ROMANIA
AGRICULTURAL POLLUTION CONTROL PROJECT

Assessment of Land Use Suitability
and
Programs for Testing/Demonstration of
Environment-friendly Agricultural Practices
and Agroforestry

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Executive Summary

The relationship between agriculture and the environment is a close one with agricultural activities having both positive and negative impacts on the environment. The challenge is to minimise negative environmental impacts and enhance positive ones, whilst still ensuring a livelihood for the farmer.

The overall project development objective of the Agricultural Pollution Control Project (APCP) is to increase significantly the use of environment-friendly agricultural practices in the project area and thereby reduce pollution from agricultural sources in Romania to the Danube River and Black Sea. In support of this objective, the project will assist the Government of Romania to: (i) promote the adoption of environment-friendly agricultural practices by farmers' associations, family farms and individual farmers in seven communas of the Calarasi Judet (county); (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 policy and local regulatory capacity; and (iv) promote regional level collaboration. The project, envisaged as a pilot activity in the Calariasi county in the southern part of Romania, along the lower Danube, will be replicated in similar sites in Romania which will, in the long term, reduce the discharge of nutrients and other agricultural pollutants and yield substantial benefits in terms of improved quality of Romanian surface and ground waters and the Black Sea.

Concerning the project area 87% of the total territory is agricultural, 3.5 % is water land and 1.9% woodland. In the last decade, the Romanian Governments have promoted the privatisation of agriculture. However, this privatisation has been accompanied by damaging effects on the environment. In fact, the agriculture systems associated with the project area are mainly characterised by monocropping or short crop rotation, intensive tilling, straw burning and forest vegetation clearing which have negative effects on soil, water quality, bio-diversity and the landscape as well as on farm productivity.

In the project area, it is arguable that the most significant impact on the environment, caused by agricultural activities is soil degradation and the decrease of soil organic matter. Historically, intensive tillage of agricultural soils (e.g. mouldboard ploughing and straw burning) has led to substantial losses of soil carbon (C), frequently over 50% in the 20-30 years. Soil erosion appears to be minimal, although water erosion occurs on some of the gentle slopes associated with the riparian zones of the terrace area and wind erosion is a localised problem in some zones of the polder and terrace areas.

Water quality has seriously deteriorated due to poor management of livestock and human wastes. Run off and drainage of nutrients from livestock waste platforms and latrines are by far the most important contaminants of surface and ground waters.

The bio-diversity is reduced and unbalanced by substitution of flora and fauna with crops, domestic animals and associated pests and diseases. Indeed, the agricultural landscape of the project area has been significantly denuded, particularly with the development of the polder area. No longer is there a mosaic of wetlands associated with the polder which in the past would have provided a rich habitat for flora and fauna and, acted as a biological filter to nutrient pollution and sediment transport. Associated with the polder is a unique micro-climate that is quite different to that of the former natural habitat. The landscape is typically flat with a patchwork of depressions of various sizes in polder area and sloping lands leading into ephemeral or permanent drainage areas. The landscape is dominated by agriculture that is mainly arable with some grassland areas to support livestock. Bisecting this landscape is poorly maintained irrigation and drainage canals and un-metaled farm tracks, as well as a multitude of plots, some windbreaks, and a number of 21 villages in terrace area. The desertification risk is significant for this area, since agroforestry and other environmental – friendly agricultural practices does not be used.

Environmentally-friendly agricultural and agroforestry practices refer to several practices which enhance the soils fertility, improve the waters quality, recover of bio-diversity, reduce desertification risk and increase farms productivity. These conservation practices include management of crop rotation, nutrients and pests, conservation tillage – soil and mulch tillage, narrow vegetative barriers or hedge rows, riparian buffers, tree planting and other specific practices as filter strips in polder area, windbreaks in terrace area, as well as land reclamation, wellhead protection, home garden and management of livestock and human wastes in village areas.

The success of the project depends on financial support to design a crop rotation, fertiliser and manure management regime, and pest and diseases control that will enhance the area environmentally, whilst creating and maintaining the livelihoods of farmers. Associated with this is a requirement to afforest parts of the project area thereby creating new habitats and landscape elements. In addition, and perhaps most importantly, will be the need to communicate to the rural population of the project area, and other stakeholders the benefits of integrating environmental actions into the farming systems through demonstration farms and publicity campaigns. Allied to this will be the need to engage the farming community in testing and applying new techniques and practices in a fully participatory manner thereby ensuring rapid take-up of appropriate technologies. This will partly be achieved by testing and demonstrating conservation tillage, manure management and specific agroforestry practices in four places located in on the polder (2) , agricultural terrace and village areas.

An environmental information system will be developed, based on geographical information system (GIS) technology that will integrate much of the data collected throughout the duration of the project. The system will provide the scope to manipulate and analyse the data and provide a tool for effective communication to a variety of stakeholders based on maps and associated tabular data.

1. Introduction: Origin and Objectives of the Assignment

1.1 Background

Agriculture can have a positive and negative impact on the environment. The principle negative effects of agriculture on the environment include:

- poor water quality due to contamination by sediment, nitrates, and pesticides;
- soil degradation including soil erosion, compaction, crusting and organic matter depletion;
- landscape degradation; and
- loss of bio-diversity and habitats.

The essential goal of the project is to reduce the discharge of nutrients and other agricultural pollutants into the Danube River and Black Sea through improved land and water management, whereby the negative impact of agricultural activities on the environment are reduced. The pilot project, will be implemented in southern Romania in the Calarasi county, and will be replicated in similar sites in Romania resulting , in the long term, in the reduction of agricultural pollutants and yield substantial benefits in terms of improved quality of Romanian surface and ground waters draining to the Black Sea.

1.2 Objectives

The project will assist the Government of Romania to:

- promote the adoption of environment - friendly agricultural practices by agricultural companies, farmers associations, family associations and individual farmers;
- promote ecologically sustainable land use of rivers meadow area, including a conservation management plan for the waters body;
- strengthen national and local policy and regulatory capacity; and
- promote regional level collaboration.

The project aims to significantly increase the use of environmentally friendly agricultural and agroforestry practices in the pilot area and other similar areas.

The objectives of this report are to:

(a) briefly outline the important environmental problems caused by agriculture in pilot area;
(b) prepare a land use suitability map for this area and;
(c) recommend testing / demonstration programs for introducing environmentally-friendly agricultural and agroforestry practices.

2. Project Background

The background information is based on primary and secondary data collection. Most data were collected through observations and interviews with individual farmers and other important informants from communes, farming associations and agricultural companies. In addition local government and government agencies were consulted for example the Environmental Inspectorate of Calarasi. The data collection and analysis was carried out over a period of less than one month and in the absence of up to date reports or information concerning climate, farming systems, soil quality or condition, land use change or land suitability. Consequently, this report reflects expert opinion and informed judgement based on the rapid rural appraisal of local stakeholders and available data and is presented here as a geographical description of the pilot area, summary of land use systems, information on cropping and livestock systems, evaluation of available data and maps and recommendations concerning agriculturally practices that will enhance the local environment.

2.1 Geographical description

The pilot area is situated in South-eastern part of Romania, in the Calarasi county and includes the territory of 21 villages in seven communes: Ciocanesti (4), Gradistea (4), Cuza Voda (3), Independenta (3), Alexandru Odobescu (3), Vlad Tepes(2) and Vîlcele (2).

The pilot area covers two distinct landscape elements (see Annex 1 for detail):

- A **water meadow in the south (part of the Danube floodplain)** and abutting the River Danube and;
- **plain in north** , on the terrace of Danube.

The southern part of the pilot area, formerly a flood plain area that was drained and transformed in the 1960's to productive agricultural land. This area, know as the **Boianu - Sticleanu polder** falls within the Ciocanesti, Gradistea and Cuza Voda communes, as well as the Dorobantu commune and Calarasi municipium. The landscape is typically flat and uniform with a patchwork of depressions of various sizes. The land is drained, although this system is not well managed and frequently these depressions become water logged. At the northeastern end of the polder area is a large expanse of freshwater, the Iezer Calarasi, providing an important habitat for water birds. The immediate area around the southern part of this water body is grassland. Along the edge of the Danube River, and at the southern extremity of the polder, is an area of natural vegetation and wetlands including forest areas. The landscape is bisected be an extensive network of poorly maintained irrigation and drainage canals and unmetaled farm tracks. Field size is large (> 50 ha), with few physical field boundaries or natural areas of vegetation. There are no villages associated with the polder area and only some farm buildings.

The northern part of pilot area, the **terrace** area, falls within the Ciocanesti, Gradistea, Cuza Voda, Independenta, Al.Odobescu, Vlad Tepes and Vilcele communes. The terrace area has a uniform topography being largely flat with sloping lands leading into ephemeral or permanent drainage canals. The southern 'tail' of the terrace slopes gently down onto the floodplain of the Danube. The landscape is dominated by agriculture that is mainly arable with some grassland areas to support livestock. Fields vary in size some are very large (> 50 ha) whilst others, mainly associated with farmers growing vegetables or potatoes for their own consumption, are small (< 0.5 has). , There are few physical field boundaries creating a landscape that should be considered as 'open' and therefore exacerbating problems such as wind erosion. Bisecting this landscape is artificial irrigation and drainage canals (poorly maintained), an irregular network of windbreaks, and a number of small villages. The transport network is well established, although not dense, the major roads sealed with a high density of unmetaled farm tracks.

2.2 Local climate

The climate of the project area is temperate - continental with average air temperature of 11^0 C. Yearly rainfall is about 520 mm of which 67 % falls in the growing season of crops (April - October). Also, during the growing season the sun shines from 190 to 316 hours/month, and air humidity falls below 80 % (table 1). Average annual frequency and velocity values indicate predominant winds from North and West.

Table 1 Average monthly climate parameters

Parameters	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Air temperature (C^0)	- 2	1	6	12	17	21	23	22	17	12	7	1
Rainfall (mm)	31	32	32	34	64	68	54	53	42	32	39	35
Sunshine (∑ hours)	65	91	138	195	253	280	316	299	231	190	93	50
Air humidity (%)	86	84	78	71	70	69	68	69	73	78	84	87

Source: Calarasi climate station

The data indicates that there are four seasons associated with the project area:

- a long winter (~120 days);
- two normal seasons - spring (~ 90 days) and summer (~100 days) and:
- a short autumn (~ 45 days).

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In this area the crops and livestock productions are limited by drought and intense heat in summer time, as well as by frost and snow and cold north-westerly winds in the winter.

2.3 Soils

The soils of pilot area are mainly uniform characterised in general by alluvial soils in the polder area and chernozems in terrace area (see Annex 2).

More specifically the polder area is characterised by three alluvial soils:

- chernozems (~ 5%) associated with higher lying land;
- gley soils (~ 27 %) associated with the former Boianu and Sticleanu lakes;
- and typical alluvial soils (~ 68 %) covering the remainder of the area.

Agricultural yields of this area are limited by soil salinity, occasional flooding and moisture, alkalinity, low organic matter content, crusts, compaction and, some times, wind erosion.

The terrace area is characterised by two chernozem like soils:

- typical chernozem (~ 40 %);
- and cambic chernozem (~ 60 %).

These soils, generally, have a high production potential with few limitations for arable production although they do suffer from compaction and depletion of organic matter content.

2.5 Flora

The flora is determinated by the relief and pedo-climatic characteristics associated with the project area. For the polder area, the representative species of natural flora are the sedge (Carex sp.), the reed mace (Typha sp.), the reed (Phragmites communis), the couch grass (Agropyrum repens), dutch rush (Blysmus sp.), the duckweed (Lemna sp.), the willow (Salix sp.), the poplar (Populus sp.) and algae in canal ditches.

