Solid Waste Management in Garla Mare

Managing the beauty of the Danube Delta

Part 3:

- ***Gender and mangement.***
- ***Conclusions and recommendations.***
- ***Literature and annexes.***

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This report is written in three parts. This is part three of the trilogie on waste mangement in Garla Mare.

- *The first part* dexcribes the contemporary solid waste mangement in Romania and in Garla Mare. The local situation, governmental organisation and legislation is described here. This part can be reused for other projects concerning Garla Mare.

- *The second* part deals with solid waste management techniques, such as biogas installations, composting, recycling of plastic and open burning of household waste. This part can be reused for other projects concerning waste management.

- *The third part* discusses the possible sollutions from which the villagers can choose to deal with their solid waste mangement in an environmental friendly way. There is a recommendation from the author, but local circumstances might still have some unxepected surprices, wo that another sollution might fit better. With the knowledge of this report, the villagers will be able to judge the situation and the proposed sollutions from all stakeholders better.

Content

11. Gender and solid waste management.

There are some point to be made on the gender specific problems of solid waste mangement:

In Romania most women are responsible for the household. This means that it is women who know and decide what is useful and what is waste within the household. They are also resposible for dividing waste streams.

Women and men (and also children) are almost certain to have different (and not always overlapping) knowledge of waste disposal places in their neighbourhoods. In Garla Mare, the men bring the solid waste to the landfills.

Women are far more likely than men to be involved in handling, cleaning up, or being associated with faecal waste, especially from children. It will be interesting to find out who is responsible for the cleaning up of animal waste in the households.

The boundary between household and community is an important one, as it is at this point that discarded objects pass from the individual property of the household to becoming the community's waste stream; This boundary, also a gender boundary in relation to waste, often defines the limits of women's autonomy and control of waste materials.

Women "have to" handle waste in their homes: it is part of the definition of who they are and what they do, and no-one considers it strange or unfair that they do not get paid, even when these activities extend beyond the home to community cleaning. Women who are able to afford it may pass this responsibility to servants. Men, on the other hand, tend only to handle waste when they are paid for it, or when it is specific to their activities.

A key milestone in the process of urbanisation or "development" is creating systems to manage waste outside of the household, rather than within it (where it traditionally is handled by composting, burning, burying, feeding to animals, reusing, or the like). It then becomes the responsibility of women to take the waste to that point at the boundary of the household. In some cultureit is not accepted for women to tresspass the border of the household, in Garla Mare women stay at home more then men, but they are free to move outside their households.

This point, which can be referred to as the "point of set-out" is the point at which whatever has been defined as waste is placed outside of the household for handling by whomever or whatever institution is understood to be responsible for waste. It is at this point that ownership of the waste actually passes from the household to the community or city.

If this reasoning is correct, any process of urbanisation or development will tend to reduce women's relationship to controlling the handling of waste materials by creating the expectation that those materials will be handled outside of the household, that is, outside of women's area of control. When this happens, women's access to and control of the resource components of waste is likely to decrease, and their experiences of recovery become less relevant.
Waste, 2001

Women are partners when it comes to awareness-raising and motivating others, thanks to their pragmatic knowledge of the environment, the sanitation issues involved and their ability to settle conflicts in the neighbourhood. In *Cebu City*, two-thirds of the members of the public hygiene surveillance teams set up by community organisations are women.

Women turn out to be messengers of social transformation and political modernisation. Projects show that if they are in a dominant position economically, then they do not become marginalised. Beyond their role as actors in the popular urban economy, women contribute to changes in sanitary comportment as

intermediaries in awareness-raising and as managers of community services. The participation of women, henceforth visible and recognised by the authorities, would seem to be symbolic of the underprivileged classes asserting themselves and becoming mobilised.
Anschütz, 1996

It is extremely interesting to see the gender division in terms of when waste is considered a social responsibility and when it becomes a technical one. The ‘switch over’ reflects some interesting underlining issues in terms of gender and waste management. Experience with community based enterprises tends to reinforce the insight that women may often be involved at a civic activity level, but when there is an opportunity to institutionalise “volunteer” or civic-minded activities, it is overwhelmingly men who are selected for paid labour. Even when women participate, it is unusual for them to work outside of stereotypically acceptable women’s roles in administration, communication, or “making the coffee”.

In terms of the formal planning process, participants’ contributions pointed to the fact that gender analytic tools are important (and generally neglected) in any waste management or recycling diagnostic, assessment, or planning process. Specific tools mentioned in practice include community mapping and transects, separate-sex planning meetings, and stakeholder analysis. Here, the feeling was clear that there is a continuing need for analysis, for new theory, and the elaboration of insights into intra-household economic relationships, service and logistics preferences, willingness to pay, location for primary and secondary collection points, final disposal, separation protocols, and related factors. In this area, the main need for additional work would appear to be focused on using gender tools to improve the environmental, social, and economic performance of waste handling systems, rather than specifically for the purpose of benefiting individuals or groups of women. This suggests that a follow-up activity might include a gender component in waste planning processes, and/or the addition of gender information to manuals, technical documents, and the like.

The body of work in gender and waste is not large. While certain individual projects have integrated gender and waste, there is not a ready source of information nor well-known resource documents. In the case of policy and planning, even the questions have not been well-articulated.
Waste, 2001

12. How to start an integrated sustainable waste management?

Community participation in solid waste management may take different forms or levels. Community management is one of them. Real community management, involving all three aspects of responsibility, authority and control, is not very common in solid waste management in urban low-income neighbourhoods. Local leaders, formal and informal, women and youths often have special roles in community-based solid waste management. Organizational structures differ, depending on locally variable partnerships between different agencies. As a rule, in community management of solid waste management, there is an active community-based organization, an existing CBO or a newly established one.

The most important social and management problems faced by community-based solid waste management projects appear to be motivational issues and cooperation with municipalities. Motivational issues refer to the motivation of participating households and their servants, of operators and managers of solid waste services. They have crucial roles in the functioning of the service. These groups are all affected by the low status of waste and its dirty image, resulting in low willingness to participate in recycling and collection, unreliable service, and low willingness to manage.

Education appears to be an inadequate solution for these problems. Education alone does not seem to be enough to change the behaviour of households or to increase their willingness to pay. Moreover, it has to be tuned to the benefits of the solid waste service as perceived by the target community.

Another major problem is the failing of the central collection, which can undermine the motivation of the community undertaking collection and household level and offering the waste at the right time, place and in the right package. Bad coordination collection, illustrated by accumulated garbage at transfer stations, is a problem that is mentioned by most community-based initiatives. The bad performance of the municipalities in this respect is rooted in a lack of funds, inappropriate equipment, inefficient management, and unskilled personnel.

Other important managerial problems are those related to financial issues, because these determine reliability and sustainability of a service for a major part, notably inadequate fee collection and lack of sanctions for non-payment. It has to be noted that community-based solid waste recycling and collection projects face different problems. There is also a difference between projects that operate with or without (ex)waste-pickers.

As we have seen, the empowerment of city dwellers to manage services, making them durable, goes by way of making residents responsible for environmental issues. This goes further than informing them by means of campaigns: it means they must become genuinely involved and be consulted at all stages of a project, so as to integrate their cultural habits, their sanitary behaviours and social rhythms and to recognise their informal practices in the management of refuse.

Research topics and questions concerning social and management problems in solid waste mangement projects that should be considered formulating a project are:

- Community management:
Who has taken the initiative for the solid waste service?
How has it become a community activity?
Which conditions have to be fulfilled to create willingness to manage?

- Motivation
With which incentives are households stimulated to participate?
Which incentives can be used to motivate operators and managers?
How are city competitions organized and what makes them effective?

- Education

Which combination of incentives and education is needed to influence behaviour of households?
Which kind of education is needed in this respect??

- Finances
Which factors determine willingness to pay for a solid waste service?
Which tariff systems, ways of payment and sanctions do function and in which circumstances?
What experiences do exist with cross-subsidies sharing income from different services or different income groups?

- Women
What is the role of women in community based solid waste service?
Which conditionsdetermine womens involvement?
Are women more motivated for operation and management of community based solid waste management projects than men?If so, why?

- Cooperation
How can cooperation between formal (governmental-related) and informal (NGO, CBO, traditional leaders etc.) leaders be improved?
How can primary and secondary collection become better integrated?
How can the informal solid waste sector be integrated in community based management?
Anschütz, 1996

13. Conclusions and recommendations

Local situation

Since Romania changed from a communistic regime towards a more democratic and capitalistic system, agricultural development stagnated. The lack of jobs in rural areas in Romania, is worry number one. Garla Mare is situated in such a rural area. There used to be a lively corn and pigindustrie, but this ceased to exist.

The living conditions in Garla Mare are hard: there are no drinking water supply and gas sypply. The roads are in bad condition, people use mostly a horse and wagon for transportation. Transport must be done with local means, that might be horses, but tractors are possible. Weather conditions influence the roads, this might cause logistic problems while collection solid waste. Drinking water comes from public and private wells, the sanitory system consists of pit latrines. There is also no local solid waste management programm.

There is no local waste management system in Garla Mare that organises a save disposal of household waste. All solid waste is disposed of at the edge of the village. Citizens throw their waste down the steep slopes towards the Danube and the North of the village. Rats and other rodents are seen frequently.

People don't know how dangerous waste disposalor open burning of waste is for their health and the environment, they sit amongst their waste when they wait for their cattle to arrive. In Garla Mare citizens throw even dead animals at their landfills.

Somehow there is not much information about the dangers of living around solid household waste in literature. Given the bad information level on the dangers of on-site landfilling, chances in eco-tourism are much more motivating to develop a solid waste management programm then the public health concern.

Garla Mare is situated on the banks of the Danube. The village is situated on a small hill, the slopes towards the Danube are steep. The slopes surrounding the village are very vulnerable for erosion. Some sites already show signs of erosion.

The top layer of the soil consists of clay, under this layer are more sandy grounds. Given the thick clay top layer, starting a proper composting site might be done in the north of Garla Mare without having to built a water resistant floor. This needs further research.

The sandy grounds are situated on, again, a clay layer. The slopes towards the Danube contain hardly any clay, in these slopes are springs situated. Sipot is one of the major springs in Garla Mare, the local authority wants to use it for a drinking water supply. The groundwater that ends up in the springs is transported in the more sandy and calcium rich layer.

Governmental organisation and legislation

After the overthrow of the communist regime, environmental protection restructuring did take place. A ministry of Waters, Forests and Environmental Protection was established, the main actor on governmental level involved in environmental policy development. The ministry works

together with the 42 Counties and the 41 Environmental Inspection Agencies (EPAs). These inspections are responsible for reinforcing environmental law and providing permits. Unfortunately the staff of the EPAs have hardly any means to implement practical measures. They also are not properly informed about new legislation and dealing with public participation is new. Public participation is something that could be initiated by WECF. This new item in the Romanian legislation is familiar to WECF. They could train Geo-san in public participation so that they can demand their rights on environmental data according to Law 426.

The EPA already showed interest in the composting site that might be built. They want to be involved. It will be good to have them in, they know the newest regulations, or know how to get to that, and they will deal with the permits for the waste management as well. Maybe they want to be involved in an educational programm for local governments, public e.d. concerning solid waste management and European legislation.

A Directorate of waste and dangerous substances was set up within the ministry of Water, Forests and Environmental Protection. Because of the harmonisation with the European legislation, a new environmental law has been developed. Following from these new regulations, also a new waste management legislation is under construction. It is not completely clear is the legislation contains already detailed measures and rules. Romania requests a transition period of 10 years, until 2017 for the implementation of Council Directive No 99/31/EC on landfilling of waste. The local government and EPAs have to convert the national legislation into pratical measures, this means that staff with little means have to implement regulations. It is to be expected that the implementation of solid waste management regulation differs from County to County and from EPA to EPA.

However, some general remarks can be made:
The government is developing a plan for national central collection and landfilling.
There will be a monitoring programm for sites that deal with solid wastes and reusables. This means that, amongst others, data on the kind of garbage and the location where it comes from must be registrated.
Participants have to apply for a permit for any construction or activity that might influence the environment.
Solid waste can only be stored on grounds that are appointed by the national government.

This means that the national government wants to control landfilling by means of the Counties and the EPAs. That solid waste management is a national issue does not mean that measures will reach rural areas. Even in the USA the rural areas have no proper waste care, though the means and knowledge are there. It is not wise to take the risk of being overthrown by new national legislation over some period of time, but it is also not wise the wait for the legislation, this will take some years. But building a landfill on not appointed grounds is a great risk, it will probably have to be removed in the end.

If the main reason for solid waste management is the eco tourism development plan, it could be wise not to start any landfilling activity in Garla Marel. The looks and smell will not invite guests. Signs of recycling and composting might give a better eco-image that matches the eco-tourism image.

We could already offer solid waste management according to European legislation. We can start a solid waste diverting program and take other measures according to the European legislation to be sure that our solid waste management program will not be overruled by new legislational developments.

Solid waste management in Romania

Solid waste management in Romania is organised in the larger cities, but not in villages in rural areas. There are not many central collection systems and landfills available in Romania. The fact that there are not many national recognised landfills, will probably mean high transportation costs for transporting waste towards an existing landfill. Diverting en resue of waste reduces these costs.

Most of the existing landfills are not in compliance with the new environmental legisation. The national government is working on the establishment of a central collection management, more lanfills and 5 incinerators, but those goals are plannend for 2010 – 2015.

There are some national principles on paying for waste management: The polluter pays. This means that households, waste producers and others dumping at landfills will have to pay for the disposal of their garbage. Given the economical situation it will be hard to let people pay for a waste management system. A system with fines for littering might be more appropriate, the national policy will probably disfunction in Garla Mare. Burning household waste in the USA also takes place because citizens don't want to pay taxes, there is no collection system or the collection is inconvenient. This shows that people might try to avoid the central collection when it needs to be payed for. Other alternatives are giving receits for collected properly diverted waste that add up to a tax relieve or the free collection of diverted waste while people have to pay for collection of non diverted waste. Or the free disposal of diverted waste on special spots in or around the village while central collection costs money.

Household waste in Romania consists mostly of organic waste. There is not much paper waste. In the winter there is a vast amount of ashes, up to 30%. 10% of the household waste is plastic. The mix of household waste is different in Romania then in Western Europe. The use of a vehicle crushing waste together is useless because of the high amount of organic waste. An advantage is that seperating organic waste and ashes from other waste and reuse it for other purposes diminishes the amount of household waste probably with 80 – 90%. This makes the transport of non reusable waste to landfills much cheaper.

The tools for reuse of solid organic waste described in this report are: Open burning of household waste, waste spreading, composting and biogas production.

Burning household waste

Burning household waste causes air pollution. This pollution consists of particle matter, dioxines (mostly from PVC),, carbon monoxide. PAH, VOC and nitrogen oxides. These pollutions have adverse effects on lungs and veins. The dioxines settle on plants that cattle eat, humans eating milk, eggs and meat from these animals accumulate dioxines.

The combination of particulate matter from household waste burning with dust from fields and roads, makes the health effects even worse.

The ashes contain substances like dioxins and heavy metals. They will pollute soil and groundwater.

The contemporary air pollution from burning household waste at the landfills must be stopped.

Waste spreading

Waste spreading must be seen as a measure to prevent organic waste and it's nutrients ending up in a landfill. Waste spreading means spreading household organic waste on fields, leaving it there to biodegrade. There is no control of pests. The big advantage is its economics.

In winter we cannot spread waste on the froozen fields. In that case there must be a storage facility. Actually, all organic waste recycling option have the disadvantage of being more or less inactive in winter. Only the biogas installation can be heated in winter and continue to work.

There is a risk of spreading pathogens and pests through the fields and affecting wild live and herds. When applied on the farmers own land, a cycle of pathogen infections might occur. This can also be the case if waste from plants have diseases and are spread upon cropland again. Other environmental effects can be run off of nitrates or aeaerobe circumstances in the soil. This reduces plant growth. Here we see the advantage of composting clearly.

Waste spreading is probably the cheapest sollution for recycling organic waste, but the EU must be convinced that waste spreading is done in order to recycle the nutrients, not in order to dispose of garbage cheap. This can be proved by registring the source of the waste, and reporting about the results of waste spreading. It is probable that under the new environmental law a permit is needed for waste spreading in Romania.

Public acceptance of waste spreading is important, some customers don't want food from fields that have been waste spreaded. There are many empty fields in Garla Mare. Since no products are kept on these fields, customer acception is not an issue.

We could start with waste spreading, and growing trees for burning wood on the fields that are now empty or other not easy to steal crops, that provides the local government an income with which the transportation can be payed for. To prevent odour and erosion, we supply, plow and plant directly.

