

Technical, Economical and Social Solutions for Integrated and Sustainable Waste Management Systems in Rural Areas in Romania

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Abstract:

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General Data

Location: Romania is situated in the south-east of Central Europe, in the lower Danube basin, bordering in East with the Black Sea

Area: 237,500 sq km

Population: 21 mil. Inhabitants

Capital: Bucharest – 1.98 millions inhabitants (2006)

Romania is divided into 8 regions, 41 counties, including 423 towns and municipalities, 2,859 communes and 12,951 villages.

Introduction

Romania enjoys an important yet underexploited development potential.

With an area of 237,500 thousand km² and a population of more than 21 million inhabitants, Romania is the second largest new member state, after Poland. It accounts for 6% of the total EU area and 4% of its population.

Investments and competitiveness in Romania still need to be improved in order to accelerate economic growth and secure income convergence with the EU. In 2005, Romania accounted less than 1% of the Community GDP, with the GDP per capita growing rapidly but still only representing 34% of the EU25 average (*NSI – Romanian Statistical Yearbook, 2006*).

Rural areas have substantial growth potential but, most importantly, play a vital social role.

According to the national definition, rural areas in Romania cover 87.1% of the territory, and include 45.1% of the population (as of the 1st of July 2005 indicators of National Statistical Institute), i.e. 9.7 million inhabitants. The average population density in rural areas has remained relatively constant over the years (45.1 inhabitants/km²). The OECD definition of rurality results in slightly different figures, but allows for international comparisons. Though similar in territorial distribution, Romania's population is significantly more rural. The share of Romanian rural population reflects the high incidence compared to the EU countries with less densely populated, smaller-scale settlements as an alternative to urban concentrations. Many of these rural communities make a small contribution to economic growth but preserve the social fabric and the traditional way of life.

Rural population is not evenly distributed.

There are significant differences in population densities across Romania. Most communes with less than 50 inhabitants/km² are clustered in the western part of the country, which contrast with the Eastern and Southern parts where communes with densities between 50 and 100 inhabitants/km² dominate. The most populated rural territories are in North East, where birth rates are high, and South, where a high degree of industrialization was achieved during communist times. There are important gaps, in particular as a result of the relief influence at regional and county level. In this context, the 24 communes and cities that are overlapping totally or partially with the Biosphere Reservation Danube Delta are to be remarked, where the population average density is of 28.7 inhabitants/km².

Major development opportunities can arise from restructuring the agriculture and from revitalizing the rural economy.

The contribution of the agriculture to the national GDP has been traditionally high. The Gross Value Added (GVA) of agriculture accounted for 12.1% in the GDP and for 13.6% in the total GVA (*NSI, 2006*). However, this remains low having in regard the unused resources. The population occupied in agriculture and forestry, for instance, accounts for a much higher share (32%), reflecting under-employment and low labour productivity. The restructuring of agriculture will have a tremendous impact on the wider rural economy, as farming continues to be the most important activity in rural areas, and an essential source of income for rural households.

The restructuring of the activities at farms' level and the capital intensification for commercial farms will definitively lead to using fewer work forces for improving the competitiveness. The experience of other agricultural systems, either of other EU Member States or of other countries represents a main testimonial on these lines.

Active population stands for 46.3% of the rural dwellers and can sustain rural economic growth if adequate incentives become available.

Rural incomes are relatively low and the gap with urban areas is widening.

The rural economy is poorly diversified and still depends upon the agricultural activities that has as consequence low incomes for the rural area entrepreneurs.

Concerning the households' incomes they vary from one household to another, thus in the rural area, the income average/person/month is of about 95 Euro, meanwhile in urban area is of about 135 Euro.

The income at rural households' level come especially from the agricultural production and ensure about 45% of the total income, in comparison with urban area where 61.1% comes from wages. The income average from non-agricultural activities at household level was in the year 2005 of about 12 Euro/month, representing only 4.1% of the net income (*"Social Trends"- NSI, 2005*).