Poa bulbosa, the brome grass (Bromus inermis), Hordeum murinum, hair grass (Festuca pseudovina), the feather grass (Stipa pennata), beard grass (Andropogon ischaemum), meadow sage (Salvia pratensis), vetch (Vicia sp.), crown vetch (Coronila varia), Astragalus cicer, the chicory (Cichorium sp.), burdock (Xanthium spinosum), motherwort (Artemisia sp.), thistle (Cardus sp.), blackthorn (Prunus spinosa), wild rose (Rosa canina), blackberry bush (Rubus sp.) and Robinia (Robinia pseudoacacia) are the main flora species of the terrace area.

For both area the natural vegetation has been mostly replaced by agricultural crops - barley, wheat, oilseed rape, peas, soybean, bean, sunflower, vegetable, forage crops and typical agricultural weeds including Sorghum halepense, bristle grass (Setaria sp.), thistle (Cirsium arvense), bindweed (Convolvulus arvensis), volunteer oilseed rape and burdock (Xanthium).

2.6 Fauna

The pilot areas fauna can be grouped, more or less, by zones according to each species characteristics. Therefore, the polder is dominated by aquatic fauna - 13 birds sp., 7 mammals sp., 3 reptiles sp., 2 amphibians sp., 7 fish sp. and 4 mollusc species. The terrace area is mainly associated with domestic animals - cattle, horses, sheep, pigs, dogs and poultry, as well as by wild animals typical of the steppe including hares, fox, deer, wild boars, ground squirrels, mute, mice, rats, crows, magpies, wood - peckers, starlings, skylarks, sparrow, ringdoves, pheasants, partridges and other many woodland birds.

2.7 Summary of land use systems

The study area covers a total area of 78371 ha (approximately 15 % of the total area of the Calarasi county) of which 70 % is the terrace and 30 % the polder area (Table 2). The land of the pilot area is divided by seven administrative areas or communes, 3 Danubian communes (Ciocanesti, Gradistea and Cuza Voda), placed in close vicinity to the polder area.and another four communes associated with the terrace.

The land of the pilot area is mainly used for agricultural production. The remaining area (6 - 17%) is covered by waters and ponds, forest vegetation, buildings, and roads.

The agricultural area is almost arable. The other agricultural land categories are insignificant in terms of land area (although they may have a significant impact in terms of agricultural pollution sources e.g. manure platforms, livestock units) except vineyards which cover 1.3 - 2.8% of the agricultural area. There are few natural pastures and meadowsand perennial and annual forage crop area is also very low comparative with livestock needs.

There are three different types of land property rights (i) state land, located mostly on the polder; (ii) public land situated around communes and (iii) private land mainly associated with the terrace area.
More specifically for the polder area:

- the state land is covered by field crops (21449 ha), natural pastures (20 ha), vineyards (21 ha), forest (14 ha), waters and ponds (1391 ha), roads and buildings (311 ha) and unproductive land (139 ha);
- The agricultural land is managed by three state farming companies - CERES Ciocanesti (6048 ha), AGROSERVCOM Gradistea (4254 ha) and AGROZOOTEHNICA Mircea Voda (6055 ha);
- the forest land is managed by the National Forestry Organisation and;
- land associated with Iezer Calarasi by Piscicola Calarasi.

For the terrace area:

- the public land is covered by natural pastures (366 ha) and roads and it is managed by mayoralties;
- the private land is, generally, arable land and it is managed by farming companies, farming associations and individual farmers. Every commune has at least one farming association constituted on former agricultural co-operative frame, one farming company constituted by former agricultural mechanisation station and a great number of small family associations and individual farmers. This land is not merged, each farming enterprise having many plots of

different sizes and spread over a large area. Land ownership is becoming increasingly fragmented as a result of inheritance.

2.8 Information on cropping and livestock systems

This section summaries the characteristics of the farming systems associated with the project area and includes information on crop rotation, soil tillage, fertilisers and fertilisation, crop protection, irrigation and crop yields, and livestock systems, feeding systems, manure management and so on.

In general the crop rotation differs for State managed farms compared to privately owed enterprises, for example:

- State enterprises: wheat + barley - wheat + peas (rape) + sunflower - soyabean - maize;
- Private enterprises: wheat - wheat - maize - (maize) - sunflower.

Field cultivation practices are similar for both farming systems i.e. mouldboard tillage and disk harrow.

Table 2 Existing "LAND USE" in pilot area

Land use	**Communes** (hectares)							**Total**
	Ciocanesti	Gradistea	Cuza Voda	Independenta	Al. Odobescu	Vlad Tepes	Vilcele	
1. Agricultural area	**10832**	**14984**	**12433**	**5507**	**5775**	**6468**	**5720**	**61719**
- in polder	*3795*	*8161*	*2747*	*0*	*0*	*0*	*0*	*14703*
- in terrace	7037	6823	9686	5507	5775	6468	5720	47016
1.1 Arable area	**10547**	**14752**	**12108**	**5435**	**5432**	**6233**	**5560**	**60067**
- in polder	*3790*	*8148*	*2747*	*0*	*0*	*0*	*0*	*14685*
- in terrace	6757	6604	9361	5435	5432	6233	5560	45382
1.2 Pastures	**19**	**13**	**0**	**1**	**238**	**105**	**0**	**376**
- in polder	*5*	*13*	*0*	*0*	*0*	*0*	*0*	*18*
- in terrace	14	0	0	1	238	105	0	358
1.3 Meadows	**8**	**0**	**0**	**0**	**0**	**0**	**0**	**8**
- in polder			*0*			*0*		
- in terrace	8	0	0	0	0	0	0	8
1.4 Vineyards and nurseries	**256**	**219**	**322**	**71**	**0**	**130**	**160**	**1158**
- in polder	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
- in terrace	256	219	322	71	0	130	160	1158
1.5 Orchard including nurseries	**2**	**0**	**3**	**0**	**105**	**0**	**0**	**110**
- in polder	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
- in terrace	2	0	3	0	105	0	0	110
2. Forest and other areas with forest vegetation	**520**	**371**	**125**	**1**	**5**	**323**	**167**	**1512**
- in polder	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
- in terrace	520	371	125	1	5	323	167	1512
3. Waters and ponds	**405**	**166**	**1156**	**49**	**133**	**256**	**151**	**2316**
- in polder	*405*	*166*	*409*	*0*	*0*	*0*	*0*	*980*
- in terrace	0	0	747	49	133	256	151	1336
4. Other areas	**1355**	**2218**	**336**	**299**	**351**	**395**	**419**	**5373**
- in polder	*108*	*85*	*18*	*0*	*0*	*0*	*0*	*211*
- in terrace	1247	2133	318	299	351	395	419	5162
TOTAL area	**13112**	**17739**	**14050**	**5856**	**6264**	**7442**	**6457**	**70920**
- in polder	*4308*	8412	3174	*0*	*0*	*0*	*0*	*15894*
- in terrace	8804	9327	10876	5856	6264	7442	6457	55026

b. Existing land in polder area uses by Dorobantu commune and Calarasi municipium
(hectares)

Locality	1	1.1	1.2	1.3	1.4	1.5	2	3	4	TOTAL
Dorobantu	2254	2254	0	0	0	0	14	91	33	2392
Calarasi	4533	4510	2	0	21	0	0	320	206	5059
TOTAL	**6787**	**6764**	**2**	**0**	**21**	**0**	**14**	**411**	**239**	**7451**

Crop nutrition is exclusively chemical based on complex fertilisers (22:22:0) and ammonium nitrate. The fertiliser rate is 44 - 50 kg P_2O_5/ha and 110 - 120 kg N/ha. These fertilisers are applied, usually to wheat before sowing, as complex fertilisers and during the winter season as ammonium nitrate. Occasionally sunflower is fertilised too. Crop residues may be incorporated into the soil, but may also be used for animal feed (maize stalks and soybean steams) or bedding (straw), however, the majority is usually burned.

Crop protection includes weeds, pest and disease control and is usually undertaken chemical seed treatments and herbicides. Herbicides are usually used to control weeds in wheat, barley, soybean and sunflower crops. Maize is protected against weeds by mechanical and manual means.

Nutrients (N, P) from fertilisers and pesticide residues are the main sources of diffuse pollutants. Nutrient pollution is evident from the indicator species prevalent in aquatic areas. Over the last decade there has been a decline in the use of fertilisers due to a down turn in the economic status of many of the farming enterprises. Although practices of spreading fertiliser during the winter is likely to result in N emissions to air and water. Certainly, a lot of the diffuse nutrient pollution observed in the area is historical in nature and associated with the farming systems pre-1990. On the polder area high nitrate concentrations are likely to be associated with the radical change to the whole ecosystem and the release of nitrates through breakdown of organic matter previously associated with the wetland ecosystem. However, a significant problem today is the leachate and runoff associated with the manure platforms which are poorly constructed and afford little protection to surface or ground waters. In addition, there is a concern that as agriculture becomes more profitable in the area then rates of fertiliser application will increase, and if poorly applied may exacerbate the situation. Similarly, it is likely that livestock production will pick up with the resultant generation of excessive manure production that will careful management if, unlike in the past, leaching of nitrate is to be minimised.

There is not a lot of scientifically published data describing the fate of pesticides in the project area, however it is likely that there is some contamination of water bodies from pesticides.

An extensive irrigation system is associated with the project area, and in particular the polder. Today irrigation is only used by AGROSERVCOM Gradistea. The irrigation system is in a very poor state of repair with leakage of water from many of the canals and many of the pumps and associated infrastructure failing to work. Consequently the management of the whole irrigation system has broken down resulting in many of the problems associated with irrigation including:

- Soil salinity and alkalinity;
- Water logging;
- Low crop yields and poor crop quality.

Table 3 gives an indication of the variability in crop yield for the three farming enterprises on the polder.

Table 2.3 Crops production in different farming systems

Crops	Year	kg/ha		
		AGRAS Rasa Gradistea	AGROMIMAR Cuza Voda	AGROZOOTEHNICA Mircea Voda
Wheat	1996	1002	2875	2514
	1997	4620	3050	3728
	1998	2785	3780	3900
	1999	3380	3800	4628
	2000	2930	4660	3378
Barley	1996	-	-	3607
	1997	3120	-	4817
	1998	4070	5850	-
	1999	-	-	4185
	2000	4000	-	4835
Sunflower	1996	928	1930	1771
	1997	1040	1875	1224
	1998	1530	1800	-
	1999	1212	1850	931
	2000	1238	1300	732
Maize	1996	1835	4625	2870
	1997	Landowners	5500	5036
	1998	Landowners	6175	-
	1999	Landowners	6900	2900
	2000	Landowners	3150	2000
Soybean (Peas)	1996	-	(1860)	2052
	1997	-	2180	2116
	1998	-	-	-
	1999	-	-	2314
	2000	-	-	1710

There are two different livestock systems associated with the pilot area, (i) a household system and (ii) large farm. Many households or small farmers keep livestock, usually only one or two animals to supplement their income. The larger farms tend to specialise in either cattle, sheep or pig production. As it is showed in tables 4 and 5, the main livestock species of this area are cattle, horses, sheep and goats, pigs and poultry.

