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SUSTAINABLE DEVELOPMENT IN RURAL POLAND FROM THE PERSPECTIVE OF ENVIRONMENTAL ECONOMICS

1. Sustainable development

Measuring the sustainablility of Polish economic and social development is the main field of research by Borys and his collaborators [Borys, 1999, 2005] and Śleszyński [1998, 2002]. A series of domestic and some international conferences have been devoted to the definition and characteristics of sustainable or eco-development [Poskrobko, 1998; Sasinowski, 2000; Piontek, 2001; Dobrzański, 2002], including the most recent one organized by CSDEM in Białystok in December 2005.

One more definition of sustainable development could be added to the innumerable set of definitions as follows: *Sustainable development means social progress combined with economic growth without entailing a rise in the entropy of the natural environment.* The notion of entropy, derived from physics, is interpreted in environmental economics mainly as a relative measure of energy dispersed in the environment which cannot be profitably used and/or of a chaotic dispersion of matter resulting in the same effect.

In the light of the second law of thermodynamics, any economic activity not counteracted by appropriate measures to protect the environment adds to the growing entropy of the environment [Czaja, 2001].

Though entropy takes values between 0 and 1, its measurement seems impossible given the present capacity to process data. Therefore, other indices of sustainability, not directly using the notion of entropy, are used. The most popular are ISEW (Index of Sustainable Economic Welfare)

and EF (Ecological Footprint). These indices were recently estimated for Poland by Śleszyński [2002]. This author has observed a decreasing trend for the first of these over the past few decades and a decisively excessive value of the second, which has induced him to bluntly state that development in Poland is unsustainable. Regarding rural areas, this statement was confirmed by a recent study by Wasiak and Lewociuk [2005], who estimated values of ISEW which dramatically fell in two mainly rural provinces, Białystok and Podlasie, in the years from 1980 to 2002. Although at the beginning of this period the ISEW for the two voivodeships was higher than the Polish average, in the late 1990's it became much lower. This might be interpreted as a relative worsening of welfare in rural areas compared with the Polish average. Though Polish GDP per capita also displayed a slow decreasing trend in that period, combined with strong fluctuations [Wasiak and Lewociuk, 2005], the much more prominent decrease in ISEW in these two provinces indicates that environmental and social (inequality) factors had a stronger influence on the change in ISEW. In conclusion, at least two of the three aspects of sustainable development, *i.e.* social and economic cannot be judged to be sustainable, particularly in rural areas.

The level of social development has significantly fallen. While in 1996, 4.3% of the Polish population had an income below the existence level (the level that satisfies needs that cannot be postponed and the minimum level of consumption to ensure survival) [Ubóstwo, 1997], in 2004 this percentage reached 12% [Warunki życia ludności, 2005]. The rapidly growing share of the population living below the existence level is especially conspicuous in rural areas. In 2004 18.5% of the rural population lived below the existence level. Moreover, in 1994 47.9% of Poles had an income below the minimum social level, while in 2004 this percentage grew to 57% [Instytut Pracy i Spraw Socjalnych, 2005].

2. Space management

Urban areas in Poland have surface area of 20.9 thousand km^2, which amounts to 6.7% of the total surface area of the country, including the surface of inland waters. Rural areas cover 291.9 thousand km^2, *i.e.* 93.3% of the total surface area. However, 75.2% of communal waste comes from urban areas (data for 2000), while 62% of inhabitants live in towns [Uchwała Rady Ministrów w Sprawie Krajowego Planu Gospodarki Odpadami, 2003]. 423.7 kg/year of communal waste per capita is produced in towns and only 223.6 kg/year per capita in rural areas [Uchwała Rady Ministrów w Sprawie Krajowego Planu Gospodarki Odpadami, 2003].

Hence, much more communal waste is generated in towns than in rural areas, both in relative and absolute terms. This applies even more strongly to industrial waste.

In general, rural areas serve as the main receptor for emissions of pollutants from urban areas.

Landfills are most frequently localised in rural areas for two reasons: because land is much cheaper in the country and landfill sites can be situated much farther away from residential areas. In this way, objections to localizations are much weaker and, additionally, raised by a sector of the population which possesses much less political and social power.

According to the law of entropy, pollution of the atmosphere and of surface waters propagates itself until it reaches a constant level over a given ecosystem. In rural areas pollution is counteracted by the processes of natural absorption and degradation. These processes, if purposefully taken advantage of, are commonly called quantitative methods for the neutralization of pollutants and lead to a reduction in the concentrations of pollutants.

