	0.20	2.69	0.36	3.32	0.56
SO2KM	Anthropogenic SO_2 emissions per populated land area (at 5 or more persons per km^2)	$tons/km^2$	0.95	4.85	2.06	56.18	0.64

table 1. continued

code	Variable description	Units	Belarus	Poland	Ukraine	146 countries mean	146 countries median
VOCKM	Anthropogenic VOC (volatile organic compounds) emissions per populated land area (at 5 or more persons per km^2)	tons/km^2	1.24	1.92	2.04	5.0	1.65
CARSKM	Vehicles in use per populated area (at 5 or more persons per km^2, excluding motorcycles)	number /km^2	7.08	40.35	9.03	86.22	8.49
FOREST	Annual average forest cover change rate from 1990 to 2000	%	3.20	0.20	0.30	-0.11	0.0
ACEXC	Acidification over critical exceedance from anthropogenic sulphur deposition	% of surface at risk	4.91	53.45	0.0	4.6	0.0
GR2050	Percentage change in projected population 2004 – 2050	% increase to 2050	-13.0	-15.0	-19.0	58.58	42
TFR	Total Fertility Rate	births/woman	1.23	1.25	1.17	3.19	2.65
EFPC	Ecological footprint per capita (required biologically productive land)	hectares per capita	3.17	3.40	3.53	2.55	1.73
RECYCLE	Waste recycle rates (excluding internal recycling within enterprise)	%	0.0	17.20	not av.	20.12	8,0
HAZWST	Generation of hazardous waste	tons/year	1387	10293	25445	2245	325
BODWAT	Industrial organic water pollutant (BOD) emissions per available freshwater	tons BOD/ km^3 /day	1.18	5.76	5.03	-2.51	0.62
FERTHA	Fertilizer consumption per hectare of agricultural land	kg/hectare	127.2	111.42	14.56	152.7	56.9
PESTHA	Pesticide consumption per hectare of agricultural land	kg/hectare	0.74	0.78	1.90	3.12	1.10
WATSTR	Percentage of country area under water stress (consumption over 40% of available water)	% of area	0.0	0.98	16.88	25.18	5.13
OVRFSH	Sea productivity overfishing	score 1 to 7	not appl.	6.0	5.0	3.89	4.0
FORCERT	Percentage of total forest area that is certified for sustainable management	% of forest area	1.13	68.45	2.12	4.92	0.0
WEFSUB	World Economic Forum Survey on Subsidies (the higher score, the more agreed the subsidies to firms are widely practiced)	score from 1 to 7	0.0	4.07	3.36	4.18	4.15
IRRSAL	Salinized area due to irrigation as percentage of total agricultural land	% of area	0.0	0.0	not av.	3.54	0
AGSUB	Agricultural subsidies level (0.0 means data missing)	scale from 1 to 8	0.0	2	0.0	0.67	0
DISINT	Death rate from intestinal infectious diseases per 100000 population and year	deaths/ year	.71	0.12	0.80	9.86	1.2
DISRES	Child death rate from respiratory diseases per 100000 population aged 0 – 14	deaths/ year	5.30	0.01	7.86	11.54	0.58