Composting

Composting organic waste is an aerobic process, during which bacteria brake down complex materials into organic materials and mineral nutrients that can be used as a soil conditioner and for improving plant growth. Separation of organic waste at private home results in the least polluted compost.

The erosion at the slopes of the village are already 'treated' with organic waste. Luckily villagers decided to prevent erosion by filling the slopes with solid waste, this already decreased erosion. The application of compost on eroded spots should prevent losing living area, especially if this is combined with planting bushes.

Compost releases nitrogen slow, but improves plant growth after various applications. The application of compost also decreases the effects of erosion. The combination of compost with

mineral N-fertiliser yields the same effect as the use of a mineral NPK- fertiliser. Because of the high organic content of compost, herbicides and pesticides stay longer in the soil. A lower amount of these substances can be used.

Open windrow composting seems to be the best composting method for Garla Mare. The biological process is not fulnerable to management mistakes and the construction is much less expensive than other composting options. There is not much literature on composting in winter in cold areas. The composting process will decrease, the amount of organice waste will increase during winter.

The location must be choosen properly, far from areas that can be flooded or are protected wetlands. Also groundwater protection must be taken into account. Especially since the concentration of nitrates in the is already high, we must prevent the composting site from polluting drinking water with more nitrates. There must also be water available at the site for watering the compost. The wind direction and odourproblems should also be taken into account in the choice of the location. The location will probably be best north of Garla Mare (wind direction), on a thick clay layer (groundwater protectoin), near the fields (transportation costs). The site itself must provide such a floor that water running of can be reused at the composting site. We msut think about the water used for watering the compost, if there is much atrazine in that water, the compost might get higher concentrations of atrazine after watering..

The composting site itself can be organised in such a way that mixing one pile automaticaly yields a new pile,ais the piles are in rows, we have 'moving' rows of different maturity. This improves the efficiency in the site. The compost must be protected from weather influences like sun, rain and snow. Reusing the water from the site saves water and improves the compost quality. Composting can also be done with a combination of piles in layers and passive aeration. But we must be aware that the pipes might be stolen from the composting site.

Composting can also be done in small units situated at the border of the village. In Belgium neighbourhoods have their own composting unit for garden waste.

Composting usually is not profitable,even if the compost can be sold. Mostly it is (partly) financed by local governments as a part of the solid waste management program. Apart from the investment in the composting site, transportation costs and workers must be payed.

There are other options for reusing organic waste and compost:

In Germany there is a special fertiliser made from the organic waste from ecological grapeprocessing industry. Most of the fertiliser comes from the stones. This fertiliser is sold in Germany for 19 euros for 7,5 kilos.

The mushroom farmers in Germany use straw and organic cow waste for growing mushrooms. This can also be done with a combination of straw and organic waste from chickens.

It might be worth to find out is the urine from the dry diverting toilet can be used as a N-fertiliser in combination with the compost. Maybe a mix of these substances gives better yields..

Biogas

Biogas production is a biochemical process in which bacteria feed on organic waste and produce methane and other gases under anearobic circumstances. Controlling the process is quiet complicated. PH, temperature, water content and feedstock determine biological processes and thus the gas production. After processing organic waste a slurry stays behind that can be used as a fertiliser or soil conditioner if the quality is according to standards. That means no pathogens, low heavy metal content etc. this slurry has better fertilising properties than composted manure.

The pasteurisation of the sludge, and with it weed seeds, animal and human waste will happen during the biogas production. The European Union has set standards for pasturising organic waste, it should be heated at 70°C for at least one hour. But other sources claim that lower temperatures over a longer period have the same effect. Given the Romanian project from the University of Timisoara, Romanian legislation might differ from the European standards at this point. If human waste is used, not only the pasteurisation must be taken into account, also the transportation of human waste to the biogas installation must be safe.

Designing and constructing a biogas plant is rather complex. This requires special experts advising on the feedstock, mixing devices and other construction elements. The size of a central biogas installation is huge, the height can be 20 meters. A biogas installation should be built into the ground to fit into the landscape, in this way the attracting surroundings for ecotourism aren't ruined. The installation can cause odour problems if it functions not properly.

Because of the climate, the biological process will decrease in winter and special measures have to be taken to avoid this. Heating the biogasinstallatingin winter will cost biogas. If the biogas production stops in winter, there must be a facility for storing the produced organic waste.

Building, maintaining and operating a biogas plant is expensive. Every day the installation must be taken care of by proper trained workers. The investment and maintenance costs are probably too high for the local community.

Tools for recycling of non organic waste:

Plastic recycling

Plastics are mostly polymers such as polyethylene (PE), polypropylene (PP), polystyrene (PS) and polyvinyl chloride (PVC). The additives such as flame retardants, pigments and stabilizers are the most harmfull substances in plastics. PVC is an exeption, the chlorus in PVC is also harmfull if PVC is burned.

Plastic is a solid waste that does not biodegrate.The polymers themselves don`t pollute the environment, but their additives might leak. Research does not show much pollution from landfilling plastics, including PVC. Burning plastics on the other hand is more dangerous to public health.

Plastics can be recycled by reheating and extrusion. Large companies usually don't buy recycled material because hard rests within the plastic might ruin their machines and interrupt their production processes. The process of recycling plastics starts with collection, cleaning and sorting. Diverting plastic from other kinds of waste must be done at home, this gives the best results, prohibiting pollution of plastic by other waste.

The material has to be cut into smalles pieces that will fill the extruding machine. Size reduction of plastics can also save room in landfills. Since landfilling of plastics does not pollute the environment much and there is not jet a huge amount to be recycled, proper landfilling of plastics is an option to be considered.

The recyling of plactics is environmentaly friendly because it saves raw materials, energy and water. On the other hand, during recycling waste water and fumes are produced. The handling of waste water in Garla Mare is not organised. The waste water from cleaning the plastic recycling might contain toxic substances such as motor oil. With this waste water must be delt during recycling in this way.

It is not usefull to start recycling when the market is not research properly. After the communist regime, no citizen was trained to work in a kapitalist environment. In other words: a marketing training learning citizens about starting enterprices and researching markets is necessary to start a succesfull business. Contacting the Rabobank and applying for the project on small loans will make citizens more aware of the kapitalist business environment. This will increase self supporting behaviour, thus decreasing the dependence on funding.

There is much plastic laying around that can be used, but the stream of new plastic waste in Garla Mare is not very big. Probably a recyling process using extrusion of recycled plastics requiers importing plastics from other villages as wel.
Simple measure might also help: Forbidding shops to use plastics bags or selling plastic bottles. The local government or WECF could provide textile shoppingbags. Asking shops to buy articles with little plastic packages.

Of course we could also try to avoid plastic waste by asking shops to sell plastic bags instead of giving them away. Or by asking them to avoid products with plastic packages.

Heavy metals
Heavy metals in organic waste spoil the produced compost or biogas sludge. It seems that heavy metals are not a main source of pollution coming from household waste in Garla Mare. But future economical growth might induce a growth hazardous waste. So it is important to start already with a separation of hazardous waste, to make people aware of the dangers of these materials.

There should be a special location for storing these hazardous wastes and other waste that cannot be reused on the spot. This requiers a permit from the EPA. After collecting this waste, it should be transported to a national landfill or incineration plant.

Landfill reclamation
Cleaning up the existing landfills is done in countries where land is scarce. The material in the landfill is filtered and the organic material might be reused if it is not polluted by hazardous wastes. Landfill reclamation can unearth hazardous materials that are difficult to manage, it is costly and the site collapse or erode during the process.

One of the big advantages of cleaning the contemporary landfills in Garla Mare, is the removal of all the plastics. When we leave the landfills unattended, the organic material will cease to exist and every year new plastic from older layers will appear.

Total cleaning is unfortunately no option because of the erosion risk at the steep slopes. On horizonzal sites however, that have a thick clay layer, landfill reclamation is an option. The best option is probably to search the top layer for plastics and plant trees or bushes to prevent plastic from being blown around and to prevent erosion if the organic material is biodegraded after some time. We have to think of plants that are not eaten by the herds and horses grazing there.

The surrounding might also look better, if some park management is included, some nice spots might be created to sit and enjoy the view. This improves the circumstances for tourism.

The nitrate concentration from the organic waste, which runs now easily of because fresh manure is applied, will decrease over time if an alternative waste disposal program is started together with the cleaning of the contemporary landfills.

Management

The most important social and management problems faced by community-based solid waste management projects appear to be motivational issues and cooperation with municipalities. Education alone does not seem to be enough to change the behaviour of households or to increase their willingness to pay. Moreover, it has to be tuned to the benefits of the solid waste service as perceived by the target community. Involving all parties is an important issue. The people in Garla Mare get motivated by economical incentives most, because of their low income. Releiving the pressure on their health and the opportunities for ecotourism might be incentives too.

A faling central collection demotivates citizens to participate properly. From the start the collection has to be regular and reliable. The bad performance of the municipalities in this respect is rooted in a lack of funds, inappropriate equipment, inefficient management, and unskilled personnel.

Involving citizens cannot be done by campaigns alone, citizens must be genuinely involved and consulted at all stages of a project. Cultural habits, sanitory behaviours, informal practises and social rhythms must be incorporated in the project management.

Coming to a completely accepted solid waste management plan is which cultural, financial and ecological measures are combined is very complicated. Investigations from Geo-San involving the behaviour of citizens concerning waste and how to change it, is nesscary to come to an accepted plan.

The management will be in the hands of the local government, according to the Romanian legislation landfilling and recycling is a concern of the national and local government.

At the start of the project all steakholders must be involved. This does not mean only the citizens, NGO's and local government. But also the EPA, The County and Apele Romane will have a voice in the matter and need to be consulted.

For a proper organisation or lay out of stakeholders, a student from the faculty Technology, Policy and Managementfrom the TU-Delft could investigate the stakeholders and combine the technical and financial means with inside in policy and management. So that a proper management plan can be formed. The ecological and technical means from this study can be used in the proposed later study. It might be a good plan to imbed this student into a multi disciplinair team of an anthropologist for the cultural issues and an environmentalist for the overview over the environmental consequences of the proposed management.

Gender issues

Women are more likely to be involved in waste mangement in the household. Women are good at initiating waste management in their neighbourhood, Women turn out to be messengers of social transformation and political modernisation. But when the waste management becomes professionalized and payments get involved, men take over. Even when women participate, it is unusual for them to work outside of stereotypically acceptable women's roles in administration, communication, or "making the coffee".

In Garla Mare women take care of the household and the waste inside the household. The men carry the solid waste to the landfills. This stereotype modell might eventually end in men dealing with the professional care for household waste and recycling activities.

This also means that women will get more tasks, dividing the household waste amd the men get an easier job when solid waste is centrally collected.

We also have to consider the communist time, when women worked the same jobs as men. Some research will be needed to sort out the expected task and earnings division between men and women. An anthropologist could research this issue.

14. Suggestion from the author

Working on a project together with people that have a different historical and cultural inheritage is difficult. What seems the best sollution for the supporting NGO, might not prove right in the local circumstances. The differences in criteria between a student from Austria and a student from Romania for the building of a biogas installation, prove that the best sollution does not exist, there is only a perception of the best sollution with stakeholders. The Romanian student names energy costs, difficulties in operation and totall costs as the main arguments in decision making. Emissions in the soil are named as the 6th important criteria. The Austrian student starts with protecting the soil from emmisions followed by totall costs and energy costs. In Romania it is well understood that environmental care requires investments and knowledge and that both are scarce goods in rural Romania.

That is why a Dutch student can only advise on a possible route towards a better solid waste management and not give one best combination of tools. The best sollution for the solid waste problem in Garla Mare is given by the local stakeholders. There is a chance that foreign and local parties agree upon one best sollution, but the chances for that to happen are odd.

The local discussion about the sollution will make citizens aware of problems and sollutions, suggestions for measures can come from all parties involved. In such a democratic process, the outcome will be supported by most stakeholders. People will be motivated to support their own sollution. That is why tools ar represented here, followed by a short suggestion from a Dutch student. The goal is to start the discussion about solid waste management, not pretending to know the best sollution. That is why the following is just a suggestion, and probably not the best sollution.

A plan combining waste mangement tools into an economical developing Garla Mare.

The criteria for the solution stated by citizens are:

- *Ecotourism must fit into the solution*
- *Cheap and easy solution*
- *Better health conditions for the citizens*
- *Environmental friendly*
- *The solution must provide jobs or income. Now or in the nearby future*

All the solutions that reuse organic waste have in common that waste seperation is nessesary. A reliable collection of properly seperated waste is the base for the new solid waste management program. The waste should be sepearted in the households. In this way, also future waste streams can be dealt with in a proper way.

At the same time waste collection is started, the top layer of the contemporary landfills is cleaned, the non organic waste is removed and bushes or trees are planted. This shows the citizens that the local government is serious about the new waste collection system, the old landfills are no longer in operation. Another accent can be provided by waste pickers in streets

and on fields, mainly recovering plastics. This way jobs are provided and there is staff to discuss behaviour of citizens concerning solid waste management and littering.

It will be important for the mayor to make his point clear by a fine for littering or other incentives It is reasonable that this measure is taken when the solid waste collection system works well and is reliable for all citizens.

The organic waste could be spreaded first on empty fields. On these fields trees could be planted for firewood, providing the mayor with a small income to compensate a small piece of the transportation costs of the new solid waste management.

When the diverted waste collection functions well and a composting site has been found and developed, the composting of organic waste can beginn. This way the organic material will provide a better soil conditioner than waste spreading does. The material can be applied on the fields for growing crops. Of course composting will induce more costs, the mayor has to be sure he can support his activity in the long run.

Now biogas is simply too expensive. But when some economical development in Garla Mare takes place, this might be the best sollution for treatment of organic waste. If old activities are started up again, we will see more and richer corn farmers and more pig industry. The local government could decide to cooperate with the farmers and start a biogas plant together. In some countries the farmers themselves start an initiative to comply with organic waste and other environmental regulations. There is more money available, expertise can be hired and education for workers at the biogas plant can be bought and maintenance garanteed.

A great advantage of following the order or waste spreading, then composing and then biogas production is that the diverting system can be reused for every sollution. A good functioning divering system is important for composting, but even more for biogas installations where mixing parts wear under the influence of bad separated solid waste. During the composting phase, the citizens can be trained to seperate their waste in a proper way, this experience can be used in the next stage where biogas production will be possible.

The plastic waste that will be seperated from the start will be collected seperately. Landfilling plastic waste does not impose a major burden upon the environment, but this sollution will be overruled by national policies. From the start the plastic can be stored in containers to find out how much of this waste is produced in Garla Mare. If it proves little, it can better be transported to an official landfill. Then size reduction will reduce the transportation costs.

If it proves that much plastic is available we can think about local recycling. This kind of project must start with a course in marketing and business development. Then a market research must take place to find out what products from recycled plastc customers will buy. From thes research we can decide if we want to invest in extruding machines or that the products can be made out of the existing material. In Turkey pipes for irrigation are produced.

The plastic recycling might grow when the economical situation improves and the solid wast stream contains more and more plastic. This might interfere with the ecotourism activities. This must be researched in the future.

Heavy metals and other hazardous wastes, such as motor oil or pesticide cans, must be collected seperately from the start. Together with the EPA, there must become a sollution for a transfer location and for transport of these wastes. Nothing can be done with these wastes, it is best to deposit them at a proper landfill where hazardous waste is registered.

Glass and paper are reused now. Paper is burned in stoves, glass is reused in thte kitchen. Glass can be transported to another landfill or recycling facility in combination with the hazardous waste.

Metal is already collected seperately in Garla Mare. This service is provided by the Roma and can be incorporated in the solid waste management plan. It is wise to find out what is done with the metals and under what working conditions. Remelting of metals can produce toxic gases. Metal objects collected could contain heavy metals and other hazardous wastes, it is wise to look after proper disposal of that by the recyclers.