Description and gap analysis of provision of services in rural areas

The rural areas from Romania are affected by the significant lack of the infrastructure of its deficiencies which impede both the economic development and the quality of life. The most important needs are linked to:

Roads

In rural areas, the roads are the most important transportation routes, but the quality and, generally the development of rural roads and traffic is far from the European standard. Only half of the communes have direct access to the road network, meaning that the current road network only serves 3/5 of the total rural population. More than 25% of the communes cannot use the roads if there are precipitations (*World Bank Study, 2004*).

Water supply

Adequate **networks for drinking water** are a key **the quality of life** problem as well as in relation to the development of economic activities in rural areas. Only 33% of the rural inhabitants (3.4 million inhabitants) have access to the public water networks and for the supply of hot water the situation is even worse (*MESD 2004*). Because of this situation, most households (70%) are forced to get their water from wells.

In 2003, 43.6% of the total length of drinking water distribution networks was located in the rural area and 56.4% in the urban area.

Public sewerage network

The public sewerage network is still in the incipient stages in rural areas; at the end of 2004, 373 communes (10% of the total rural population) had sewerage networks (*NSI - Romanian Statistical Yearbook 2006*). The differences between the rural and the urban area are also important in terms of sewerage infrastructure, with 93.2% of the pipes length being situated in the towns in 2003 and only 6.8% in the villages.

Electric heating

In the rural area, the connecting at the public network for electric supply still remains a problem. In Romania, there are a number of 37,977 households situated in 1,772 partially electrified rural localities and 3,327 households situated in 121 non electrified rural localities (*MIAR, 2007*).

District heating

The heating supplying services are limited in rural area, only 0.5% out the total heating energy being distributed in those areas, due to the fact that many of the factories that produced and distributed this energy to the boundary villages reduced their activities or renounced supplying those services.

Currently, as a result, only 26 rural localities at national level benefit of this service (results based on NSI data, 2005).

Regarding the thermo heating only 2.4% of the rural households benefit of this service, while 89% of the households use wood, coal and oil based stoves. (NSI, 2005).

Waste management

Generally, in rural area the services regarding the management of waste are poor developed or, in some localities, even inexistent.

Usually, the transportation of waste to dumping sites is made individually by each generator. Only a limited number of rural localities are covered by organized services for waste management, and in particular rural localities situated in the neighborhood of urban centres. Apart from the landfills in urban areas in Romania there are 2,686 dumping sites in rural areas, the most having a surface of 1 ha. The closure and cleaning of these spaces will be done until 16th of July 2009, in parallel with the extension of collection services in rural areas, the organization of transport and transfer systems and construction of zonal landfills.

National Rural Development Programme for the period 2007 – 2013 is focused in the village renewal and the priority will be given to integrated projects combining water supply, sewage and waste water treatment, and projects with regional operators involved in order to ensure appropriate technical solutions on local level in compliance with regional systems.

Further investment sustainability is ensured through the obligation of the communes to guarantee maintenance of investments. Selection criteria include priority to poor areas, projects integrated in local strategies and inter-commune projects.

For all investment measures advance payments will be available to facilitate the private co-financing.

Type of services/action supported will be:

- Construction of new roads, extension and improvement of local roads network (commune roads, vicinity roads, and streets within communes), which belong to the public propriety of the administrative territorial unit (the commune) in which they are located, according to the definition and classification of the national law in force;
- First establishment (set-up), extension and modernization of the infrastructure for water (collection, treatment stations, water supply) for the rural settlements with less than 10,000 equivalent population (e.p.);
- First establishment (set-up), expanding and improving the wastewater network (sewage, wastewater cleaning stations) for rural settlements of less than 10,000 equivalent population (e.p.);
- First establishment (set-up) and extension of low tension electrical energy distribution network and public lighting network with high energetic efficiency;
- First establishment (set-up) and extension of the public gas distribution network towards other rural towns and villages or towards other rural areas which are not linked to the network;

Investments in transfer stations for waste and purchase of related equipment for waste management (*transfer stations - installations used for the transfer of waste or for the waste storage for short terms following that to be load by compression in the pres-container and transported in order to be recycled, treated or eliminated*).

Waste management systems

The collection of household waste is not generalized at a country's level.

