R O M A N I A

AGRICULTURAL POLLUTION CONTROL PROJECT

Working Paper 6

DESIGN OF VILLAGE-LEVEL MANURE MANAGEMENT STORAGE AND HANDLING SYSTEM

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ROMANIA
AGRICULTURAL POLLUTION CONTROL PROJECT
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1. Executive summary

The Government of Romania (GOR) has obtained an agreement from the Global Environment Facility (GEF) to support an Agricultural Pollution Control Project (APCP). The ultimate goal of the project is to reduce the discharge of nutrients and other agricultural pollutants into the Danube River and Black Sea through integrated land and water management.

The objective of the consultancy assignment is to: design and cost a typical waste management system at the village level; propose criteria for selecting eligible investments; prepare an indicative five-year investment program; and prepare construction and equipment specifications for bidding documents.

This report is to support the project preparation of the World Bank Agricultural Pollution Control Project.

Evaluation of Existing Situation

The present waste management system has the following features

- The management policy of households is to mix house waste materials such as plastic, glass and metal containers with livestock waste.
- Waste is accumulated in a household store before it leaves the holding
- Urine and water run off from the store is allowed to leach into the soil.
- Water contamination is increased by large areas of dirty yard and roof water.
- The management of cattle waste at household level involves handling waste twice when a single operation is possible.
- Storage areas without concrete make picking up and collection of the waste more difficult.

After accumulation of waste at the household store the mixed waste is taken by the householder by cart a communal waste storage area called a platform. At waste platforms the following environmental problems were identified.

- The waste platforms are a major source of pollution from livestock wastes as direct pollution and as run off to watercourses and diffuse pollution through drainage into the water table.
- The management of the waste at the platforms is minimal so waste becomes distributed over a large area.
- The extensive areas covered and low height of stored waste results in higher than necessary catchment of rainfall and increased potential for leaching.
- The location of the waste collection areas can lead to direct contamination of watercourse from run off.
- The contamination of the agricultural solid waste with the house waste makes much of it unsuitable for recycling in agriculture.
- Relatively small amounts of waste are responsible for contaminating large amounts of agricultural waste.
- The waste at the platforms has been present for several years and more material has been added. These will continue to pose a threat to the environment by continued leaching of nutrients from the material already deposited unless the waste is removed and recycled or stabilised.

Design of Manure Storage System

A new waste management strategy is proposed involving

1. Segregation of inert and recyclable materials such as metal cans, glass and plastics from livestock wastes through the provision of a separate household waste container.
2. Provide improved manure stores for storage of waste at a single impermeable store at the household with enough storage for up to 1 month's production.
3. Utilise the existing practice of the householder who transported his waste by cart to the village platform. For those householders who do not have transport a chargeable collection service to the village or comuna platform could be offered.
4. Make use of the transfer of waste from the farm store to the platform to aerate the waste, promoting continued bacterial activity in the waste.
5. Deposition of the segregated inert materials in designated bunkers.
6. Management of the waste at the main bunker involving stacking in shaped heaps.
7. The transfer of the waste from the household storage to the main platform will allow aeration and mixing of the waste.
8. Store the waste deep so that the areas receiving rainfall is minimised.
9. Provide impermeable walls and floor to eliminate leaching.
10. Provide storage capacity for over the winter so that matured material will be available for use on the land

The waste is to be stored for up to one month at the household by the provision of impermeable storage. Transfer to the platform will achieve sufficient aeration for aerobic decomposition to take place. The waste must be stacked high to avoid excessive water and effluent. A further 5 months storage is provided, making 6 in all.

Costs

The typical size of platform to serve a village to hold 3200 tonnes has a cost of $99,273.
A management loader and up to 3 waste spreaders will be required for each comuna

7 loaders
14 tractors
14 spreaders
1 shredder
7 trailers
7 vacuum tankers

Cost of 14 platforms to manage 2/3 of the waste arisings at households and the machinery complement with monitoring, training and technical advice plus stores and segregation containers at 4200 households is $3,467,767

Indicative five-year investment program

The investment programme is proposed in 5 stages.

- training and information
- household segregation encouragement
- pilot village platform
- household stores construction
- 1st platform investment
- Monitoring and evaluation
- Further platform construction

A programme which installs 1 platform in the first year is proposed with monitoring for use to enable design size optimisation.
The criteria for selection for the investments.

- Demonstration of ability to control the segregation of waste by householders at the household and the platform. Indicators: Achievements on existing platforms, Guidance provided to households, Provision of staff to manage and operate the facility, Training program for staff.

- Commitment to the recycling of the quantities of material on agricultural land in the comuna. Indicators: Associations and farmers declared as requiring recyclable material. Quantities committed.
- A location that is at least 10 m away from a watercourse or drainage channel and 50m away from any well. Indicators: Site location plan.
- The size of facility must match the number of households it is intended to serve. Indicators: Number of households, livestock numbers, waste quantities, platform dimensions.
- Existing equipment available that they are able to commit to the management of the waste. Indicators: Machinery held at mayor's office, and potential users.

Environmental and Economic assessments

The recycling of waste will provide the following environmental and financial benefits

Environmental Impact	**IMPACT REDUCTION ON (✓)**					
	Place	**Landscape**	**Stock**	**General Public**	**Water Quality**	**Soil**
Smell/Odour				✓		
Noise						
Dust		✓		✓		✓
Solid Waste	✓	✓		✓	✓	✓
Image	✓	✓		✓	✓	
Effluents	✓	✓	✓	✓	✓	✓

- Saving on primary sum invested in fertilisers by farmers recycling the waste to their agricultural land.
- Reduced interest payments
- Increased revenues from delayed sales of produce if a surplus is present after sales for interest repayments at harvest.
- Increased yields from recycled nutrients.

2. Introduction: Origin and objectives of the assignment

2.1 Origin

The wider goal of the project is to reduce the discharge of nutrients and other agricultural pollutants into the Danube River and Black Sea through integrated land and water management. The project is envisaged as a pilot activity in the Calarasi Judet of southern Romania, along the lower Danube. The project aims to increase significantly the use of environment-friendly agricultural practices in the area to achieve the wider goal.

2.2 Objectives

The project will assist the Government of Romania to: (i) promote the adoption of environment-friendly agricultural practices by farmers associations, family associations and individual farmers in seven communes of the Calarasi Judet; (ii) promote ecologically sustainable land use in the Boianu-Sticleanu Polder including a conservation management plan for the Iezer Calarasi water body; (iii) strengthen national and local policy and regulatory capacity; and (iv) promote regional level collaboration. The pilot project will be replicated in similar sites in Romania which will, in the long term, reduce the discharge of organic matter and yield substantial benefits in terms of improved quality of Romanian surface and ground waters and the Black Sea.

3. Background

3.1 Project

The project area comprises the following comunae: Al. Odobescu, Ciocãnesti, Grãdistea, Cuza Vodã, Vlad Tepes, Vîlcelele and Independenta. The total area is about 74,200 hectares. There are 3-4 villages in each comuna and each village has about 1000 inhabitants, or 500 households. Typically each household has 2 cows, 3 sows with fattening pigs, and poultry contained in a small area around the house.

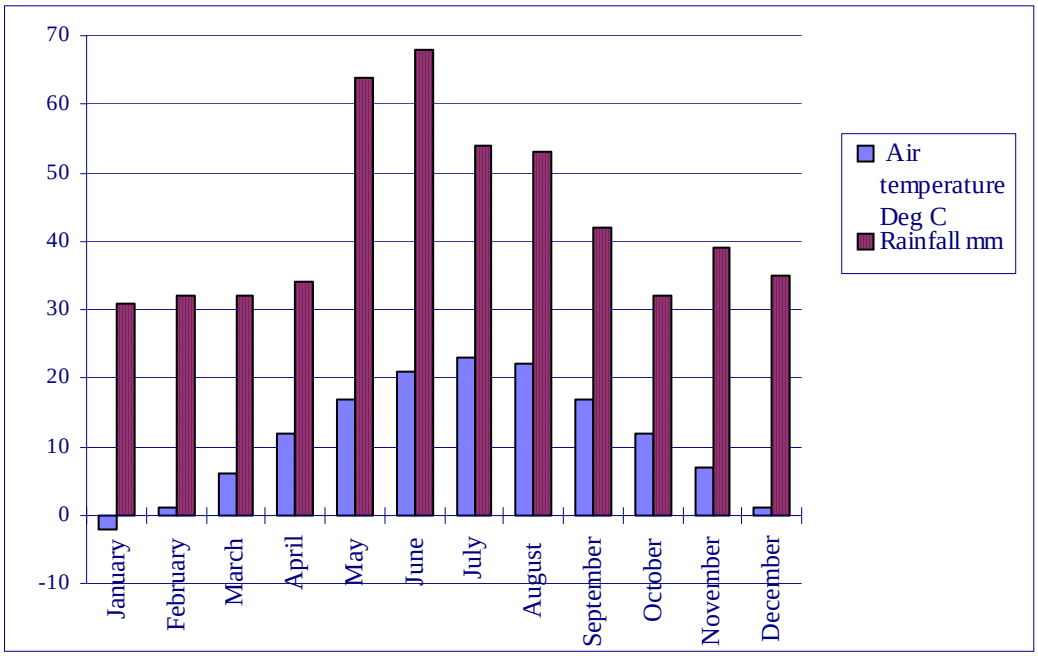
3.2 Household and village organisation

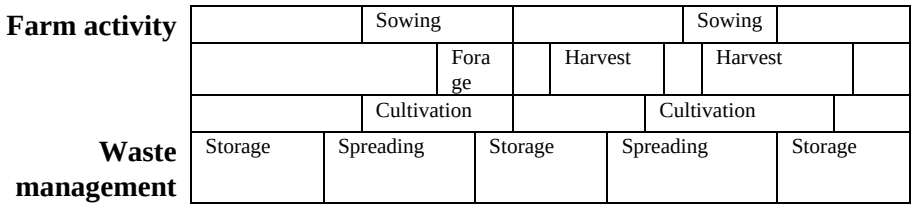
Livestock housing systems were rudimentary with accumulation of dung plus urine and effluent that was allowed to soak into the ground. A few households had simple tanks for collecting effluent. These were regularly emptied and effluent added to the solid, straw waste. Solid waste was often dumped by the roadside or left in the water-courses. A number of incumbent village Mayors had introduced "platforms" (part of a field near the village) to where the people are obliged to take the solid waste. Villagers were generally unprepared to separate different materials – bottles, scrap iron, organic waste - so that the platform for waste ends up as a rubbish dump containing a significant amount of organic animal excrement and associated waste.

3.3 Pattern analysis

The recycling of wastes to agricultural crops is constrained by the cropping pattern and the climate. The risk to water from nutrients is influenced by the local topography and periods when the waste can be applied. The annual weather data is shown in figure 1 with the corresponding agricultural activity and waste management activities shown underneath this.

Figure 1: Average Monthly Air Temperature and Rainfall





3.4 Land area

The area of land in each of the seven comunae is shown in Table 1:

Table 1: Land area in the comunae

Comuna	Total agricultural surface	Arable	% total	Pasture and forage	% total	Vines	% total	Orchards	% total
Gradistea	14984	14796	98.75%	25	0.17%	163	1.09%	-	-
Al. Odobescu	5761	5409	93.89%	77	1.34%	275	4.77%	-	-
Ciocanesti	10834	10561	97.48%	13	0.12%	256	2.36%	2	0.02%
Independenta	5494	5394	98.18%	1	0.02%	99	1.80%	-	-
Vilcelele	5720	5560	97.20%	-	-	160	2.80%	-	-
Vlad Tepes	6468	6268	96.91%	69	1.07%	131	2.03%	-	-
Cuza Voda	12433	12108	97.39%	-	-	322	2.59%	3	0.02%
Total	61694	60096		185		1406		5	

3.5 Livestock numbers per household

Livestock on holdings in the Judet by types and number is listed by comuna from the agricultural returns submitted to the Calarasi office of the Director General for Agriculture at 30th September 2000. (DGA 2000).These were split between the larger farmer associations, individual households and the Commercial societies.