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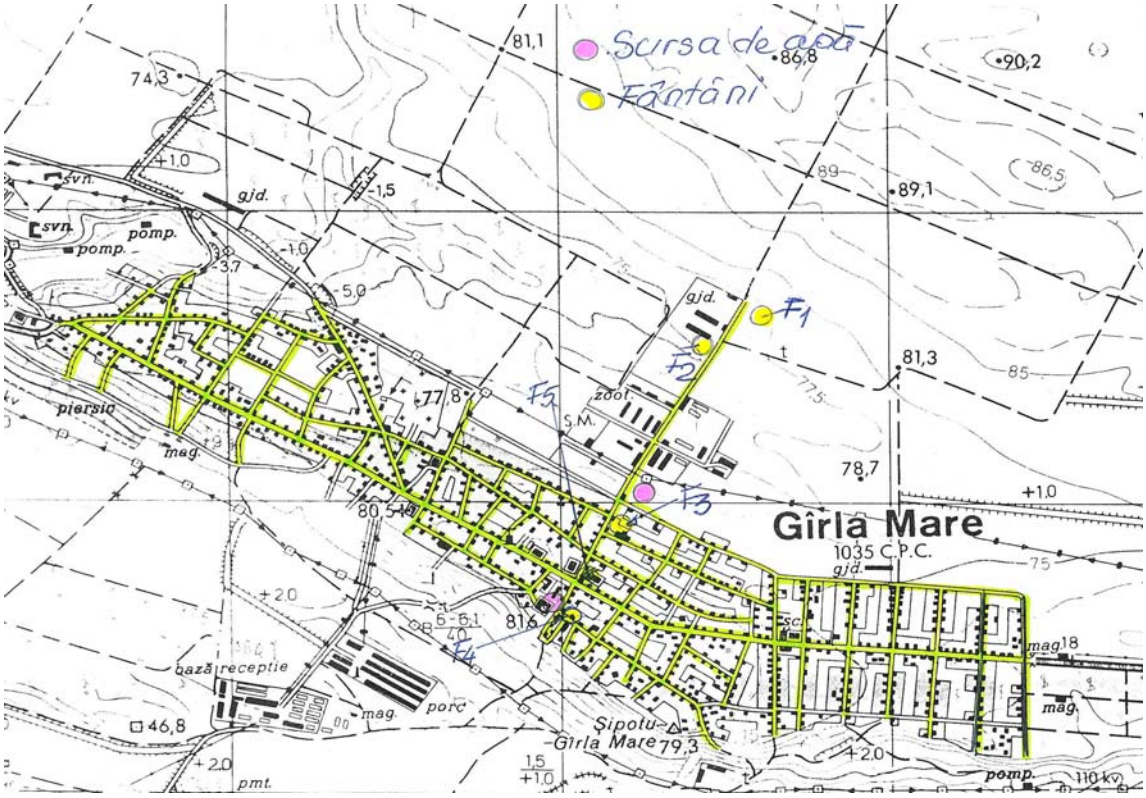
Annexes

ANNEX 1

Map of Garla Mare



ANNEX 2

LAW no. 137 of 1995 on the environmental protection.

CHAPTER I
General principles and provisions

Art. 1. - The object of the present law is to regulate environmental protection, an objective of major public interest, on the basis of the principles and strategic elements which lead to the sustainable development of society.

Art. 2. - The wording of the definitions in this law is comprised in Appendix No. I, which is an integral part of the present law.

Art. 3. - The principles and strategic elements that lay at the base of the present law for the purpose of assuring a sustainable development are the following:
a) principle of precaution in decision-making;
b) principle of prevention of ecological risks and damage occurrence;
c) principle of conservation of biodiversity and ecosystems specific to the natural biogeographical structure;
d) "polluter-pays" principle;
e) the removal on a priority basis of the pollutants that directly and severely jeopardize public health;
f) setting up of the integrated national environmental monitoring system;
g) sustainable use;
h) maintenance, improvement of environmental quality, and reconstruction of damaged areas;
i) setting up of a framework for the participation of non-governmental organizations and of the population in the decision-making and implementation;
j) developing international collaboration to ensure the quality of the environment.

Art. 4. - The ways of implementing the principles and strategic elements are:
a) adopting of environmental policies harmonized with the development programs;
b) compulsory procedure for environmental impact assessment in the initial stage of the projects, programs, or activities;
c) correlation of environmental planning with the territorial and urban planning;
d) introduction of economic incentive-based or coercive instruments;
e) resolving of environmental problems on levels of competence, depending on their extensiveness;
f) elaboration of rules and standards, their harmonization with the international regulations, and introduction of compliance programs;
g) promotion of basic and applicative research in the environmental protection field;
h) training and education of the population as well as the participation of the non-governmental organizations in the decision-making and implementation.

Art. 5. - The State recognizes the right of all persons to a healthy environment, and to this end it guarantees:
a) the access to information regarding environmental quality;
b) the right of association in organizations defending environmental quality;
c) the right of being consulted in the decision-making regarding the development of environmental policies, legislation and regulations, the issuing of environmental agreements and permits, including for territorial and urban planning;
d) the right to appeal directly or through some associations to the administrative or

judicial authorities in view of prevention or in the case of direct or indirect damage occurrence;
e) the right of indemnification for the damage experienced.

Art. 6. - Environmental protection shall be an obligation of the central and local public administration authorities as well as of all natural and legal persons.

Art. 7. - The responsibility for environmental protection shall be incumbent on the central environmental pro- tection authority and on its local agencies.

CHAPTER II
Regulation of economic and social activities having an environmental impact

Section 1
Permitting procedure

Art. 8. - The environmental protection authorities shall conduct the permitting procedure and shall issue environmental agreements and permits in accordance with Article 11.
The environmental agreement application is compulsory for new investments, for the modification of the existent ones, and for the activities provided in Appendix No. II to the present law.
The permit application is compulsory for putting into operation of the new objectives which have an environmental agreement and, within one year from the date the present law comes into force, for the existent activities.
The activities which do not involve construction and erection works shall require only environmental permit, except for those stated under item 8, subparagraphs g) and i) of Appendix No. II to the present law.
The environmental agreement and/or permit shall be issued after all the other endorsements required by law shall have been obtained.

Art. 9. - The central environmental protection authority shall elaborate the specific permitting procedure for the economic and social activities, the frame-sample of the report on the environmental impact study and the competent level to issue the agreement and/or, as applicable, the environmental permit, within sixty days after the coming into force of the present law.
The validity of the environmental agreement and permit shall be of maximum five years.
The environmental agreement or permit shall not be issued in the case in which no variant of project or compliance program provides for the eradication of the negative environmental effects, as against the standards and regulations in force.

Art. 10. - The environmental agreement or permit may be revised if new elements occur, unknown at the date of issue, and in the case of their renewal, when the remaking of the report on the environmental impact study may also be requested.
The environmental agreement or permit shall be suspended for non-compliance with the provisions thereof after a preliminary summons, with a time limit, and it shall be maintained until the suspension determining causes shall have been removed, but not longer than six months.
After the expiration of the suspension time limit, the environmental protection authorities shall dispose the termination of the project or the cessation of the activity.
For existent activities which do not meet the permitting conditions, the environmental protection authority shall dispose the carrying out of the environmental audit, and shall establish the compliance program in agreement with the title holder. After the expiration of each granted time limit, in the case of non-compliance, the competent environmental protection authority shall dispose the cessation of the respective activity. The cessation disposition shall be executory.
Litigations generated by the issue, revision, or suspension of the environmental

agreement or permit shall be settled according to the Law of the administrative disputed claims office.

Art. 11. - The procedure for environmental impact assessment shall consist of the preliminary stage, the main stage, and the analysis and validation stage.
The environmental protection authority shall organize and decide on the application of the stages of the procedure as follows:
a) the application accompanied by the description of the project addressed in writing to the environmental protection authority by the title holder of the project or activity;
b) the identifying of the proposed action in the types of activities that are subjected or not to the environmental impact study; if additional information is required, the title holder may be requested a preliminary study;
c) the analysis of the scope of the proposed action with the participation of the environmental protection authority, of the title holder, of some experts and representatives of the local public administration authorities who may be aggrieved by the environmental modifications resulting from its application;
d) the drawing up by the environmental protection authority of the guide with the issues that resulted from the analysis as per subparagraph c) and that shall have to be followed in the report on the environmental impact study; conveying such guide to the title holder, at the same time with the list of the other endorsements necessary to be obtained;
e) the submitting by the title holder of the project or activity of the report on the environmental impact study by taking into consideration all the alternatives, including that of renouncing the proposed action;
f) the preliminary review of the report by the environmental protection authority and its acceptance or the grounded request to revise it;
g) public notification and hearing of the report; the registration of the resulting comments and conclusions;
h) the final decision of the environmental protection authority, made publicly and motivated on the basis of the findings under subparagraphs f) and g);
i) the issue or grounded denial of the agreement or permit within thirty days at the most after the final decision.

Art. 12. - The permitting procedure shall be public. The publicity of the projects and activities requiring agreement or permit and of the impact studies, as well as the public hearing shall be assured by the environmental protection authority.
The impact studies shall be carried out through specialized units, certified natural or legal persons, the expenses being borne by the title holder of the project or activity also when he/she is requested to draw up the study again or to resume it.
The responsibility for the authenticity of the information supplied regarding the proposed action shall be incumbent on the title holder, and the responsibility for the accuracy of the impact study report shall be incumbent on the person who has prepared it.

Art. 13. - The sums obtained from the fees for the issue of environmental agreements and permits shall be cashed by the environmental protection authorities.
The quantum of the fees shall be established by a decision of the Government, upon the proposal of the central environmental protection authority.

Art. 14. - Upon the change of the destination or owner of the investment, as well as on the cessation of the activities generating an impact on the environment, the assuring of the environmental audit performance by the previous owner shall be compulsory, for the purpose of establishing the liabilities regarding the environmental quality rehabilitation in the impact area of the respective activity.
The competent environmental protection authority shall revise the environmental audit, shall establish the compliance program, and the previous owner shall negotiate with the new owner the assuming of previous liabilities and the compensations he/she would benefit by applying the ecological protection and reconstruction measures.

Section 2
Regime of dangerous substances, hazardous waste, as well as of other wastes

Art. 15. - The activities subjected to a special administration and management regime shall refer to the manufacture, trade and utilization of dangerous substances, and to the transport, transit, temporary or permanent storage, destruction, handling, as well as to the import and export of dangerous substances and hazardous waste.

Art. 16. - The import in Romania of wastes of any kind, in raw or processed form, shall be forbidden, with the exception of certain categories of wastes that constitute secondary resources of useful raw materials, in accordance with the regulations imposed by norms proposed by the central environmental protection authority and approved by the Government.
The transit and export of wastes of any kind may be effected in accordance with the agreements and conventions Romania is a part of.

Art. 17. - The activities provided for in Articles 15 and 16 shall be allowed only on the basis of the environmental agreement and/or permit.

Art. 18. - The central environmental protection authority and the environmental protection agencies, as applicable, shall supervise and control the observance of the regulations on dangerous substances and hazardous waste.

Art. 19. - The local public administration authorities shall be obliged to take measures to prevent and limit the impact of substances and wastes of any kind on the environment, and to notify the territorial environmental protection authorities on any activity that does not comply with the legal regulations.

Art. 20. - The customs authorities shall control and shall be responsible for the enforcement of the provisions under Article 17 with reference to the entry into and exit from the country of dangerous substances and hazardous waste, on the basis of the regulations of the central environmental protection authority.

Art. 21. - The natural and legal persons shall have the following obligations in the field:
a) to keep strict records - on quantity, characteristics, means of assurance - of the dangerous substances and hazardous waste, including their containers and packings, that are covered by their activity area, and to supply the necessary data monthly to the competent environmental protection authorities;
b) to request environmental agreement and/or permit, and to implement the legal regulations on dangerous substances and hazardous waste;
c) to carry out, through their own systems, the surveillance of the environment, according to the permit provisions, with an aim to identify and prevent risks, to keep records of the results, and to notify the competent authorities for environmental, protection and disaster defence on the imminence or occurrence of unpredicted discharges or of accidents.

Art. 22. - Within ninety days after the present law comes into force, the central environmental protection authority shall elaborate the regulations regarding:
a) location, siting and construction, and supervision of various types of storage;
b) collecting, processing, treatment, neutralization of wastes, as well as the recycling of reusable ones;
c) transport of wastes;
d) rehabilitation of the natural environment in the damaged areas;
e) installations for cremation of industrial, domestic, agricultural, and other wastes;
f) waste water and sludge treatment installations;
g) use of sludge, waste waters, industrial, domestic wastes and those resulting from cremation;

h) permitting procedure for the location and siting and construction of storage, transport, cremation, processing, and utilization of wastes of any kind;
i) import, export, and transit of dangerous substances and hazardous waste.

Art. 23. - The control of management of wastes of any kind shall be incumbent on the environmental protection authorities and on the other competent authorities, as provided by law.

Art. 24. - The local public administration authorities, the natural and legal persons whose scope of activity includes activities covered by the regulations stated under Article 22 have the following obligations:
a) to request an environmental agreement and/or permit, as per Article 22, subparagraph h);
b) to store the domestic, industrial, agricultural, or other wastes only on surfaces authorized for such purposes;
c) to use in the case of waste cremation only installations certified by the health and environmental protection authorities;
d) to site and construct waste storages according to the prerogatives granted by law;
e) to observe the conditions for the natural environmental rehabilitation in the storage areas provided in the environinental agreement and/or permit, and to guarantee, through financial means, for such rehabilitation;
f) to recover the reusable wastes and to turn them to account through specialized units;
g) to use on farming lands only wastes certified by the competent environmental protection, health, and agriculture authorities;
h) to store wastes in the underground environment only in the case in which they hold the environmental agreement and/or permit.

Section 3
Regime of chemical fertilizers and pesticides

Art. 25. - The chemical fertilizers, pesticides, and other products used in the phytosanitary, human and veterinary sanitary prophylaxis shall be produced only by means of authorized technological and biotechnological processes.
On delivery, the products shall be accompanied by the authorized technical norms of utilization, under the conditions provided by law.

Art. 26. - With the approval of the central environmental protection authority, the competent ministries shall have the following obligations:
a) to regulate the regime of phytosanitary products and of other pesticides that are used in the human and veterinary sanitary prophylaxis;
b) to organize the territorial network of laboratories for the analysis and control of chemical fertilizers and of pesticides, as well as of the pesticide concentrations in soil, crops, fodder, vegetal and animal agriculture-food products;
c) to prepare the list of chemical fertilizers and pesticides from within the country and from abroad, as well as of the maximum admissible pesticide concentration limits, in accordance with the international standards.
The list of chemical fertilizers and pesticides shall be prepared within thirty days after the date the present law comes into force, and shall be yearly updated.

Art. 27. - The central environmental protection authority together with the agriculture, forestry, health authorities and their departments decentralized into territorial administrative units, as applicable, shall supervise and control for the enforcement of the regulations regarding the chemical fertilizers and pesticides.

Art. 28. - The natural and legal persons producing, trading and/or utilizing chemical fertilizers and pesticides shall have the following obligations:
a) to request an environmental agreement and/or permit for their manufacture;

b) to deliver, handle, transport, and trade chemical fertilizers and pesticides packed and bearing identification, warning labels, safety and utilization instructions, in conditions that shall not cause contamination of the transport means and of the environment;
c) to store the chemical fertilizers and pesticides only packed and in protected places;
d) not to use the chemical fertilizers and pesticides in areas or on surfaces where special protection measures have been set up;
e) to spread pesticides by aircraft only with the approval of the environmental protection agencies, health departments, and of the county commissions of honey production sites and pastoral bee-breeding, in accordance with the legal regulations;
f) to apply, during the blooming period of insect pollinated crops, only such pesticide treatments that do not harm the pollinating insects;
g) not to use dangerous baits, except for specially authorized cases.

Section 4
Regime for assuring the protection against ionizing radiation and safety of radiation sources

Art. 29. - The regime for the protection of population, environment and welfare against exposure to ionizing radiation and the assuring of the safety of radiation sources shall be achieved by applying the various procedures and devices for maintaining doses and risks as low as they can reasonably be, within the allowable limits, and for the purpose of preventing accidents, of limiting and eliminating their consequences.

Art. 30. - The activities in the nuclear field require the assuring of protection and safety means, and may be carried out only based on the environmental agreement and permit, issued pursuant to Article 8.
The environmental agreement and permit regarding the high nuclear risk installations - nuclear-electrical plants, research reactors, nuclear fuel manufacture plants, and final repositories for spent nuclear fuel - shall be issued by the Government.

Art. 31. - The competent authority in the nuclear field shall elaborate technical norms, standards, and application rules with regard to:
a) population and environmental protection in nuclear risk areas;
b) physical protection of nuclear material and installations;
c) intervention levels and emergency plans which refer to transfrontier events as well;
d) transport of radioactive substances;
e) specific permitting procedures.
The permitting procedure for the high nuclear risk installations shall be elaborated within sixty days after the date the present law comes into force.

Art. 32. - The control of the nuclear activities shall be carried out by the central environmental protection authority and by other competent authorities according to the law.
The central environmental protection authority shall have the following prerogatives:
a) to organize the monitoring of the environmental radioactivity country wide;
b) to supervise, control, and decide on the necessary measures to be taken for observing the legal provisions on the environmental radioprotection;
c) to collaborate with the competent bodies in the disaster defence.