Table 4. Total livestock numbers

Commune	Cattle	Horses	Sheep and goats	Pigs	Poultry	Total LU/ha
Ciocanesti	955	294	9,338	5,993	52,469	0.60
Gradistea	1,820	637	3,556	6,336	48,700	0.43
Cuza Vodã	1,151	341	7,173	1,549	38,159	0.35
Independenta	1,406	328	865	2,695	34,780	0.69
Al. Odobescu	676	587	3,644	1,725	23,006	0.53
Vlad Tepes	452	390	2,018	1,763	27,000	0.41
Vîlcele	649	350	2,331	2,364	68,108	0.83
Total stock	7,109	2,927	28,925	22,425	292,222	0.51

LU – Livestock Units

Heads number of each livestock species is different for each commune and livestock systems. The stocking density of animals is very low (0.35 - 0.83 LU/ha) particularly when compared with photosyntetic potential (2 - 3 LU/ha) of the area.

The animal load (LU) was estimated by formula:

$$LU = \frac{\sum (\text{Cattle X } 0.80 + \text{Horses X } 0.85 + \text{Sheep X } 0.15 + \text{Pigs X } 0..30 + \text{Poultry X } 0.04)}{\text{Arable land + pastures + meadow areas (ha)}}$$

The photosyntetic potential of area is covered by animals only in household systems from Al. Odobescu, Ciocanesti and Independenta communes (table 5).

The principle problem with livestock production in the study area is how animal waste, manure, is effectively managed to minimise gaseous emissions and loss of nutrients to surface and ground waters. The problem is covered in more detail in TOR 3 of the Project Preparation phase of the APCP.

Table 5: Number of stock households

Commune	Cattle	Horses	Sheep and goats	Pigs	Poultry	Total LU/ha
Ciocanesti	955	294	9,224	5,993	52,469	2.68
Gradistea	1,820	637	3,468	6,336	48,700	1.19
Cuza Vodã	1,067	341	4,005	1,408	29,240	0.67
Independenta	1,232	328	865	2,695	34,780	2.75
Al. Odobescu	646	587	3,644	1,725	23,006	2.17
Vlad Tepes	452	390	2,018	1,736	27,000	1.04
Vîlcele	457	350	2,331	2,264	68,108	1.43
Total stock	6,629	2,927	25,555	22,157	283,303	1.42

LU – Livestock Units

3. Evaluation of Available data and Maps

This section of the report reviews the existing and available data that can be used to faciliate the implementation of the project. In addition, data collected in the field is presented and, recommendations are given as to what additional data might be collected during the project and how this can be stored and analysed using geographical information system (GIS) technology.

Existing data collected from reports and maps, and especially, the primary data collected direct by field observations and interviews with individual farmers and other key informants from communes, and farming associations and private companies (a copy of the questionnaire used to collect some of the data is annexed to this report) was used extensively in compiling this report. The landusemaps were not possible to fully evaluate or assess since this type of information, and allied data such as soil, land cover and hydrology was not readily available, or was at too large a scale (e.g. 1:250 000 whereas 1:25 000 is a more appropriate scale).

3.1 *List of available data and maps*

Existing data sources were reviewed based on four levels of hierarchy:

National level

There are many national organisations and institutes which have collected data covering the project area:

- Research Institute for Cereals and Industrial Crops (**ICCPT**) Fundulea has a lot information and experience with environmentally-friendly agricultural practices – grass based crop rotation, conservation tillage, fertilisers and fertilisation, crops protection, irrigation and windbreaks;
- Research Institute for Soil Science and Agro-chemistry (**ICPA**) maintained and managed a large volume of soil databases. The convertion of this data into digital databases, stored on a Geographical Information System (GIS), would provide a significant asset to the project;
- Institute of Study and Design for Land Reclamation (**ISPIF**) has undertaken a number of studies on the project area, most notably on the polder area. Two reports, published in the 1990's document in detail the reclamation of the polder and the associated impacts of agriculture on the environment, changes to soil and potential for irrigation. Both reports include a number of maps (mainly at 1:100 000 scale) which serve as a useful indication of the land suitability of the area. The reports are comprehensive and give a useful description of the environmental conditions of the polder area, the limitations and potential;
- The Romanian Centre for Remote Sensing Applications in Agriculture (**CRUTA**) has developed a number of agricultural and climate databases covering Romania under the EC MARS (Monitoring Agriculture with Remote Sensing) programme. The Romanian MARS project was undertaken in the late 1990's and included the whole of Romania. A detailed archive of SPOT and NOAA satellite imagery is held by CRUTA covering this period. CRUTA has also undertaken work funded by WHO (World Health Organisation) to map waste dumps and areas posing a risk to human health including those associated with Agricultural Pollution Control Project. This data is held on the GIS at CRUTA. Additional digital data may also be available at such as transport networks. The databases are mainly at the scale of 1:100 000.

County level

Most of these data spring from secondary sources - soils, climate and hydrological data, county council and organisations reports, maps, registers, agricultural production statistics, etc.
In Calarasi county there are many organisations which are responsible for agriculture and environment - DGA, OCAOTA, OSPA, APM, DSP etc. In principle this would mean that there are enough secondary data sources for any farming and environmental study, or to support the implementation of this project, however, and this is an important point, access to this data is frequently limited. Such poor access, witnessed during

the preparation phase of this project, could severely hamper the design and implementation of the demonstration and test sites, as well as the development of land use suitability plans.

Commune level

Important sources of secondary information are the office of the Mayor, churchs, schools, health centres, police offices and their workers. Much of the data used in this report was sourced from secondary data collected from registers maintained by the mayors office, as well as on mayors and others key informants of authority.

Farm level

Many of the farming enterprises, particularly those owned and run by the state, large private or association farms collect and maintain basic farm information such as yields, inputs, gross margins and so on. Many of these farms also have plans of the arms showing field layout, road access and irrigation and canal network and, in some cases there are also detailed (1:10 000) soil maps. The farm there fore is an important source of information, not only for this tangible data but also the knowledge embodied in the farm manager.

3.2 Results of field verification

Wherever possible the data collected from secondary sources was verified by field observation. Follows is a brief description of the land use of the pilot area, and should be considered in conjunction with the previous chapter describing the farming systems.

The polder area, formerly part of the Danube floodplain, is a fragile agricultural habitat that is particularly important for water birds. This area, having been reclaimed by draining the wetlands, was intensively managed for arable agricultural production although livestock enterprises on the three former state farms were also significant. Over the last decade (post-1989) there has been a general decline in the intensity of management of this area largely due to financial constraints rather than lack of know how (although it is important to note that the intention is to maximise the outputs from the land following intensive farming practices, and that generally there is little concern regarding the environmental impact. This may in part be due to a lack of understanding of alternative farming practices that minimise the impact of agricultural practices on the environment). Consequently, much of the pollution (nitrates, phosphates and pesticides) associated with the polder is historic in nature, and despite the preponderance of area down to arable land pollution levels are likely to be generally low. The vegetation bordering the canals along the urban fringe with the polder area (e.g. Gradistea) are indicative of high levels of eutrophication and this was confirmed in many places by the high levels of algae in these canals. It is likely though that much of the pollution causing these problems is associated with the gardens of properties that back right onto the canals. In the majority of these gardens it was observed that maize stalks, straw and animal waste were deposited along the banks of the canal. Run-off high in nitrates and other pollutants into the canal is likely to be high and be a significant contribution to the pollution of these waterways rather than agricultural activities *per se*. There was no evidence of soil erosion from water, although wind erosion may be a localised problem in some areas.

There is a concern that with the decline in the irrigation and drainage network that water logging is occurring in places and that the soil is becoming more saline (and alkaline) in nature. This will effect yields. Indeed, on the AGROSERVCOM farming company over 150 ha of cereals had been lost due to water logging (equivalent to $30 000).

The state farms on the polder area will be privatised. There is concern that following privatisation there will be greater access to credit or funds to rehabilitate the irrigation and drainage network and purchase non-farm resources such as pesticides and inorganic fertilisers leading to a more intensive form of agricultural production. Many of the current farm managers of these farms also expressed a desire to start livestock farming as well (on two of the state farms about 400 sheep are managed). These investments and access to non-farm resources should result in greater productivity however, these foreseen changes will also pose a considerable risk to the environment.

There is now an opportunity to influence the development of the polder area and the type of agricultural practices. Consideration should be given in identifying areas on the polder that can revert to wetlands or extensive grassland to encourage water birds. The application and timing of inorganic and organic fertiliser will require careful management to minimise the loss of nitrate to surface and ground waters. The introduction of agroforestry and shelter-belts will reduce the risk of wind erosion encourage bio-diversity. Informing the managers of these enterprises about the impacts of farming activities on the environment, and giving them alternatives that still generate comparable incomes or show savings in use of inorganic fertilisers will be important.

The land use of the **terrace area** is almost entirely agricultural, with the exception of some large water bodies and village areas. The agriculture practised here is generally intensive in as much that it is largely mechanised (although the machinery is small relative to field size) and agro-chemical based. The farms associated with the terrace are under capitalised and consequently the inputs in terms of pesticides and fertilisers are relatively low. Agricultural pollution associated with the terrace area is mainly historical and attributed to practices pre-revolution (pre-1990's). Current application rates of pesticides are low and fertiliser use conservative. Soil erosion appears to be minimal, wind erosion apparent in some of the large fields where there are no or poorly maintained shelter belts. Water erosion occurs on some of the gentle slopes associated with the riparian zones although this is not wide spread. The rates of soil erosion do not appear to be greater than the accepted natural rate of 11 t/ha.

Also, other important issues posing an environmental risk include latrines pollution, manure bridges (manure that has been piled into canals to form a bridge across which people and animals pass) and pollution from urban human waste of polder drainage canals These sources of pollution are likely to be significant but are not addressed in this project.

There appears to a shortage of fuel wood in the local vicinity and consequently people have to travel considerable distance frequently relying on crop residues as an alternative. There is considerable scope to develop community wood lots to supplement the source of fuel wood and timber and the land around villages appears quite suitable for this. Fast growing species such as Robinia, popular and willow would be appropriate.

3.3 Description of Land Use Suitability supported with map(s)

This section deals with the limitations to agricultural productivity, identifies the main land units of the project area and assesses the suitability of the land to the major crops currently grown. Recommendations are given to the management of the land and possible changes in land use to meet the wider objectives of the project.

The polder and terrace areas are distinguished by a number of land forms of which there are three associated with each area (see fig. 1).

The land elements of **polder area** are freshwater alluvium, reclaimed polder and micro-depressions.

<u>Freshwater alluvium</u>

Although not falling in project area, this is nonetheless important in terms of its relationship to the polder. This 'strip' of land extends along the northern embankment of the Danube and is a remnant of the former floodplain. The strip of land is effectively a buffer between the reclaimed polder area and Danube river. The vegetation associated with this area is a mixture of wetland grasses, reed beds and trees (e.g. various willows). The alluvial soils occur with various textures and stages of siltation and are generally waterlogged.

This area is suitable as a natural habitat providing an important haven for wildlife and in particular water birds. The area also acts as an important buffer zone between the agricultural area acting as a biological filter trapping silts, toxic compounds and diffuse pollutants. The area could be more actively managed to improve the bio-diversity of the surrounding area i.e. where it borders the reclaimed polder (i.e. establishment of wildlife corridors into the polder area) and may also benefit from the development of agro-tourism.

Reclaimed polder

A reclaimed floodplain bordering the Danube this substantial agricultural area is characterised by a range of alluvial soils including chernozems, mollic alluvial soils and alluvial protosoils with large areas which are either waterlogged and / or salinised. Irrigation and drainage is widely practised in this area, although in the last decade the overall management and infrastructure has declined significantly, so that today only one of the farming enterprises of the polder undertake irrigation regularly.