In particular, rural areas have also become receptors of urban pollutants in the case of agricultural utilisation of industrial sewage and field fertilization using urban sewer sludge or compost containing sewage sediments. 14% of urban communal sewage sediments are utilised in agriculture and a further 7% used to produce compost [Uchwała Rady Ministrów w Sprawie Krajowego Planu Gospodarki Odpadami, 2003].

This serves as an example of the changing role of rural areas in our times. Their role has evolved quickly from that of a foodstuffs producing area into the role of a so-called ecological sink. In particular, green areas are more and more often treated as 'carbon parks' assimilating the carbon dioxide emitted by fuel burning. Simultaneously, traditional agriculture is gradually becoming an obsolete branch of economic activity and is being replaced by industrial methods of food production.[1] Farmers are changing their role from food producers into environmental guardians, who oversee the functioning of the environmental sink, as well as supplying environmental amenity services to the urban public. They are also receiving a growing proportion of their income for providing services of both kinds, *e.g.* from funds in the Polish agro-environmental programme [Przewodnik po Krajowym Programie Rolnośrodowiskowym, 2004].

[1] Production of milk in the state of California is a good example of such a transition. Recently California has outstripped Wisconsin as the largest milk producing state in the US. A typical farm has around 3000 cows. They are concentrated in a tower of several floors, max mally 8, each hosting about 300 cows. A central communication shaft facilitates transportation of water and fodder upwards and milk and excreta downwards [Bernhardt, 2006].

In order to render services of both these types, space should be appropriately managed. For example, 47% of north-eastern Poland already falls under various categories of protected areas and according to Wolfram [2005] this should be extended to 60%. In general, the rural environment of Poland is relatively less polluted than in other European countries. 27% of agricultural land is classified as clean. This is a result of what is called the retardation bonus. However, this advantage of agricultural areas in Poland, so much emphasized by foreign authors, *e.g.* Mouchet and Darrot [2004], nowadays seems to have lost its beneficial impact on the state of the rural environment.

3. Space appropriation

Since the introduction of capitalism in Poland 15 years ago, rural areas have been exposed to very intensive pollution of the landscape, in the form of dispersed and chaotic urbanisation, commercial (shopping centres, supermarkets, wholesale stores, petrol stations) and industrial developments (transportation bases and factories, mainly for the food industry). As in the case of landfills, the most important reason for locating in the country is the relatively low price of land and relatively easy road access. Industrial and commercial premises are optimally located among fields and woods from the point of view of their owners, minimizing the costs of land and transportation to the urban agglomerations supplied, *i.e.* in reverse proportions to the distance and the mass of load delivered.[2] Firms easily obtain licences from local authorities craving for increased employment and a rise in local income. An enormous amount of pollution of the rural landscape, which started with the change in the economic system, also results from putting up great numbers of advertising billboards of all kinds, dimensions, shapes and colouring along public roads. Members of the public are now beginning to protest. On a national scale, the monetary value of the willingness to pay for the introduction of a ban on free standing billboards along roadsides has been estimated at 8302.5 million złoty and at 11.32 złoty/household/billboard [Manteuffel Szoege et al., 2004]. About 65% of the travelling public sampled think billboards are a nuisance and about 25% agree with a ban on placing them along roads.

When walking or driving a car we cannot avoid looking at the aggressive advertisements located along roads or streets, also in the country.

[2] *i.e.* in accordance with Weber's cost theory of location [Kuciński, 1997].

This makes the appropriation of the visual space above ground level especially unpleasant in this case. Some hope for the future may be attached to the greater sensitivity of younger people to this form of spoiling the landscape (Fig. 1).