Table 2: Total livestock numbers

Comuna	cattle (heads)	pigs (heads)	sheep and goats (heads)	horses (heads)	poultry (heads)
Gradistea	1,820	6,336	3,556	637	48,700
Al. Odobescu	676	1,725	3,644	587	23,006
Ciocanesti	955	5,993	9,338	294	52,469
Independenta	1,406	2,695	865	328	34,780
Vilcelele	649	2,364	2,331	350	68,108
Vlad Tepes	452	1,763	2,018	390	27,000
Cuza Voda	1,151	1,549	7,173	341	38,159
Total Stock	7,109	22,425	28,925	2,927	292,222

Some stock is held on large former state farms. The number of stock on households is given in the table below.

Table 3: Number of stock on households

Comuna	cattle (heads)	pigs (heads)	sheep and goats (heads)	horses (heads)	poultry (heads)
Gradistea	1,820	6,336	3,468	637	48,700
Al. Odobescu	646	1,725	3,644	587	23,006
Ciocanesti	955	5,993	9,224	294	52,469
Independenta	1,232	2,695	865	328	34,780
Vilcelele	457	2,264	2,331	350	68,108
Vlad Tepes	452	1,736	2,018	390	27,000
Cuza Voda	1,067	1,408	4,005	341	29,240
Total Stock	6,629	22,157	25,555	2,927	283,303

For the five comunae visited, the mayoral offices provided house numbers. The Mayors of each comuna suggested that approximately 60 % of households kept livestock. This data was then used to calculate the average number of livestock on each comuna visited. The calculation is shown in Annex 4.

Table 4: Livestock at each household

Comuna	households	with stock	Cattle (heads)	pigs (heads)	sheep and goats (heads)	horses (heads)	poultry (heads)
Gradistea	1975	60%	2	5	3	1	41
Al. Odobescu	1800	60%	1	2	3	1	21
Ciocanesti	2900	60%	1	3	5	0	30
Independenta	1396	60%	1	3	1	0	42
Vilcelele	900	60%	1	4	4	1	126
Vlad Tepes	1300	60%	1	2	3	1	35
Cuza Voda	1720	60%	1	1	4	0	28

The number of stock seen on individual households as shown in Annex 3 is in accordance with this estimation. Some stock is held on large former state farms. By comuna the number of stock on large farms is shown below.

Table 5: Stock on large farms

Comuna	cattle (heads)	pigs (heads)	Sheep and goats (heads)	horses (heads)	poultry (heads)
Gradistea	0	0	88	0	0
Al. Odobescu	30	0	0	0	0
Ciocanesti	0	0	114	0	0
Independenta	174	0	0	0	0
Vilcelele	192	100	0	0	0
Vlad Tepes	0	27	0	0	0
Cuza Voda	84	141	3,168	0	8,919
Total Stock	480	268	3,370	0	8,919

There are only one or two large farms in each comuna so the numbers presented above represent major concentrations of stock that can pose a risk to the environment. This is further increased by the poor current state of the complicated slurry and solid waste systems installed

Trends in livestock numbers and location

The trend is for more households to keep stock. The number of farming businesses keeping a large number of animals was also anticipated increase. These businesses would invest in housing and waste storage on sites that are not connected to households. The large farms visited have less stock then they have had in the past. In future they may increase their number of stock. The concentration of stock on a small number of large farms means that each represents a potential hot spot for potential pollution. These farms should also be encouraged to adopt good practice on their waste stores and in the way they manage and recycle this resource.

4. Evaluation of Existing Situation

4.1 Existing waste management at village level

The Comunae of Vilcelele, Cuza Voda, Independenta, Alexandru Odobescu and Gradistea were visited. Inspection of households and farms followed discussion with the locally elected representatives. Reports of the households and farms which were visited are included in detail in Annex 3.

Livestock housing

The permanent stock housing was generally located at the rear of the household. Cattle pigs, poultry and horses were kept at the household. Sheep were housed for four months during winter. The housing of cattle and pigs is usually in adjoining buildings. On most sites visited winter and summer accommodation for cattle was provided in separate buildings. The cattle and horses had concrete lying areas. This was completely flat. There was no raised lying area and no wide channel for the collection of faeces. As a result of this the cows were able to lie in the waste and were dirty. The concrete was laid with a slope to a urine collection channel cast onto the concrete behind the animals.

The pig housing consisted of the kennel and the yard at the front. There was not usually a channel in the concrete for the liquid run off. The liquid was collected into unlined pits.

Poultry were housed in percheries with waste collection on concrete beneath. The birds were allowed free range of the enclosure so that waste was present over the surface of the whole of their enclosure.

Materials

The agricultural waste consisted of the faeces and urine from the animals, bedding, and discarded fodder. Cereal straw was obtained from the large cereal farms. It was stored loose in stacks in the household area. Members of farming associations received their income as feed and fodder therefore it was in their interest to utilise the materials. Maize straw was also collected from the farmers own and association arable land. It was utilised primarily as fodder. The leaves and cereal were eaten by the stock. The stalk material which was left was then used as a bedding or placed directly onto the waste store. The maize straw is coarse and fibrous and does not easily absorb waste or liquid in its long form. This would work better as bedding after it had been chopped. The waste taken from the cattle areas consisted of a mixture of faeces, cereal straw and long fibres of maize straw.

At the end of the growing season vegetable crops and tomatoes were taken out of the soil and disposed of at the platform. The vines from the tomatoes were long and fibrous and provided additional difficulty in handling and storage.

On site Handling of livestock waste

To keep the cow lying area clean the cattle waste was thrown at various times of the day from the impermeable concrete and placed outside onto the earth. The waste deposited on the earth adjacent to the stock housing was allowed to accumulate over 2-3 days before it is scraped up into a wheelbarrow and taken to a waste store. The waste store was usually close to large gates at the front of the holding. The effect was that the waste was handled twice. It was difficult to scrape up from the earth. It is impossible to

completely remove all waste from the soil in this area. There is a continuous opportunity for nutrients to enter the soil by leaching at this point in the practiced manure management system.

Finally the waste was accumulated in a main storage area without a concrete base. The waste was not stacked high and the heap can cover a considerable area. The heaps were not fenced off and it was possible for other stock such as poultry to pick over the heap further spreading the waste over the surface. The low height and lack of retaining structure results in a large surface area for the catchment of rainfall and leaching of nutrients.

The urine channel was successful in intercepting the urine on the cattle housing. There was sometimes no channel in the concrete yards of pig housing so the liquid flowed from the concrete onto the bare earth. On all sites the liquid waste was managed by allowing it to soak away. The liquid was channelled to unlined pits. These were emptied periodically with a bucket and the liquid tipped over the solid waste.

Household waste
The wastes arising from the household were:

Containers made from plastic glass, metal, and cardboard. These were placed on the main waste store and transported with this waste for deposition at the village platform.

Human latrine waste was provide for with an unlined pit. There was no management of this. When the area becomes saturated the latrine location was changed and the area was covered with a slab.

In Vilcelele and Cuza Voda the stock accommodation and the size of the holding were very similar at 6000 m^2. Independenta had small holding areas of 1000 m^2. Households in Gradistea were the largest at approximately 1 hectare and had better access with gates at both front and rear

4.2 Extent of pollution and impact on water quality

The main pollutants going to water were identified as:

- liquid waste as urine
- leachate from solid waste and rainwater which can be contaminated by yard areas or solid waste stores
- latrine wastes (not considered within the scope of the project)
- Pollutant sources to water were identified as:
- Directly through diffuse pollution from households .
- Indirectly from households via waste taken to waste platforms
- Indirectly from large farms via waste stored at their own waste platforms
- Indirectly from large farms where waste was washed off dirty concrete areas
- The main polluted places were households, platforms and large farms with livestock.
- The pollution on site from household waste management is diffuse pollution from a number of sources. These include:
- Unlined pits for cattle urine
- Unlined pits for pig yard run off
- Yards for free range poultry receiving rainfall.
- The surface storage of cattle and horse waste on earth

- The main storage area.
- The latrine

The size of each holding was such that all these sources of pollution were within 50 metres of the well. There was thus a localised risk to the well water in addition to the general level of pollution of the water table. The proximity of other households with similar numbers of livestock located at their perimeter leads to the conclusion that the well was at risk from three times the quantities produced by a single household. The water table is generally polluted with Nitrogen compounds in all villages in each comuna visited. This comes from the leaching from the platforms as indirect pollution to the soil, and also direct run off of nutrients and solids into waste courses where platforms were placed too close to and on slopes adjacent to open water courses and drainage ditches. Eutrophication of the surface water was indicated growth of water plants in drainage ditches and streams.

4.3 Waste management at large farm level

The large farms there utilise the housing of former state farms and co-operatives. The cows were housed in cowsheds with stalls and neck bands. The floors have a dung channel with automatic scrapers. These deliver the waste into a pit at the end of the building or into trailers by elevator. The waste from the cowsheds is then taken by trailer and tipped at the farm waste platform. Young stock were loose housed in pens with straw bedding. The straw bedding is taken to the farm waste platform. Other stock were kept in pens on concrete areas. There were few roof gutters to the buildings. Rainfall can wash waste from the concrete of these dirty yard areas the soil.

Pigs were housed in large buildings with pens with dunging areas with slats(grid covers). The automatic feeding systems installed no longer work. A slurry system was in place with a 2m wide slatted area and a water flushing system. Due to operating cost and complexity a settlement lagoon system had been abandoned. The electrically driven main transfer pump was now used to discharge the slurry into a large unlined pit at the edge of a wood. No attempt is made to utilise the waste. This area represents a major pollution source. The farm did not have a manure spreader.

The farm platforms covered areas of typically 230 metres by 30 metres. The waste that was tipped onto the platform was pushed up into heaps up to 3 metres high and allowed to mature for up to a year. The waste from the farm platforms was spread and ploughed in at summer time or at spring time. The methods of spreading the waste from large farms included:

- Loading into tipping lorries, tipping on the field and spreading with a bulldozer at rates of 100 tonnes/ha.
- Spreading by manure spreader on only two large farms. Many of the spreaders which were on the former state farms were no longer serviceable. The farms have chosen to invest in cultivation and harvesting machinery in preference to waste handling and spreading equipment.

4.4 Problems of disposal of livestock effluent and solid waste at household level

The flow diagram showing the existing waste management at household and at the platforms is shown in Annex 2

Effluents
Urine and leachate from dung was collected from cows and horses. For pigs the effluents were not collected from the edge of the concrete yard area. Thus their disposal was not well managed. Where effluents were collected they were directed to unlined pits (in all cases but one) There was no containment of the liquid. The disposal through drainage into the soil gives rise to diffuse pollution to the water table. With prolonged use of these pits, their effectiveness will reduce as the suspended solids reduce the infiltration rates but effectively the loss of nutrients to the soil is continuous.

The householder will not appreciate the volumes involved when he empties the pit because the liquid soaks away. Handling of the effluents from the pits is carried out by bucket. Tipping the liquid over the waste heap which is on the soil enables that which is not absorbed by the waste heap to leach. This was likely to be increased in the wet winter months when rainfall adds to the moisture entering the solid waste heap.

In addition to the effluent produced by the stock directly there is also the rainfall on to yard areas and onto roofs. Rainfall onto dirty yard areas such as poultry compounds will wash the nutrients directly into the soil. Rain water from roofed areas which enters the waste stream can increase the volumes of effluents which can pollute. Examples of this were where asbestos roofs overhang existing unlined effluent pits, roofs which leak onto the livestock concrete areas, drainpipes which discharge onto dirty yard areas.

The householders have no sealed tank for the effluent. There is no machinery available in the communes for the handling and disposal of accumulated effluent.

Solid waste
The main problems of solid waste handling arise from:

- Stock housing without dunging channels and which results in the need for frequent cleaning of the flat lying areas.
- The double handling of the waste onto areas without a concrete base which creates an avenue of pollution and makes gathering up of the waste even with simple tools such as a shovel difficult.
- Location of the livestock at the rear boundary of the household and the main waste store near to the front gate of the holding makes access for mechanical handling difficult.
- Lack of an impermeable concrete base for the main waste store. This also makes picking up the waste difficult.
- The waste could not be stacked high nor livestock kept out because there were no retaining walls.
- Most holdings did not have access to mechanical handling equipment such as tractors with loaders and were limited to horse and cart.
- There were no manure spreaders available for the spreading of waste from the platforms.