The productivity of this area is mixed and highly dependent on appropriate irrigation and drainage practices. According to the ISPIF reports about 60% of the land area in the polder area is considered as suitable for irrigation, and only 26% as good or very good land suitable for irrigation. The crops grown (typically wheat, barley, maize, sunflower and soya bean) give low to medium yields receiving low inputs of inorganic fertiliser and pesticides. The scope to improve yields is significant but it is important that this is not at the expense of the environment. The increase in the area affected by alkalinity is a concern as is the threat of salinity.

Nutrient management for the area will be critical to minimise diffuse pollution, Nitrate levels associated with the polder are recorded as low. Practices in the past have not been conducive to low nitrate levels e.g. irrigation using waste water from livestock enterprises and poor manure management on the terrace area giving rise to run-off onto the polder.

Micro-depressions

There a number of areas that forms lower lying areas or depressions that are commonly waterlogged. These would generally have been wetland areas or small lakes and the soils of these features are of a low productivity and difficult to manage.

Given the current decline in irrigation and drainage capital these areas would be more suitable for agroforestry (e.g. willows), extensive grassland production (for grazing purposes) or to be left to revert to a natural habitat (mixture of reeds and grasses). Wildlife corridors could be established from Calarasi lake to the freshwater alluvial area to encourage bio-diversity and generally enrich the habitat.

The terrace area has, also, three minor elements – agricultural terrace, village area and riparian zone.

Agricultural terrace

Agriculture is the dominant land use of the terrace area that is composed of largely uniform and fertile soils, typically chernozems and cambic chernozems. Crop productivity is low to medium, the main hindrance being soil moisture availability particularly in dry years, and lack of inorganic fertiliser and pesticides. Concern at the decline in fertility has been expressed and greater use of organic fertiliser and introduction of soil moisture conservation practices (these will be addressed by the project) could address this.

Village area

The intra-village environment is affected by households and farms waste, as well as by village waste platforms. The wastes arising from the households are: animal urine and manure; straw and other vegetal residues; inorganic wastes (plastic, glass, metal and cardboard materials), as well as latrine waste. The waste arising from large farms (i.e. animal urine and manure), is not as great a problem as it used to be since livestock numbers have declined.

The waste platforms are the major source of pollution from livestock waste, both as direct pollution by run off to water courses, and diffuse pollution by leaching into the water table and gaseous emissions to the atmosphere. These platforms will continue to pose a threat to the environment unless the waste is managed and contained more effectively.

In some areas, particularly in close proximity to communes, the establishment of agroforestry or community forestry as a source of fuel wood may be considered as a more suitable land use.

Riparian zone

These areas are associated with the water bodies and ephemeral drainage networks of the terrace area. These areas may be prone to water erosion since they are associated with sloping land and will also be potential hot-spots for diffuse sources of agricultural pollution such as run-off carrying sediments, nitrates or pesticides. The banks around water bodies are also prone to collapse in places, particularly where cultivation is taking place right up to the edge of these banks.

For sloping land associated with natural drainage networks agricultural practices are acceptable as long as measures are taken to minimise the risk from water erosion (e.g. cultivation across the slope). Buffer strips, particularly at the foot of slopes, would minimise the sedimentation of water courses and act as a filter thereby improving water quality.

3.4 Land use suitability map(s) at 1:10 000

The development of a detailed land suitability assessment within the scope of this report is not feasible due to the lack of readily available information. Nonetheless, based on the indicative land units described ipreviously an indication of the land suitability for the predominant crops gown in the project area has been described in table 6. Crucially, for the polder area, agricultural productivity and land suitability will depend on the viability of the irrigation and drainage infrastructure, and the careful management of waters and soil. Whilst irrigation and drainage are not so significant for the terrace area (although would certainly improve yields during dry seasons), the maintenance of soil fertility will be crucial.

Alternative crops are not discussed in this report, although the land is suitable for growing vegetables, root crops such as sugar beet, and sorghum. However, a more detailed study into the economic viability of establishing these crops would be required and are outside the scope of this report.

Livestock production is not as significant now as it was in the past (i.e. pre-revolution). A more mixed farming system could play an important role in terms of enhancing the environment via the recycling of organic manure and the use of rotational grasslands to improve soil structure and maintain or increase organic matter. However, such an approach does suppose the careful management of livestock waste and appropriate stocking densities to ensure overgrazing does not occur.

In the **polder area** the introduction of extensively managed grassland breaks in the rotation could contribute to minimising the amount of nitrogen leached. The use of cover crops during the autumn, such as mustard, may also reduce the amount of nitrate leached. Livestock production is suitable for the polder area, although not in water logged areas, but the associated manure management will be critical to ensure the loss of nitrate to the environment is minimised. A summary of suitable crops for the project area is given in table 7.

Table 7 Suitable crops for project area

Land Unit	Natural fertility	Erosion risk	Crop Suitability (Small holder or commercial production)						
			Wheat	Maize	Sunflower	Barley	Soya Beans	Grass	Agro-Forestry
Polder area									
Riparian plain	Low	Low	*	*	*	*	*	****	*****
Reclaimed plain	Medium	Low	****	****	****	****	****	****	**
Micro-depressions	Low	Low	***	***	***	***	***	****	*****
Terrace area									
Riparian zones	High	Medium	****	****	****	****	***	****	****
Terrace	High	Low	*****	*****	****	*****	***	****	***

Key to crop suitability

*****	Highly suitable
****	Suitable
***	Marginally suitable or partially unsuitable
**	Largely unsuitable
*	Totally unsuitable

3.5 Additional considerations

Land is well suited to agricultural production within the project area, however, there are a number of other related issues that should be considered to enhance the environment and rural community and a brief description of them follows.

Agri-environment schemes

Agri-environment schemes are an increasingly important part of the EU's Common Agricultural Policy (CAP) to which Romania will have to comply before joining the EU. The overarching objective of the agri-environment programmes implemented by Member States is to minimise or reduce the impact of agricultural activities on the environment. The SAPARD (Special Accession Programme for Agriculture and Rural Development) pre-accession instrument provides opportunities to introduce and develop appropriate agri-environment schemes. Consideration for a SAPARD programme in the project area would seem appropriate since the objectives are mutually beneficial.

Environment legislation

Important EC environmental legislation relevant to the project area include the Nitrates Directive (EC 676/91) and Habitats and Birds Directive (EC 43/92 and EC 409/79 respectively). Allied to these latter Directives is the international Ramsar convention.

The Nitrates Directive, address both nitrate pollution in surface and ground waters through the designation of nitrate vulnerable zones (NVZ's). The Directive requires that a set of rules are put in place in NVZ's to reduce existing nitrate pollution from agricultural land and to prevent further pollution from arising. The rules are known as *Action Programme* rules or measures. Compliance with the rules is a legal requirement within those areas designated by the government as NVZ's

The Romanian Government Resolution nr. 964/13 October 2000 concerning Action Plan for Waters Protection Against Nitrates Pollution Resulting from Agricultural Sources promote the same international rules to reduce existing nitrate pollution from agricultural land and to prevent further pollution from arising.

The Birds Directive seeks to conserve all species of naturally occurring birds in the wild state in the European territory of the Member States. Whilst the Habitats Directive seeks to contribute towards ensuring bio-diversity through the conservation of natural habitats and wild flora and fauna in the EU. The Ramsar convention addresses the stemming of loss of wetlands and to ensure their conservation and wise use.

Iezer Calarasi as an important habitat for water birds. The Iezer Calarasi wetland is about 3200 ha and the waterbody itself about 400 ha and is an important migratory passage. There is a risk that increasing agricultural activity in the area will threaten this important habitat and therefore the site has been put forward to be gazetted as a protected area by the government, the 400 ha forming the core area and the remainder making up a buffer zone. A detailed management plan will be required to ensure that the objectives of the proposed protected area are fully met. Consideration must be given to getting the co-operation of local farmers and farms in the implementation of the management plan and cross compliance with other agri-environment measure and programmes should be fully explored and developed to ensure maximum benefit. The Environment Inspectorate of Calarssi has an important role to play in the development of a management plan

Fuel wood

Fuel wood is an important supplement to heating during the winter months for the village population. There appears to a shortage of fuel wood in the local vicinity and consequently people have to travel considerable distance frequently relying on crop residues as an alternative. There is considerable scope to develop community wood lots to supplement the source of fuel wood and the land around villages appears quite suitable for this. Fast growing species such as Robinia, popular and willow would be appropriate.

3.6 Collation and management of information

Mapped data for preparation of land suitability and to assist in monitoring and selection of demonstration sites for the project activities is available although the distribution is disparate and not readily accessible nor in a format (i.e. digital) that enables easy manipulation or analyses. Much of this data, as already described is available at DGA in one form or another however during the early stages of the project (year 1) it will be necessary and important to capture the appropriate data digitally. These digital geographical databases can then be stored in a geographical information system (GIS).

A GIS is computer-based software that stores digital map data and associated attribute data. A PC based GIS is recommended for the project serving as a database of mapped data and other monitoring data collected during the project. The PPU and DGA will be able to easily produce colour maps (up to A3 size) to communicate monitoring results and progress. In addition, as this capability strengthens DGA will be able to develop value added and new services to its existing products.

Additional data, to assist in project monitoring and planning, should include land cover / land use (see chapter eight for detail). This should be collected at least twice in a growing season (autumn and spring since these are critical times during which nitrate leaching will occur). This data can be easily collected from satellite data at a suitable scale (1:10000 or 1:50000) from a variety of platforms including:

- Landsat TM
- SPOT XS
- IKONOS
- IRS - C or IRS - D;
- KVR 1000

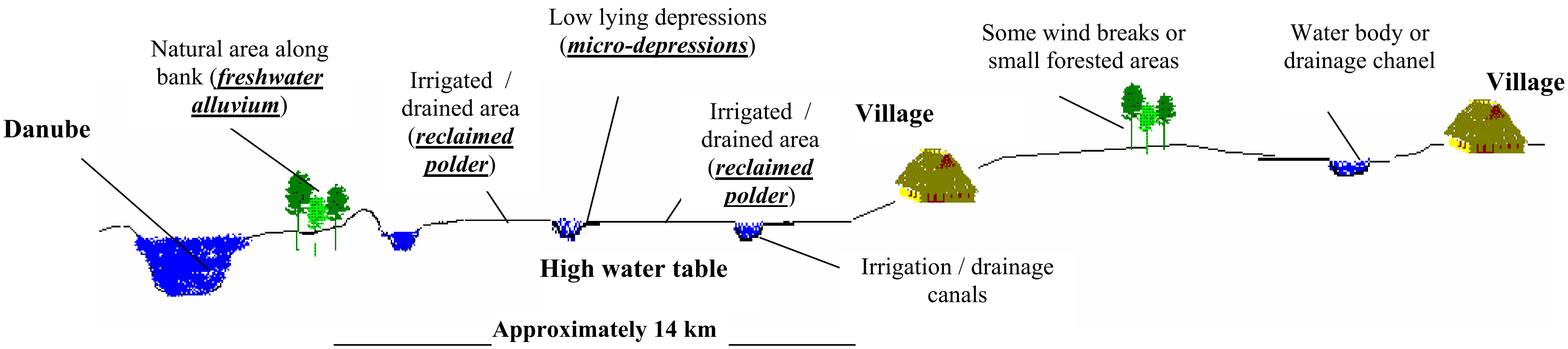
Additional data will be collected during the project (soil and water quality data). Using a global position system (GPS) accurate (± 10m in x and y) geographical information can be quickly and easily collected including point (e.g. monitoring stations, wells, spot heights etc.) and line data (e.g. boundaries, networks etc.). The data can then be uploaded into the project GIS database. Such data can be used to facilitate project monitoring including areas planted under agro-forestry, converted to grassland or natural areas.