Art. 33. - The natural and legal persons who carry out activities in the nuclear field shall have the following obligations:
a) to observe the radioprotection and safety norms;
b) to assess, directly or through the authorized bodies, the potential risk, to carry out the environmental audit for the existent activities, and to apply for the environmental permit;
c) to carry out procedures and provide for devices for the new activities which shall permit the achievement of the lowest reasonable level of doses and risks to the population and environment, and to apply for the environmental agreement and permit;

d) to keep strict records of ionizing radiation sources and to assure their physical protection;
e) to apply, through their own systems, programs for the surveillance of environmental radioactive contamination and for the exposure evaluation of critical groups -the population in the surveillance area -, which shall assure that the conditions provided by the permit on the radioactive substance discharges shall not be violated, and that the doses shall be maintained within the permissible limits;
f) to maintain the local environmental monitoring capability in operating condition in order to detect any significant radioactive contamination that would result from an accidental discharge of radioactive substances;
g) to keep the record of the surveillance results and of the estimated doses for critical groups;
h) to report, at the established intervals, the record results to the competent authorities;
i) to report promptly to the competent authority any significant increase of the environmental contamination and whether it is attributable to the activity carried out or not;
j) to verify continuously the accuracy of the assumptions made through the probabilistic assessments on the radiological consequences of the radioactive discharges.

CHAPTER III
Protection of natural resources and conservation of biodiversity

Art. 34. - The central environmental protection authority, in consultation with the central specialized authorities which manage natural resources, shall draw up, on the basis of the present law, technical regulations regarding the measures for the protection of ecosystems, conservation of biodiversity, sustainable management of natural resources, and for assuring the human health.
On designing the works which may change the natural environment of an area, the procedure for the impact assessment on that area shall be compulsory, followed by the submitting of technical solutions to maintain the natural habitat areas, to conserve the ecosystem functions, and to protect the vegetable and animal organisms, including the migratory ones, by observing the alternative and the conditions imposed by the environmental agreement and/or permit, as well as by the own monitoring until their fulfilment.
The terrestrial and aquatic areas that are subjected to a conservation regime as natural habitats or for ecological rehabilitation shall be managed by the legal title holders only in the case in which they commit themselves to apply the conservation measures set forth by the central environmental protection authority.
The holders of any title who apply such measures shall be exempted from tax; the private holders shall be compensated according to the value of the rehabilitation works undertaken.
The protection of some rare and endangered organism species, the conservation of biodiversity, and the setting up of protected areas, as well as the measures established by the environmental protection authorities shall have priority as against other interests.
The central environmental protection authority, in consultation with the Romanian Academy and UNESCO National Commission, shall establish the criteria for the setting up of protected areas and for the biodiversity conservation.

Section 1
Protection of waters and of aquatic ecosystems

Art. 35. - The protection of surface and underground waters and of aquatic ecosystems shall be meant to maintain and improve the quality and natural productivity thereof, for the purpose of avoiding some negative effects on the environment, human health and welfare.

Art. 36. - Within sixty days from the date the present law comes into force, the central environmental protection authority shall elaborate the regulations on:

a) technical norms regarding the protection of waters and of aquatic ecosystems, the population inclusively, in the case of accidental pollution and in transfrontier context;
b) permitting procedure for water sources and aquatic ecosystem exploitation, for hydrotechnical construction accomplishment for works of embanking and course-regularization, irrigation, and draining-drainage;
c) emission standards;
d) water quality standards;
e) requirements for waste water discharge, treatment, and for the restriction of effluent discharge in waters.

Art. 37. - The control over the water and aquatic ecosystem protection regulation enforcement shall be organized and exercised by the environmental protection, waters, health authorities, as well as by other authorities, in accordance with legal competences.

Art. 38. - The environmental protection and water management authorities, together with the navigation authorities, shall supervise and control the observance of the provisions and shall enforce the legal measures concerning the protection of waters against the consequences of navigation activities, by complying with the international conventions in the field to which Romania is a party.

Art. 39. - The natural and legal persons shall have the following obligations:
a) to apply for environmental agreement and/or permit for the activities provided in Appendix No. II to the present law. The wells drilled at depths that do not exceed 50 m to meet the needs of individual farms shall be exempted from permit;
b) to observe the emission and water quality standards, the agreement and permit provisions, and to submit water samples for analysis to authorized laboratories, upon the established terms;
c) not to throw and store wastes of any kind on river banks and beds and in wetlands, and not to introduce therein explosives, electric power, narcotics, or other dangerous substances;
d) not to wash in the natural waters motor vehicles, equipment and packages which contained oils, liquid fuels, lubricants, dangerous substances, or pesticides;
e) to perform all the works concerning natural resource rehabilitation, assuring the aquatic fauna migration, and water quality improvement, provided with a time limit in the environmental agreement and permit, and to monitor the impact area;
f) to endow themselves with installations for storage or treatment of wastes for treatment of waste water, and outlets for their unloading in shore or floating plants, in the case of holding of vessels, floating platforms, or offshore drillings;
g) to fit out harbours with collecting, processing, recycling, or neutralizing installations for petroleum, domestic, or any other kind of wastes, stored on river or sea vessels, and to organize intervention teams in the case of accidental pollution of waters and coast areas;
h) not to discharge waste waters from vessels or floating platforms directly into natural waters, and not to throw away any kind of wastes from them.

Section 2
Protection of atmosphere

Art. 40. - The protection of atmosphere shall aim at preventing, limiting the deterioration and improving its quality in order to avoid the occurrence of some negative effects on the environment, human health and welfare.

Art. 41. - The central environmental protection authority promotes the regional and global policies by substantiating the specific principles and actions, at both national and local level, with regard to the protection of atmosphere.
The national policy of the protection of atmosphere shall consist primarily of the following:

a) introduction of adequate techniques and technologies for the holding back of the pollutants at the source;
b) management of the air resource in the sense of reducing pollutant emission to the lowest levels which shall not exceed the regeneration capacity of the atmosphere;
c) management of the air resource in the sense of assuring the appropriate quality for human health safety;
d) modernization and improvement of the air quality national integrated monitoring system.

Art. 42. - The central environmental protection authority, in consultation with the competent ministries, shall elaborate the technical norms, standards, and application rules with regard to:
a) the air quality depending on the pollutants discharged in the atmosphere;
b) the atmosphere pollutant emissions for the mobile and fixed sources, as well as the utilization restriction or prohibition conditions, including the substances which affect the ozone layer;
c) the quality of fuels and carburants, as well as the regulations regarding their sale-purchase, and transport;
d) the sound standard and regulations for noise restriction;
e) the supervision of the air quality, sampling and analyzing procedures, location of sampling and analysis points and instruments, measurement frequency and others;
f) the identification, supervision, and control of the economic agents whose activity is generating potential risk and/or atmosphere pollution;
g) the system for the fast notification, in the case of severe atmosphere pollution with transfrontier effects, of the authorities assigned for the implementation of the Convention on the Transfrontier Effects of Industrial Accidents.
The technical norms, the implementation rules, respectively the standards, shall be elaborated within one year, respectively two years, from the date the present law comes into force.

Art. 43. - The central environmental protection authority supervises and controls the enforcement of the atmosphere protection legal provisions for which purpose it shall:
a) ascertain the occurrence of atmosphere pollution events, alert and/or issue forecasts in relation therewith;
b) dispose the temporary or permanent cessation of po1-lution generating activities in order to enforce emergency measures or for disregarding the compliance program;
c) dispose the technological measures, enforce restrictions and proscriptions in order to prevent, limit, or eliminate the pollutant emissions;
d) apply the penalties provided by law in case of disregarding the disposed measures.

Art. 44. - The legal land owners and holders shall be obliged to maintain and extend the protective vegetation belts and alignments, verdure spots, parks, hedges for the improvement of the atmosphere regeneration capacity, the sound and colian protection.

Art. 45. - The customs authorities shall have the obligation not to permit the entering/leaving from the country of polluting mobile sources which do not meet the provisions of the competent authorities, pursuant to the law.

Art. 46. - The natural and legal persons shall have the following obligations in the field:
a) to observe the atmosphere protection regulations by adopting adequate technological measures of holding back and neutralizing the atmosphere pollutants;
b) to endow the technological installations which are pollution sources with measurement systems, to assure their correct functioning, to ensure qualified personnel, and to provide the necessary data to the environmental protection authorities, upon request or according to the compliance program;
c) to improve the technological performances for the purpose of reducing the emissions and not to put in operation the installations through which the maximum permissible limits are exceeded;

d) to ensure, upon the disposal of the environmental protection authorities, the reduction, modification, or cessation of pollution generating activities;
e) to assure special measures and endowments for the sound insulation and protection for noise and vibration generating sources, to control their efficiency, and to commission only those which do not exceed the permissible sound standards.

Section 3
Protection of soil subsoil and of terrestrial ecosystems

Art. 47. - The protection of soil, subsoil, and of terrestrial ecosystems by adequate measures of territorial management, conservation, organization, and planning shall be compulsory for all holders of any title.

Art. 48. - The central environmental protection authority, in consultation with the competent ministries, shall establish:
a) the system for monitoring the soil quality for the purpose of ascertaining its present state and evolution tendencies;
b) the regulations regarding the protection of soil, subsoil, terrestrial ecosystem quality, and the conservation of biodiversity;
c) the permitting procedure regarding the environmental protection issues comprised in the territorial arrangement plans, torrent planning for forest planning preparation, soil erosion control, study drillings and geologic and hydrogeologic prospections, as well as for extraction mining activities;
d) the regulations on natural environmental rehabilitation in areas in which the soil, subsoil, and terrestrial ecosystems were affected by natural phenomena or by activities with a negative impact on the environment.

Art. 49. - The central agriculture and forestry authorities shall have the following obligations:
a) to elaborate regulations on agriculture systems, technologies of plant culture and animal husbandry, forest regeneration, wood harvesting, collecting and transport, and soil quality standards, for the purpose of maintaining and improving thereof, eliminating the negative consequences on terrestrial and aquatic ecosystems, and assuring the conservation of specific functions, biodiversity, and natural habitats, and to convey them to the central environmental protection authority;
b) to keep records of lands that have become improper for agricultural output and to provide, upon the holders' request, specialized technical assistance for the improvement or change of utilization;
c) to direct and perform the specialized technical control for land reclamation and agropedoamelioration works;
d) to guide and provide technical assistance, upon the farmers' request, with regard to the most adequate techniques and technologies of soil management and improvement.

Art. 50. - The control for the observance of the legal regulations regarding the protection and conservation, improvement and judicious utilization of soils, subsoils, and terrestrial ecosystems shall be organized and exercised by the environmental protection authorities, as well as by other competent public administration authorities, as applicable, in compliance with the legal provisions.

Art. 51. - For the purpose of assuring the soil quality protection, the land holders of any title shall have the following obligations:
a) to prevent, based on the regulations in the field, the soil quality deterioration;
b) to assure the conditions provided in the environmental agreement and permit upon locating, designing, building, and putting in operation of any kind of objectives, as well as upon changing of land destination;
c) not to burn the stubble fields, reed, shrubs, or herbaceous vegetation without a permit issued by the competent environmental protection authority.

Art. 52. - The holders of any title of forests, forest vegetation outside the forest stock and lawns shall have the following obligations:
a) to maintain the forest area of forest vegetation outside the forest stock, including the junipers and the existing lawns and bushes, their reduction being forbidden, except for the cases provided by law;
b) to exploit the wood volume only within the forest capacity limit, as established by forest planning and approved by law;
c) to assure the observance of the forest rules for wood exploitation and technological transport, as established by law, for the purpose of maintaining forest biodiversity and ecological balance;
d) to observe the forest regime for the afforestation of the exploited areas, as established by the central forestry authority, according to the forest sustainable use conditions provided by the central environmental protection authority;
e) to assure the application of special conservation measures for the forests with special protection functions, located on lands with very high slopes, with sliding and erosion processes, on screes, rocks, at the highest altitude limit of forest vegetation, as well as for other such forests;
f) to observe the forest regime established for the conservation of the wooden vegetation from afforested pastures that have protection functions for soil and water resources;
g) to assure the rational exploitation and physical planning of lawns, according to their rehabilitation capacity;
h) to exploit the forest resources, game and fishing stock within the regeneration capacity limits, according to the legal provisions;
i) to notify the environmental protection authorities on the accidents or activities which affect the forest ecosystems or other such terrestrial ecosystems.

Art. 53. - The natural or legal persons who prospect or exploit the subsoil resources shall have the following obligations:
a) to apply for an environmental agreement and/or permit according to the law and to comply with the provisions thereof;
b) to rehabilitate the affected lands, bringing them to productive and natural ecological parameters or to a new functional ecosystem, in accordance with the provisions and terms of the agreement and/or permit, by assuring the financial means therefor and by monitoring the area;
c) to notify the environmental protection authorities or those competent by law on any accidental situations which jeopardize the terrestrial ecosystem, and to act for its rehabilitation.

Section 4
Regime of protected areas and of natural monuments

Art. 54. - For the conservation of some natural habitats, of the biodiversity that defines the biogeographical specific of the country, as well as of the natural structures and systems of ecological, scientific, and landscape value, the national network of protected areas and natural monuments shall be maintained and developed.
The protected areas and natural monuments shall be declared by normative acts or regulations, including by forest planning; those declared until the date the present law comes into force shall maintain such quality.
The protected areas shall be indicated in the urban and territorial planning projects, approved according to the law.

Art. 55. - The central environmental protection authority shall:
a) upon the Romanian Academy's proposal, declare new areas for the extending of the national network of protected areas and natural monuments and identify them into categories;
b) organize the network for the supervision, security of the protected areas and natural monuments and establish their management regime, as well as the ecotourism principles;

c) control the enforcement of the regulations by those who manage the proteded areas and natural monuments;
d) elaborate, publish, update, and disseminate the "Catalogue of Protected Areas and Natural Monuments" as well as the "Red Book of Plant and Animal Species in Romania".

Art. 56. - The local public administration authorities shall assure the informing of the economic agents, population, and tourists on the existence of protected areas and natural monuments in the area, on their importance, on the rules and restrictions established, as well as on the penalties applicable for disregarding their statute.

Art. 57. - Upon the request of the environmental protection agencies, of other interested organizations, natural or legal persons, the local public administration authorities may, based on the documentation endorsed by the Romanian Academy, place protected areas or natural monuments or certain substantiated objectives under temporary protection, with the view of declaration.

Art. 58. - The holders of land or aquatic areas adjacent to protected areas, natural monuments, or those on whose lands elements liable to be protected have been identified, shall be obliged to observe their statute in order to pass them on to the future generations.

Art. 59. - The plant collecting and trading, the capturing by any means, holding and trading of animals declared as natural monuments, as well as the dislocation, holding and trading of some mineralogical, spelaeological, and palaeontological pieces originating from sites declared as natural monuments shall be forbidden.
Except for the cases provided by the law, the introduction of microorganism cultures, plants and living animals into the country without the agreement issued by the central environmental protection authority in consultation with the Romanian Academy shall be forbidden.

Section 5
Protection of human settlements

Art. 60. - In the process of social-economic development, of urban, territorial, and human settlement planning, the ecological principles shall be compulsorily observed to assure a healthy living environment. Towards this end, the local councils as well as the natural and legal persons, as the case may be, shall be responsible for:
a) the improvement of the urban microclimate by managing and maintaining springs and water mirrors within the localities and in adjacent zones, improving the beauty and protection of the landscape, and maintaining the street cleanliness;
b) the location of the industrial objectives, of ways and means of transport, of sewerage systems, water treatment plants, domestic, street and industrial waste storage, and of other objectives and activities, without causing prejudice to public health, environment, resting, treatment and recreation places, to the health and comfort state of the population;
c) the observance of the special protection regime of balneary and climatic localities, zones of tourism and recreation interest, historical monuments, protected areas, and natural monuments. The location of objectives and performance of damage generating activities within their perimeter and in their protection zones shall be forbidden;
d) the adoption of adequate architectural elements, the optimizing of the density of the dwelling houses concurrently with the maintaining and development of verdure spots, parks, tree alignments and protective street belts, of landscape arrangements with ecological, aesthetic, and leisure functions;
e) the regulating, by temporary or permanent prohibition inclusively, of the access of certain types of motor vehicles or of the carrying out of discomfort generating activities for the population in certain zones of the localities with living space predominance, zones meant for treatment, rest, recreation, and leisure;

f) the adopting of compulsory measures for all natural and legal persons regarding the maintenance and adornment of buildings, yards and their surroundings, of the verdure spots in yards and between buildings, of decorative trees and shrubs;
g) the initiating at local level of some projects for the set up of hygienic-sanitary facilities and for road sewerage maintenance and development.