The presence of the maize straw as bedding or as rejected fodder material makes direct use of the solid waste onto agricultural land unacceptable. Decomposition of the waste is required to break down the fibrous lignocelluloses material. The combination of this material and the finely divided animal wastes were not easily handled together.

4.5 Evaluation of existing "waste storage platforms"

The waste platforms were located on land controlled by the council.

At Cuza Voda and Vilcelele, waste was placed in a strip of land 5m wide and 200 m long along the edge of drainage ditches. The area at Vilcelele was adjacent to the point where this ditch discharged into a water course. The end of the heap being less than 5 meters from this watercourse. The slope of the land and the closeness of the track would result in run off from the full length of the heap discharging directly into the stream. This is clearly poor practice which in times of higher precipitation rates gives rise to direct pollution.

As the heaps were inspected in autumn after a particularly dry summer much of the, material was very dry and had been burnt. This practice was discouraged by the village administration. The effect of burning is to leave a fine cover of ash on the waste pile. This then weathers and with the addition of rainfall forms a surface cover to the waste. It is suspected that this will inhibit aerobic decomposition of the waste.

A feature of all the heaps was the presence of contaminating amounts of inert domestic refuse which consisted of cans, bottles, glass and plastic. Demolition and construction waste was seen at some of the waste platforms. The maize straw in the livestock waste was very bulky and resistant to weathering. This does not break down quickly.

Most of the platforms had been in place for 10-12 years. Although the surface is dry they have ability to retain moisture and a mixture of anaerobic and aerobic conditions will be present. The heaps will also be a source of methane emission to atmosphere. As the material in the platforms remains in place, additional rainfall and liquid release from anaerobic digestion will lead to continued release of leachate into the soils. Indicator species of weed (*datura stramonium*) for the presence of high nitrogen were observed.

Of the seven community waste platforms inspected, six were on the surface but on one site large pits had been excavated to increase the capacity prior to tipping operations. The height of material on the platforms was not usually greater than 1 metre. No effort had been made to pile the material. The size of fresh heaps was equivalent to a loaded cart (approximately 2 m^3). On one site was the waste periodically moved by bulldozer up into a heap to reduce the storage area and manage the site. There was no separate place where non agricultural wastes could be placed.

A programme of waste segregation had been practised at Independenta in the mid 1990s. This had been successful enough to produce a sufficiently decomposed waste, free from contaminants that was sold as an organic fertiliser to vegetable growers outside the area. Segregation of wastes had now fallen into disuse. The reasons for this lie in:

- Low perception of value to agricultural production of the clean waste.
- Lack of ownership of the resource, the joint management of the land by the agricultural associations
- Lack of specialised equipment for its handling and application.

At Alexandru Odobescu the platform was better organised with the material arranged in rows up to 2m high and 4 m wide at the base. The waste was still contaminated. There were concentrations of plastic bottles and other inert waste where an attempt had been made to encourage segregation of these items from the livestock waste. At this site was

an unlined pit for the disposal of fallen stock. This represents a further potential hazard for pollution and spread of disease.

Conclusions

The waste platforms were a major source of pollution from livestock wastes both as direct pollution and as run off to watercourses and diffuse pollution through drainage into the water table.

The extensive areas covered and low height results in higher than necessary catchment of rainfall and increased potential for leaching

The location of the waste collection areas can lead to direct contamination of watercourse from run off.

The contamination of the agricultural solid waste makes much of that waste unusable.

Relatively small amounts of waste were responsible for contaminating large amounts of agricultural waste.

The management of the waste at the platforms is minimal.

The waste at the platforms has been present for several years and more material has been added. These will continue to pose a threat to the environment unless the waste is removed and recycled or stabilised.

5. Design of Manure Storage System

5.1 Concept

The management of the household waste has 10 key elements

1. Segregation of inert and recyclable materials such as metal cans, glass and plastics from livestock wastes through the provision of a separate household waste container.

2. Provide improved manure stores for storage of waste at a single impermeable store at the household with enough storage for up to 1 month's production.

3. Utilise the existing practice of the householder who transported his waste by cart to the village platform. For those householders who do not have transport a chargeable collection service to the village or comuna platform could be offered.

4. Make use of the transfer of waste from the farm store to the platform to aerate the waste, promoting continued bacterial activity in the waste.

5. Deposition of the segregated inert materials in designated bunkers.

6. Management of the waste at the main bunker involving stacking in shaped windrow heaps 3 metres tall.

7. The transfer of the waste from the household storage to the main platform will allow aeration and mixing of the waste. Active management of composting of a proportion of the waste is likely to be necessary. In particular this should include the tomato vines and the long maize stalks. This activity should be kept to a minimum in order to reduce operating costs.

8. Store the waste deep so that the areas receiving rainfall is minimised.

9. Provide impermeable walls and floor to eliminate leaching.

10. Provide storage capacity for over the winter so that matured material will be available for use on the land

The flow diagram for the waste management system from household to agricultural land is shown at Annex 2

5.2 Storage systems on households

The development of the concept of waste handling is best integrated with the housing system for the stock. In many cases there would be most benefit from the replacement of the livestock housing with better structures. This would also assist the rationalisation of materials handling and the location of investments in waste storage. For new and existing stock housing it proposed that the waste storage and handling system should have the following characteristics.

- Locate the waste store close to the livestock housing.
- Avoid double handling of the waste before the store

- Provide impermeable storage for the solid livestock waste
- Stack the waste to reduce run off
- Stack the waste to increase storage capacity
- Provide catchment to effluent run off and urine
- Direct all rainfall onto roofs away from waste
- Provide facilities for the optional composting of waste within the storage areas.
- Provide sufficient storage period for over winter storage this should be a minimum of 1 month.

Household Waste Store
The size should be selected according the number of stock at the households it is required to serve. The householders will be required to stack the material up to 1.2 m high at the back.

5.3 Storage systems at the main platform

Constraints affecting the storage periods required:
1. The ground is likely to be frozen between November and February.
2. Ploughing is between August to October.
3. Seedbed preparation occurs in Spring.
4. Cultivation of spring sown crop seedbeds from the over wintered ploughed ground is between March and May.

The minimum period for the management and storage of waste should be for 4 months. With capability of storage at the house hold for at least one month the effective storage period is 5 months. The objective should be to empty the store by the end of autumn. The length of time that is needed to hold the material can be put to good effect in the stabilisation of the waste. The recommended facilities at the platform were :
1. Concrete area for the management of the waste.

2. Bunkers for the segregated household wastes.
   a) metal cans to go for recycling
   b) glass for landfill and future recycling markets
   c) plastic and other materials for landfill.

3. Platforms for the safe disposal of b, and c. It is may be possible to utilise the existing platform locations where these do not pose additional environmental threat.

4. Catchment channel for run off from the platform.

5. Storage pits and tanks with impermeable base and walls.

6. A wall to the perimeter of the platform to contain the waste and prevent effluent leakage.

7. Security fencing.

8. Safety fencing of the effluent storage area.

9. Office / Staff facilities.
10. Landscaping

11. Monitoring wells for the water table

5.4 Concept for waste storage at large farms

The existing farm stores observed in the visits to the comunae were also in need of environmental upgrading. The problems of storage of waste from large farms must be addressed in order to provide the overall solution to the waste management needs of the region

Dairy cattle waste
Dairy cattle were wintered in cowsheds and fed on hay and straw with considerable quantities of straw used for bedding. The existing system of waste storage employed a farmyard manure based management technique. The store could be updated along the lines of the village platforms for a farmyard manure system. This would require impermeable floors and walls and catchment of run off to a reception tank. Some managers have in place or proposed slurry systems. Although some solid material was to be produced using separators, no significant reduction in the volume of waste would be expected. Straw based housing systems are likely to be more appropriate. Assistance in the selection of components of the system should be made available. The abundance of straw in the region is likely to make a straw based system suitable.

Dirty water
Dirty water arises from rain water contaminated when it falls on dirty yards and water used for washing surfaces and equipment. It can also include urine where this is collected separately from the solid waste. Rainfall was allowed to fall upon dirty yard areas from the cowshed roofs. All roofs should be fitted with roof gutters so that this rainwater can be conducted away from dirty yard areas and to soak away without becoming contaminated with waste. The water falling directly onto dirty concrete yard areas must be intercepted by a channel cast into concrete at the edge of the dirty yards and channelled away to below ground dirty water storage tanks which can also store the waste water which has been used to wash the milking equipment and dairy. The tanks must be of sufficient size to allow for maximum daily rainfall and the capacity of the waste handling system to dispose of it safely to land.

Pig Farm Wastes
The pig farm observed utilised a slurry system with added water to flush the waste out.. This slurry was pumped to an unlined pit where the liquid fraction was allowed to soak away. This practice is environmentally unacceptable. The options available were:

1. An impermeable basin can be excavated and lined and in which the slurry can be stored. This could be fitted with a de-watering section into which the liquid can drain so that it can be removed and spread by a vacuum spreader.

2. Mix the pig slurry with the cattle waste in an above ground store with permeable walls and a collection channel around the perimeter. The separated liquid is collected in a basin with an impermeable lining.

3. An above ground slurry tank with mixing equipment to avoid settlement of the slurry. This could utilise the existing below ground mixing tank and transfer pump at the farm. The slurry would then be handled and spread with vacuum spreaders.

5.5 Existing platform remediation.

The existing platforms will continue to be a source of pollution. Once the addition of the waste from households to the existing old platform has ceased then a programme of remediation must be implemented. The preferred option is the segregation of the inert

wastes within the deposits and the recycling of the agricultural waste. The remaining inert waste can be recycled or landfilled as for the inert and recyclable wastes from new platforms. The alternative is to stabilise the waste to avoid further leaching. This can be achieved by composting.

5.6 Designs

Household Stores

The waste quantities arising at the average household have been used to calculate nominal capacity of household agricultural waste stores.

A simple open fronted store with concrete base and 1.2 m tall walls would be sufficient for most households.

A separate small capacity container should be provided for the collection of recyclable and non recyclable household wastes. This should be approximately 90 litres capacity.

The minimum width of the agricultural waste store should enable access by machine and enable the waste to be manually loaded by fork.

The concrete floor shall slope at 1:100 towards the front.

A drainage channel should be cast into the concrete base .

This should connect to a covered below ground tank of 250-500 litres capacity.

Dimensions for a typical property is shown below. This capacity is recommended for all properties. It is expected that households with greater numbers of stock will empty their stores more frequently

Vol. m3	Depth m	Area m2	Width m	Length m
5.4	1.2	4.5	2	2.2

5.7 Bill of quantities for household stores

Household waste store

Household store	width m	length m	apron length m	depth/ height m	volume m3	area m2
Preliminaries						
Excavation of topsoil under base	2	2.24	1.2	0.3	2	
Excavation of foundation under walls	2	6.49		0.3	4	
Hard-core under base	2	2.24	1.2	0.15	1	
Concrete floor	2	2.24	1.2	0.15	1	
Concrete foundation	2	6.49		0.3	4	
Damp proof membrane	2	2.24	1.2	1		7
Concrete walling or block	0.25	6.49		1.2	2	

5.8 Costs

The cost for materials for the construction of the house store is shown below

House Store	2	2.2	4.4	240
Apron	2	1.2	2.4	79
Tank 500litres				20
Cost per household				339

5.9 Design of main platform

The main platform should preferably be a walled on 3 sides of a rectangular platform to contain the waste. The walls must be able to withstand the load waste piled against them and the loads from the loading machine. The costs of the walls were equivalent to 50% of the cost of the platform.

The activities within the platform should be unrestricted by internal walls so that the space needed for management and storage can be flexible. This will suit the requirements for active management of composting if this is necessary for certain materials. An apron of concrete is provided for the movement of machinery and the unloading of the household cart or an agricultural trailer.

An effluent collection channel is provided across the full width of the front of the platform. This collects rainfall and effluent into a large basin to the side of the platform. Also provided at the platform were 3 open fronted bunkers for the householders to deposit the three types of waste: steel, glass and plastic/cartons. The bunkers were 2,5 metres wide so that they can be emptied by a mechanical loader shovel.

This size of the platform has been calculated for a typical village. This was calculated from the typical waste volumes from the size of stock observed for the number for households in each comuna and number of villages in each comuna. It is recommend that this capacity should be calculated for each individual village or where a platform is required to serve a number of villages.