The project should establish close links with the Romania institute responsible for implementing the Corine Land Cover program and MARS (Monitoring Agriculture using Remote Sensing). These data will prove useful additional data sources for the project. In addition the GIS unit should forge working links the Danube Delta GIS at Tulcea.

The investment in a geographical information system is justified on the added value it will bring to the project as a means of storing and analysing mapped based data and information and the ability to produce quality cartographic products for stakeholders of the project.

The benefits to the project and DGA are listed below:

- Storage of project data;
- Improved efficiency in handling and manipulating geographical data;
- Improved access to geographical data;
- Functionality to combine databases to derive new information;
- Spatial analyses functionality enabling interpolation of database to derive new information e.g. spot height information interpolated to derive a slope or aspect database;
- Ability to produce quality map and cartographic products;



After Ion Toncea, (2000)

Polder area		Terrace
Soils	Chernozems (~ 5%) Gley soils (~ 27%) Typical alluvial soils (~ 68%)	Typical chernozems (~ 40%) Cambic chernozems (~ 60%)
Crops	Wheat Barley Maize Sunflower (Rape) Soya beans	Wheat Barley Sunflower Maize Pea
Key issues	Poorly maintained irrigation and drainage infrastructure (mixture of soil moisture problems, i.e. water logging or draughtiness in dry years) Wind erosion Soil compaction Soil salinity Soil alkalinity Decrease in organic matter Eutrophication	Poorly maintained irrigation and drainage infrastructure (soil moisture problems in dry years) Soil erosion (water erosion on sloping land,, wind erosion elsewhere) Soil compaction Decrease in organic matter Soil contamination (isolated and largely associated with manure platforms) Lack of fuel wood for communities

Fig. 1 Schematic transect of the project area

4. Recommendation for trial and demonstration of environment-friendly agricultural practices

Based on the previous observations and critical environmental problems as described the following environmentally friendly practices have been identified as set out in this chapter.

Practices were selected that can be applied by farmers using inexpensive material and labour. The environmental effects for all recommended practices are beneficial, but quantifying the effects will require long-term monitoring of the ground and surface water within the project area. The overriding natural resource concern that prompted development of this project is pollution of the Danube river and Black Sea from water leaving Romania through groundwater lateral flow, and runoff into tributaries. Addressing this primary concern will provide spin-off effects that will benefit other natural resources and social concerns identified by stakeholders during our field review. Those expressed concerns are:

- Pollution of water caused by leakage of pollutants into the water system
- Unsuitable drinking water and associated diseases throughout much of the project area
- Moisture conservation on cropland
- Declining soil tilth
- Inadequate forage for current and planned increases in livestock production
- Lack of community pride and economic stability
- Uninformed citizens concerning environment - friendly agricultural technologies

In meetings with the citizens within the communes, it was notable that they expressed full support and gave first priority to waste management, land use improvement and sustainability of the cropping and livestock systems within the project area.

4.1 Evaluation of existing practices and constraints to adoption of improved practices

Existing practices are almost exclusively crop production oriented with very little consideration for higher technology related to public benefits.

Practices currently being applied are cultural practices characteristic of farmers who keep themselves informed concerning agronomic principles, but lack financial resources to invest in environmental-friendly practices that have mutual public benefits. These practices include:

1. Crop Rotation - consisting of cereals and industrial crops traditionally cultivated in the local area. They are grown in various rotations to break disease cycles, and for other traditional and economical reasons. Very few farmers manage a grass based rotation. Research Institute for Cereals and Industrial Crops located at Fundulea reports a favourable yield response from grass based crop rotations, and with fewer inputs. This would be a very beneficial practice. In most areas of the project no particular objections to high level crop rotations was expressed and due to current interest in increasing livestock there appears to be potential for increasing forage crops including grasses for inclusion in crop rotations.

2. Soil Tillage - is applied with the traditional mouldboard plough and heavy disk-harrow during the summer or fall. The soils apparently receive intensive tillage for weed control and seedbed preparation. This is generally considered sustainable for deep soils. However, there is clear evidence that soil tilth needs improvement. The only way to significantly increase soil organic matter and subsequently improve soil tilth is to perform tillage operations designed and timed to leave crop residue on or near the soil surface consistently for many years. A long term objective for agriculture in Romania should be elimination of the mouldboard plough. Excessive tillage, particularly mouldboard ploughing, causes rapid loss of organic material needed for humus formation, and accumulation. There are constraints to immediate adoption of conservation tillage. However, the many of the farmers are familiar with the practice, but do not believe it is feasible under current economic conditions. If funds are made available to provide tillage tools for a proper long-term demonstration of reduced tillage, a gradual increase should occur over a ten to twenty year time period. This would represent the normal adoption of new agriculture technology.

3. Fertilisation - is exclusively chemical: The fertilisers are applied, usually before sowing as complex fertilisers and during winter or spring time as ammonium nitrate or urea. The main constraint to increase the efficiency of nutrients is not existing of a Crop Nutrient Management Plan, especially not including of all nutrient sources – manure, crop residues, fertilisers, previous crops, irrigation etc, and specific nutrient management practice: soil and manure testing and variable rate technologies.

4. Weed and Pest Management - involves the use chemical seed treatments, herbicides and mechanical and manual means. The low efficiency of these practices is laid to the lack of weeds and pest management strategies.

5. Irrigation is the key of the farming system successes in this area. However, the existing irrigation systems need a substantial investment for restoration, and this effort should be correlated with the public awareness programme.

4.2 Recommended practices by sub-zone

There are many environmental - friendly practices used on cropland in various location to help solve natural resource problems. The practices included in this section of the report were selected for the following reasons:

- No adverse environmental effects;
- Cost effectiveness/low-input;
- Ease of installation using farm labour and local material;
- Technology is readily transferable;
- Aesthetic appeal;.
- Acceptable to the farmers;
- Positive social effects;
- Effective as a stand-alone practice if necessary;
- Low or no secondary side effects.

With the exception of conservation tillage, practice that are expensive to install and maintain are not considerate candidate practice for this project: This portion of the report will discuss the list of candidate practices :

1. Conservation Tillage is any tillage system that leaves about 1/3 of the soil covered after the crop is planted. To accomplish that objective only very limited tillage can be performed as follows – inverting to 15 cm depth and loosening to 30 cm depth, non-inverting, loosening to 30 cm depth. Several residue management techniques are also, necessary to apply this practice. Straw spreaders must be attached to the combines or any accumulations of straw must be evenly distributed to allow proper operation of the planter. Conventional corn planters can often be converted for conservation tillage by installing coulters (disk blades) that run ahead of the seed placement part of the planter. The more sophisticated planters plant the seed, apply starter fertiliser and pesticides in one operation.

2. Narrow Vegetative Barriers are rows of stiff-upright-tall grass (about 1 meter wide) that provide benefits similar to windbreaks. They are very easy and inexpensive to install and become effective within the first year. They may be installed on the contour to help control small gullies, and reduce sheet and rill erosion. They may also be used in conjunction with other practices such as filter strips to prevent excessive amounts of sediments from entering the filter strip area. In this project area their primary purpose would be to trap winter snow for moisture management purposes.

3. Crop Rotation is following a planned rotation of crops designed to improve soil quality, break pest cycles, and satisfy other crop production requirements.

4. Grasses and Legumes in Rotation is a crop rotation that includes grasses and/or legumes in the rotation to increase organic matter content, break pest cycles, and satisfy other crop production requirements.

5. Crop Nutrient Management is utilizing available plant nutrients by developing and following a nutrient budget designed to prescribe correct field applications.

6. Weed and Pest Management is using pesticides only when necessary after considering more environmentally acceptable alternatives for pest control.

7. Filter Strips are strips of perennial grass established along the lower portion of a field to filter out potential pollutants.

8. Land reclamation is need to reduce pollution from water runoff and deep percolation of polluted water. The land should be cleaned of garbage, shaped and vegetated to restore aesthetics, provide fuel wood, grazing, wildlife food and cover, and possibly recreation areas for the public benefit.

9. Wellhead Protection is designing and installing structures to reduce the risk of pollutants entering the water system at or near the wellhead. The structures, for this project, would generally consist of a concrete or asphalt apron that prevents water accumulation around the wellhead.

10. Grazing management - demonstrates how rotation grazing can improve land fertility and productivity.

The practices will function as stand-alone practices but field application has proven the benefits of applying systems of practices that benefit each other in synergistic ways.

The selected environmentally-friendly agricultural practices are acceptable to most of the farmers in the project area:

Polder area

- Conservation tillage - soil and mulch tillage
- Crop rotation
- Crop Nutrient Management
- Weed and Pest Management
- Narrow Vegetative Barriers
- Filter strips - for micro-depressions areas
- Grazing management

Terrace area

- Conservation tillage - soil and mulch tillage
- Crop rotation
- Crop Nutrient Management
- Weed and Pest Management
- Narrow Vegetative Barriers
- Manure management
- Grazing management

Villages area

- Organic gardening - Crop rotation & Nutrient and Pests Management
- Land reclamation
- Wellhead protection

4.3 Criteria foe selecting sites for Testing and Demonstrating program

The sites selected for testing and demonstrating (T/D) practices were chosen for the following reasons:

- **Site adaptation for the specific practice -** Each practice has specific soil and site requirements for proper testing and demonstration. However, most of the practices chosen for demonstration are adapted to almost any location within the project area. Site selection was, therefore, based more on geographic and strategic locations than soil and site characteristics.

- **Enthusiasm expressed by commune representatives -** It is imperative that practices be located on sites where stakeholders are ready, willing, and able to apply and manage the conservation practice. The field review indicated a lot of enthusiasm exists for testing and demonstrating the practices.

- **Technical abilities of the stakeholders -** Most of the practices will require training to assure the practice is planned, applied, and managed to assure project objectives are met. Practices range from low-tech to very high-tech and care must be taken to assure the proper people are selected to apply and manage the practices.

- **Logistics for public display and monitoring activities -** It is important to locate the practices where people can see them and visit the sites efficiently. It is also advantageous to locate many of the sites in a central location to improve efficiency during the monitoring phase of the project.

4.4 First year program

The following is the first year (2001) practice recommendations, and rational for selection. Each individual project will require a detailed plan of work prepared by participants specifying each individual necessary task, the person responsible, and the deadline date for successful completing of each step.

1. Crop rotation - will provide a suitable crop rotation. This project will be installed during summer and fall of 2001 in both polder and terrace areas. The crop rotation should be established to the adapted field crops, including annual crops and perennial grass.

2. Manure management – will provide the farm and commune waste management plan for reducing the risk of waters and land pollution from handling, storing and land spreading systems. A waste composting training course and assistance will be required too.

3. Crop nutrient management – will increase nutrient efficiency to maximize economic return while maintaining or improving the environment. To increase nutrient efficiency, growers apply plant nutrients at the right time and place to achieve their estimated yield. This approach helps reduce potential pollution of surface and ground water for whole project area.

4. Weed and Pest management – will involve the use of various management practices that either prevent or reduce economically harmful weed, insect, disease and other pest population. Specific practices will include scouting fields, rotating crops, planting resistant crops, encouraging beneficial insect and, when necessary, using crop protection products – herbicides, insecticides and fungicides.