Art. 61. - Upon the issuance of the environmental agreement for urban and territorial planning projects, the environmental protection authorities shall specify the measures for maintaining and improving the natural landscape and anthropic stock of each zone and locality, the damaged zones and the conditions of their landscape and ecological rehabilitation and of verdure spots development, and shall control the implementation thereof.

Art. 62. - The local public administration authorities, natural and legal persons who manage the public property shall have the obligation to assure the accomplishment of the measures and conditions provided under Article 61.
The change of the utilization of the lands sited as verdure spots provided in the urban plans shall be made in accordance with the law.

Art. 63. - The environmental protection authorities and local councils shall initiate information and participation actions, through public hearing regarding the town development and communal management programs, on the importance of the environmental and human settlement protection measures.

CHAPTER IV
Prerogatives and responsibilities

Section 1
Prerogatives and responsibilities of the environmental protection authorities

Art. 64. - The central environmental protection authority shall have the following prerogatives and responsibilities:
a) to elaborate and promote the environmental national strategy for sustainable development within one year from the date the present law comes into force;
b) to elaborate the recommendations for the environmental sector strategies and policy by adopting time limits established in accordance with the stages of the market-economy transition, as well as the environmental planning correlated with the territorial and urban planning, ecological restoration and reconstruction for the purpose of assuring the environmental national strategy;
c) to create the functioning framework which shall allow the access to information and the participation in environmental decision-making - policies, regulations, permitting procedures, territorial and urban development plans - for the other central and local public administration authorities, of non-governmental organizations and population;
d) to initiate draft laws, technical norms, regulations. procedures and directives in accordance with the international standards; to endorse the norms and other regulations set forth by other ministries and departments regarding activities with a negative impact on the environment or by environmental protection organizations, and to check for the enforcement thereof. The draft special laws stated under CHAPTER VI shall be initiated within two years, and the regulations within one year from the date the present law comes into force, except for the cases in which it is otherwise provided herein;
e) to organize the national integrated background and impact monitoring system for all environmental factors, and the environmental inspection system, within one year from the date the present law comes into force;
f) to create the institutional-administrative framework for identifying and promoting research programs, for educating and training qualified personnel for the surveillance, analysis, assessment, and control of the environment, and to certify such personnel;
g) to assign expert commissions, when applicable, for revising the environmental audit;

to certify its own laboratories for the control of the quality of the environment, of dangerous substances and hazardous waste, pesticides, and to indicate the types of the analyses required and the standard laboratories;
h) to elaborate and implement programs; to elaborate educational material regarding the importance of the environmental protection;
i) to follow the implementation of the program and measures for the compliance with the international conventions in which Romania is a party, as far as the environment is concerned;
j) to follow and analyze the enforcement of the present law and to prepare annually reports on the state of the environment, which are submitted to the Government; the reports shall be published;
k) to collaborate with similar organizations and authorities in other countries and to represent the Government in the international environmental protection relationships;
l) to propose to the Government reductions of or exemptions from fees, taxes, as well as other fiscal facilities for title holders of activities which replace dangerous substances in the manufacture process, or who invest in technological processes and products which diminish the impact or the risk of a negative impact on the environment, as well as for those who implement the special ecological protection, preservation, and reconstruction measures set forth by the central environmental protection authority;
m) to apply penalties to the title holders of activities for non-compliance;
n) to publish directives and guide the other ministries and departments, economic agents, natural and legal persons, for the purpose of diminishing the negative effects of economic activities on the environment and of encouraging environmentally appropriate techniques and technologies;
o) to provide the interested parties with centralized data on the state of the environment, the central environmental protection policy and programs;
p) to consult periodically with non-governmental organization representatives and with other representatives of the civil society to set up the general environmental strategy and to take decision in cases which might affect the environment;
r) to prepare, in collaboration with the Ministry of Finance, the implementation of new financial instruments assisting the protection and improvement of the environmental media quality, in accordance with those applied internationally;
s) to organize, within two years from the date the present law is promulgated, the ecological control body;
t) in special situations, ascertained on the basis of the data obtained from the supervision of the environment, the central environmental authority shall be entitled to declare, with notification to the Government, high pollution risk zones in certain regions of the country, and shall have the obligation to elaborate together with other central institutions and local authorities special programs for the removal of risk occurred in these zones. After the high pollution risk is eliminated, based on the new data resulted from the supervision of the environmental status development, the respective zone is declared as re-entering normality.

Art. 65. - The environmental protection agencies shall carry out at territorial level the prerogatives and responsibilities of the central environmental protection authority they are subordinated to, pursuant to Article 64, subparagraphs b), c), d), h), i), j), in), o), p), r), and t), and draw up reports on the activities performed throughout the financial year and on the application of the environmental programs; such reports shall be published in the local newspapers.

Art. 66. - In view of exerting its functions, the central environmental protection authority shall:
a) request the necessary information from ministries, local public administration authorities, natural and legal persons, with regard to the provisions under Article 64, subparagraphs a), b), d), e), f), h), i), j), l), p), r), and t);
b) appoint the chief inspectors and accredit inspectors at territorial level.

Art. 67. - The inspectors, appointed by the central environmental protection authority to exercise their duties, shall be allowed at any time, under the conditions of the law, with the permit of environmental authorities, the access to any premises where an activity generating a negative impact on the environment is being performed.
The natural or legal person that suffers a prejudice as a result of exerting the inspection prerogatives may lodge a complaint with the competent law court within thirty days from the date such prejudice has been ascertained.
The amount of the compensation for the eventual losses incurred shall be established by the agreement of the parties and, in the absence of such agreement, by the competent court.

Section 2
Prerogatives and responsibilities of other central and local authorities

Art. 68. - The central and local public administration authorities shall be obliged to convey all the data requested pursuant to Article 66, subparagraph a) to the central environmental protection authority, to the territorial agencies respectively, and to enforce the provisions of the present law.

Art. 69. - The central public administration authorities shall have the following obligations:
a) to assure within their organization structure departments with environmental protection duties and specialized personnel;
b) to develop, with the central environmental protection authorityrs assistance, restructuring programs in agreement with the national environmental strategy and environmental policies, and to assist the subordinate economic agents in the implementation of the compliance programs;
c) to elaborate the norms and regulations specific to the environmental protection field of activity and to submit them to the central environmental protection authority for approval;
d) to notify on the extent to which certain provisions can prevent any authority from effectively acting for the protection of the environment and to concurrently indicate the progress made by the enforcement of the present law.

Art. 70. - The Ministry of Health shall have the following prerogatives and responsibilities:
a) to survey the evolution of the population's state of health in connection with the quality of the environment;
b) to control drinking water and food product quality;
c) to draw up environmental hygiene standards in collaboration with the central environmental protection authority and check for the observance of such standards;
d) to draw up periodical reports on the influence of the environment on the population's health and collaborate with the central environmental protection authority in setting up and applying life quality improvement measures. Such reports shall be published yearly;
e) to collaborate with the other ministries having their own health network for ensuring an accurate awareness of the state of public health and environmental protection in their scope of activity.

Art. 71. - The Ministry of National Defence shall have the following prerogatives:
a) to develop specific norms and guidelines consistent with the internal legislation and by complying with the ecological principles for environmental protection, for its scopes of activity;
b) to supervise the compliance by the Ministry of National Defence's personnel with the environmental protection norms for the activities in the military zones;
c) to control the activities and apply penalties for the violation by the Ministry of National Defence's personnel of the environmental protection legislation in the military domain.

Art. 72. - The Ministry of Education shall ensure the adaptation of education plans and syllabi at all levels, for the purpose of acquiring knowledge on ecology and environmental protection notions and principles, to assure the awareness, education, and training in this field.

Art. 73. - The Ministry of Research and Technology shall promote study themes and research programs answering the priorities set forth by the central environmental protection authority in this field.

Art. 74. - Based on the norms approved by the central environmental protection authority, the Ministry of Transport and the Ministry of the Interior shall assure the control of:
a) exhaust gases;
b) intensity of noises and vibrations produced by vehicles;
c) material transport.

Art. 75. - The Ministry of Tourism and the Ministry of Youth and Sport shall develop educational programs for the purpose of designing an environmental responsible behaviour and shall encourage the application of the principles of ecotourism.

Art. 76. - The local public administration authorities shall have the following prerogatives and responsibilities:
a) to supervise the enforcement of the provisions under the urban and territorial planning, in agreement with the environmental planning;
b) to supervise the subordinate economic agents with a view to preventing accidental pollutant discharges or uncontrolled waste depositing, and develop reusable waste collection systems;
c) to adopt programs for the development of sewerage networks, rain water collecting, drinking water supply, locality waste water treatment plants, as well as for public transport;
d) to assure services with town ecology and environmental protection specialists and collaborate towards this end with the competent environmental protection authorities;
e) to promote an appropriate behaviour of the communities with respect to the importance of the environmental protection.

Art. 77. - The customs authorities shall carry out the prerogatives set forth by the present law.

Art. 78. - The Police and Financial Guard shall be obliged to support, upon their request, the representatives of the environmental protection authorities in the exercise of their prerogatives.

Section 3
Obligations of natural and legal persons

Art. 79. - The environmental protection shall represent an obligation of all natural and legal persons, towards which end they shall:
a) request the environmental protection authorities for environmental agreement and/or permit, as the case may be, pursuant to the present law;
b) assist the persons empowered to do the inspections by providing them records of their own measurements, all relevant documents, and shall facilitate the inspecting of activities and taking of samples;
c) obey the temporary or permanent activity cessation order;
d) bear the costs for the remedy of the prejudice and shall remove the consequences thereof by reconstructing the conditions existing prior to the occurrence of the prejudice;
e) assure their own supervision systems for technological installations and processes, and for the analysis and control of pollutants within the scope of the performed activities,

and the recording of the results, for the purpose of preventing and avoiding technological risks and accidental pollutant discharges into the environment, and shall report the environmental supervision results to the competent environmental protection authority, on a monthly basis;
f) inform the competent authorities and the population in the case of accidental pollutant discharges into the environment or major accident;
g) modify their structure for the existing activities and, upon application for permit, shall propose compliance programs within six months from the date the present law comes into force;
h) adopt adequate environmental solutions when proposing new projects or activities, as well as for the modification of the existent ones;
i) not impair the natural or created environment by uncontrolled disposals of wastes of any kind.

Art. 80. - The liability for the prejudice shall have an objective character, irrespective of the guilt. In case of plurality of authors, the liability is joint and several.
In the case of major risk-generating activities, the insurance for the damages shall be mandatory.

CHAPTER V
Penalties

Art. 81. - The violation of the provisions of the present law shall involve civil, contraventional, or criminal responsibility, as the case may be.

Art. 82. - The following facts shall constitute petty offences and shall be penalyzed as follows:
1. With a fine from 50,000 lei to 300,000 lei for natural persons, and from 250,000 lei to 1,500,000 lei for legal persons, for violating the provisions of the law with regard to:
a) the obligations of the central and local public authorities mentioned under Article 9, paragraph 3, Article 12, paragraph 1, Article 14, paragraph 2, Articles 31, 38, 44, Article 60, subparagraphs a), d)-f), Article 62, paragraph 1, Article 68, Article 69, subparagraphs a)-c), Article 70, sub-paragraphs a)-d), Articles 71, 72, 73, 74, 75, Article 76, sub-paragraphs a)-e), Articles 77 and 78;
b) the application for agreement/permit mentioned under Article 51, subparagraph c);
c) the regulations mentioned under Article 51, subparagraph a);
d) the regulations for the protection of the terrestrial ecosystems mentioned under Article 52, subparagraphs a), c), and Article 79, subparagraph i).
2. With a fine from 100,000 lei to 600,000 lei for natural persons, and from 500,000 lei to 3,000,000 lei for legal persons, for violating the provisions of the law with regard to:
a) the obligations of the local public authorities mentioned under Article 19, Article 24, subparagraphs d) and f), Article 56, Article 60, subparagraph b), and Article 62, paragraph 2;
b) the supply and use of accurate data in the elaboration of the impact studies mentioned under Article 12, paragraph 3;
c) the measures, endowments, legal provisions mentioned under Article 46, subparagraph e), and Article 52, subparagraph h);
d) the regulations on chemical fertilizers, pesticides, and any other chemical substances, water protection and protected areas mentioned under Article 28, subparagraph c), and Article 39, subparagraph d).
3. With a fine from 150,000 lei to 750,000 lei for natural persons, and from 750,000 lei to 3,750,000 lei for legal persons, for violating the provisions of the law with regard to:
a) the obligations of harbour administration authorities mentioned under Article 39, subparagraph g);
b) the compliance with the environmental protection authority's orders mentioned under Article 46, subparagraph d), and Article 79, subparagraph b);
c) the application for agreement/permit mentioned under Articles 15-17, Article 21, subparagraph b), Article 24, subparagraphs a)-c), g)-h), Article 28, subparagraphs a),

e), g), Article 33, subparagraphs b), c), Article 34, paragraph 2, Article 39, subparagraph a), Article 51, subparagraph b), Article 53, subparagraph a), Article 59, paragraph 2, and Article 79, subparagraphs a) and g);
d) the standards, norms, technological performances mentioned under Article 33, subparagraph a), Article 39, subparagraph b), and Article 46, subparagraph c);
e) the regulations for chemical fertilizers, pesticides, and any other chemical substances, utilization of ionizing radiation sources, water and atmosphere protection, rational exploitation of natural resources, and observance of the special protection regime, mentioned under Article 28, subparagraphs b), d), and f), Article 33, subparagraph j), Article 39, subparagraphs c), f), and h), Article 46, subparagraph a), Article 52, subparagraph b), Article 58, Article 59, paragraph 1, and Article 60, subparagraph c);
f) the own supervision systems mentioned under Article 21, subparagraph c), Article 33, subparagraphs e) and f), and Article 46, subparagraph b);
g) the keeping of records on the substances mentioned under Article 21, subparagraph a), and Article 33, subparagraphs d), g), and h);
h) the natural environmental rehabilitation and/or nature conservation mentioned under Article 24, subparagraph e), Article 39, subparagraph e), Article 52, subparagraphs f)-g), and Article 79, subparagraphs d) and h).
4. The quantum of fines shall be annually updated by a decision of the Government.

Art. 83. - The ascertaining of the petty offences and the enforcement of the penalties shall be made by the personnel empowered to this end by the central public environmental protection authority, by the police officers and sub-officers, by the empowered personnel of the local and county public administration authorities, and by the Ministry of National Defence's personnel empowered in its fields of activity, according to the legal competences.
Against the report on ascertaining of the petty offence and applying of the penalty a complaint may be lodged within thirty days from the date the document was reported. The complaints shall be settled by the competent court of instance.
The provisions of the Law No. 32/1968 with regard to the ascertaining and penalyzing of petty offences, except for Articles 25, 26, and 27, shall apply.