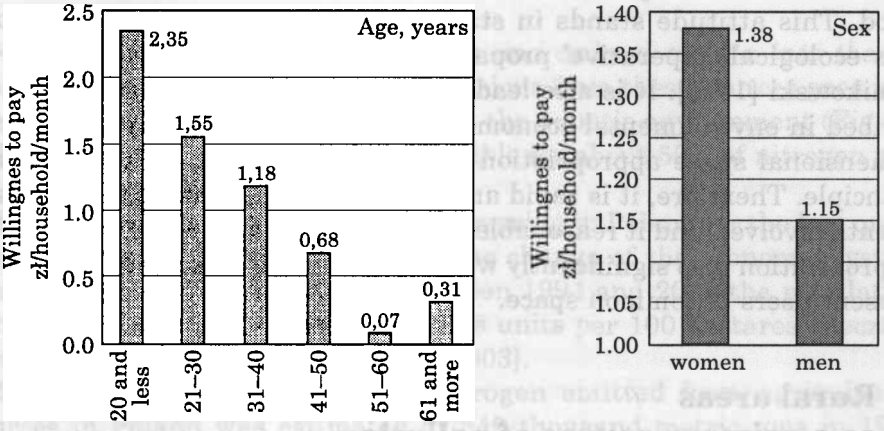

Fig. 1. Social differentiation of the willingness to pay for the removal of billboards standing along public roads

Source: Manteuffel Szoege et al., 2004.

Growing income differentiation gives rise to a phenomenon that can be labelled over-consumption by wealthy social groups. Among others things, this is expressed in building summer and/or winter residences in the country, in environmentally attractive neighbourhoods such as lakeside, seaside or mountainous areas. These residences are spoiling the natural landscape by urbanisation, particularly in off-season periods, when such residences form 'ghost towns'.

Also, the acoustic space in rural areas is being subjected to accelerated appropriation.[3] This results from rapid growth in both road and air traffic. As a preventative measure, not very commonly used in Poland as yet, in many cases tall plastic fencing walls are being constructed along motorways and airfields. They both pollute visual space in the countryside and evoke an unpleasant feeling of claustrophobia in travellers.

Combining both acoustic and visual space appropriation in summer 2005, a small aircraft towing a huge contraceptive sheath inflated by the

[3] In the author's opinion appropriation well describes the process of an ever increasing level of the private use of space, which has the character of a common good. This harms the rest of society, the use being justified by often ill-defined property rights to this space in legal terms.

wind with the 'Condom' trademark on it flew over the beaches in West Pomerania.

Consumption of the kind corresponding to the way of life called 'homo ludens' and advertising lead to an apparently peaceful appropriation of three-dimensional space, which is still treated in Poland as a common good. This attitude stands in stark contrast to the idea of 'a consumer's ecological imperative' propagated in environmental economics by Janikowski [1998]. It is also leading to the well known phenomenon described in environmental economics as 'the tragedy of commons'. Three-dimensional space appropriation is ruled by the 'first come, first serve' principle. Therefore, it is rapid and wasteful, while none of the economic agents involved find it reasonable to incur any costs of conservation. This appropriation also significantly widens the ecological footprint left by the present users of common space.

4. Rural areas as a primary source of pollution

Rural pollution may be associated with:

A. Existential activities of inhabitants. The sources of this kind of pollution are very dispersed and therefore much less controlled than in towns. For example, the organised collection of waste covers 94% of inhabitants in towns, but only 7% of inhabitants in rural areas [Uchwała Rady Ministrów w Sprawie Krajowego Planu Gospodarki Odpadami, 2003]. The law allows the individual disposal of domestic waste by households [Ustawa o odpadach, 2001]. As a result, woodlands close to villages have changed into illegal waste landfills. In 2000 only 48% of the inhabitants of Poland were served by sewage treatment plants, mostly in towns. A European directive imposes on Poland the obligation to install them in all towns and villages of more than 2 000 inhabitants [EU Directive on Municipal Sewage Treatment, 1991]. However, villages of such a size are rather rare in Poland. Collective water supplies now cover more than 70% of rural inhabitants. However, in most cases the construction of water conduits has not been accompanied by the construction of a canalisation system or a sewage treatment plant, in particular.

B. Economic activities: industrial, commercial and above all agricultural. Industrial and commercial activities have an impact on the environment similar in kind, but far smaller in magnitude, to such activities in urban areas. Agricultural impacts are specific to rural areas.

5. Agricultural pollution

The major sources of pollution in agriculture are listed below.

• *Storage and application of manure.* Manure can be a source of both volatile and liquid emissions into the environment. Some of the forms of pollution are listed below.

• *Ammonia emissions from manure and animal excreta into the atmosphere.* About 80% of ammonia emissions from these sources goes into the air, the rest is directly emitted into the aquatic environment (Fig. 2). Volatile forms of ammonia are responsible for about 50% of nitrogen pollution in the Baltic Sea.