5. Narrow Vegetative Barriers - will demonstrate how grass strips can trap snow and increase available moisture between the strips. The strips should be established to an adapted tall growing species. This will be established during fall 2001, within fields with existing tree windbreaks and drainage channels as part of the total system including conservation tillage, crop rotation & nutrient and pests management. Narrow vegetative barriers will provide a good comparison of the farming practices and be a decision tool for area farmers who observe performance of these practices. It will also enhance credibility of yield data collected by the farmer.

Training of farming managers from the project area is also part of the first year program. Also, up to ten participants may be identified for a study tour hosted by the USDA or a university located within the corn belt area of the United States.

4.5 Indicative 2 – 5 year programme

1. Soil conservation tillage - will provide the best alternative to conventional soil tillage by implement chisel or paraplow and a high tech tillage - planters plant the seed, apply starter fertiliser and pesticides in one operation or tillage attachments to make existing planted suitable for minimum tillage

2. Mulch tillage - high residue drill necessary for drilling of the field crops residue. This tillage system usually includes straw spreaders. Also, any accumulations of straw must be evenly distributed to allow proper operation of the planter.

3. Filter strips - will improve agricultural quality of the polder land by slow water runoff from the micro-depressions, as well as the water quality by filtering action of grass or other vegetation and increased opportunity time for decomposition, de-nitrification and other chemical processes that cleanse the water intercepted by the strips of vegetation.

4. Land reclamation - will be demonstrate on the current manure platform areas. Land reclamation is need to reduce pollution from water runoff and deep percolation of polluted water. The land should be cleaned of garbage, shaped and vegetated to restore aesthetics, provide fuel wood, grazing, wildlife food and cover, and possibly recreation areas for the public benefit.

5. Wellhead protection is needed for many wells in the 7 communes. An inventory will be conducted by the local people and unprotected wellheads will be improved to drain water away from the wellheads by planting vegetation around public and private wells. The project will provide material and local people will install the improvements.

6. Organic gardening will be develop in village area as alternative to traditional gardening. The householders will discover the satisfaction of recycling their house waste, of choosing a fine diversity of vegetables, medicinal and aromatic plants and ornamental flowers, or of eating fresh, health and substantial fruits, grapes, vegetables, etc.

7. Grazing management - will demonstrate how grazing plan can improve grass and livestock yields. It should be implement in village grazing areas to reduce the soil erosion too.

Practice application schedules will need to be reaffirmed following site planning activities with local farmers and community leaders. The above application schedule is based on discussions and tentative plans for project planning purposes.

4.6 Performance indicators to evaluate impact on agricultural productivity and the environment

Measuring the environmental impacts of agronomic practices requires a long-term evaluation. Impacts that occur beneath the soil surface are insidious and require very precise data collection. The practices included in the total system will have additive benefits a multitude of performance indicators. Soil improvement will be significant within 5 years. Crop yields can be documented as soon as the vegetative strips are effective. Wildlife food and cover will increase significantly and a more diverse animal inventory should be documentable within a few years. Earthworms and other soil organisms are depleted in the soil and changes in this soil parameter will be significant. Any runoff water will be significantly cleaner, and groundwater quality may improve where it is currently polluted.

4.6.1 Indicators for Soil Quality Evaluation

The soil quality indicators are important to guide land use decisions, evaluate the effects of the agricultural practices and to focus conservation efforts on maintaining and improving the soil quality. Indicators of soil quality can be categorized into four general groups: visual, physical, chemical and biological parameters.

Visual indicators may be obtained from observation or photographic interpretation. Exposure of subsoil, topsoil and subsoil colour, ephemeral gullies, ponding, runoff, plant response, weed species, blowing soil and deposition are the main locally determinated indicators.

Physical indicators are related to the arrangement of solid particles and pore. Examples include topsoil depth, bulk density, porosity, aggregate stability, texture, crusting, fissuring and compaction. Physical indicators primarily reflect limitations to root growth, seedling emergence, infiltration, or movement of water within the soil profile.

Chemical indicators include measurements of pH, salinity, organic matter, phosphorus concentrations, cation-exchange capacity, nutrient cycling, and concentrations of elements that may be potential contaminants (heavy metals, radioactive compounds, etc.), those that are needed for plant growth and development. The soil's chemical condition effects soil-plant relations, water quality, buffering capacity, availability of nutrients and water to plants and other organisms, mobility of contaminants, and some physical conditions, such as the tendency for crust to form.

Biological indicators include measurements of micro- and macro-organisms, their diversity and activity. Earthworm or nematode populations have been suggested for use in some parts of the project area. Respiration rate can be used to detect microbial activity, specifically microbial decomposition of organic matter in the soil. Ergosterol, a fungal bio-product, has been used to measure the activity of organisms that play an important role in the formation and stability of soil aggregates. Measurement of decomposition rate of plant residue in bags or measurements of weed seed numbers, or pathogen populations can also serve as biological indicators of soil quality.

4.6.2 Indicators for Farming Systems Productivity Evaluation

The main indicators of farming systems productivity are the yields, resource efficiency and farm income. Important for farmers, also, are soil covering rate, stocking rate, is growth rate and monitoring of hot farming activities – crop rotation and management of waste, crop nutrients, water and weeds and pest.

4.6.3 Indicators for water quality evaluation

Standardized water quality indicators are needed to provide reliable data on problems and trends in water quality of the Danube River and its tributaries and the Black Sea.

A water quality monitoring program should be included and the following parameters recorded:

- pH, turbidity, odour, suspended solids, electric conductibility;
- nitrates (NO3), ortho and total phosphorus (P), calcium (Ca), magnesium (Mg), sodium (Na), carbonates (CO3), sulphates (SO4), and pesticides content;
- faecal coliform and streptococus bacteria infestation;
- observation on algae in canals.

5. Recommendation for trial and demonstration of agroforestry practices

Agroforestry is a distinct land-use system, which may include combinations of tree production with other crops and/or animals on the same land at the same time, with the main objectives of reducing risk and increasing total productivity as results of efficient use of sunlight, moisture and plant nutrients. Between rows of trees, food crops, forage crops, vineyards, fruits and a number of specially crops may be grown and harvested or grazed by the domestic animals. This is a relatively new concept that is becoming accepted as a cost effective way to produce income from land partially devoted to tree production. During field trips, the farmers expressed interest in planting windbreaks, and using other agroforestry technologies to improve the environment in the project area. Those expressed concerns are:

- Deforestation and subsequent effects;
- Global warming;
- Wind and water erosion in a few areas;
- Lack of fish and wildlife food and cover;
- Lack of recreational opportunities for citizens and tourists;

5.1 Evaluation of existing practices and constraints to adoption of improved practices

The existing agroforestry practices include tree planting in the polder area and windbreaks in the terrace area including home gardens in village areas. A number of different reasons for agro-forestry practices are evident in the project area and these are summarised as follows:

1. **General tree planting** is undertaken soil fertility, and to restore natural plant cover, as well as provide a source for fuel wood and timber. Inter-cropping with 'food' crops is widely practised for the first 4 - 5 years after planting tree seedlings. Following this period the forest stand is managed as a mono-culture by the Forestry Service and inter-cropping is not permitted. Along the bank of the river Danube afforestation has been supported by the Forestry Service. The vegetation associated with this area is a mixture of wetland grasses and willows trees. In general afforestation is not widely practised by the rural population of farmers because of the high costs of tree seedlings and the lack of saplings to meet the demand that exists.

2. **Windbreaks** are used to protect soils and modify the microclimate associated with crops, orchards, livestock, settlements and transport networks . Windbreaks, comprising of trees, are located in Cuza Voda and Marculesti communes but have been seriously denuded by the local population largely to satisfy fuel wood needs. These windbreaks were established in the 1960's throughout the terrace area and supported with State intervention. Despite the presence of windbreaks, and the support in the past to establish them, there has been little or no development in recent times in their establishment partly due to poor economic circumstances and the confusion between the role of the Forestry Service in providing this service on privately owned land.

3. **Home gardens** are a traditional source of agroforestry practices in the project area, and these have been developed without State intervention. These systems are characterized by the intensive use of multipurpose tree species, shrubs, food and fodder crops and animals on the same piece of land at the same time. In a home garden, the rear part of the garden often comprises of tree species that produce fuel wood, fruits, fodder, flowers and shade. The middle area may be planted up to produce grapes and vegetables. The front area of the garden is the place of buildings (house, animal stables) and of herbs and medicinal and ornamental plants. Often undervalued are the many benefits of home gardens including amenity functions, reduced wind speeds, shade, privacy and the source of income.

The development of agro-forestry in the project area may in part be attributed to:

- the lack of quantitative data which prevent a rigorous cost-benefit analysis. Therefore, adopting agroforestry systems is something of a gamble, particularly when a long-term tree component is involved;
- no obvious way of fully recovering of investment costs because some agroforestry benefits (e.g. extension of wildlife habitat; improving of life for society as a whole, etc.) are not marketable, although this provides scope for government to under right these investment costs with grants for example or to support the development of new opportunities such as agro- or green-tourism;

5.2 Recommended practices by sub-zone

Most of the stakeholders in the project area expressed interest in planting tree and using buffer technologies to improve the environment because these practices are effective even if installed as a single practice, and can be applied by the farmers with labour and tools readily available.

The project provides a number of opportunities to introduce agro-forestry practices that will enhance the local environment, and contribute to control agricultural sources of pollution. These practices include:

1. **Hedge rows** are shrubs planted along field or plots edges (usually a single row) to provide environmental benefits such as soil protection from wind erosion, crop protection from wind damage, control drifting snow, enhance soil moisture, habitat for beneficial insects and food and nesting cover for wildlife.

2. **Tree planting** is combining fuel wood, timber and fruit trees production with other crops on the same land at same time. Between rows trees, annual field crops, forage crops, vegetables and other special crops may be grown and harvested. This is a relatively new concept that is becoming accepted as a cost effective way to produce income from land partially devoted to tree production,

3. **Windbreaks** are rows of trees and shrubs planted for the purpose of reducing wind surface, protection of crops from the desiccating winds, providing food and cover for wildlife and, recently, human food and animals feed. They are usually 5 to 50 meters wide and 2 – 4 meters spacing between tree rows.

4. **Riparian buffers** are streamside plantings of trees, shrubs and grasses that can intercept pollutants from both surface and shallow groundwater before they reach a river or stream. Riparian buffers stabilise lake and river banks and provide habitat for wildlife and enhance fish habitat by, among other things, reducing water temperature.

5. **Shelterbelts** are rows of shrubs (usually two or three rows) planted for protection gardens, livestock and farm buildings from harsh weather and for livestock sheltered and fencing of trees plantations and grazing areas.

According to the problems associated with the project area (described in previous sections), it is recommended the follow specific agroforestry practices are applied as follows:

Polder area

- Hedge rows - for reducing wind erosion;
- Tree planting - for suitability land use;
- Riparian buffers - for protection Iezer Calarasi, an important habitat for water birds.

Agricultural terrace area

- Hedge rows – for protection crops and wildlife habitat;
- Tree planting - for fuel wood and timber;
- Windbreaks - for improving field microclimate and wildlife habitat;
- Riparian buffers – for protection Galatui lake banks

Villages area

- Shelterbelts – for fencing trees plantation, grazing areas and home gardens.

5.3 Criteria for selecting sites for Testing and Demonstrating

The selection of sites for testing and demonstrating Agroforestry Practices should satisfy three basic criteria: Adoptability, Sustainability and Productivity.

1. Adoptabilty

Adoption of agroforestry practices has to be in the citizen's and farmer's own interest. Full support expressed by householders, farmers and mayoralties must be carry out by involving the intended users directly in the technology development process from the beginning as active participants in the design, trial, evaluation and redesign of agroforestry practices. Agroforestry is not the answer to every land use problem, but the range of agroforestry options is extremely broad, and every agroforestry user has his or her favourite practices. What is needed is a systematic way of matching agroforestry practices to the actual needs and potentials of existing land use systems.