Art. 84. - The facts provided below shall constitute offences and shall be punished as follows:
1. With imprisonment from three months to one year, or with a fine from 250,000 lei to 1,500,000 lei, if they were a hazard to human, animal, or vegetable life or health:
a) burning of stubble fields, reed, shrubs, and herbaceous vegetation in protected areas and on the ecological rehabilitation land (Article 54, paragraphs 2 and 3);
b) deforestation of wooden vegetation outside the forest stock, located on high slope land or at the upper limit of forest vegetation [Article 52, subparagraph e)];
c) generating of accidental pollution as a result of the failure to supervise the performance of new works, the functioning of the installations, technological, treatment, and neutralizing equipment, mentioned under the provisions of the environmental agreement and/or permit [Article 79, subparagraph e)];
d) generating pollution by intentionally discharging hazardous waste and dangerous substances in water, atmosphere, or on soil [Article 79, subparagraph i)].
2. With imprisonment from six months to three years, or with a fine from 500,000 lei to 3,000,000 lei, if the facts were a hazard to human, animal, or vegetable life or health:
a) disregarding of the restrictions or prohibitions established for water and atmosphere protection [Articles 35-38, Article 39, subparagraphs a), b), c), e), f), g), and h), and Article 46, subparagraphs a)-d)];
b) using of dangerous baits and electrical means to kill wild animals and fish for consumption or sale purposes [Article 28, subparagraph g), and Article 39, subparagraph c)];
c) washing in natural waters of pesticide packages and of other dangerous substances, as well as of the equipment by which they were transported or applied [Article 39, subparagraph dXI;
d) generating of noises above the permissible limits, if human health is thereby severely

endangered [Article 46, subparagraph e)];
e) disregarding of the restrictions and prohibitions on hunting and fishing of species protected or temporarily forbidden by law, and in zones of full protection regime [Article 52, subparagraph h), and Article 59, paragraph 1];
f) continuing of the activity after the environmental agreement or permit has been suspended (Article 10, paragraph 2);
g) failure to supervise and assure the hazardous waste and dangerous substances storages [Article 21, subparagraph a), and Article 28, subparagraph c)].
3. With imprisonment from one to five years:
a) issuance of the environmental agreement and/or permit without the compulsory and complete documentation (Article 9, paragraph 3);
b) presentation of false information and conclusions in the impact analyses and studies (Article 12, paragraph 3);
c) introduction into the country of hazardous waste and dangerous substances for storage and/or destruction purposes (Article 16);
d) failure to submit to test any new substance from within or outside the country (Articles 15-17);
e) transport or transit of pesticides, dangerous substances, or hazardous waste without a permit [Articles 15, 16, and Article 21, subparagraph b)];
f) omission to report promptly any major accident [Article 21, subparagraph cYl;
g) cremation of hazardous waste in not certified installations [Article 24, subparagraph c)];
h) siting and construction of underground or on-ground storages for hazardous waste in the absence of a permit [Article 24, subparagraphs d) and h)];
i) storing of hazardous waste and dangerous substances in underground spaces [Article 24, subparagraphs d) and
j) manufacture, delivery, and utilization of unauthorized dangerous substances and pesticides (Article 25);
k) failure to comply with the pro scriptions regarding the utilization of pesticides or chemical fertilizers on farming land [Article 28, subparagraphs d), e), and f)];
1) causing, through the failure to supervise the ionizing radiation sources, the contamination of the environment and/or the population's exposure to ionizing radiation [Article 33, subparagraph f)];
m) omitting to report promptly on an increase of the environment contamination above the permissible limits [Article 33, subparagraph i)];
n) discharging of waste waters and wastes from vessels or floating platforms directly into natural waters [Article 39, subparagraph h)];
o) concealing of data or disseminating of false information regarding the quality of the environment and human health by civil officials [Article 64, subparagraph j), Article 68];
p) continuing of an activity after its cessation was disposed [Article 79, subparagraph c)];
r) failure to take measures to limit the impact of dangerous substances or hazardous waste on the environment (Article 19);
s) approving and facilitating the introduction into the country of dangerous substances and hazardous waste (Article 20).
4. With imprisonment from two to seven years:
a) inadequately enforcing or failing to take the intervention measures in case of nuclear accident;
b) declining intervention in the case of accidental pollution of waters and coast areas [Article 39, subparagraph g)];
c) intentionally causing pollution by discharging or dumping dangerous substances or hazardous waste in natural waters, directly or from ships or floating platforms [Article 39, subparagraph h)].
5. If the facts provided for under items 3 and 4 endangered the health or physical condition of a large number of persons, had any of the consequences stated in Article 182 of the Criminal Code, or caused a significant material loss, the penalty shall be imprisonment from three to ten years and forbidding of certain rights, and, in case the death of one or more persons, or losses important to the national economy occurred, the penalty shall be imprisonment from seven to twenty years and forbidding of certain

rights.
The tentative shall be punished.

Art. 85. - The ascertaining and investigation of the offences shall be done ex officio by the bodies for criminal prosecution, according to the legal competence.

Art. 86. - The non-governmental organizations have the right of lawsuit with the view of environmental conservation, irrespective of who suffered from the prejudice.

CHAPTER VI
Final and transitory provisions

Art. 87. - To the interpretation of the present law, the central environmental protection authority shall be the Ministry of Waters, Forests, and Environmental Protection.

Art. 88. - With the view of efficient application of environmental protection measures, the following domains shall be regulated through special, revised, or new laws, which shall develop the general provisions in the present law:
a) regime of dangerous substances and hazardous waste;
b) domestic, industrial, and agricultural waste management;
c) pesticides regime;
d) regime for assuring radioprotection;
e) carrying out of nuclear activities and assuring of radiation source safety, including civil liability for nuclear damages;
f) water and aquatic ecosystems management;
g) land improvement works management;
h) seashore and coast area protection;
i) pisciculture and fishing;
j) atmosphere protection;
k) lawn management and conservation;
l) forest stock management;
n) game stock protection and hunting;
n) bee-breeding and melliferous flora protection;
o) spelaeological, geological, and palaeontological objectives management;
p) protected areas and natural monuments;
r) liability for the prejudices caused to the environment.

Art. 89. - At the date the present law comes into force, the Law No. 9/1973 on environmental protection, published in the "Buletinul Oficial" (Official Bulletin) No. 91 of June 23, 1973, as well as any other provisions contrary to the present law, shall be abrogated.

APPENDIX No. I

THE MEANING
of some terms to the interpretation of the present law

- atmosphere - the air mass that surrounds the surface of the earth, including the ozone layer;
- biodiversity - the diversity among living organisms from terrestrial and aquatic ecosystems, as well as among the ecological complexes of which they are part; it includes the diversity within species, among species, and among ecosystems;
- biotechnology - the technological application that uses biological systems, living organisms, components or parts thereof, to make or modify products or processes of a specific use;

- compliance program - a plan of measures comprising stages that shall be followed within time-frames specified through environmental permit provisions, by the competent authority in order to observe the environmental protection regulations;
- dangerous substances - any substance or product which used, even in quantities, concentrations, or conditions presumably not dangerous, represents significant risk to humans, environment, or welfare; they can be explosive, oxidizing, inflammable, toxic, noxious, corrosive, irritant, mutagenic, radioactive;
- ecological balance - the assembly of states and interrelations between the components of an ecological system, which assures the maintaining of its structure, its harmonious functioning and dynamics;
- ecosystem - a dynamic complex of plant, animal, and micro-organism communities and their non-living environment, interacting in a functional unit;
- ecotourism - the performing of a tourism in compliance with the environmental protection rules;
- effluent - any form of discharge in the environment, point or diffuse emission, including through leakage, jets, injections, inoculations, storage, drainage, or vaporization;
- emission - pollutants evacuated in the environment, including noise, vibrations, electromagnetic and ionizing radiation, which occur and are measured at the source emerging point;
- environment - the complex of natural conditions and elements of the Earth: air, water, soil and subsoil, all atmospheric layers, all organic and inorganic materials, as well as all living beings, natural systems in interaction comprising the above listed elements, including the material and spiritual values;
- environmental agreement - the technical and legal act which establishes the conditions for implementing a project or an activity from the environmental impact point of view;
- environmental audit - the procedure for obtaining information on the causes and consequences of cumulated past and anticipated negative effects, which is a part of the action for environmental impact assessment;
- environmental detriment - the deterioration of physical-chemical and structural characteristics of environment natural components, the diminishing of biological diversity and productivity of natural and anthropic ecosystems, the spoilage of ecological balance and of quality of life mainly caused by water, atmosphere, and soil pollution, the over-exploitation of resources, their inappropriate management and use, as well as by the improper territorial planning;
- environmental impact assessment - the quantification of the effects of human activities and of the natural processes on the environment, human health and safety, as well as of goods of any kind;
- environmental monitoring - a system for the surveillance, prediction, warning, and intervention, which is based on the systematic assessment of the dynamics of the environmental media qualitative characteristics for the purpose of perceiving the quality status and ecological meaning thereof, the evolution and social implications of the changes produced, followed by the appropriate measures;
- environmental permit - the technical and legal act which establishes the conditions and operating parameters for existent activities and for new ones, on the basis of the environmental agreement;
- habitant - the place or type of place where an organism or population naturally exists;
- hazardous waste - the toxic, inflammable, explosive, infectious, corrosive, radioactive waste, or others, which, when introduced or maintained in the environment, can cause damage to plants, animals, or humans;
- ionizing radiation source - a physical, natural entity, manufactured or used as an element of an activity which can generate exposure to radiation by emitting ionizing radiation or releasing radioactive substances;
- natural monument - species of rare or endangered plants and animals, isolated trees, geological formations and structures of a scientific or landscape interest;

- natural resources - the totality of natural elements of the environment that can be used in human activity: nonrenewable resources - mineral and fossil fuels -, renewable resources - water, air, soil, flora, wild fauna -, and permanent resources - sun, eolian, geothermal, and tide energy;
- nuclear activity permit - the technical and legal act by which the competent regulatory authority authorizes the title holder of the activity to site, design, purchase, manufacture, produce, construct, transport, import, export, receive, locate, put into operation, possess, use, operate, transfer, remove, and have discretion over any ionizing radiation source, nuclear installation, or radioactive waste management facilities;
- pollutant - any solid, liquid, gaseous, or vapor substance, or form of energy (electromagnetic, ionizing, thermal, sound, or vibration), which, when introduced in the environment, modifies the balance of its components and of the living organisms and causes damage to material welfare;
- potential ecological risk - the probability of producing some environmentally negative effects, that can be prevented based on an assessment study;
- prejudice - the cost quantifiable effect of the damages on human health, welfare, or environment, caused by pollutants, damaging activities, or disasters;
- protected area - the geographically defined zone, with rare or a high percentage of natural elements, designated or regulated, and managed to achieve specific conservation objectives; it includes national parks, natural reservations, biosphere reservations, natural monuments, and others;
- sustainable (levelopment - the development that meets the present needs without compromising the possibility of future generations to meet theirs;
- sustainable use - the use of renewable resources in a way and at a rate that shall not lead to their long-term decline, thereby maintaining their potential in agreement with the needs and aspirations of present and future generations;
- title holder of the project or activity - the natural or legal person who proposes, possesses and/or manages an economic or social activity;
- wastes - the substances resulting from some biological or technological processes, which cannot be further used as such, some of which being reusable;
- wetland - an area of excessive humidity which includes marshes, flood areas, coasts, estuaries, and lagoons.

APPENDIX No. II

LIST
with activities which are subject to the procedure for environmental impact assessment for the issuing of the environmental agreement and/or permit

1. Transports
1.1. Road traffic
a) highways;
b) main roads with busy traffic;
c) other main roads; all roads within protected areas;
d) parkings for stationing (lands or buildings) for more than 300 cars;
e) new public transportation lines.
1.2. Rail traffic
a) new rail roads lines;
b) other rail installations, including doubling or expending of existing lines.
1.3. Water navigation
a) harbour installations for ships belonging to public shipping companies;
b) industrial harbours with fixed loading and unloading installations;
c) recreation harbours with more than 100 places for mooring;
d) navigable routes.
1.4. Air navigation
a) airports;

b) airdromes, with the exception of heliports;
c) heliports in protected areas.

2. Energy
2.1. Energy production
a) nuclear energy production installations (nuclearpower plants), self-sustained nuclear reaction installations (research reactors), installations for nuclear fuels extraction and production, and other installations generating ionizing radiation;
b) thermal installations for the production of an energy of more than 10 Mw;
c) hydroelectric plants with a power of more than 1 MW;
d) geothermal installations, including those which exploit the underground water heat;
e) gas plants, coke plants, coal liquefaction installations;
f) prospection, exploration and exploitation of oil, natural gas or coal, and of other mineral resources, including those from the sea.
2.2. Energy transport and storage
a) installations of transport via pipes of liquid or gaseous fuels and combustibles;
b) air wires and buried cables of high voltages, designed for 220 kV or more;
c) tanks for gas, fuel, and combustible storage;
d) coal and other mineral resources warehouses;
e) building of transport means for hydrocarbons, dangerous substances, and hazardous waste.

3. Hydrotechnical constructions
a) works for level regularization or for water drainage from natural lakes;
b) hydrotechnical works, such as: embanking, corrections, installations for retention of dragged alluvial deposits or for protection against floods;
c) sedimentary materials discharging into lakes;
d) exploitation of gravel, sand, therapeutic mud, or other materials from lakes, water courses, or from underground water (with the exception of punctual extractions motivated by flood prevention);
e) works of collection of underground and on-ground waters;
f) works of coast areas planning and related natural resources exploitation;
g) water supply wells deeper than 50 meters.

4. Waste and packages removal
a) warehouses for temporary or permanent storage of hazardous and radioactive waste;
b) radioactive waste processing and treatment installations;
c) cemeteries;
d) inert materials discharging and/or depositing;
e) controlled, bioactive discharging;
f) controlled discharging for stabilized waste;
g) installations for waste sorting, treatment, recycling, or incineration;
h) temporary storage for liquid, solid, or muddy waste;
i) waste water treatment installations.

5. National defence
a) batteries, shooting and exercise grounds for the army;
b) military airdromes;
c) other installations belonging to the army, which can be integrated within one of the types of installations mentioned in the present appendix.

6. Sports, tourism, recreation
a) cable railways and ski lifts (for turning to good account the new skiing slopes or new areas within the already existent skiing slopes, or for connection between them of different skiing slopes);
b) running tracks for motor vehicles, for different sport activities;
c) snow cannons;
d) stadiums with fixed stands able to accommodate more than 20,000 spectators;

e) amusement parks;
f) green areas.

7. Industry
a) aluminum plants;
b) steel plants;
c) nonferrous metals plants;
d) installations for old metals pre-treatment and melting;
e) installations for the synthesis of chemical products, including of heavy water;
f) installations for chemical product transformation;
g) warehouses for chemical product storage;
h) explosive matters and ammunition plants;
i) slaughter-houses and butcher's shops with an output of more than 5,000 tones per year;
j) cement plants;
k) glass plants with an output of more than 20,000 tones per year;
l) pulp and paper plants;
m) plants for extraction and transformation of binders and materials which contain binders;
n) plants producing particle panels;
o) wood processing installations;
p) textile and leather products installations;
r) dangerous substances and pesticides manufacture, trading, and using;
s) oil, petrochemical, and chemical products depositing installations;
t) industrial units for food and agrotechnical products manufacture;
u) log squaring units.

8. Other works or installations
a) land improvement made through works of art, as well as interventions on areas bigger than 200 ha, and/or accompanied by technical measures for agricultural purposes, such as agricultural land irrigations or draining on areas bigger than 20 ha, as well as general projects of land removing from agricultural use;
b) gravel and sand pits and other works of extraction of materials not used with the view of energy production;
c) constructions and installations for raising farm animals, with capacities bigger than:
- 100 heads for beef cattle;
- 500 heads for meat pigs;
- 6,000 heads for egg-laying hens;
- 6,000 heads of chicken for poultry;
- 1,500 heads of turkeys;
d) commercial centres;
e) places of merchandise transshipment and distribution centres;
f) fixed equipment for electrical or radioelectrical transmission of signals, images, or sound (only transmission equipment), with a power bigger than 500 kW;
g) deforestation of forest vegetation outside the forest stock;
h) piscicultural works;
i) import and export of plants and animals from spontaneous flora and fauna;
j) urban and territorial planning.

The list of activities for which the procedure for impact assessment is compulsory for the obtaining of the environmental agreement and/or permit shall be supplemented by the central environmental protection authority with any other new activity, not known at the date the list was drawn up.

ANNEX 3

4.1 **Legislation on waste mangement after accessing the European Union.**

The European Union's approach to waste management is based on three principles:

Waste prevention: This is a key factor in any waste management strategy. If we can reduce the amount of waste generated in the first place and reduce its hazardousness by reducing the presence of dangerous substances in products, then disposing of it will automatically become simpler. Waste prevention is closely linked with improving manufacturing methods and influencing consumers to demand greener products and less packaging.

Recycling and reuse: If waste cannot be prevented, as many of the materials as possible should be recovered, preferably by recycling. The European Commission has defined several specific 'waste streams' for priority attention, the aim being to reduce their overall environmental impact. This includes packaging waste, end-of-life vehicles, batteries, electrical and electronic waste. EU directives now require Member States to introduce legislation on waste collection, reuse, recycling and disposal of these waste streams. Several EU countries are already managing to recycle over 50% of packaging waste.

Improving final disposal and monitoring: Where possible, waste that cannot be recycled or reused should be safely incinerated, with landfill only used as a last resort. Both these methods need close monitoring because of their potential for causing severe environmental damage. The EU has recently approved a directive setting strict guidelines for landfill management. It bans certain types of waste, such as used tyres, and sets targets for reducing quantities of biodegradable rubbish. Another recent directive lays down tough limits on emission levels from incinerators. The Union also wants to reduce emissions of dioxins and acid gases such as nitrogen oxides (NOx), sulphur dioxides (SO2), and hydrogen chlorides (HCL), which can be harmful to human health.

The Council Directive 99/31/EC describes the legislation on the landfill of waste.

The Directive is intended to prevent or reduce the adverse effects of the landfill of waste on the environment, in particular on surface water, groundwater, soil, air and human health.
It defines the different categories of waste (municipal waste, hazardous waste, non-hazardous waste and inert waste) and applies to all landfills, defined as waste disposal sites for the deposit of waste onto or into land. Landfills are divided into three classes:

- landfills for hazardous waste;
- landfills for non-hazardous waste;
- landfills for inert waste.