The generated quantities are estimated at 0.9 kg/capitaxday in urban areas and 0.4 kg/capitaxday in rural areas.

In 2006, the municipal councils and the sanitation operators have collected household waste from 79.53% of the urban area population and 11.44% from the rural area population, that is, at a national level, an average of 48.84%.

The quantity of municipal waste collected (including household waste) in 2006 was at the level of 6.8 millions of tones and the quantity of municipal waste no collected estimated at the level of 2.06 millions tones, a total 8.86 millions tones that represents 2.76% of the total quantities of waste generated in Romania (409 kg/capitaxyear).

The percentage of selective collection of municipal waste is 2% and out of a total of generated municipal waste, approximately 98%, are deposited each year.

There are not many studies performed on the rural waste characterization, but from the existing data could be considerate the following values:

- paper and cardboard – 5%;
- glass – 4%;
- metal – 2%;
- plastics – 6%;
- wood – 3%;
- biodegradable – 70%;
- others – 10%.

Generated quantities are estimated at 0.4 kg/capitaxday, but in some areas the measurements showed values of 0.5 to 0.6 kg/capita x day.

The evolution of waste management systems in EU and the present situation in Romania are presented in Figure No. 1.



Figure No.1 – Evolution of waste management systems and the present situation in Romania

Conclusions

- collection, transportation and disposal of municipal waste is the municipality responsibility, directly, through the specialised departments within the Local Boards, or indirectly – by granting this duty to special sanitation services, on a contract basis;
- the sanitation services exist and operate mainly in the urban areas;
- the lack of sanitation actions in communes and villages excepting several communes located near the great municipalities and towns;
- budgets of austerity which do not provide funds for important sectors of environmental protection, in general, and sanitation, in particular;
- insufficient support rendered by competent state bodies to private sector;
- negligible actions of ecological parties and non- governmental organisations to promote solutions and measures for sanitation;
- legislation should be harmonised to the technological progress (Waste-to-Energy, Anaerobic Digestion, Home Composting, “Zero Waste”, aso);
- activities of selective collecting, recovery and recycling are not profitable and should be supported by the Romanian Environment Fund;
- costs should be reasonable and accepted by the population (supportability - 1,5% of monthly income – present tariffs of 0.2...1.2 Euro – enough for maintaining but not for develop the existing waste management systems);
- population - “willingness to pay” - has not been analyzed in Regional Waste Management Plans (Iasi – 1997 – USAID study, 2006 – RDNIIEP study – some answers – 1) water supply, 2) heating, 3) transportation, 4) education,... parks,...waste).

Future solutions for rural areas

National and Regional Strategies for Waste Management for the period 2008 – 2013, include actions as are:

- Reduction of the impact on the environment due to the existing landfills that are not in compliance with UE legislation;
- Implementation of selective collection systems (household waste);
- Construction of transfer stations;
- Construction of WEEE collection centers;
- Construction of composting plants;
- Construction of landfills (one for each county);
- Construction of recovery plants.

From the above mentioned actions in the case of rural areas are considered as appropriated:

- Reduction of the impact on the environment due to the existing landfills that are not in compliance with UE legislation; there are over 1,000 uncontrolled dumps in rural areas in Romania (as an example in Bistrita-Nasaud County there are 175 uncontrolled dumps in rural areas);
- Implementation of selective collection systems (household waste);
- Construction of transfer stations with or without manual sorting plants, completed with the regional/county installations for recovery and disposal as sorting, composting, MBT and landfill.

Investment costs will be covered by Romanian State and EU but the operation and maintenance costs will be supported by the population.

In the period 2006 – 2008 has been elaborated and verified an economic model for the evaluation of transportation costs of the waste generated in rural areas to the regional/county installations for recovery and disposal as sorting, composting, MBT and landfill.