The calculated capacity for a typical village is for 3200 tonnes of material after 4 months. Consultation with the mayors indicated that they would have preferred 6 months of storage. The additional 1 month of storage at households partly addresses this concern. A density of 0.75 tonnes per cubic metre is assumed for the fresh material to allow for the bulky nature of the fibrous material. The material will be stacked to a height of 3 metres.

The storage basin has been designed to hold 30 days rainfall as it is expected that the liquid can be applied to land or returned to the waste at more frequent intervals than the waste is spread.

Platform capacity for seasonal storage	**Waste**	**height**	**Vol. t/m3**	**area m2**	**width m**	**length m**
120 day storage	3200	3	0.75	1422	33	46.10

Storage tank for run off	**rainfall mm**	**volume m3**	**absorbed by store**	**depth**	**area**	**width**	**length**
30 day	38	76	1.00	1.20	82.5	10	8.25

5.10 Evaluation of Comuna platform design proposals

The comuna of Alexandru Odobescu had advanced plans for the construction of 3 platforms. Scheme plans showing construction and layout were produced. These can be seen in Annex 5. The general principles of segregation and delivery of the material as proposed in this document.

Inert waste store

1. The pit for inert waste is large. There appears to be no provision for extraction of the waste for its transport to further recycling or a more permanent location. The fence around the compound would impede the emptying of this area by use of an excavator. It is recommended that the area is smaller with adequate access.

2. The depth of 4 m may not be suitable for sites with high water table. this also means that drainage cannot be supplied for this structure.

3. There is no provision for the removal of accumulated rainwater and effluents. A sump for the extraction of effluent would be a minimum requirement.

4. A permanent lined structure would be uneconomic as a permanent store for the waste.

5. The position in front of the main platform for agricultural waste is acceptable.

6. There appears to be no segregation of plastics and glass. It is assumed that the metal items were to be taken away in the platform container.

Apron areas

1. The area at the front of the agricultural waste storage area is very wide at 15 metres leading to collection of water on a dirty yard area. If this and the perimeter tack can be kept as clean road area then this could be drained to land. There is a risk that this area will be contaminated by spilled waste.

2. The positioning of the container close to the entry point of the site is recommended to encourage the deposition of the inert and recyclable components of the waste before the agricultural waste is dumped.

Main platform areas

1. The use of two separate areas for waste of different age is useful. This involves extra cost over a single zone which has designated areas only instead of physical barriers which may become restrictive.

2. It is recommended that the entrance ramp is extended across the full width of the front of the waste storage area. The fence will then not be required and there will be easier access for the loading of vehicles and turning.

3. The designation of areas for composting and storage must be flexible.

4. The partial submersion of the platforms results in a basin for the collection of rainfall. It causes the level of water in the collection basin to be lower, and reduces capacity. This produces risks for high water tables. This solution can be accepted for AL. Odobescu but will be unsuited to high water table areas. An all above ground installation is recommended for this reason. The cost of the construction of a submersed platform was considered by the civil engineer to be more expensive than a structure built on the surface.

5. The use of a concrete platform construction with a membrane is good practice.

6. The basin capacity shown is too small. The frequent emptying that this will require may not be possible.

7. The tree screen is good landscaping practice and will also protect from run off of nutrients and give shelter against the wind. A higher security fence is required.

Basins

1. The drainage water basin should be larger.

2. Paved access should be provided for the vacuum spreader that will be used to empty it.

3. The provision of a sealed septic tank for carcasses provides effective containment of this waste. These were well suited for small animals and young stock. Lime should not be used and the chamber should be seeded with bacteria from well-rotted livestock waste. The problem of emptying and disposal of the effluent remains. They were less suitable for adult ruminants.

4. The installation of an animal carcass incinerator for large carcasses should be considered as an alternative.

5.11 Bill of quantities for Main platform

The following bills of quantities are provided for a platform for 3200 tonnes. Detailed information relating to this size of platform is required from the civil engineers who were available for assistance in the last 5 days of the International consultant's visit to Romania.

Main Platform	width m	length m	apron length m	depth m	volume m3	area m2
Preliminaries						
Excavation of topsoil under base	35	47	6	0.3	557	
Excavation of foundation under walls	2	129		0.5	129	
Hardcore under base	35	47	6	0.15	278	
Concrete floor	35	47	6	0.25	464	
Concrete foundation	2	129		0.3	77	
Damp proof membrane	33	47	6	1		1749
Concrete walling or block	0.25	129		3	97	
Reinforcing fabric perimeter	2	129				258
Reinforcing fabric wall		129		3		774
Reinforcing fabric main floor and apron	33	47	6	1		1749

Basin	width m	Length m	apron length m	depth m	volume m 3	area m2
Excavation of topsoil under base	10	8	6	1.5	214	
Excavation of foundation under walls	1.5	36		0.3	16	
Hard-core under base	10	8	6	0.15	21	
Concrete floor	10	8	6	0.15	21	
Concrete foundation	1.5	36		0.3	16	
Damp proof membrane	10	8	6	1		142
Concrete walling	0.25	36		1.5	14	
Reinforcing fabric wall		36		1.5		55
Reinforcing fabric main floor and apron	10	8	6	1		142

Waste segregation bunker(1 of 3)	width m	Length m	apron length m	depth m	volume m3	area m2
Excavation of topsoil under base	2.5	4	6	0.3	7.5	
Excavation of foundation under walls	1.5	10.5		0.3	4.725	
Hard-core under base	2.5	4	6	0.15	3.75	
Concrete floor	2.5	4	6	0.15	3.75	
Concrete foundation	1.5	10.5		0.3	4.725	
Damp proof membrane	2.5	4	6	1		25
walling block	0.25	10.5		2	5.25	
Reinforcing fabric wall		10.5		2		21
Reinforcing fabric main floor and apron	2.5	4	6	1		25

5.12 Costs

Indicative costs were estimated from the layout plan drawing for a typical village platform shown in Annexe 5. This was undertaken by the civil engineer for a larger store capable of holding 4800 m3. The costs for this option were $144, 756 including a platform structure cost of 117,355. This would have made very few platforms available within the project budget. It was therefore decided to produce costs for a smaller platform capable of storing 3200 tonnes of waste based on the revised store length of 46 metres. The cost of the main perimeter fence was also removed from the budget. The costs for a walled platform area shown below:

Costs	**Price $US**
Main platform	
Base and walls	79,387
Apron and fencing	8,850
Basin	9,400
Bunkers	1,636
Total	99,273

This cost has been included in projected costs at Annex 6
The cost of the platform should be investigated further by seeking quotations from building contractors in the Calarasi area. Further work is required on the design to refine the bills of quantities for control of cost.

6. Design of Manure Handling and Application System

6.1 Concept and management of collection, storage and application system

Collection of waste from households and farms. The current practice of bringing waste to the platform is to be retained and encouraged. The agricultural waste and the segregated waste is to be brought by the householder to the platform. The household waste will be deposited in the recycling bunkers. The use of skips would involve investment in specialised lorries which would increase the project costs so this approach is not recommended.

Unloading of waste at the platform. The carts of agricultural waste will be unloaded on a concrete apron at the front of the platform or driven into the platform area.

Managing waste at the platform. The periods over which the waste must be stored when it cannot be applied to land can be utilised to reduce the amount of active management of the waste to encourage it to break down. The movement of the waste after the period of storage from holding will be sufficient to aerate the material. Further handling once it has been placed on the platform should be minimised

The waste which consists mainly of animal waste is not expected to require active management. For the composting of some of the fibrous waste such as maize stalks and tomato haulm these should be placed in rows running the length of the storage area. Turning and mixing can be achieved by moving the row to an equivalent position to one side with the loader avoiding the need for specialised compost turners. Waste must be moved from the reception area and placed on the platform in a heap 2-3 metres high. For this operation and turning of the heap to assist the composting process as appropriate a loader machine is required. This should be a specialised machine. The loader should have an interchangeable fork and bucket attachment. The bucket attachment will be required for handling some waste on the platform and also for transferring the accumulation of household wastes from the reception bunkers to trailers for recycling or deposition at the landfill.

Spreading of the waste. After the waste has been stored. it will be required as a nutrient source in agriculture. To enable best use of the waste during spring and late summer on cultivated ground and on growing crops specialised spreading machinery will be required. Given the high dry matter of the incoming waste rear discharge spreaders will be required. A tractor will be required to operate the spreader allowing the loader tractor to load the spreader.

The rainfall onto the platform and associated run off will be collected in a separate lagoon or tank with an impermeable lining. To empty this and spread to the liquid onto crops or return it to the waste heap a vacuum tanker is required.

Long fibrous material such as tomato vines and maize stalks should be chopped up to speed up the decomposition process. A small shredding machine is required for this.

Additional items
The following additional items will be required

Hand tools, shovels, forks, brushes.

An incinerator for animal carcasses. This could be of local design and use wood or corn cobs as fuel.

6.2 Equipment specifications

Equipment specifications.

Loader
Type: - 4 wheel drive.
Loading height: 4 m
Fork capacity: $2m^3$
Bucket capacity $2m^3$
Minimum Engine power 90 hp
Number required per comuna 1 initially but up to 1 per platform

Waste spreader
Type rear discharge
Capacity- 5 m^3 (largest Romanian supply)
Number required 10

Vacuum tanker
Type: vacuum
Capacity: 5000 l
Number required per comuna 1

Trailer
Type: single axle tipping body
Nominal capacity: 5 tonnes
Number required 1 per comuna

Tractor
Type: 2 wheel drive.
Power: 65 hp
Manufacturer: Universal
Number required 10
Number per comuna 2

Waste Shredder
One per comuna.

Indicative costs for these machines from local supplier information are shown in Annexe 6.

7. Options for handling livestock effluent at household level

Livestock effluent at household level consists of the urine from cows and horses and liquids running off the yard areas of pig housing. The effluent from the cows and horse is caught in the channel in the concrete floor at the front of the housing. The pig effluent is either caught in a channel or is allowed to drain directly into the soil where it runs off the concrete floor at the front of the yard. Where roof water is badly managed it is allowed to fall onto these yard areas or into the channel where it can increase the volume of effluent and also wash further solids and nutrients into the system.

The strategy for controlling effluents is :

1 *Minimisation* of volumes by attention to detail on roof drainage and keeping yard areas clean so that roof and yard drainage of rainwater does not come into contact with waste.

2. *Catchment* of all effluents and rainfall on to concrete areas where there is waste. This will involve the construction of drainage channels to catch urine, drainage from pig yards and rainfall from dirty yard areas.

3. *Containment* - all channels must be collected in a lined pit or storage tank. This tank must be covered and be located close to the stock housing. It must also be placed near to the storage facility so that effluent from this can also be contained.

4. *Safe Disposal* -The first option for disposal of effluent is to lift it out of the tank by long handled 4 litre scoop or with a bucket and pour it over the solid waste so that it is absorbed. When the waste has reached saturation the catchment channel will return any excess to the tank. Good practice would be to apply this liquid to the waste store when it is almost full with dry solid waste. The tank must be small so that the practice of application of the collected liquid must be carried out frequently. A long narrow plan shape will make it easier to empty. The tank must have heavy well fitting lid with a lockable fastener to prevent unauthorised opening.

The second option is to utilise the service of the vacuum tanker associated with the main platform to provide a special service of emptying the storage tank.

8. Indicative five-year investment program

The investment programme is proposed in five stages.

- training and information
- pilot first village platform with monitoring
- main platforms investment
- household segregation encouragement
- household stores construction

8.1 Training and information

Before any investment in materials or equipment can be authorised an information and training programme for the implementation of the programme by Mayors, farmers' householders and operational staff must be in place:

- To gain the confidence that the investment is at appropriate levels and will be supported by changes in practices.
- To achieve a higher turnover on recycling to land than the present methods used on farm stores and platforms.
- Promote correct use of the facilities.
- Maximise the number of households served
- Safeguard quality of materials for recycling
- To ensure markets for the stored material
- Responsible recycling

1. A seven day study tour of farms in the UK demonstrating the storage and recycling of agricultural wastes. Commercial farms in the UK have been involved in a series of Government sponsored demonstrations on the recycling of livestock wastes to land. The purpose of this training is to

   - Demonstrate that very long storage periods were not necessary for effective recycling.
   - Encourage changes in the farming practices designed to make better use of the waste.
   - Demonstrate choice of housing and waste system as an integrated concept.