The number of livestock has been decreasing in Poland for the last quarter of a century, in particular, since the change of the economic system to capitalism. For example, only between 1994 and 2002 the population density diminished from 59 to 48 gross units per 100 hectares [Rocznik Statystyczny Rzeczpospolitej Polski, 2003].

The total amount of ammonia nitrogen emitted from agricultural sources in Poland was estimated at 540 thousand metric tons in 1985

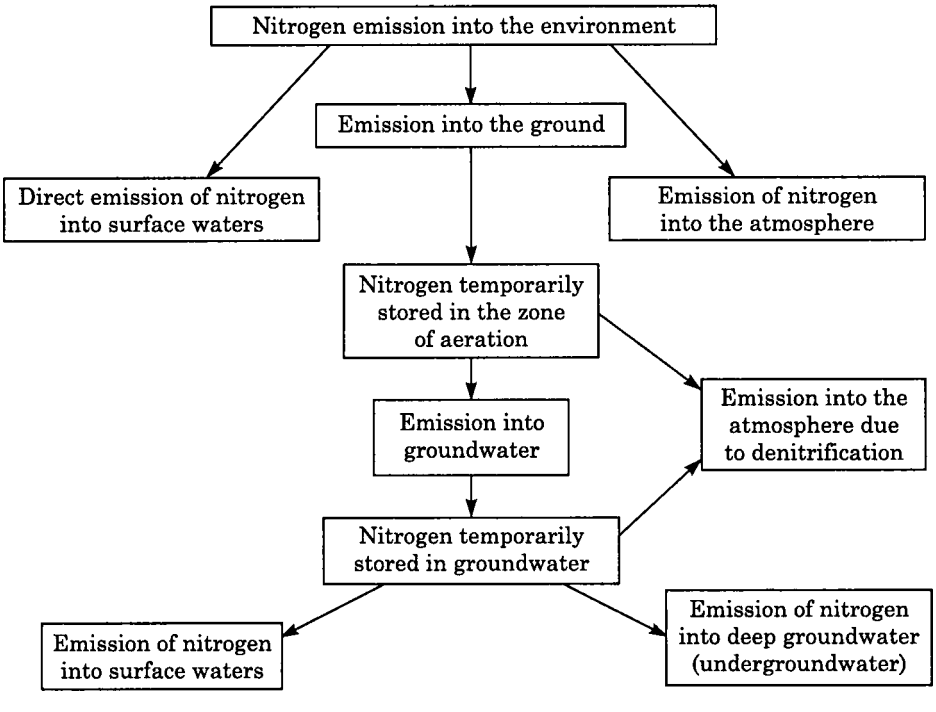

Fig. 2. Migration of nitrogen originating from animal waste into the environment
Source: Manteuffel Szoege and Sobolewska, 2003.

and 416 thousand metric tons in 1992. This 23% decrease in emissions can be explained by decreasing livestock on private farms and liquidation of state farms. A detailed analysis of the spatial distribution of emissions by Sapek et al. [2002] demonstrates their concentration in central and southern regions of Poland, which supports this conjecture (state farms were less frequent there).

• *Nitrogen in nitrate form leached into ground waters.* This sort of pollution comes from both artificial and natural fertilizing of fields. A sharp change in the relations of fertilizer and crop prices resulted from the introduction of capitalism in Poland leading to a dramatic drop in the use of artificial fertilizers and an ensuing decrease in pollution.

• *Storage and application of silage.* Silage pits which are not properly protected may lead to nitrogen leaching into the environment.

• *Green fertilizers.* These are nitrogen binding plants, mainly papilionaceae, planted in the soil. If used excessively, they may become a source of nitrogen pollution in ground waters, as was the case with the original version of the Polish agro-environmental programme [Sobolewska, 2002].

• *Dust emissions into the atmosphere.* These occur when working in the fields in dry periods.

• *Surface runoff from fields, storage facilities and farmyards into surface waters.* Runoff is usually rich in nitrogen and phosphorus. A drop in the fertilizing rates in the early 1990's caused a decrease in this sort of pollution. This was observed in the falling volumes of nitrogen and phosphorus discharges into the Baltic sea [Niemirycz et al., 1996]. Since then these discharges have returned more or less to their previous volumes.

• *Contamination of ground surface by solid waste.* Abandoned agricultural machines, remnants of construction materials, household waste, pesticide and herbicide containers and mineral fertilizer packaging are frequently not properly disposed of. Metallic scrap has disappeared from illegal waste deposits, thanks to higher prices (due to global, and in particular Chinese, demand) and the growing pauperisation of the rural population, for whom selling scrap iron to junk merchants has become financially beneficial.