The model takes into consideration:

- number of population connected (served) at the selective collection and transfer station – 10,000/15,000/20,000/25,000/30,000/35,000/40,000/45,000/50,000 and 75,000 inhabitants;
- maximum distance to the regional/county landfill – 50 km;

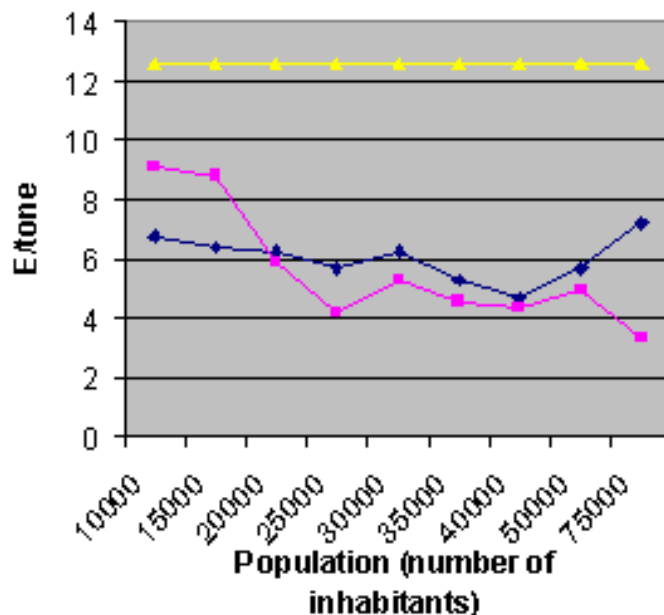
- investment costs - roofed area, machinery (transfer vehicle with 2 containers 24 m³ per trip), hook lift with trailer, container;
- operation cost – repair and maintenance of building (2% of investment per year); repair and maintenance of vehicles including tires; petrol consumption; consumables (electricity, water, wastewater, aso; salaries;
- daily operation system – a) operation of 3 transfer stations with one vehicle; b) operation of 2 transfer stations with one vehicle; c) operation of 1.5 transfer stations with 1 vehicle; d) operation of 1 transfer stations with one vehicle;
- operation systems – direct transportation without transfer station; transportation from transfer station/stations; transportation from transfer and manual sorting stations.

The model has been verified together with a county operator in the period 2007 – 2008.

The results are presented in the Table No. 1 and Figure No. 2.

Table – Transportation costs of waste generated in rural areas at 50 km for three different systems

Population connected (number of inhabitants served)	Direct transportation (E/tonne)	Transfer Station (E/tonne)	Transfer and Sorting Station (E/tonne)
10,000	12.58	6.80	9.10
15,000	12.58	6.37	8.80
20,000	12.58	6.24	5.87
25,000	12.58	5.73	4.20
30,000	12.58	6.24	5.32
35,000	12.58	5.35	4.56
40,000	12.58	4.68	4.34
50,000	12.58	5.73	4.96
75,000	12.58	7.25	3.37






	Transfer station
	Transfer station with manual sorting station
	Direct transportation

Figure No. 2 - Transportation costs of waste generated in rural areas at 50 km for three different systems

Conclusions:

- transfer stations assure the a lower operation and maintenance costs if the minimum transportation distance is 50 km, population connected (served) minimum 25,000 inhabitants, daily transportation of waste from 2 transfer stations with one vehicle;
- transfer stations with manual sorting stations assure the a lower operation and maintenance costs if a) the minimum transportation distance is 50 km, population connected (served) minimum 25,000 inhabitants, daily transportation of waste from 3 transfer stations with one vehicle; b) the minimum transportation distance is 50 km, population connected (served) minimum 75,000 inhabitants, daily transportation of waste from 1 transfer stations with one vehicle.

It is very important to be taken into consideration from the beginning the construction and operation of transfer stations including sorting stations in the rural areas, due to the fact that at the level of 2013 in the Romanian rural areas will be generated and collected 1,478,952 tones/year of household waste form which:

- paper and cardboard – 114,462 tones;
- glass – 55,190 tones;
- plastics – 114,744 tones;
- metals – 48,119 tones;
- textiles – 35,136 tones;
- biodegradable – 939,127 tones.

The recyclable materials sorted from the rural household waste in the sorting stations will represent an income for the community and will decrease the tariff paid by the population for waste management.

The results started to be taken into consideration by design companies which consider that is a “real figure” for operation and maintenance of processing installations located in rural areas comparing with the “standard figure”, 2.5 Euro/tonne, presented in Order 951/2007 of Minister of Environmental Protection and Sustainable Development.