table 1. continued

Variable code	Variable description	Units	Belarus	Poland	Ukraine	146 countries mean	146 countries median
U5MORT	Children under five mortality rate per 1000 live births	deaths/ 1000 births	20.0	7.50	20.0	62.25	29.5
UND_NO	Percentage of undernourished in total population	%	3.0	0.0	4.0	16.93	11.0
WATSUP	Percentage of population with access to improved drinking water source	%	100.0	102.2	98.0	81.42	86.0
DISCAS	Average number of deaths per million inhabitants from floods, tropical cyclones and droughts	deaths/ million people/ year	0.01	0.08	0.06	39.11	0.24
DISEXP	Environmental Hazard Exposure Index	scale from 0 to 4	0.01	0.18	0.05	0.59	0.51
GASPR	Ratio of gasoline price to world average	ratio	0.82	1.36	0.77	1	0.95
GRAFT	Corruption measure (high scores correspond to effective control of corruption)	standardized (z) score	-0.78	0.39	-0.96	0.01	-0.25
GOVEFF	Government effectiveness (aggregate index created by World Bank; high scores correspond to high level of effectiveness)	standardized (z) score	-1.03	0.61	-0.743	0.0	-0.2
PRAREA	Percentage of total country area under protected status	% of country area	6.40	23.50	3.30	10.91	7.1
WEFGOV	World Economic Forum survey on environmental governance	aggregate score	31.55	38.51	32.52	37.72	35.76
LAW	Rule of law (aggregate index created by World Bank)	standardized (z) score	-1.12	0.65	-0.79	0.0	-0.27
AGENDA 21	Local Agenda 21 initiatives per million people	initiatives/ million people	not avail.	1.81	0.18	6.37	0.58
CIVLIB	Civil and political liberties (aggregate index; low scores correspond to high level of liberties)	scale from 0 to 7	6.0	1.50	4.0	3.35	3.0
CSDMIS	Percentage of variables missing from the CGSDI Rio to Joburg Dashboard (in table of 60 indicators describing country progress in 10 years between two world summits)	% of missing information variables	32.61	15.22	23.91	28.68	26.09
IUCN	IUCN (World Conservation Union) member organizations per million population	number/ million people	0.0	0.23	0.06	1.63	0.18
KNWLDG	Knowledge creation in environmental science, technology and policy (aggregate score; low scores correspond to above average performance)	scale from 0 to 78	47.0	47.33	48.33	39.5	42.67
POLITY	Democracy measure (in scale invented by university of Maryland, USA)	scale from -10 to +10	-1.12	9.80	7.70	2.79	5.2

table 1. continued

Variable code	description	Units	Belarus	Poland	Ukraine	146 countries mean	median
ENEF	Energy efficiency (energy consumption per million dollars GDP adjusted for dollar purchasing power parity)	Terajoules/ million $ GDP (PPP)	19.93	7.77	26.19	8.17	5.91
RENPC	Hydropower and renewable energy production as a percentage of total energy consumption	% share	0.02	0.90	1.58	12.84	3.63
DJSGI	Dow Jones Sustainability Group Index (ratio of market capitalisation of firms included in the index to capitalisation of firms eligible)	ratio	not avail.	not av.	not av.	0.28	0.18
ECOVAL	Average Innovest Eco Value rating of firms headquartered in a country (measure of environmental performance at firm level, versus the neutral score of 0 in the global peer group of firms)	score weighted by capital-isation of firms	not avail.	-0.34	not av.	0.18	0.0
ISO14	Number of ISO14001 certified companies per billion US dollars GDP (adjusted for dollar local purchasing power parity)	number/ billion $ GDP (PPP)	0.04	1.06	0.02	0.85	0.03
WBPR1	World Economic Forum survey on private sector environmental innovation	aggregate score	9.84	10.28	8.82	10.78	10.61
RESCARE	Participation in the Responsible Care Program of the Chemical Manufacturer's Association	score from 0 to 4	0.0	4.0	0.0	0.77	0.0
INNOV	Innovation index (capacity measured by aggregate index including investment in R&D and number of new US patents)	score from 0 to 7	2.47	3.20	2.79	2.71	2.33
DAI	Digital Access Index (aggregate index measuring access to internet and schooling)	score from 0 to 1	0.49	0.59	0.43	0.42	0.43
PERCR	Female primary education completion rate (percentage of women completing primary education)	%	100	98.0	100	91.43	100.0
ENROL	Gross tertiary enrollment rate (percentage of pupils enrolled at tertiary level of schooling)	%	55.95	55.54	43.30	25.44	22.22
RESEARCH	Number of researchers in per million inhabitants	number/ million	1004	1473.0	2117.6	1629	1258
EIONUM	Number of memberships in environmental inter-governmental organizations (in selected 100 organizations)	number	4	11	7	7.1	6
FUNDING	Contribution to international and bilateral funding of environmental projects and development aid (both donors and recipients, higher score means bigger participation)	score from 0 to 100	15.38	23.72	4.49	50.96	50.96
PARTICIP	Participation in international environmental agreements (in selected 7, adjusted for activity and compliance)	score from 0 to 1	0.54	0.82	0.63	0.52	0.57
CO2GDP	Carbon emissions per million US dollars GDP (constant 1995 prices)	tons/million $ GDP	850.8	578.54	2147.4	364.0	187.8

table 1. continued

Variable code	Variable description	Units	Belarus	Poland	Ukraine	146 countries mean	146 countries median
CO2PC	Carbon emissions per capita per year	tons per capita/year	5.90	8.22	6.23	5.14	2.59
SO2PC	SO_2 exports (transboundary emissions)	Gg SO_2/year	150.7	1564.0	1029.0	305.5	85.24
POLEXP	Import of polluting goods and raw materials as percentage of total import of goods and services	%	23.10	33.32	20.19	23.85	23.15

Source: [2005 ESI… 2006], modified.