On the other hand, the Directive does not apply to:

- the spreading on the soil of sludges (including sewage sludges and sludges resulting from dredging operations); for this there is a special directive.
- the use in landfills of inert waste for redevelopment or restoration work;
- the deposit of unpolluted soil or of non-hazardous inert waste resulting from prospecting and extraction, treatment and storage of mineral resources as well as from the operation of quarries;
- the deposit of non-hazardous dredging sludges alongside small waterways from which they have been dredged and of non-hazardous sludges in surface water, including the bed and its subsoil.

A standard waste acceptance procedure is laid down so as to avoid any risks:

- waste must be treated before being landfilled;
- hazardous waste within the meaning of the Directive must be assigned to a hazardous waste landfill;
- landfills for non-hazardous waste must be used for municipal waste and for non-hazardous waste;

- landfill sites for inert waste must be used only for inert waste.

The following wastes may not be accepted in a landfill:

- liquid waste;
- flammable waste;
- explosive or oxidising waste;
- hospital and other clinical waste which is infectious;
- used tyres, with certain exceptions;
- any other type of waste which does not meet the acceptance criteria laid down in Annex II of the directive. *(See annex 1 of this report)*

The Directive sets up a system of operating permits for landfill sites. Applications for permits must contain the following information:

- the identity of the applicant and, in some cases, of the operator;
- a description of the types and total quantity of waste to be deposited;
- the capacity of the disposal site;
- a description of the site;
- the proposed methods for pollution prevention and abatement;
- the proposed operation, monitoring and control plan;
- the plan for closure and aftercare procedures;
- the applicant's financial security;
- an impact assessment study, where required under Council Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment.

Member States must ensure that existing landfill sites may not continue to operate unless they comply with the provisions of the Directive as soon as possible.

Member States must report to the Commission every three years on the implementation of the Directive.

On the basis of these reports, the Commission must publish a Community report on the implementation of the Directive.

EC, 1999.

ANNEX I.A.

Wastes displaying any of the properties listed in Annex III and which consist of:

1. anatomical substances; hospital and other clinical wastes; 2. pharmaceuticals, medicines and veterinary compounds; 3. wood preservatives; 4. biocides and phyto-pharmaceutical substances; 5. residue from substances employed as solvents; 6. halogenated organic substances not employed as solvents excluding inert polymerized materials; 7. tempering salts containing cyanides; 8. mineral oils and oily substances (e.g. cutting sludges, etc.); 9. oil/water, hydrocarbon/water mixtures, emulsions; 10. substances containing PCBs and/or PCTs (e.g. dielectrics etc.); 11. tarry materials arising from refining, distillation and any pyrolytic treatment (e.g. still bottoms, etc.); 12. inks, dyes, pigments, paints, lacquers, varnishes; 13. resins, latex, plasticizers, glues/adhesives; 14. chemical substances arising from research and development or teaching activities which are not identified and/or are new and whose effects on man and/or the environment are not known (e.g. laboratory residues, etc.); 15. pyrotechnics and other explosive materials; 16. photographic chemicals and processing materials; 17. any material contaminated with any congener of polychlorinated dibenzo-furan; 18. any material contaminated with any congener of polychlorinated dibenzo-p-dioxin.

ANNEX I.B.

Wastes which contain any of the constituents listed in Annex II and having any of the properties listed in Annex III and consisting of:

19. animal or vegetable soaps, fats, waxes; 20. non-halogenated organic substances not employed as solvents; 21. inorganic substances without metals or metal compounds; 22. ashes and/or cinders; 23. soil, sand, clay including dredging spoils; 24. non-cyanidic tempering salts; 25. metallic dust, powder; 26. spent catalyst materials; 27. liquids or sludges containing metals or metal compounds; 28. residue from pollution control operations (e.g. baghouse dusts, etc.) except (29), (30) and (33); 29. scrubber sludges; 30. sludges from water purification plants; 31. decarbonization residue; 32. ion-exchange column residue; 33. sewage sludges, untreated or unsuitable for use in agriculture; 34. residue from cleaning of tanks and/or equipment; 35. contaminated equipment; 36. contaminated containers (e.g. packaging, gas cylinders, etc.) whose contents included one or more of the constituents listed in Annex II; 37. batteries and other electrical cells; 38. vegetable oils; 39. materials resulting from selective waste collections from households and which exhibit any of the characteristics listed in Annex III; 40. any other wastes which contain any of the constituents listed in Annex II and any of the properties listed in Annex III. (*) Certain duplications of entries found in Annex II are intentional.

ANNEX II

CONSTITUENTS OF THE WASTES IN ANNEX I.B. WHICH RENDER THEM HAZARDOUS WHEN THEY HAVE THE PROPERTIES DESCRIBED IN ANNEX III (*)

Wastes having as constituents:

C1 beryllium; beryllium compounds; C2 vanadium compounds; C3 chromium (VI) compounds; C4 cobalt compounds; C5 nickel compounds; C6 copper compounds; C7 zinc compounds; C8 arsenic; arsenic compounds; C9 selenium; selenium compounds; C10 silver compounds; C11 cadmium; cadmium compounds; C12 tin compounds; C13 antimony;

antimony compounds; C14 tellurium; tellurium compounds; C15 barium compounds; excluding barium sulfate; C16 mercury; mercury compounds; C17 thallium; thallium compounds; C18 lead; lead compounds; C19 inorganic sulphides; C20 inorganic fluorine compounds, excluding calcium fluoride; C21 inorganic cyanides; C22 the following alkaline or alkaline earth metals: lithium, sodium, potassium, calcium, magnesium in uncombined form; C23 acidic solutions or acids in solid form; C24 basic solutions or bases in solid form; C25 asbestos (dust and fibres); C26 phosphorus: phosphorus compounds, excluding mineral phosphates; C27 metal carbonyls; C28 peroxides; C29 chlorates; C30 perchlorates; C31 azides; C32 PCBs and/or PCTs; C33 pharmaceutical or veterinary coumpounds; C34 biocides and phyto-pharmaceutical substances (e.g. pesticides, etc.); C35 infectious substances; C36 creosotes; C37 isocyanates; thiocyanates; C38 organic cyanides (e.g. nitriles, etc.); C39 phenols; phenol compounds; C40 halogenated solvents; C41 organic solvents, excluding halogenated solvents; C42 organohalogen compounds, excluding inert polymerized materials and other substances referred to in this Annex; C43 aromatic compounds; polycyclic and heterocyclic organic compounds; C44 aliphatic amines; C45 aromatic amines C46 ethers; C47 substances of an explosive character, excluding those listed elsewhere in this Annex; C48 sulphur organic compounds; C49 any congener of polychlorinated dibenzo-furan; C50 any congener of polychlorinated dibenzo-p-dioxin; C51 hydrocarbons and their oxygen; nitrogen and/or sulphur compounds not otherwise taken into account in this Annex. (*)Certain duplications of generic types of hazardous wastes listed in Annex I are intentional.

Annex III

PROPERTIES OF WASTES WHICH RENDER THEM HAZARDOUS

H1 'Explosive`: substances and preparations which may explode under the effect of flame or which are more sensitive to shocks or friction than dinitrobenzene.

H2 'Oxidizing`: substances and preparations which exhibit highly exothermic reactions when in contact with other substances, particularly flammable substances.

H3-A 'Highly flammable`: - liquid substances and preparations having a flash point below 21 °C (including extremely flammable liquids), or - substances and preparations which may become hot and finally catch fire in contact with air at ambient temperature without any application of energy, or - solid substances and preparations which may readily catch fire after brief contact with a source of ignition and which continue to burn or to be consumed after removal of the source of ignition, or - gaseous substances and preparations which are flammable in air at normal pressure, or - substances and preparations which, in contact with water or damp air, evolve highly flammable gases in dangerous quantities.

H3-B 'Flammable`: liquid substances and preparations having a flash point equal to or greater than 21 °C and less than or equal to 55 °C.

H4 'Irritant`: non-corrosive substances and preparations which, through immediate, prolonged or repeated contact with the skin or mucous membrane, can cause inflammation.

H5 'harmful`: substances and preparations which, if they are inhaled or ingested or if they penetrate the skin, may involve limited health risks.

H6 'Toxic`: substances and preparations (including very toxic substances and preparations) which, if they are inhaled or ingested or if they penetrate the skin, may involve serious, acute or chronic health risks and even death.

H7 'Carcinogenic`: substances and preparations which, if they are inhaled or ingested or if they penetrate the skin, may induce cancer or increase its incidence.

H8 'Corrosive`: substances and preparations which may destroy living tissue on contacts.

H9 'Infectious`: substances containing viable micro-organisms or their toxins which are known or reliably believed to cause disease in man or other living organisms.

H10 'Teratogenic`: substances and preparations which, if they are inhaled or ingested or if they penetrate the skin, may induce non-hereditary congenital malformations or increase their incidence.

H11 'Mutagenic`: substances and preparations which, if they are inhaled or ingested or if they penetrate the skin, may induce hereditary genetic defects or increase their incidence.

H12 Substances and preparations which release toxic or very toxic gases in contact with water, air or an acid.

H13 Substances and preparations capable by any means, after disposal, of yielding another substance, e.g. a leachate, which possesses any of the characteristics listed above.

H14 'Ecotoxic`: substances and preparations which present or may present immediate or delayed risks for one or more sectors of the environment.

Notes

1. Attribution of the hazard properties 'toxic` (and 'very toxic`), 'harmful`, 'corrosive` and 'irritant` is made on the basis of the criteria laid down by Annex VI, part I A and part II B, of Council Directive 67/548/EEC of 27 June 1967 of the approximation of laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances (1), in the version as amended by Council Directive 79/831/EEC (2).

2. With regard to attribution of the properties 'carcinogenic`, 'teratogenic` and 'mutagenic`, and reflecting the most recent findings, additional criteria are contained in the Guide to the classification and labelling of dangerous substances and preparations of Annex VI (part II D) to Directive 67/548/EEC in the version as amended by Commission Directive 83/467/EEC (1).

There are currently no specific regulatory controls at the Community level on wastes applied to land with the exception of sewage sludge. However, in Annex IIB of the Waste Framework Directive 75/442/EEC as amended by Directive 91/156/EEC (CEC 1991), landspreading operations of wastes other than animal carcasses and animal manures are considered as recovery operations as long as they are carried in accordance with Article 4, i.e. without endangering human health and the environment. The Directive specifies that companies undertaking such recovery operations can be exempted from a permit requirement if the competent authorities have adopted specific rules for these exemptions.

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Annex 3

Type of feedstock	Organic content	C:N ratio	DM %	VS % of DM	Biogas yield m^3*kg^{-1} VS	Unwanted physical impurities	Other unwanted matters
Pig slurry	Carbohydrates, proteins, lipids	3-10	3-8	70-80	0.25-0.50	Wood shavings, bristles, water, sand, cords, straw	Antibiotics, disinfectants
Cattle slurry	Carbohydrates, proteins, lipids	6-20	5-12	80	0.20-0.30	Bristles, soil, water, straw, wood	Antibiotics, disinfectants, NH_4^+
Poultry slurry	Carbohydrates, proteins, lipids	3-10	10-30	80	0.35-0.60	grit, sand, feathers	Antibiotics, Disinfectants, NH_4^+,
Stomach/intestine content	Carbohydrates, proteins, lipids	3-5	15	80	0.40-0.68	Animal tissues	Antibiotics, disinfectants
Whey	75-80% lactose 20-25% protein	n.a.	8-12	90	0.35-0.80	Transportation impurities	
Concentrated whey	75-80% lactose 20-25% protein	n.a.	20-25	90	0.80-0.95	Transportation impurities	
Flotation sludge	65-70% proteins 30-35%lipids					Animal tissues	Heavy metals, disinfectants, organic pollutants
Ferment. slops	Carbohydrates	4-10	1-5	80-95	0.35-0.78	Undegradable fruit remains	
Straw	Carbohydrates, lipids	80-100	70-90	80-90	0.15-0.35	Sand, grit	
Garden wastes		100-150	60-70	90	0.20-0.50	Soil, cellulosic components	Pesticides
Grass		12-25	20-25	90	0.55	Grit	Pesticides
Grass silage		10-25	15-25	90	0.56	Grit	
Fruit wastes		35	15-20	75	0.25-0.50		
Fish oil	30-50% lipids	n.a.					
Soya oil/margarine	90% vegetable oil	n.a.					
Alcohol	40% alcohol	n.a.					
Food remains			10	80	0.50-0.60	Bones, plastic	Disinfectants
Organic household waste						Plastic, metal, stones, wood, glass	Heavy metals, organic pollutants
Sewage sludge							Heavy metals, organic pollutants

Al Seadi T, 2000.

ANNEX 4

Table 3.2 Coefficient of waste generated per animal category

Animal category	Quantity (l/week)
Cattle	
Less than 1 year	80
Between 1 – 2 years	140
More than 2 years:	
Male/heifer	250
Dairy cow	315
Other cow	280
Pigs	
Less than 20 kg	15
Fattening pigs more than 20 kg	30
Breeding pigs	60
Covered sows	100
Poultry	
Broiler	0.2
Laying hens	1.1

Gendebien A.H. , 2001.

Annex 5

Sludge from septic tanks and latrines should be treated as sewage sludge. Sewage sludge can vary in the quality and quantity of its organic and inorganic content, including the types and numbers of pathogens it contains. Such variations occur not only geographically but also over time at the same site.
The nature of sewage, and hence its sludge, is such that it may contain enteric pathogens, i.e. those which are excreted with faecal material and generally are infective by the oral route. Man is obviously the most likely source but, depending upon local conditions, the sewage may also contain excreta from pets - arising from storm runoff - or from farm animals. Washings from vegetable preparation, both domestic and commercial, are the major source of plant pathogens.

Because septic tanks are usually associated with individual families or similar closely related communities the range of pathogens present at any one time will be small. However, it is likely that if one individual becomes infected the whole community will be infected. Therefore the concentration of pathogens will either be very low or relatively high.

Bacteria are capable of independent existence and can multiply wherever suitable conditions are present. Most are inactivated at temperatures in excess of 70 °C over a relatively short period of time. Lower temperatures over longer time periods are equally effective. Research suggests that sludge is pathogen free after 7 minutes at 70°C, 30 minutes at 30°C, 2 hours at 60°C, 15 hours at 55°C and 3 days at 50°C. However some that produce spores, e.g. Clostridium species, require higher temperatures for complete kill.

The bacterial pathogens of mammals have optimum growth temperatures around the body temperature, which is 35-40°C. They are unlikely to multiply rapidly at temperatures below about 25°C. For multiplication they also need suitable nutrients and water levels. As the natural habitat of these organisms is the intestine, nutrients will not be lacking in sewage sludges. Conditions unsuitable for growth are not necessarily lethal to micro-organisms. Some organisms have further evolved structures - cysts or spores - as a means of survival in adverse conditions.

Worms, e.g. Taenia spp. and Ascaris spp., have evolved an egg stage as a means of transferring from one host to another. Pathogenic protozoa e.g., Cryptosporidium and Giardia have evolved a cyst stage for the same purpose. These structures are extremely resistant to the stresses of the ambient environment. However, these organisms cannot reproduce outside a suitable host and this means that their concentrations in sludges are relatively low.

The sludge treatment processes that operate at mesophilic temperatures (33-37 °C) were developed for the stabilisation of sludge. The mean retention time in such plants is usually in the region of 12-15 days, but to enable the process to operate on a continuous basis there must be an addition of fresh material in the form of raw sludge, normally at least once every day. For maximum effect of the reduction of numbers of pathogens the removal of treated sludge must take place before the addition of raw sludge. This still means, however, that a fraction of the withdrawn sludge will have been exposed to the digesting conditions for 24 hours or less.

Prolonged exposure to mesophilic temperatures will have an effect on the survival of pathogens. The simple effect of temperature will be enhanced by the fatty acids and other antagonistic compounds developed during the digestion process. However because different micro-organisms have different survival times at these temperatures and because the pathogen load in the local population varies with their state of health it is not possible with mesophilic systems alone to produce a sludge that is virtually free of pathogens consistently.

In conditions where the daily temperatures are considerably lower the survival periods will be considerably longer. The main processes for the reduction of pathogen numbers during sludge treatment at ambient temperatures, particularly in colder climates, will be the production of fatty acids and other anti-microbials during the stabilisation of the sludge, and the activity of the micro-flora, such as protozoa. Because of the many uncontrollable variables it would never be possible to produce sludge that was virtually pathogen free.