2. Productivity

The agroforestry systems have to improve the rural welfare through a variety of direct production roles (food, fodder, fuel, fibre, and many industrial products), as well as through a wide range of indirect service roles within land use systems (soil and water conservation, fertility maintenance, microclimate amelioration, etc.). Productivity improvements can be achieved not only by raising or diversifying yields of useful products, but also by reducing the costs of production inputs – fertilisers and pesticides.

3. Sustainability

Most farmers often have short time horizons when it comes to the planning of agroforestry practices, particularly if they have secure tenure over the plots they cultivate. Therefore, in agroforestry there is ample scope to the combination of long-term benefits with short and medium-term productivity gains. Also, incentives are often required to encourage the adoption of these conservation farming practices.

5.4 First year program

1. Hedge Rows - will demonstrate how shrubs can alter micro-environment to increase production and overall environmental quality. The shrubs will be planted within fields with existing terrace windbreaks and polder drainage channels as part of the total system including environmental – friendly agricultural practices.

2. Tree planting - will restore natural plant cover on the vulnerable polder land and on the bench terraced areas. This practice will help increase land suitability and the sources of fuel wood and timber, as well as will reduce soil erosion and waters pollution risks. The project will result in about 65 hectares (about 10 hectares in each commune) cropland converted to native tree species.

Training of agroforestry practice users is a compulsory part of the first year program because agroforestry is very new for most of them.

5.5 Indicative 2 - 5 year program

The remainder of the programme is intended to assist the farmer's and villages in tree planting, and an area of about 1400 hectares is envisaged. Also, it is planned that an additional three new testing and demonstrating projects will be established for:

1. Tree windbreaks – will be planted on the terrace farms to alleviate the desertification effects through moisture conservation, to improve local landscape, to create favourable wildlife food and cover conditions, to increase the crop yields and to diversify the human activities.

2. Riparian buffers - will be settled for bank stabilisation and buffering for water quality around the perimeter of Galatui lake and Calarasi Iezer.

3. Shelterbelts - will be planted on the village gardens, pasture areas and/or vegetable farms. This project will demonstrate how shrubs and three vegetation can protect crops, livestock and buildings from harsh climate conditions and biotic enemies.

5.6 Indicators to evaluate agro-forestry practices on on agricultural productivity and the environment

Assessing the impact of agro-forestry practices on agricultural practices and the environment are presented here:

The impacts of tree planting could be evaluated by measuring changes in selected bio-diversity indicators, water quality, area of land afforested changes in crop and tree productivity. The increase in afforested area should also improve the supply of fuel wood for the communes and improving recreation opportunities for people.. The effect on wildlife habitat food and cover are measurable effects can also be described.

Windbreaks/Shelterbelts should result in increased yields by modifying the micro-climate and improving moisture management. Wildlife habitat will be enhanced and measurable changes should be the result when the practice is widespread over the landscape.

Shrub rows will provide the same impacts as windbreaks but possibly to a smaller degree.

Riparian buffers should control the spatial spread of many pollutants and inorganic ions and prevent down-hill soil run-off through the water erosion. The filter of the surface flow, as well as the lateral spring flow and tie up potential pollutants. The pollutants may be harvested in biomass removed from the site or stored in the organic form within the biomass. They also provide an opportunity for bacterial action to decompose harmful compounds back into elements. Therefore, the main impact of riparian buffers will be on the environment, and it will be evaluate through specific indicators concerning water quality, land use and flora and fauna diversity.

Careful thought should be given to the selection of appropriate indicators, since it is likely that some of the benefits of associated with agro-forestry practices will not be evident during the life of the project. This may be further confounded by the interaction of project measures that all contribute to improving the project environment, for example improvement in water quality may be associated with improved agricultural practices such as manure management as well as increase in forest area along riparian zones.

6. Environmental Assessment

The agricultural and agro-forestry practices described earlier and designed to be implemented during this project have no significant adverse environmental effects, and will have many positive socio-economic impacts. The following environmental impacts are summarised below:

6.1 The environmental assessment of agricultural practices

Crop rotations will be designed so as to minimise negative impacts on the environment, including the introduction of cover and break crops to maintain and enhance soil fauna and flora, organic matter, soil structure and reduce the loss of agricultural nutrients to surface and ground waters. The introduction of grass and legumes into the rotation will reduce the susceptibility of soils to compaction and erosion.

Improved manure management is fundamental to reducing agriculture pollution in the project area. Ensuring the correct stocking rate, improving manure management (timing and methods of disposal), better manure storage and handling facilities will ensure that the risk of surface and ground water pollution is minimised.

Crop nutrient management will maximize farms profit, conserve or enhance soil organic matter and improve surface and ground waters pollution.

Improved weed and pest management particularly through the introduction of techniques such as Integrated Pest Management (IPM) and Integrated Crop Management (ICM) will contribute to less reliance on pesticides and herbicides and the associated risk of environmental degradation. Research has shown that gross margins can be maintained or improved by applying such integrated techniques.

Narrow Vegetative Barriers improves fields microclimate, landscape diversity and wildlife habitat.

Soil conservation tillage benefits are: increasing humus contents in whole crumb profile, augmentation of earthworm population density and raising up of soil infiltration capacity. Research shows, also, soil conservation tillage can reduce fuel consumption.

Mulch tillage obvious effect is 90 % erosion reduction. Also, this practice increases organic matter content in the arable layer of soil about 0.1% each year, optimizes soil moisture and improves wildlife habitat.

Filter strips provides a suitable land use, good wildlife habitat and an opportunity for water pollution control.

Land reclamation aims introduction of former waste platforms land in the farming circuit, decreasing of waste odour and punctiform soil and waters pollution.

Wellhead protection benefits are wells protection from domestic contamination and clean and healthy drinking water.

Organic gardening is a new challenge to conserve and improve waters and soils quality by using of the local resources and traditional means. Also, the recreational and pleasure values of gardening will be much improved.

Grazing management could play an important role to minimise soil erosion and amount of nutrients leached, and, indirectly, to improve soil structure and organic matter content.

Improvements in irrigation practice, and the associated infrastructure, would almost certainly result in greater agricultural productivity and, given favourable market conditions, returns on investment and profitability. Although, soil quality is likely to be improved it will be important to monitor closely the impact of such practices on the environment, both in terms of water quality but also biodiversity. The authors of this report would recommend that guidelines be drawn up regarding a Code of Good Irrigation Practice that addresses the efficient use of water for irrigation and how to minimise impacts on the environment.

6.2 The environmental assessment of agroforestry practices

Hedge rows have similar environmental effects with narrow vegetative barriers. Moreover, they can be an additional source for fuel wood and healthy fruits, lives and flowers.

Tree planting main environmental effects are: enhancing the value of marginal or abandoned agriculture land, improving the micro-climate, creating wildlife habitat, providing a source of local fuel wood and timber, and increasing of recreational and pleasure values.

Tree windbreaks reduce wind erosion, protect field crops, decrease (by up to 34 %) evapo-transpiration, provide a source of fuel wood and timber , and offer a niche for wildlife.

Riparian buffers has positive effects in order to control leaching of nutrients and wastewaters to Calarasi Iezer and Galatui lake, to stabilise the banks of lakes and to provide new or enhanced habitats for flora and fauna.

Shelterbelts prevent wind and water erosion and protect crops, trees, livestock and buildings against harsh weather.

7. Terms of reference for any additional work deemed necessary to improve land use suitability data

7.1 Background

The wider objective of the Agricultural Pollution Control Project is to reduce agricultural sources of pollution to the river Danube and Black Sea. There is considerable evidence of poor water quality arising from agricultural activities such as fertiliser and pesticide application and poor manure management and a decline in the drainage and irrigation infrastructure resulting in water logging, saline and alkaline soils particularly in the polder area. In some years farmers have witnessed algae blooms, an indicator of poor water quality, in some of the larger water bodies associated with the project area.

The reduction of agricultural sources of pollution will be achieved using a number of techniques including the introduction of improved land practices and environmentally friendly farming practices, such as integrated crop management, the introduction of agroforestry measures and wind breaks. Associated with these new practices a large area falling within the project will be designated a nature reserve affording a degree of protection from agriculture activities and other forms of economic activity. The core nature area, which includes lake Calarasi, will be protected by a substantial buffer zone within which there are anticipated land use changes, for example forestation with native tree species and less intensive forms of agriculture.

Monitoring these changes will be an important part of the project. Although there will be an extensive field campaign to collect soil and water quality data and to assess and measure (using GPS equipment) changes in land use it is unlikely that a comprehensive assessment of the whole project will be achievable.

Therefore to supplement the data collected via the soil and water monitoring campaign, and ancillary data alluded to above, the use of remotely sensed information is deemed appropriate to the overall scheme of monitoring. The remotely sensed information will be stored and managed by the project GIS which will include other thematic layers of information such as soil type, hydrological network, topographic information, elevation, slope and so on. It is anticipated that the general scale of the digital geographical databases will range from 1:10 000 - 1:50 000 and will be projected on the standard national co-ordinate system.

At this stage it is not clear what imagery will be most appropriate for the project, although it is likely to be SPOT XS or panchromatic or IRS - C or D since these provide sufficient spatial accuracy to derive 1:10 000 - 1:50 000 geographical databases. However, it may be appropriate to utilise the high resolution KVR 1000 imagery from the Russian space mapping system, Kometa, which although only providing panchromatic images are of high resolution (1 metre) and would enable mapping of small features such as manure platforms, wind breaks, community forest lots and so on.

The land use of the project area is primarily agricultural and therefore in deriving land cover information the agricultural growing season must be accounted for. In terms of assessing the impact of agricultural activity on the environment an assessment of land cover at the beginning of the agricultural season (i.e. drilling or sowing of crops), that is the autumn period coinciding with September - October, will be important. This information combined with land cover information in the spring (when the crops are emerging and when spring cereals are drilled (April - May) would also be preferable. Naturally, obtaining suitable imagery for these windows in the growing season will depend on a number of variables particularly weather.

7.2 Objectives

The purpose of the contract will be to meet the needs of the GIS unit at DGA with remotely sensed derived information.

The primary objective of the contract is to:

1. provide advice and procure the most suitable imagery to monitor land cover within the project area;
2. acquire the imagery and process to derive a geo-rectified image (corrected and filtered for any geometric and atmospheric distortions) of the project area (if necessary the image should split into a number of tiles to facilitate data management and manipulation within the project GIS) and to
3. derive a geographical database describing land cover of the project area. The exact attributes will be agreed with DGA, but should include the principle crop types and natural vegetation types of the project area, water bodies, wet lands, urban and village areas. The land cover database should be supplied in a format that can be stored on the project GIS, and include full documentation.

The secondary objective of the contract will be to provide more general advice concerning remotely sensed information anticipating future or additional information products that may complement or enhance the basic land cover information and monitoring programme of the project.

7.3 Requirements

The contractor should be well informed of the different remotely sensed imagery available covering the project area and with anticipated developments of the technology.

The contractor should have considerable experience in the acquisition of satellite and remotely sensed imagery. They will have already gained experience in undertaking the processing of this imagery to derive land cover information suitable for GIS databases. It would be desirable if they were familiar with the CORINE land cover mapping programme and the associated typology since there may be synergies between ongoing national land cover mapping programmes. Ideally, they will be familiar with the associated land cover and vegetation types peculiar to the project area and, since the area is predominately a agricultural landscape, with the associated agricultural practices and crop rotations.