   It is recommended that these are included in an itinerary which should also demonstrate the integration of livestock housing with the waste management and recycling system. The recommended criteria for selection for this awareness training were:
   Mayors, farming associations leaders, research consultants, extension consultants, DGA officials

2. Implementation of training for the operating staff in the use of machines and the management of segregation.

3. Implementation of a training and information plan to educate the householders
   This must include;
   - Awareness information on the benefits to the community of waste recycling.
   - The collection of effluents.
   - The use of the household store.
   - Procedures for the use of containers for the house waste

- Management of the waste at household level.
- Deposition of segregated waste at the platform.
- The use of the platform and the need to deposit the segregated waste into the appropriate bunker.

4. Information and training in the business management and administration of a waste recycling facility. For Mayors, other comuna officials and the site staff. This must also deal with the recycling of materials from the livestock and the households.

5. Training and extension aimed at all farmers and the farming associations
   - The value and other benefits of the recycling of nutrients form livestock with rotation examples.
   - Good practice in the storage and recycling of nutrients.
   - Timing of applications.
   - Preparation of application plans.

8.2 First-year numbers with location and cost estimates

The first year will be the production of platforms for the waste.
It is proposed that 1 village platform is constructed in the first year. This single platform will be monitored for utilisation , uptake by householders, management and recycling of nutrients to farmland. This will enable the practical verification of these assumptions for the designed as outlined in section 6. The remainder of the program can then be completed providing opportunity to revise the dimensions of platforms for later investments and implementing any changes as indicated from the results of monitoring and evaluation.

The criteria for selection for the investments.

- Demonstration of ability to control the segregation of waste by householders at the household and the platform. Indicators: Achievements on existing platforms, Guidance provided to households, Staff provision commitment, Training program for staff.
- Demonstration of a commitment to the recycling of the quantities of material on agricultural land in the comuna. Indicators: associations and farmers declared as requiring recyclable material, Quantities committed.
- A location which is at least 10 m away from a watercourse or drainage channel and 50m away from any well. Indicators: site location plan.
- The size of facility must match the number of households it is intended to serve. Indicators: Number of households, livestock numbers, waste quantities, platform dimensions.
- Existing equipment available which they were able to commit to the management of the waste. Indicators: Machinery held by mayors' office, and potential users.

The first platform will be supplied with an assisted materials handler.
Assisted purchase of a waste spreader, tractor and trailer, shredder and vacuum tanker per comuna.

The first year platform must be monitored, evaluated and necessary actions taken prior to further investments

Monitoring and evaluation of segregation at household levels. Indicator: Degree of contamination of the agricultural waste, Volumes of wastes by type deposited in the inert waste bunkers.

Monitoring and evaluation of platforms. Indicators: Waste quantities accommodated and how rapidly this was recycled. Volumes of run off from the platform Volumes applied to crops.

8.3 Indicative program for years 2 - 5

The remainder of the programme is intended to assist the villages in the implementation of platform and household stores providing up to 2/3 the total estimated capacity.

year 2
Villages supplied with bins for house wastes
Construction of household stores
Construction of 3 more platforms with equipment on 3 comunae
Additional assisted purchase of spreaders by agricultural associations.

Year 3
Construction of 3 more platforms with equipment on 3 comunae
Construction of household stores
Assisted spreader purchase

Yr. 4
Construction of 3 second platforms on 3 comunae
Construction of household stores
Construction of farm stores

Yr. 5
Construction of 4 second platforms 4 comunae
Construction of household stores

The indicative programme is shown in Annexe 6

9. Environmental and Economic assessments

9.1 Environmental assessment

The impact of waste at the household and platform levels is summarised in tables below:

Households

Environmental Impact	IMPACT ON (✓)					
	Site	Farmer	Neighbours	Stock	General Public	Water Quality
Smell/Odour	✓	✓	✓		✓	
Noise						
Dust						
Solid Waste	✓		✓	✓		✓
Visual Intrusion	✓	✓	✓		✓	
Effluents	✓	✓	✓	✓	✓	✓

The sources of pollution arising from households include:

1. Diffuse pollution from leachate from waste storage areas.
2. Diffuse pollution from unlined reception pits for urine and liquids running off concreted areas.

Platforms

Environmental Impact	IMPACT ON (✓)					
	Place	Landscape	Stock	General Public	Water Quality	Soil
Smell/Odour	✓			✓		
Noise				✓		
Dust		✓		✓		✓
Solid Waste	✓	✓	✓		✓	✓
Image	✓	✓		✓		
Effluents	✓	✓	✓	✓	✓	✓

The sources of pollution from platforms arise from:

1. All platforms cause nitrogen impact through indirect pollution. This comes from leachate entering the water table through the soil beneath and close to the platform.
2. Comuna platforms close to water courses cause impact through direct pollution from surface run off into watercourses.
3. Former state farms and large farm platforms cause diffuse pollution through the leaching of effluent from their permeable bases.
4. All existing community platforms will continue to pose a risk to the environment from the continuation of leaching
5. The main type of pollution observed from indicator plants was that of nitrogen pollution and eutrophication by phosphate.

The quantity of Nitrogen entering the water system was estimated to be 404 tonnes per year. This was based on the number of stock, (DGA 2000) and the assumption that all available nitrogen is leached. In addition to this quantity the additional direct pollution from household latrines represents a further 21% increase in nitrogen.

The quantity of phosphate which could be lost to the water resource was estimated to be 238 tonnes. This was based on the assumption that all soluble phosphate would be lost.

Environmental Impacts of the Proposed Measures
The impact of waste management measures at the household and platform levels is summarised in tables below.

Household

Reduction of Environmental Impact	IMPACT REDUCTION ON (✓)					
	Site	Farmer	Neighbours	Stock	General Public	Water Quality
Smell/Odour			✓			
Noise						
Dust						
Solid Waste	✓	✓	✓		✓	✓
Visual Intrusion	✓	✓	✓		✓	
Effluents	✓	✓	✓	✓	✓	✓

Platforms

Environmental Impact	IMPACT REDUCTION ON (✓)					
	Place	Landscape	Stock	General Public	Water Quality	Soil
Smell/Odour				✓		
Noise						
Dust		✓		✓		✓
Solid Waste	✓	✓		✓	✓	✓
Image	✓	✓		✓	✓	
Effluents	✓	✓	✓	✓	✓	✓

1. The actions will eliminate all future sources of pollution at the platforms from leaching into ground water and direct drainage of liquids into surface water.

2. All waste can be utilised in autumn and spring replacing purchased fertiliser. More likely in the short term it will be used to increase yields through addition of nutrients.

3. It is recommended that the waste be applied to cropped land so that the maximum utilisation of nutrients can be achieved. The maximum rate of nutrient loss for

farmyard manure will be limited to 5% of the total nitrogen applied (Smith et al., 1998). The effect of adoption of the recommendation will be to reduce nitrogen loss to the water table by 90% for future waste arisings.

4. The increased use of the waste will maintain organic matter in the soil so reducing susceptibility to erosion. Maintaining soil structure will also assist the in the avoidance of soil structural problems. This in turn will avoid unnecessary use of energy in cultivations.

5. The loss of agricultural land to platforms for agricultural waste will be arrested.

6. The detrimental effect of water quality on livestock and human health will be decreased.

7. Energy use reductions and environmental benefits of resource savings from recycling of the inert materials will be achieved.

8. The platforms will be managed in a sustainable way and be cleared at the end of autumn each year. The unsightly appearance of the existing facilities will not continue.

9. There will not be any immediate effect on releases from the existing wastes deposited. The presence of sustainable facilities will enable a strategy for the clean up of the existing platforms

10. The human effort will decrease. The labour required for two handling operations will change to a single operation of placing the waste into the household store. A concrete base to the waste store will make it much easier to gather the waste into the cart for transport to the platform. The labour input into handling waste at household level when unloading at the platform will be reduced.

Impact of waste disposal

The available area for the recycling of the wastes is 59616 ha (DGA2000)
Applied once every 4 years in a rotation this would give an available area for recycling of 14720 ha. At an application rate of 40 tonnes /ha the total area needed would be 3123 ha. This demonstrates that the nutrient loading on the land is easily within the accepted maximum rates (MAFF 1998) associated with good agricultural practice.

9.2 Economic assessments

The main economic benefit from management of agricultural waste will be realised in the recycling of the nutrients in crop production. Known nutrient contents and utilisation by the crops in a rotation which is typical of the region can be used to calculate the financial benefit.

The expected benefit over a typical rotation of maize, wheat and soya for an application of 40 tonnes on a hectare is shown in the table below. Detail is provided in Annex 1.

	Saving (ROL/ha)
Year 1	2,730,000
Year 2	1,502,000
Year 3	995,000
Year 4	negligible

Total	5,227,000	($211)

If the waste can be recycled on 3123 ha then this represents an annual saving in the project area of $658,222

The benefit to farms arises from the savings shown above. There will also be a benefit in that the waste applied nutrients represents lower borrowing from financial institutions. This will reduce pressure to dispose of the harvested crop immediately after the harvest when the market is weak. The benefits will therefore be:

- Saving on primary sum invested in fertilisers.
- Reduced interest payments
- Increased revenues from later sales of produce if a surplus is present after sales for interest repayments at harvest.
- Increased yields from recycled nutrients.

Un-quantified Financial Benefits

- There will be improvement of the quality of the produce. In addition to the financial savings or yield improvement related to use of waste.
- The waste generated at household level has a value which can be realised by management and storage followed by application to arable land for vegetables, vines, fruit trees and field crops.
- Number of permanent jobs created per comuna: 1 loader driver plus 1 persons for each platform constructed to supervise deliveries and assist in the waste spreading, site security and administration.
- Temporary jobs created for the construction of platforms.

ENVIRONMENTAL MANAGEMENT PLAN FORMAT

A. MITIGATION PLAN

			Cost		**Institutional Responsibility**		**Comments (e.g. secondary impacts)**
Phase	**Issue**	**Mitigation measure**	**Install**	**Operate**	**Install**	**Operate**	
location	indirect and direct pollution of water	minimum 10 m from water or drain			comuna admin.	comuna admin.	
platform construction	indirect and direct pollution of water	provide lined basin					
excavations	direct pollution of water	not into water table			contractors	contractors	
disposal of soil	loss of soil quality	store top soil separately from subsoil fill low lying areas			contractors	contractors	
supply of materials	environmental burden of extraction and transport	local supply where possible use of waste glass in hard-core			contractors	contractors	environmental burdens from manufacture
dirty water from construction	pollution of watercourse	contained in basin			contractors	contractors	
vehicle access	road traffic emissions fuel use	close to comuna and existing road			comuna admin.	comuna admin.	

Operation	**pollution of the water table by nutrients from agricultural wastes**	**containment of wastes sensible recycling to arable land**			**householders comuna admin.**	**comuna admin. householders farmer associations**	
Segregation of house waste	recycling of materials waste minimisation	instruction information containers provided			OJCA extension	OJCA extension householder	
Storage of livestock waste at household	leaching of nutrients groundwater pollution	instruction information waste store constructed			OJCA extension comuna admin. householder	OJCA extension householder	
Collection of effluents	leaching of nutrients groundwater pollution	tank installed			comuna admin. householder	householder	
Transport to platform	loss onto roads litter	existing carts secure loads			householder	householder	
Waste unloading segregated house	litter recycling of materials	instruction information bunkers at platform supervision			OJCA extension local admin.	OJCA extension householder local admin.	
Unloading livestock waste	leaching of nutrients groundwater pollution	information instruction concrete apron assistance from site loader			OJCA extension local admin.	householder	
Handling of waste	leaching of nutrients groundwater pollution odour	impermeable store			local admin.	local admin.	