When quicklime or similar substances, (e.g. pulverised fuel ash or cement kiln dust), are

mixed with sludge, in addition to the raising of the pH there is an autothermic effect and the temperature of the mixture is raised to between 55° C and 70°. Strauch (1998), describing earlier studies found that a combination of pH 12 and temperatures in the range 60-70oC destroyed Ascaris ova and a range of viruses within 24 hours

Other stabilisation processes, although working at relatively low temperatures, produce products that are deleterious to the survival of pathogens. For example, mesophilic anaerobic digestion operates at about 35°C, which is the optimum growth temperature for most enteric bacteria, but the digestion process produces amounts of fatty acids and other products that are lethal to many pathogenic organisms.

Other forms of sludge treatment, such as mesophilic anaerobic digestion, use of slaked lime, and storage in various forms, will not produce a sludge that can be considered to be free of pathogens.

In general the range of pathogens in sludge arising from the treatment of meat processing waste will be similar to those in sewage sludge so the requirements for hygienisation in terms of heat and/or pH will be similar, although the process parameters to achieve stabilisation may differ because the nature of the waste.

The wastes from vegetable processing are unlikely to pose a major risk to human or animal health. However, they are likely to contain micro-organisms that are pathogenic to plants. Generally crops are not treated to eliminate pathogens so such pathogens are widespread in the environment. There are however some serious pathogens that have limited distribution, and it is desirable that these are not allowed to spread further. As an example, the potato cyst nematode is common in some areas where potatoes are grown as a food crop. But it is undesirable to allow it in areas where basic seed potatoes are grown, as not only would it have an undesirable effect on those crops but it may well get carried in the seed tubers to previously uninfected areas.

Because of the wide range of pathogens and the diversity of genera of hosts there are no comprehensive reviews from which a ‘safe zone’ can be derived in the same way as for mammalian pathogens. However, as plants grow at ambient temperatures it is unlikely that plant pathogens would tolerate temperatures in excess of the upper end of the mesophilic temperature range (about 40oC).

Carrington, E G, 2001

Annex 6

Condition/situation	Possible source/reason	Indicators	Action
Piles fail to heat	Materials too dry	Very difficult to squeeze water from the material	Add water or turn in the rain.
	Materials too wet, moisture content > 60%	Material feels soggy, liquid squeezes out	Add dry amendments and high-carbon ingredients like straw, rice hulls, leaves, or shredded paper.
	Not enough nitrogen	Large amount of woody materials	Add high nitrogen ingredients, urinate on piles, or, if no nitrogenous materials are available, add water.
	Poor structure	Few large particles, not excessively wet	Add bulking agent, that is, materials in large chunks that maintain air space.
	Small size pile	Pile height less than 1.1 metre	Combine piles.
	pH too low	pH measures less than 5.5	Add lime or wood ash.
Temperature falling	Low oxygen	Temperature declines gradually then sharply	Turn or aerate the pile.
	Low moisture	Cannot squeeze water from the material	Add water and remix.
	Composting nearing completion; C:N ratio less than 20:1	Pile does not re-heat after turning or watering	None required.
Pile overheating	Insufficient aeration	Pile is hot	Turn the pile.
	Moderate to low moisture	Pile feels damp	Add water.
	Pile is too large	Pile height greater than 2.5 metre	Split the piles or spread them out.
Odours generated ammonia, (rotten-egg or putrid odours)	Anaerobic conditions: materials too wet, poor structure, pile compacted, insufficient aeration	Low temperatures, odours	First, turn the piles. If odour persists, then consider adding sawdust, other dry amendment, rock phosphate, or other bulking agent. Then remix, and turn piles again.
	Anaerobic conditions: pile too large	High temperatures	Split the pile or decrease its size.
	Odorous raw materials	High temperatures	Cover the piles with a thin layer of sawdust or leaves to act as an air filter. Turn and mix the materials, add bulking materials, handle raw materials promptly.
High levels of flies, mosquitos	Flies breeding in the compost piles	Fresh manure or food material at pile surface	Turn piles every 4 to 7 days. Cover static piles with 10 cm of matured compost, or with sawdust or leaves. If no cover, remove the outer 150 mm of material before turning and using it in the core of the new pile so that breeding cycle be interrupted. Allowing chicken and fowl to eat the larva helps control the fly population.
	Flies breeding in raw materials	Wet raw materials stored on site more than 4 days	Handle raw materials promptly.

Dulac N, 2001

Annex 7

POLYMER	CHARACTERISTICS	TYPICAL PRODUCTS
Low density polyethylene (LDPE)	Soft, flexible Easy to heat seal. Only glass clear if very thin; thick sections are milky white (or coloured).	Film bags, sacks and sheeting. blow-moulded bottles, Food boxes Flexible piping and hoses, household buckets, bowls, etc. Cable coverings, usually telephone cables.
Medium density polyethylene(MDPE)	Intermediate between LDPE and HDPE.	Squeeze bottles.
High density polyethylene (HDPE)	Tough, stiffer than LD.Even thin film is milky (or coloured).	High strength film for sacks and bags. Larger bottles, buckets, crates, jerry cans, pallets, dustbins and other household objects.
Polypropylene (PP)	Like HDPE but harder and more rigid. Can be bent sharply without breaking. "Oriented" film is tough and very clear.	Chairs and other furniture. Best quality homewares and other strong mouldings such as car battery housings, other car and domestic appliance parts, jerry cans, wine barrels, crates, pipes and fittings. Rope, string, strapping, tape and woven sacking and carpet backings, netting. Heat sterilizable surgical goods.
Rigid polyvinyl chloride (PVC)	Hard and rigid in its unplasticized form.	Water and irrigation pipes and fittings. Gutters and rainwater pipes, window frames, building panels. Credit cards, records, transparent packaging, bottles, thin sheet and corrugated sheet.
Plasticized PVC	Soft, flexible, rather weak.Can be highly transparent. Easily bonded to textiles, metals etc.	Sports and toy balls, inflatable toys and boats. Toys, dolls, novelties. Hose, cable coverings. Suitcases, handbags, other luggage. Shoes, flooring, raincoats, shower curtains, upholstery, automobile linings. Bottles, especially for oils and other chemically active liquids, clear film and pallet covers
Polystyrene (PS)	Easily moulded, but brittle. Can be crystal clear.	Cheap transparent kitchen ware, light fittings, bottles, lenses, jewellery. Toys, radio cases. Medical syringes and other sterilizable medical goods. Food containers and lids. Cheap baby-feeding bottles.
Impact modified PS	Less brittle but no longer clear	Refrigerator interiors and other domestic appliance mouldings. Vending cups and take-away food trays. Shoe heels.

POLYMER	CHARACTERISTICS	TYPICAL PRODUCTS
Expanded PS,	Very lightweight white, expanded foam - not economic to recycle	Ceiling tiles, insulation, packings, padding
Acrylonitrile Butadiene Styrene (ABS)	Tough, stiff, easily moulded to give shiny surface finish. Good resistance to food, oils etc,.	Food (especially margarine) containers. Telephone handsets & other office equipment, camera housings. Domestic appliance parts. Electrical hand tools. Toys.
Polyamides (Nylons)	Strong, very tough, machinable. Slippery low friction surfaces.	Engineering uses such as gears, bearings. Domestic appliance parts, pipe fittings. Textile yarn, fishing line, netting, hose reinforcement brush bristles, surgical twine, tennis raquet strings.
The following occur in leaser quantities;		
Polyrmethyl Methacrylate (Perspex or Acrylic)	Rigid, transparent, attractive when coloured. Excellent resistance to weather.	Illuminated display signs Glazing, esp. of aircraft. Automobile, light and optical lenses. Telephones, furniture, piano keys.
Polyethylene Terephthalate (Polyester, Terylene, PET)	Tough, clear, very strong. Excellent electrical properties Can be shrunk for packaging.	Polyester textile yarn. Magnetic recording tape. Transparent "oriented" film for packaging. Soft drink bottles. Photographic film base. Industrial strapping.
Polycarbonate (PC)	Very strong, rigid, heat resisting, tasteless, stain resistant, vandal resistant, can be crystal clear.	Lenses for strong electric lighting, Baby feed bottles, Tools, Glazing, Heat resistant kitchen ware.
Polyurethane (PU)	Flexible, rubbery, with good insulation properties.	As foam for furniture fillings, packaging, insulation, sponges. As solid for tyres, shock mounts, roller coverings, shoes. With textiles for clothing.

Vogler J. 1986

Annex 8

The tests are tabulated in Table 4 but the following further explanation is needed.

a) Finger nail scratch and flexibility: PE that has been exposed to the weather may have hardened and become unscratchable, rigid and brittle. Very thin material of any polymer may seem flexible; very thick of any may seem rigid.

b) Flotation test: (Fig. 13) This is very useful to make the difficult distinction between high density polyethylene (especially if it has been hardened by exposure to weather) and polypropylene. Also between high and low density polyethylene. A mixture of water and alcohol is made up of exact density, so that one material will sink and the other float.
If pure alcohol (ethyl alcohol - density about 0.79) is not available use iso-propyl alcohol (also called Propanol or Propan-2-OL - density about 0.78). Mix the two thoroughly and use a "hydrometer" (range 0.9 to 1.0) to test the density of the mixture. A density of 0.925 will ensure that poly-pro pylene floats and HDPE (or even a medium density PE) will sink. A. density of 0.93 is better to distinguish HDPE from LDPE.
Flotation tests between polypropylene and LDPE cannot be done with certainty because their densities can overlap- Use the fingernail test and visual appearance instead.
Once made up the mixtures can be kept, provided they are securely capped to avoid evaporation or checked with a hydrometer before use. Flotation may be affected by surface tension; avoid by adding a couple of drops of washing up liquid to the water or mixture, or by carefully pushing the sample under the surface and swirling gently to remove any air bubbles.

c) For the flame test, (Fig. 14) cut a sliver 5cm long and 1cm wide at one end, tapering to a point at the other end which is lit. Hold over a sink or stone, away from the body and clothing as samples may drip. The drips will only burn as they fall if they drop from within the flame.

d) PVC can be confirmed by touching the object with a red hot copper wire and returning the wire to the flame when it will burn green. Burn off all residue of material before repeating the teat with the same wire. (Other polymers that contain chlorine or fluorine, such as PTFE or polyvinlyidene chloride, also give a green flame in this test but they are rare).

e) Thermosets can be tested with a piece of wire just below red heat. If the wire penetrates it is a thermoplastic,, if not it is a thermoset.

TABLE 4 TESTS TO DISTINGUISH POLYMERS

Polymer	Flexibility	In Water	Relative Density	Burning	Smell on Burning	Scratches with finger nail	Can it be perfectly transparent.	Notes
Low Density Polyethylene LDPE	Very flexible	Floats	0.91-0.92	Blue flame with yellow tip: melts and drips burning droplets	Like candle wax	Yes Easily	No	Has a waxy feel Intermediate densities between 0.92 and 0.96 also exist
High Density Polyethylene HDPE	Much less flexible than LDPE Film crackles when bent	Floats	0.96	ditto	ditto	Yes with difficulty, especially when cold or weathered	No	Very tough, hard to tear
Polypropylene PP	Hard to bend but does not break when bent	Floats	0.90-0.91	Yellow flame with blue base. Can drip burning droplets.	Ditto but less strong	No	No	Very strong Forms an almost unbreakable hinge if folded
Polyvinyl Chloride PVC	Rigid PVC is brittle Plasticized PVC can be very flexible	Sinks	1.2-1.6	Yellow, sooty smoke; does not continue to burn if removed from flame.	Pungent hydrochloric acid. DANGER do not inhale	Rigid PVC - No Flexible, plasticised PVC - Yes	Yes	Touch with a red hot copper wire and hold wire to flame. Green flame indicates PVC or other polymer containing chlorine.
Polystyrene PS	Very Rigid and brittle	Sinks	1.0-1.1	Burns strongly with yellow sooty flame. Leaves no ash	Sweet	No	Yes	Makes Imetalic ring 'when dropped on a hard surface
Acrylo-nitrile Butadiene Styrene ABS	Less rigid than PS	Sinks	1.0-1.1	Ditto but leaves some ash.	Rubbery	No	Yes	Often has silky surface finish No metallic ring when dropped

Vogler J. 1986

Polymer	Flexibility	In Water	Relative Density	Burning	Smell on Burning	Scratches with finger nail	Can it be perfectly transparent.	Notes
Celulose Acetate CA	-	Sinks	1.5	Like paper, not if flame is removed	Woody	No	Yes	Weak
Polymethyl Methacrylate (Perspex, Acrylic) PMMA	Brittle	Sinks	1.2	Yellow flame with blue base. No smoke Does not drip	Fruity, sweet like flowers	No	No	Strong but brittle but will break if bent.. Does not ring
Nylon N	Very Flexible	Sinks	1.1	Blue flame. Melts & drips Does not continue to burn if removed from flame.	Like burning hair	No	Yes	Very tough land flexible
Polyethylene Terephthalate (Polyester) PET	Very Flexible	Sinks	1 -4	Strong yellow flame with a little black smoke.	Little smell butter.	No- unless very thin		Tough and flexible. Shiny surface Crystal clear
Polycarbonate PC]	Very Tough	Sinks			Sweet			Can be bent (with pliers) without breaking
Thermosets	-							Hot wire will not penetrate Sorting

Annex 9 Substances that form during household waste burning.

Table 9
Emissions from barrel burning of household waste (mg/kg mate
burned)

Class	Compound	Emission
VOCs (1)	1,3-Butadiene	141.25
	2-Butanone	38.75
	Benzene	979.75
	Chloromethane	163.25
	Ethylbenzene	181.75
	m,p-Xylene	21.75
	Methylenechloride	17.00
	o-Xylene	16.25
	Styrene	527.50
	Toluene	372.00
SVOCs (1)	2,4,6-Trichlorophenol	0.19
	2,4-Dichlorophenol[a]	0.24
	2,4-Dimethylphenol[a]	17.58
	2,6-Dichlorophenol[a]	0.04
	2-Chlorophenol[a]	0.95
	2-Methylnaphthalene[a]	8.53
	2-Cresol	24.59
	3- or 4-Cresol	44.18
	Acetophenone	4.69
	Benzylalcohol[a]	4.46
	Bis(2-ethylhexyl) phthalate	23.79
	Di-*n*-butylphthalate	3.45
	Dibenzofuran	3.64
	Isophorone	9.25
	Pentachloro nitrobenzene	0.01
	Phenol	112.66
Chlorobenzenes (1)	1,3-Dichlorobenzene	0.08
	1,4-Dichlorobenzene	0.03
	1,2-Dichlorobenzene[a]	0.16
	1,3,5-Trichlorobenzene[a]	0.01
	1,2,4-Trichlorobenzene	0.10
	1,2,3-Trichlorobenzene[a]	0.11
	1,2,3,5-Tetrachloro benzene[a]	0.03
	1,2,4,5-Tetrachloro benzene[a]	0.02
	1,2,3,4-Tetrachloro benzene[a]	0.08
	1,2,3,4,5-Pentachloro benzene[a]	0.08
	Hexachlorobenzene	0.04
PAHs (1)	Acenaphthene	0.64
	Acenaphthylene	7.34
	Anthracene	1.30
	Benzo[*a*]anthracene	1.51
	Benzo[*a*]pyrene	1.40
	Benzo[*b*]fluoranthene	1.86
	Benzo[*ghi*]perylene	1.30
	Benzo[*k*]fluoranthene	0.67
	Chrysene	1.80
	Dibenzo[*ah*]anthracene	0.27
	Fluoranthene	2.77
	Fluorine	2.99
	Indeno[1,2,3-*cd*]pyrene	1.27
	Naphthalene	11.36

Table 9 (*continued*)

Class	Compound	Emissions
	Phenanthrene	5.33
	Pyrene	3.18
Carbonyls (1)	Acetaldehyde	428.40
	Acetone[a]	253.75
	Acrolein	26.65
	Benzaldehyde	152.03
	Butyraldehyde[a]	1.80
	Crotonaldehyde[a]	33.53
	Formaldehyde	443.65
	Isovaleraldehyde[a]	10.20
	p-Tolualdehyde[a]	5.85
	Propionaldehyde	112.60
PCDDs/Fs and PCBs (2)	Total PCDDs/Fs	5.80×10^{-3}
	TEQ PCDDs/Fs	7.68×10^{-5}
	Total PCBs	1.26×10^{-1}
	TEQ PCBs	1.34×10^{-6}

Source. (1) Ref. [34]. (2) Ref. [37].

[a] Compound of interest not on HAP list.

Lemieux P.M., 2003