6. Selected anti-pollution plans and programmes targeted at rural areas

a) *The Rural Areas Development Plan* [2003]

Created by the Ministry of Agriculture and Rural Development for 2004–2006. Part of this plan is concerned with environmental protection.

b) *Agro-environmental programmes* [*Guide to the National Agro-Environmental Programme*, 2004]

These implement part of the plan mentioned above. They contain very detailed programmes of financial aid for farmers who join the programme and adopt certain practices on their farms.

c) *Code of Good Agricultural Practice* [2003] *and the Polish Code of Good Agricultural Practice* [1999]

The first includes agro-environmental programmes and is obligatory for the recipients of financial aid. The second was published in 1999 by the Institute of Soil Culture, Fertilization and Soil Science in Puławy as a set of instructions for appropriate environmentally friendly farming.

d) *National Plan of Waste Management* [2003]

This is a governmental plan created in 2002. It introduced the obligation of creating municipal and provincial plans for waste management, which must be passed by local councils and adopted by local authorities.

e) *'Environmental Protection in Rural Areas' Project*

This is a programme financed by the National Fund for Environmental Protection and Water Management with aid from the Nordic Environmental Finance Corporation, the World Bank and the Global Environmental Facility. A pilot programme in 1998–2003 was aimed at improving manure and slurry management on selected farms and thus at reducing the emission of nitrogen into the Baltic Sea [Rogowski, 2002]. The estimated reduction due to this project amounted on average to 0.001709% of mean Polish discharge in 1990–1999 [Manteuffel Szoege and Sobolewska, 2003]. If these project activities had been extended to all Polish farms, the percentages would have grown to a final steady state level in the 22nd year of the operation of the project of 1.069% of the total and 3.34% of agricultural discharge from Poland into the Baltic Sea.

f) *Act on Ecological (organic) agriculture* [2004]

The act of April 20th, 2004 introduced new regulations on ecological (organic) agriculture. It established the competencies of supervisory organisations and the principles of financial aid for organic farmers.

The difference in ammonia nitrogen emissions into the atmosphere between conventional and organic farms was estimated in 1997 by Wasilewski [1998]. The results of his research are displayed in Table 1. Reduced levels of livestock and the different structure of organic farming reduced emissions into the atmosphere from organic farms. This difference is about 2 kg NH_3/hectare/year, which means that ecological farms produce 13% less emission.

The difference between these two types of farming with respect to underground percolation of nitrogen in nitrate form has been estimated by

means of a simple model assuming the average level of fertilization in Poland in 1997 was equal to 48 kg N/hectare/year. This difference turned out to be 7.8 kg N/hectare/year *more on organic farms than on conventional farms*. The additional percolation (23%, the difference between 41.8 kgN / hectare/year and 34 kg N/hectare/year) was due to a much higher share of papilionaceae and spring wheat in the crop rotation on organic farms [Manteuffel Szoege and Sobolewska, 2001].

20 years earlier, when a much more intensive level of fertilization (195.5 kg N/hectare/year) prevailed, this difference would have been negligible.

Table 1. Emission of ammonia on organic and conventional farms

Animal species	Unit	Organic farms		Conventional farms	
	emission kg NH_3/gross unit/year	gross units/100 hectares	emission, kg NH_3/100 hectares/year	gross units/100 hectares	emission, kg NH_3/100 hectares/year
Cattle:					
cows	27.8	26.2	728	22	617
other	25	10.7	268	11	275
Pigs	30	6.6	198	17.5	510
Horses	10.4	0.8	8	4.2	44
Poultry*	0.26	366	95	2195	77
Sheep, goats	19	1.2	23	0.25	5
Total		45.5	**1320**	55	**1522**

* real units, data from 1994

Source: Manteuffel Szoege and Sobolewska, 2003.

7. Concluding remarks

We are most probably witnessing a growth in the entropy of matter and energy in Poland. Its sources lie mostly in urban areas, but is becoming more widespread in rural areas. This is reflected by growing disorder in space management. A process of the material, visual and acoustic, appropriation of three-dimensional space, which has the character of a common good, is also being observed. Indices of sustainable development, both general and partial, indicate a unsustainable pattern of development. The actions undertaken so far to counteract this effect have had a mediocre effect.

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