Based on feasibility studies and technical design projects the investment costs for a transfer station are 250,000 Euro for a population of 25,000 inhabitants and the investment costs for a transfer station with manual sorting station are 1,200,000 Euro for a population of 75,000 inhabitants.

Rural population supportability to pay the waste management tariffs

Population supportability to pay the waste management tariffs is considered to be between 0.75 – 1.7% of the monthly average income (World Bank Report).

Population supportability in Romania is considered, theoretically, to be 1.0 – 1.5% of the monthly average income (Order 951/2007 of Minister of Environmental Protection and Sustainable Development).

In order to verify the model, has been realized in 2008 some sociological investigations at the level of the rural population from Region 1 North – East of Romania, region that is considered to be one of the poorest regions from EU (theoretically supportability value – 1.7 Euro/capitaxmonth).

The sociological investigations were realized in the commune Milisauti and the population supportability for operation and maintenance of an future waste management system (selective collection, transfer station without sorting station) has been established at the level of maximum 1.14 Euro/capitaxmonth) which represent 68.17% of the theoretically supportability value and an optimum value of 0.83 Euro/capitaxmonth) which represent maximum 60% of the theoretically supportability value.

The sociological investigations results has confirmed the results obtained using the economic model for the evaluation of transportation costs of the waste generated in rural areas to the regional/county installations.

FINAL CONCLUSIONS

- The Romanian National Rural Development Programme, including new and modern integrated waste management systems, should be implemented in Romanian rural areas in order to fulfil the obligations assumed by Romania as a State Member of EU.
- The present rural economy has somewhat differencing features depending on the regions, set by the demographic and social features and the economic specifics. This is especially true in respect to poverty in Romanian rural areas which is reflected in a low living standard of the population and lack of alternative revenue sources.
- The investment cost will be supported by Romania State and EU.
- The present targets are not realistic (example – implementation of selective collection of household waste generated in rural areas until 2010) as time limit and population supportability.
- The existing problems should be not unevaluated, as are:
 - *Communication* - Some local authorities does not cooperate, there is not a good coordination between different departments and not enough consulting activities with the local interest groups;
 - *Financial* - In the present the costs for the implementation of an efficient management of waste are too higher for municipalities and population (for maintenance and operation);
 - *Capacities* - luck of experts, and not only, at central and local level, luck of qualified personnel for the implementation and enforcement of legislation and projects;
 - *Authorization process* - in Romania - 243 days (World Bank Report).
- The “real supportability” of Romanian rural population to pay the waste management tariffs is under 50% of the theoretic value (experience – National Program for Implementation of Drinking Water Supply in Rural Areas in Romania – in the present a part of the population is not able to pay the tariffs and request to be disconnected from the existing drinking water network).
- Tariffs of public services in rural areas, including waste management, should be supported by State through the local administration until the rural communities will became “sustainable” under all the economical aspects. It is considered that the population from rural areas will be able to pay the tariffs only after 2013 even that the systems will be put in operation in 2009 (example - population will start to work at the investments realized in 2009 in agriculture, small local industry, tourism, aso but will take 4 to 5 years of specific rural economic activities to generate the necessary funds to cover the “secondary activities” represented by public services).
- The presented model elaborated and verified in the period 2006 - 2008 offer a possibility to local administration, design companies, private investors and banks to evaluate the “real supportability” of the Romanian rural population to pay the tariffs of future investments and to start, implement and develop local sustainable and integrated waste management systems.

References:

- National Rural Development Program for the period 2007 – 2013, Government of Romania, Ministry of Agriculture and Rural Development, 2008
- Alexei Atudorei, Luminita Gabriela Atudorei – Transfer Stations, Salubritatea, 2006
- Luminita Gabriela Atudorei – Integrated Systems of Engineering Works for Environmental Protection in Rural Area, PhD Thesis, Technical University of Construction, Bucharest, 2008
- Luminita Gabriela Atudorei – Performance Indicators for Waste Management in Rural Area. Economic Aspects Concerning the Costs of Services and Population Supportability – Salubritatea, 2008