Operation	**pollution of the water table by nutrients from agricultural wastes**	**containment of wastes sensible recycling to arable land**			**householders comuna admin.**	**comuna admin. householders farmer associations**	
Control of run off	leaching of nutrients	collection channel impermeable basin			local admin.	local admin.	
Distribution of manure	leaching of nutrients groundwater pollution	Stabilised material applied maximum limit 250 kg N /ha information instruction			environmental agency OJCA extension	farmers associations	avoided burdens in fertiliser manufacture
Recycling of steel	saving energy sustainability	to metals recovery merchant			local admin.	local admin.	avoided burdens
Recycling of paper	methane release	not yet established			local admin.	local admin.	avoided burdens
Other wastes from bunkers	sustainability groundwater pollution	new regulated platform or landfill glass for aggregate			environmental agency	local admin.	sustainable landfills
Existing waste on existing platforms	sustainability groundwater pollution	pick over waste and recycle organic waste compost to stabilise nitrogen			local admin. environmental agency	local admin.	Poses a threat if not treated

REFERENCES

MAFF (1998), The Code of Good Agricultural Practice for the Protection of Water - Ministry of Agriculture, Fisheries and Food - UK.

DGA (2000), Agricultural returns for the Calarasi Judet, 30th September 2000.

Smith K.A., Chambers B., Cumby T.,Scotford I., Pain B.,(1998) - Managing livestock manures - series. Ministry of Agriculture, Fisheries and Food - UK.

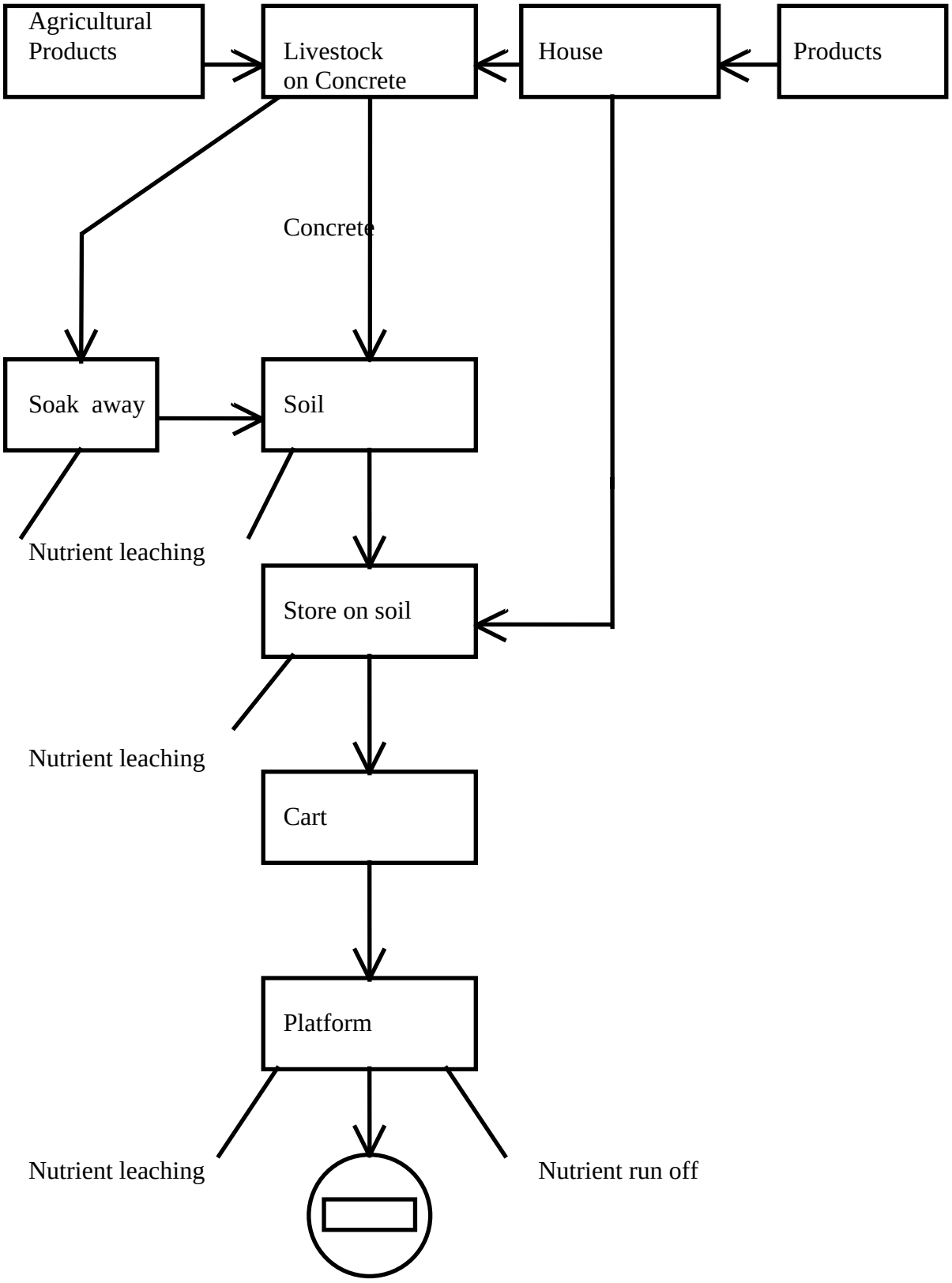
Annex 1

Calculation of financial benefit from use of waste on arable land

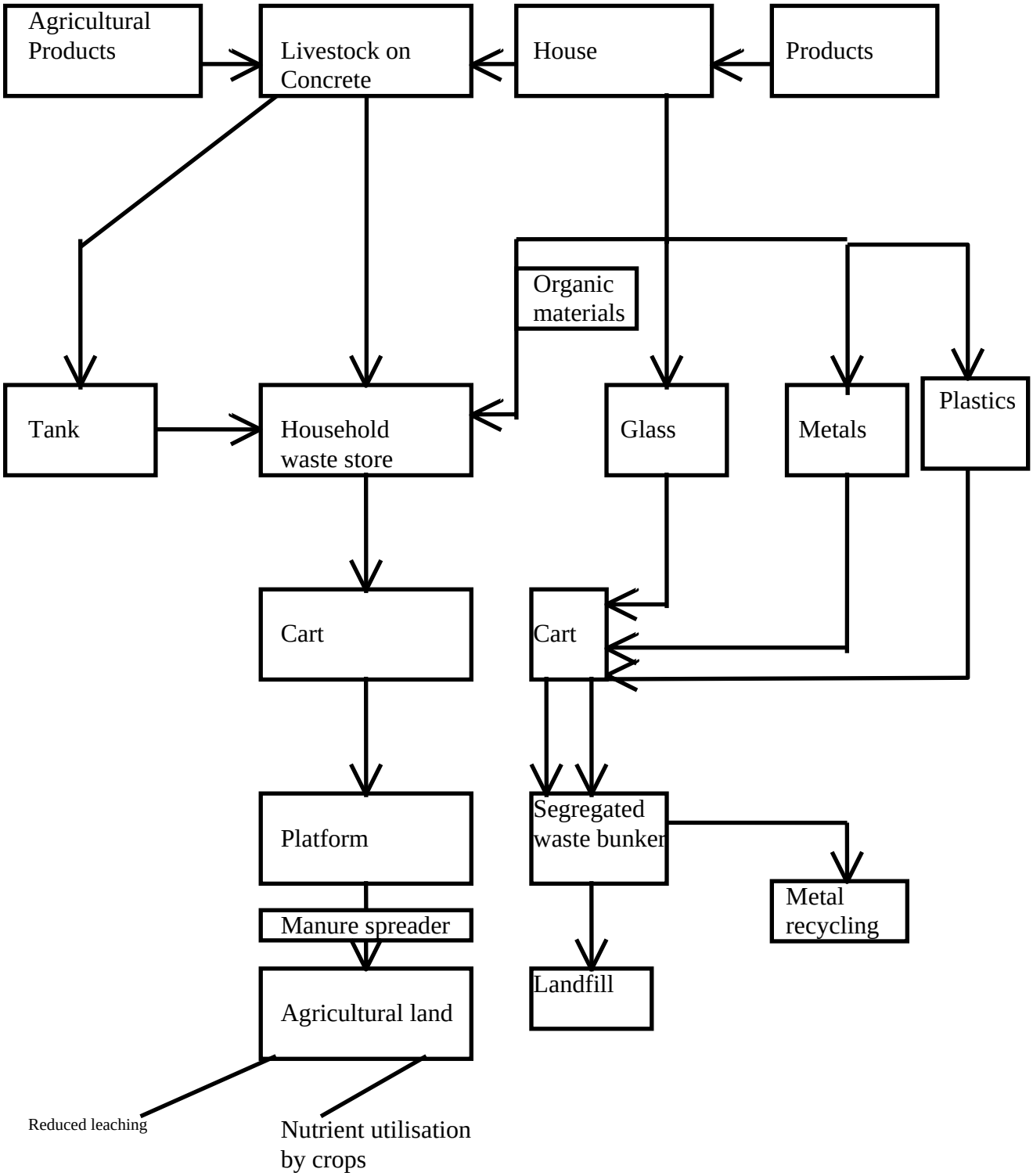
Using Livestock Manures in Arable Land

Crop rotation		4 years	maize	sunflower	wheat	wheat
Manured Crop	maize					
Rate		40 t/ha	Farmyard manure(FYM)			
Previous crop	wheat					
Stage			N	P2O5	K2O	Financial saving (ROL)
Estimate of nutrient content		kg/t	6	3.5	8	
Total Nutrients		kg/ha	240	140	320	
Available nutrients for maize		kg/t	1.75	1.5	3	
Nutrient required (7t/ha yield)		kg/ha	147	71	196	
Nutrient supply from manure		kg/ha	70	60	120	2,730,000
Inorganic fertiliser need		kg/ha	77	11	76	
Available nutrients for sunflower		kg/t	0.9	1	1.5	
Nutrient required (2.5 t/ha yield)		kg/ha	103	59	123	
Nutrient supply from manure		kg/ha	36	40	60	1,502,000
Inorganic fertiliser need		kg/ha	67	19	63	
Available nutrients for wheat		kg/t	0.5	0.75	1	
Nutrient required (5 t/ha yield)		kg/ha	128	68	140	
Nutrient supply from manure		kg/ha	20	30	40	995,000
Inorganic fertiliser need		kg/ha	108	38	100	
Total saving on NPK		kg	126	130	220	5,227,000
Prices of nutrients		ROL/kg	12,000	12,500	9,500	

Annex 2
Waste And Nutrient Flows For Existing Household System



Waste and Nutrient Flows for Proposed System



Annex 3

Diary

Date	Location	Mode	Activity	Persons Met
08/10	UK /Romania	Field	Mobilisation	Stefan Nicolau director PPU
09/10	Bucharest - World Bank Resident Mission British Embassy	Field	Background Meet DFID KHF co-ordinator	Dana Dobrescu Eugenia Stanciu Mariana Pavalan
10/10	Institute for research into cereals and industrial crops- Fundulea	Field	Meet counterpart	Ion Toncea Stefan Nicolau
11/10	World Bank	Office	Advise on Codes of Good Agric. Practice	Dana Dobrescu Petra TOR 5 legal consultant Stefan Nicolau Gabriel Vulpe assistant to PPU
12/10	DGAIA Calarasi	Field	See platforms	Christian Parapiru DGAIA development Mayor Vilcelele
13/10	Cuza Voda Independenta	Field Field	 Data collection	Ion Toncea Mayor Toma Grigore - Cuza Voda Christian Parapiru Mayor Constantin Anghel – Independenta
14/10	DGAIA Calarasi	Office	Report	Ion Toncea Christian Parapiru
15/10	Hotel	Office	Report	John Cole
16/10	EPA offices Calarasi	Field	Data collection	Christian Parapiru Ion Toncea, Mr Ciofu, Director Victoria Enache Mitea Gratiela
17/10	Gradistea DGAIA Calarasi	Field Office	Data collection Report	Ion Toncea, Gabriel Radescu Director, former state farm Mayor Iancu Florian Deputy mayor Ion Toncea Director Mr Dobre Christian Parapiru
18	Project Office	Field	Data collection	Ion Toncea
19	DGAIA Calarasi ANCA Extension service	Office	Report	Mr Anton Magearu Stefan Nicolau John Cole
20	Project Office	Office	Report	Stefan Nicolau John Cole
21	DGAIA Calarasi Independenta	Office	Data collection	British ,Spanish and Italian delegates from EU SAPARD programme

	Vilcelele			Stefan Nicolau John Cole

Date	**Location**	**Mode**	**Activity**	**Persons Met**
22	Hotel		Report	John Cole
23	Project Office	Office	Report	Ion Toncea Stefan Nicolau John Cole
24	Project Office	Office	Report	Ion Toncea Stefan Nicolau John Cole Arnold King
25	Al. Odobescu	Field	Data collection	Ion Toncea Mayor Mr Sultan
26	DGAIA Calarasi	Office	Report Presentation to Mayors	Mayors of Independenta Vilcelele Gradistea Vlad Tepes Ciocanesti Stefan Nicolau John Cole Arnold King
27	Project Office	Office	Construction Costs Reporting	Gabriel Popovici Anca Gheorghiu Ramesh Kanwar Ion Toncea Stefan Nicolau John Cole Arnold King
28	Project Office	Office	Reporting	Ion Toncea Stefan Nicolau John Cole Arnold King
29	Project Office	Office	Report	John Cole Arnold King
30	DGAIA Calarasi	Office	Presentation of proposals Monitoring programme meeting	Dana Dobrescu World Bank EPA Dept. Of Health Mayors Mr Anton Magearu Sevastel Mircea PPU procurement Stefan Nicolau Ion Toncea Local Press John Cole Ramesh Kanwar Simon Turner Arnold King

Date	Location	Mode	Activity	Persons Met
31/10	Project Office Calarasi ISPIF Bucharest	Office Field	Investment programme Construction cost Design	Stefan Nicolau John Cole Gabriel Popovici Anca Gheorghiu
01/11	World Bank – Resident Mission Bucharest	Office	Report Preparation	Sevastel Mircea Dana Dobrescu

Notes on the visits to the farms and properties

Vilcelele Comuna
Two villages: Vilcelele and Floroaica

Areas are provided where householders take waste approximately every 2 weeks.
Two areas visited were placed in a strip of land 5m wide and 200 m long along the edge of drainage ditches.