Table 2. Indicators of sustainability for Belarus Poland and Ukraine calculated by the Centre of Environmental Law and Policy

Indicator			Belarus		Poland		Ukraine	
no	name	constituent variables	rank	value	rank	value	rank	value
1	Air quality	NO2, SO2, TSP, INDOOR	4	1.46	40	0.4	2	1.87
2	Biodiversity	ECORISK, PRTBRD, PRTMAM, PRTAMPH, NBI	106	-0.15	126	-0.36	119	-0.32
3	Land	ANTH10, ANTH40	106	-0.41	123	-0.78	117	-0.58
4	Water quality	WQ_DO, WQ_EC, WQ_PH, WQ_SS	76	-0.03	78	-0.06	118	-0.53
5	Water quantity	WATAVL, GRDAVL	64	-0.14	119	-0.81	113	-0.73
6	Reducing air pollution	COALKM, NOXKM, SO2KM, VOCKM, CARSKM	70	0.21	130	-1.05	27	0.38
7	Reducing ecosystem stress	FOREST, ACEXC	7	1.12	140	-1.43	7	1.12
8	Reducing population pressure	GR2050, TFR	15	1.09	13	1.10	7	1.15
9	Reducing waste and consumption pressure	EFPC, RECYCLE, HAZWST	128	-0.49	115	-0.25	135	-0.62
10	Reducing water stress	BODWAT, FERTHA, PESTHA, WATSTR	69	0.09	108	-0.41	98	-0.33
11	Natural resources management	OVRFSH, FORCERT, WEFSUB, IRRSAL, AGSUB	29	0.38	28	0.39	36	0.33
12	Environmental health	DISINT, DISRES, U5MORT	49	0.56	16	0.92	55	0.49
13	Basic human sustenance	UND_NO, WATSUP	7	0.91	1	1.0	37	0.82
14	Reducing environment related natural disaster vulnerability	DISCAS, DISEXP	8	0.75	34	0.53	20	0.69
15	Environmental governance	GASPR, GRAFT, GOVEFF, PRAREA, WEFGOV, LAW, AGENDA21, CIVLIB, CSDMIS, IUCN, KNWLDG, POLITY	124	-0.72	29	0.67	91	-0.34
16	Eco-efficiency	ENEFF, RENPC	137	-1.22	104	-0.33	143	-1.62
17	Private sector responsiveness	DJSGI, ECOVAL, ISO14, WEFPRI, RESCARE	89	-0.54	35	0.37	127	-0.80
18	Science and technology	INNOV, DAI, PECR, ENROL, RESEARCH	35	0.51	27	0.78	32	0.57

table 2. continued

Indicator			Belarus		Poland		Ukraine	
no	name	constituent variables	rank	value	rank	value	rank	value
19	Participation in international collaborative efforts	EIONUM, FUNDING, PARTICIP	139	-1.05	71	-0.01	131	-0.83
20	Greenhouse gas emissions	CO2GDP, CO2PC	132	-1.05	128	-0.94	143	-1.49
21	Reducing transboundary environmental pressures	SO2EXP, POLEXP	67	0.21	143	-2.25	110	-0.48

Source: [2005 ESI… 2006], modified.

Table 3. Components of the Environmental Sustainability Index for Belarus, Poland and Ukraine calculated by the Centre of Environmental Law and Policy

Component	Numbers of constituent detailed indicators	Belarus		Poland		Ukraine	
		rank	value	rank	value	rank	value
Environmental systems	1 ÷ 5	44	55.8	111	37.5	74	47.7
Reducing environmental stresses (anthropogenic)	6 ÷ 11	7	65.6	125	39.2	62	53.6
Reducing human vulnerability (to environmental threats)	2 ÷ 14	18	77.0	8	79.3	18	77.0
Social and institutional capacity	15 ÷ 18	119	31.2	33	64.6	126	29.2
Global stewardship (environmental)	19 ÷ 21	125	26.4	143	14.3	139	17.5

Source: [2005 ESI… 2006], modified.