The areas at Vilcelele was adjacent to the point where this ditch discharged into a watercourse. The end of the heap being less than 5 meters from this watercourse. The slope of the land and the closeness of the track would result in run off from the full length of the heap discharging directly into the stream. this is clearly poor practice which in times of higher precipitation rates gives rise to direct pollution.

As the heaps were inspected in autumn after a particularly dry summer much of the, materiel was very and had been burnt. This practice was being discouraged by the village administration.

A feature of all the heaps was the presence of small but contaminating amounts of inert domestic refuse cans , bottles , glass and plastic.

The heaps were manages in that local farmers could apply to take away the agricultural solid waste for land application. however much of this waste could not be used because of the contamination. Discussion with the mayor indicated that there was a strong demand for this material.

The mayor in discussion favourer the provision of facilities for the separate collection of inert solid waste. This would render the agricultural waste more useable.

A third larger storage area contained solid waste from 120 dairy cows and additional village waste. this covered an area of approximately 1 ha. The majority of the waste had been contaminated by the inert waste brought by villagers. Despite the dry conditions considerable leachate was observed to be oozing from the waste.

The main source of waste was from the dairy cow feed passage scraped areas. The is was central to two sets of paddocks. The cow standing areas had at one time been covered, providing shelter for the stock and also preventing rainfall collection by the dirty cow standing area. The roofing sheets for this area had been stolen as this had previously been a state farm. As a result an rainfall will carry waste and nutrients of the side of the concrete and into the adjacent soil.

The combinat also had places for 3000 pigs although presently only 300 were housed. A slurry system was in place with a 2m wide slatted area and a water flushing system . Due to operating cost and complexity a

settlement lagoon system had been abandoned. The electrically driven main transfer pump was now used to discharge the slurry into a large unlined pit at the edge of a wood.

Spreading the waste.
There was no specialist waste spreading machinery available. Only the solid waste could be utilised. this was spread from heaps distributed across the field. the scale of this operation ranged from the use of lorries and bulldozers to hose and cart and muck fork. this resulted in very high applications of waste quoted at 50 tonnes /ha. The combinat was well equipped with machinery including several relatively new combines. These had been funded through EBRD.

Utilisation of waste was limited to late summer / autumn. This may be a function of the methods used to apply the crop in that there is no possibility of application to growing crops.

Two dwellings were visited, these had cows pigs and poultry. In to the cases liquid runoff from the concrete floor of the stock housing ran into unlined pits. These pits were emptied periodically by bucket and the liquid thrown over the main waste store. Neither of the cow sheds had a dung channel for the collection of faeces and urine. This was thrown at various times of the day outside onto the earth.. In one case this was picked up daily and moved by wheelbarrow over to a large heap adjacent to the gate. it was noted that these heaps were little more than 350 mm deep and covered an area of 25m2. The waste could then be lifted by the farmer's son who had a 900 ha farm and spread. The other holding spread their waste on their own fields by tractor drawn cart. Both sets of occupants were elderly.

None of the roof drainage was collected. Some of this fell onto the earth yards or into the unlined pits for roofs without gutters. Where gutters were present discharge spouts dropped the water onto the earth. In some cases this was onto dirty areas so that nutrients could be washed into the soil.

Conclusions

There is a basic understanding of the nutrient benefits of recycling of solid waste to agricultural crops and this is practised a much as possible.

The location of the waste collection areas can lead to direct contamination of watercourse from run off.

The contamination of the agricultural solid waste makes much of that waste unusable.

Relatively small amounts of waste are responsible for contaminating large amounts of agricultural waste.

There are no machines available to the large or small farmer for the handling and spreading of liquid waste.

Water contamination is increased by large areas of dirty yard and roof water.

The management of cattle waste at household level involves double handling.

Storage areas without concrete make picking up and collection of the waste more difficult.

Uncovered separate storage for inert waste would be unlikely to lead to nitrate loss.

Recommendations

Separate designated storage for inert domestic refuse should be provided.

Concrete based areas with retaining walls should be constructed for the central waste storage. This should be provided with a collection channel and a storage tank for leachate.

Comuna Cuza Voda
Meeting with the mayor- Toma Grigore
Date of meeting: 13/10/00

Numbers of livestock were reported as.

cattle (heads)	pigs (heads)	sheep and goats (heads)	horses & donkeys(heads)	poultry (heads)	beehives (heads)
1052	1771	4135	603	13100	260

Households 1720
6 pads for waste
3 villages make up the comuna. These are:
Cuza Voda
Ceacu
Calarasii Vechi
Only 10 % of the waste is utilised. This by one individual who grows vegetables.
General information.
The overall area of the comuna is 12800 hectares
there are 3 large farms
Agromixt commercial society. This has 1500 ha of land for arable production. The livestock is sheep and horses.
Rapid of Calarasii Vechi with 720 ha with cows and sheep.
Victoria has 1100 ha with pigs and cows.
There are many associations with only arable crops.

650 ha of pasture are available as common land for which the users have to pay rent. 350 ha of this is permanent pasture and the remainder is sown with ryegrass varieties for cattle.
Cattle are outside from the 15th April to the 6th December.

Barriers to greater use of the waste were reported as:
- Manure requires more transportation to the field which are farmed in association.
- The farming companies like to buy chemical fertiliser. They have machinery to apply it.
- They do not have specialised machinery to apply the waste.
- Use of the waste requires high labour.
- The waste is contaminated.

The waste is placed in a cart and is spread manually in autumn before ploughing.
The Mayor, suggested that the following was required to improve the waste quality:
A manned separate area at the platform.
The use of bags to collect the different waste streams and bring to the platform.

Platforms
Two examples of the platforms use were inspected:

One outside village within 10m of road side ditch .
Located on a slope and some 300 m long by 15 m wide and 1.5 m deep on a slope
Materials include demolition waste / soil , livestock solid waste.
The waste was contaminated by glass, plastic containers and metal cans in small but frequent amounts.

The second platform covers 1 ha . Agricultural solid waste with contamination by household containers plastic shoes textiles, steel wire had been deposited. Plastic was observed to be on the surface of the adjacent field.

A horticultural holding which used waste at 50 tonne ha every 3 years was visited. Good yield and quality was achieved with the use of pesticides. The crops were not grown in rotation.

A second household was visited . This had the following stock:
Stock
Cows 2
Bull 1
Horse 1
Pigs - 2 sows 20 growers

Mixed livestock waste and household contaminants were placed close to the gates to the household.
Urine and runoff from the cattle housing is collected by a channel and runs to a concrete slab lined but unsealed pit. This has dimensions 50 cm x 50 cm x 50 cm.
Adjacent to the cattle housing is the pig housing. The Pig housing has a concrete area to the front .Liquid run off from this area is not intercepted..
Solid waste is placed onto a wheel barrow and taken to the waste storage areas adjacent to the gate.
Other buildings and structures on the site include Maize cob storage and stacks of maize straw and wheat straw.

The cows and bull were not on the site. These were grazing on the common pasture land..

Comuna Independenta
Meeting with the mayor – Mr. Anghel Constantin
Date of meeting: 13/10/00

Number of livestock was reported as.

cattle (heads)	**pigs (heads)**	**sheep and goats (heads)**	**Horses & donkeys(heads)**	**poultry (heads)**	**beehives (heads)**
1400	800	4600	386	35000	260

Households 1396
6 pads for waste
3 villages make up the comuna. These are:
Independenta
Potcoava
Visini
25 % of the waste is utilised.
General information.
The overall area of the comuna is 1735 hectares

There is one large farm.
Agrozootehnica commercial society. This has 1735 ha of land for arable production with cows.
The total stock number in the herd is 174 with 74 milk cows. The waste storage area provided for the waste from this stock is separate from the village platforms. The farm manages its own waste, maturing it for a year before application

There are two small associations with a total of 40 ha each with other fields rented.

Rapid of Calarasii Vechi 720 ha with cows and sheep.
There is a common area for use by householders only of 350 ha
269 ha of common pasture land is cultivated . 60 ha for alfalfa and the remaining 209 ha for ryegrass.

Comuna Gradistea
Meeting with the mayor- Mr Iancu Florian
Date of meeting: 16/10/00

Households 1975
Population 5500
2 platforms are available for waste
2 villages make up the comuna.
Only 25-30% % of the waste is utilised. Demand was expected to increase with the increase in vegetable crops grown.

General information.
The overall area of the comuna is 27,000 hectares
There are one very large former state farm with a number of farming associations on e of which has farms in Cuza Voda.
Former State farm. This has 4524 ha of land for arable production and capacity for 200 cows. This was currently not stocked due to slaughter of the herd as a result of disease.
There are seven associations of over 500 ha with only arable crops.
693 ha of pasture are available as forage crop land for which the users have to pay rent of this 350 ha was permanent pasture. Part of the land was drained polder land
228 ha of land was designated for construction.
Cattle are outside from the 15th April to the 6th December.

Waste management
The management of waste was described as disastrous with uncontrolled dumping of waste at the perimeters of villages, on the roadside and even in the neighbouring comuna.
the comuna has already made an application to the rural development agency under the programme.
The requirement had been for two platforms , two tractors to collect and handle the waste. After winter storage and rotting of the waste this would be spread to the fields.
the plan was to raise taxes to a modest level in order to pay for the fuel and labour.

there were local examples of use of the waste by vegetable growers who were able to produce crops without chemicals. There was confidence in the economics of this method of production .

The previous use of the clean waste from former state farm platforms had demonstrated the demand for well rotted waste

Platforms
One outside village on the polder .
this was located within 10 metres of the main drainage canal which discharged directly into a major tributary to the Danube. The drainage ditch had clear water but noticeable quantities of vegetation . This indicated eutrophication of the watercourse.
The platform was 300 m long by 200 m wide with a perimeter earth bund. It has formerly been a huge slurry lagoon. After all the uncontaminated waste had been removed the area had been used as a platform for the solid wastes . The whole of the area was covered with deposition of agricultural waste which was contaminated by household waste. The waste was contaminated by glass, plastic containers and metal cans in small but frequent amounts.

Households visited
The households were larger than encountered at the other comunae. The areas were approximately 1 ha. The first household visited was owned by fit but very elderly farmer who had:
1 cow
1 horse
5 pigs

In addition to stacks of maize straw the farmer had stacks of loose wheat straw which was available for the taking away and lucerne bales which he had purchased. Other than the pig accommodation and winter cattle accommodation the accommodation did not have a concrete base. More straw was used on the earth floor for stock bedding.

The second holding was farmed by a man who had employment in Calarasi. He had purchased 10 cows. These were also accommodated in a shed with an earth floor. The building was made from steel, larger and more enclosed than any previously seen. The people who looked after the stock were young and clean bedding was used.

The waste was cleaned out of the shed daily and stored in heaps outside. It was only lightly contaminated with cattle dung. Pig accommodation was provided separately. The pigs were also kept on a deep litter system. Unfortunately this stock housing was within 10 metres of the bank of the main drain to the polder.
The foundations of new winter cattle accommodation had been constructed 50 m in from the waterside boundary.

This household was the only one in which plastic bottles and other wastes were segregated. Plastic bottles were stored in an unused hay rack.

The former state farm was also visited. Discussion were held with the Director, Gabriel Radescu
The farm grew the following crops:
2300 ha cereals and oilseed rape
700 ha maize
700 ha soya-bean
200 ha fodder crops
300 ha seed production
450 ha sunflower

Chemical fertiliser was used.
700 tonnes per year 25-20-0 compound fertiliser which was applied at rate of 200 kg /ha on cereals
300 tonnes per year ammonium nitrate which was applied at rate of 140 kg /ha on wheat

Well rotted farm wastes were use at 100 tonnes per hectare which was ploughed in autumn.
(this rate would exceed the 250 kg /ha recommended by good agricultural practice)
The farm utilised a spreader to apply the waste.

The manager has adopted the latest techniques including the growing of genetically modified soya.

His experience with other local farmers is that their knowledge is at a low level and that they are unwilling to acquire extra knowledge. His offer of advice and knowledge was usually met with indifference. Local extension services consisted of articles in the news paper.

Extension Services

Director - Mr Anton Magearu Calarasi.
The extension service is a state funded organisation providing services throughout the Calarasi Judet.

There are 20 local centres providing extension. One specialist services 2-3 comunae.

I winter training course are provided from farmers including how to understand and accept EU requirements.

The main target group for extension is younger farmers. The economic value of the use of manure is promoted to this group. The main problem for farmers is the lack of financial resources and machinery to manage and apply waste.

Extension services specific to the project should be targeted to younger and new farmers.
Information to farmers was provided through a monthly farmers magazine which was distributed free to 1000 farmers. This publication could be used to promote better management of the waste. Examples similar to the ones presented in the ADAS/ MAFF managing livestock manures series of leaflets could be used. Mr Magearu said that the examples in the booklets were applicable to Romanian conditions.

Annex 4

Waste quantities based on stock numbers at 30/09/ 2000

Comuna	cattle (heads)	pigs (heads)	sheep and goats (heads)	horses (heads)	poultry (heads)	households	% with stock
Gradistea	1,820	6,336	3,468	637	48,700	1975	60%
Al. Odobescu	646	1,725	3,644	587	23,006	1800	60%
Ciocanesti	955	5,993	9,224	294	52,469	2900	60%
Independenta	1,232	2,695	865	328	34,780	1396	60%
Vilcele	457	2,264	2,331	350	68,108	900	60%
Vlad Tepes	452	1,736	2,018	390	27,000	1300	60%
Cuza Voda	1,067	1,408	4,005	341	29,240	1720	60%
Total Stock	6,629	22,157	25,555	2,927	283,303	11991	
Waste/head l/d	42	4	2	28	0.12		
Total daily amount	278	91	38	82	33		
housing period	150	150	100	150	150		

Comuna	cattle (heads)	pigs (heads)	sheep and goats (heads)	horses (heads)	poultry (heads)
Gradistea	2	5	3	1	41
Al. Odobescu	1	2	3	1	21
Ciocanesti	1	3	5	0	30
Independenta	1	3	1	0	42
Vilcele	1	4	4	1	126
Vlad Tepes	1	2	3	1	35
Cuza Voda	1	1	4	0	28
	2.9	0.27	Straw	kg/day	
	150	150			

Waste quantity

By Comuna t/year

							number of villages	Mass/ village t
Gradistea	11,466	3,897	520	2,675	840	19,398	4	4,850
Al. Odobescu	4,070	1,061	547	2,465	397	8,540	3	2,847
Ciocanesti	6,017	3,686	1,384	1,235	905	13,226	3	4,409
Independenta	7,762	1,657	130	1,378	600	11,526	3	3,842
Vilcele	2,879	1,392	350	1,470	1,175	7,266	2	3,633
Vlad Tepes	2,848	1,068	303	1,638	466	6,322	2	3,161
Cuza Voda	6,722	866	601	1,432	504	10,125	3	3,375
Total m3	41,763	13,627	3,833	12,293	4,887	76,403		

Additional mass of straw in the waste t/year

Comuna			Total straw/ comuna t	Total Mass/ comuna t	Mass/ village t Total
Gradistea	792	257	1048	20447	**5112**
Al. Odobescu	281	70	351	8890	**2963**
Ciocanesti	415	243	658	13884	**4628**
Independenta	536	109	645	12171	**4057**
Vilcele	199	92	290	7556	**3778**
Vlad Tepes	197	70	267	6589	**3294**
Cuza Voda	464	57	521	10647	**3549**
	2884	897	3781	80184	

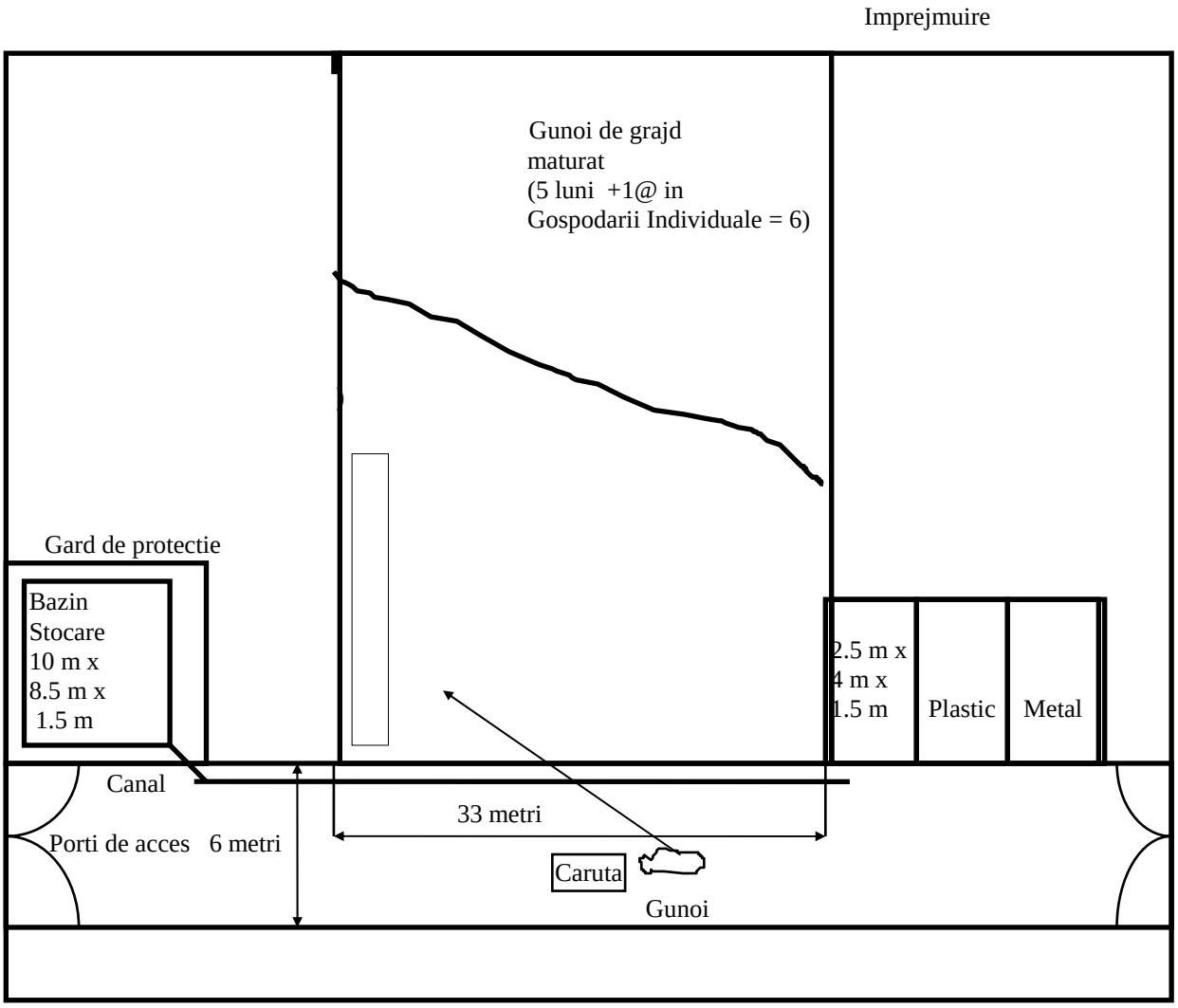
Platform capacity for seasonal	**waste**	**height**	**Vol. t/m3**	**area m2**	**width m**	**length m**

storage

150 day storage	4000	3	0.75	1778	33	56.87
Area for rain		198	36	234		
				2,012		

Storage tank for run off	**rainfall**	**mm**	**volume m3**	**absorbed by store**	**depth**	**area**	**width**	**length**
30 day		38	76	1.00	1.20	64	10	7.01

Annex 5


Imprejmuire
Gunoi de grajd
maturat
(5 luni +1@ in
Gospodarii Individuale = 6)
Gard de protectie
Bazin
Stocare
10 m x
8.5 m x
1.5 m
2.5 m x
4 m x
1.5 m
Plastic
Metal
Canal
33 metri
Porti de acces 6 metri
Caruta
Gunoi

Annex 6

Romania Cost table for each sub component

	Activity	Unit	Unit cost US$	Pre project	PY1	PY2	PY3	PY4	PY5	Total Number	Cost $	Possible Farmer inputs $
A.	Investment											
1	Civil works structures											
		Platform	99,273	1	2	2	3	3	3	14	1,389,822	347455.5
		house store materials	339	300	300	600	1000	1000	1000	4200	1,424,416	750,000
2	Goods									0		
2.1	Vehicles									0		
		Loader	17,108	1	2	2	2			7	119,759	
		Tractor	8,434	1	2	2	3	4	2	14	118,072	118072.3
2.2	Equipment									0		
		Spreader	6,750	1	2	2	3	4	2	14	94,500	
		Trailer	3,614	1	2	2	0		2	7	25,301	25301.2
		Tanker	5,060	1	2	2	2			7	35,422	
		Shredder	3,000	1	0	0	0			1	3,000	
		Bins	30	600	1800	1800	1800	750		6750	202,500	
3	Technical assistance									0		
3.1	International	consultant	621	15	10					25	15,525	
		flight	250	2	1					3	750	
3.2		transport	20	15	10					25	500	
	Local	consultant		20	10					30	0	
		transport	20	20	10					30	600	
4	Field trials /demonstrations									0		

	Activity	Unit	Unit cost US$	Pre project	PY1	PY2	PY3	PY4	PY5	Total Number	Cost $	Possible Farmer inputs $
4.1	Inputs monitoring	consultant			20	10				30		
		transport	20		20	10				30		
4.2	Demonstrations											
4.3	Small equipment											
5	Training											
5.1	Workshops											
5.2	Short courses overseas	Managers		500	7					7	3,500	
		Driver		500	7					7	3,500	
		Supervisor		500	7				7	14	7,000	
	delegates flight	9		300	1						2,700	
	delegates accommodation(	9		100	7						6,300	
	(	1		300	7						2,100	
	interpreter (	1		90	7						630	
	consultant	2		500	6						6,000	
	Transport	1		100	7						700	

	Activity	Unit	Unit cost US$	Pre project	PY1	PY2	PY3	PY4	PY5	Total Number	Cost $	Possible Farmer inputs $
B	Recurrent costs											
6	Salaries	numbers recruited			2	6	6	3	4			
		total			2	8	14	17	21			
7	Vehicle											
	Loader	Loader	17,108	86	257	428	599	599			1,967	
	Tractor	Tractor	8,434	42	127	211	337	506			1,223	1518.072
8	Operation/maintenance											
		Spreader	6,750		34	101	169	270	405		979	
		Trailer	3,614		18	54	90	90	90		343	470
		Tanker	5,060		25	76	127	177	177		582	
		Shredder	3,000		15	15	15	15	15		75	
9	Materials											
											3,467,767	1,242,817