A comparison between Belarus, Poland and Ukraine based on ESI calculation indicates a roughly equal but slightly better position of Poland than Ukraine and a decisively better position of Belarus than the other two countries with respect to the environmental sustainability. In the global ESI ranking compiled for 2005 Belarus with 52.8 points ranked 47, Ukraine with 44.7 points ranked 108 while Poland with 45.0 points ranked 102 among the 146 classified countries of the world. Theoretically the range spreads between 0 and 100 points. The extreme results were 75.1 points for Finland and 29.2 points for North Korea.

Poland has the 21st, penultimate, place among the 22 classified EU member states while Belarus the 6th and Ukraine the 12th among the 15 newly independent states which emerged from the former Soviet Union.

Out of 5 components constituting the aggregate ESI index Belarus approximately equals Poland and Ukraine in what is called Reducing Human Vulnerability (77.0 versus 79.3 and 77 points, table 3) but Poland has a significant advantage over Belarus and Ukraine, which are about equal, in what is called Social and Institutional Capacity (64.6, 31.2 and 29.2 points respectively), while Ukraine has a slight and Belarus a significant advantage over Poland with respect to what is called Global Stewardship (17.5, 26.4 and 14.3 points) and there are distinctive differences in favour of Belarus and then Ukraine versus Poland in the quality of Environmental Systems (55.8, 47.7 and 37.5 points) as well as in Reducing Environmental Stresses (65.6 and 53.6 versus 39.2 points). These results can be summarized as a rather high and equalized in all countries human safety with regard to environmental dangers, moderate, but more efficient institutional activity in the field of environmental protection in Poland, much smaller anthropogenic pressure on natural environment in Belarus, then Ukraine with Poland far behind and much cleaner environment in the first two countries, with Belarus leading in this respect. Also the service provided by the Byelorussian environment to the global environment is higher than the Ukrainian and the Polish counterparts, although all countries do not contribute much in comparison to the other countries in the world. The last two countries have about the same impact on the global environment, of a predominantly negative nature.

A popular view has it that the state of the natural environment deteriorates with the population density and the intensity of the economic activity in the country. The last prevails up to a certain turning point where the level of economic development sort of enforces pro-environmental prophylactic and protection activities which reverse the negative impact of population density and economic development on the state of nature.

In year 2001, close to the ESI 2005 investigations period, Belarus had 48, Poland 122 and Ukraine 81 inhabitants per square kilometer and they had respectively 8365 , 10309 and 4155 GDP per capita counted in USD adjusted for their purchasing power [Rocznik... 2003]. The correlation with the component Environmental systems (table 3) with population density is in the case of the three countries easily visible, although not so much with regard to the economic development measured by GDP per capita. The population factor seems to have stronger inmpact on the environment than the economic development. When the aggregate ESI index is considered, the proportions between countries seem to indicate that Poland has already passed over the turning point and the protection policy measures taken (component social and institutional capacity in table 3) have hopefully reversed the deteriorating trend in the state of environment, while the other two countries have not reached it yet. However the existence of the retardation rent seems to be confirmed. The falling ISEW represented in figure 1 are most probably due to the growing

social income differentiation and not to the environmental deterioration.

The ESI as an aggregate indicator compiled by using the method of averaging an arbitralily selected set of variables can be reckoned as a subjective measure of sustainablility. Some concepts in the selection and the relative weight of various phenomena could be probably strongly questioned. A rather long list of probable computing mistakes could be set up after a careful screening of the results[2]. However it encompasses a wide range of aspects of the basic problem of sustainability in the present economic and social development. ESI should also not be disregarded, since it is endorsed by a renowned institution, it is widely popular and has a worldwide circulation. The American and consequently the world opinion is strongly influenced by its estimates and to a great extent it is through this prism that the particular countries are perceived. It applies specifically to the viewpoint of important global decision makers, including the World Bank.

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[2] Some of them are: the improbable relations between values of the HAZWST variable, the very high mean value of the SO2KM variable, much higher than any of the values specific for the countries and accompanied by a low median, over 100% water availability in Poland (WATSUP variable), improbable values of the KNOWLDG variable for which the USA have a poorer score than e.g. Equador, negative mean value of the BODWAT variable etc.