The contractor will be expected to liase closely with DGA, the Project Management Unit (PMU) and, if necessary the EPA to determine the most appropriate land cover types that can be derived from the chosen satellite sensor. Since this is only a small component of the overall project the contractor should assume that they would be limited to a maximum of two images a year (although this may be negotiable subject to budget). Therefore they must be confident that what they are recommending in terms of derived land cover information will be achievable.

7.4 Deliverables

The project is planned for five years and at least one comprehensive land cover database should be produced per agricultural season (five in total), based on two remotely sensed images season. However, it is expected that an intermediary land cover database will be derived at the start of each season (i.e. autumn). This will be based on the first image acquired for that season (and using supplementary knowledge from the previous seasons land cover database combined with an understanding of the crop rotations and allied agricultural practices).

Therefore two land cover databases will be produced a season, an intermediary and final product.

In summary, and based on the above, the deliverables from the contractor will include:

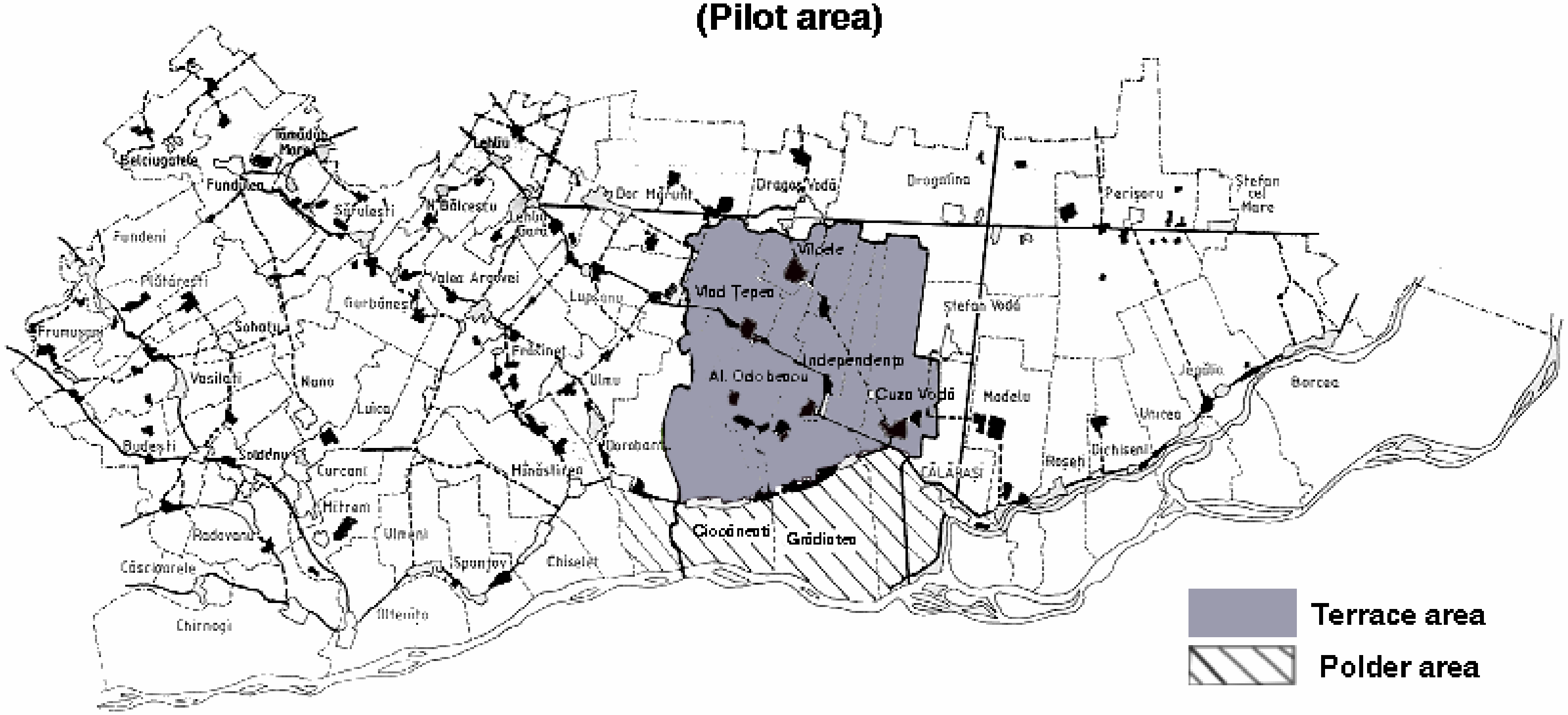
1. GIS compatible (geo-rectified and processed for atmospheric and geometric distortions) remotely sensed imagery of the project area (two images a season is anticipated) on CD-ROM or preferred media as specified by the PMU;
2. GIS land cover database with complete attribute database, based on agreed land cover typology, minimum mapping unit and agreed scale (likely to be 1:10 000 - 1:50 000 depending on selected satellite sensor) to be supplied on CD-ROM or preferred media as specified by the PMU;
3. Full documentation of the methodology, description and limitations of the land cover database.

The contractor will be expected to undertake some field checking of the classified remotely sensed data and a break down of this with budget should be specified in the proposal.

ANNEXES

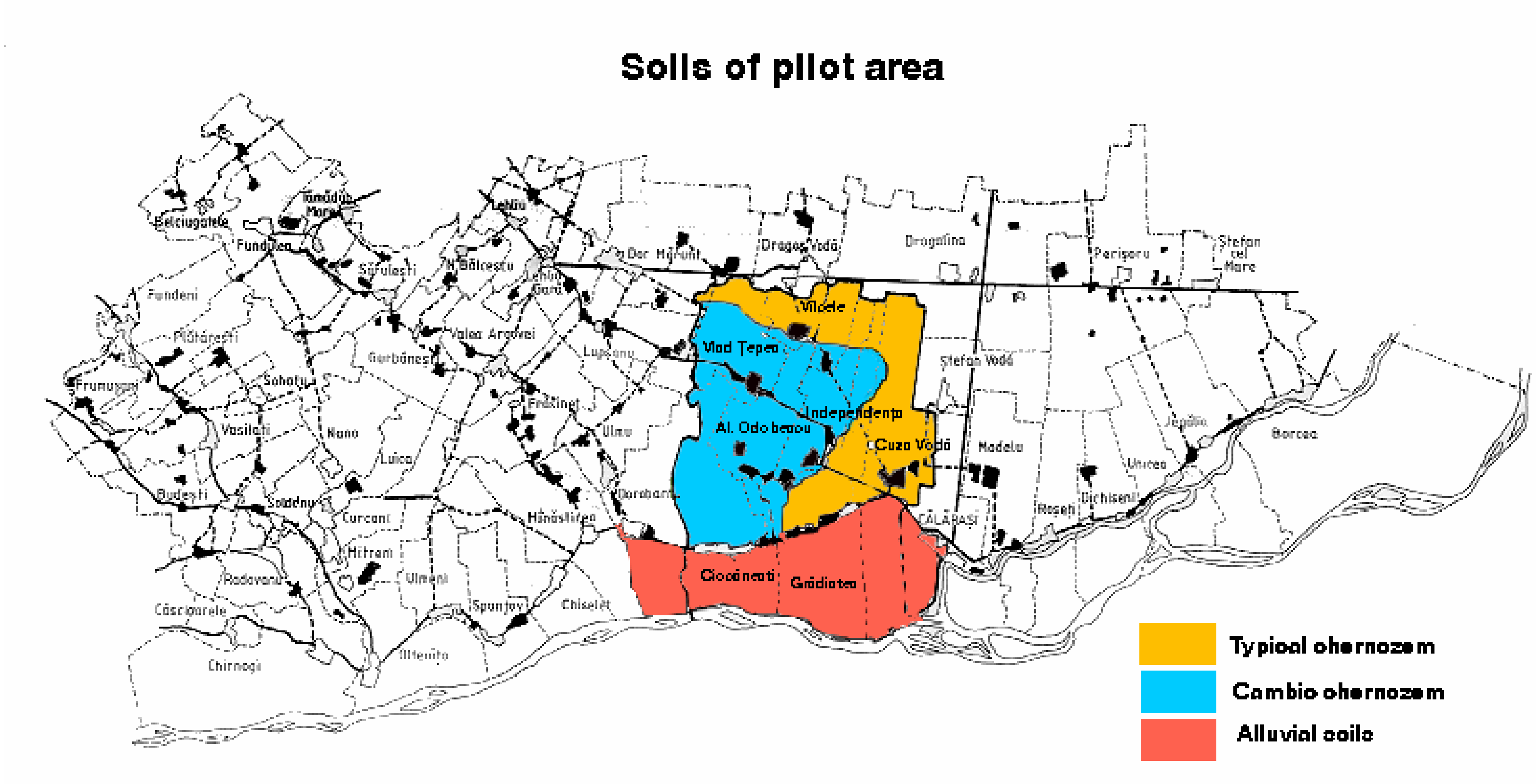
Annex 1

JUDEȚUL CĂLĂRAȘI
(Pilot area)



Romania - APCP

Annex 2


Soils of pilot area
Typical chernozem
Cambic chernozem
Alluvial soils

Annex 3

Code of Good Practices for Protection of Waters and Soils in Boianu – Sticleanu Polder

This Code of Good Practice sets out the minimum standards that farmers should seek to adhere to when undertaking their agricultural activities in the Boianu - Sticleanu polder.

1. Extension of agroforestry systems such as windbreaks/shelterbelts, hedgerows, filter strips and narrow vegetative barriers on land deemed as inadequate for agricultural purpose (e.g. with periodic waterloging, soils rich in soluble salts or exchangeable sodium or with low fertility potential).
2. Cultivation of 25 – 30% of the arable area with annual and perennial legumes.
3. Reduction of tillage depth by 5 – 10 cm and gradual replacement of the traditional mouldboard plough with conservation tillage and reduced tillage systems.
4. Combined utilization of existing drainage schemes, both for draining surplus water and for the completion of crop water demand.
5. Crop irrigation using conventional clean water and application rates in correlation with the soil moisture storage capacity. For the case of applying irrigation prior to sowing, the tilth depth would be of maximum 25 cm.
6. Crop fertilization using solid organic and chemical fertilizers. Liquid fertilizers, with the exception of the foliage-targeted ones, are forbidden from use.
7. Allowed organic fertilizers are: semi-digested manure, compost, composted vegetable matter, green fertilizers and bacterial fertilizers.
8. The application rate for semi-digested manure and compost should be a maximum of 10 t/ha and year. For a 4-5 year rotation, the maximum rate is 40 – 50 t/ha. Manure would only be applied during July – October interval, as the main fertilizer, by even spreading on the land, immediately followed by soil incorporation using the disk-harrow, after which the land is ploughed.
9. Leguminous seed treatment using specialized bio-products (e.g.NITRAGIN) for peas, beans, soya-bean, alfa-alfa, etc. Dosage: 4 bottles (200 – 250 ml each) for the amount of seed required for one hectare.
10. Growing green fertilizers and incorporating them into the soil, together with the entire residue (straw, sunflower stems, weeds, etc.). Field burning of various straw, stems and other vegetal residues is prohibited.
11. Accurate chemical fertilizer dosage application, in accordance with the requirement of each crop, correlated with the soil's agro-chemical indices and the previous agricultural practices .
12. The use on nitrogen-based (urea, ammonium nitrate, ammonium sulphate,etc) and foliage-targeted should only occur in the spring and summer (during the vegetation season) and phosphorus & potassium-based fertilizers should be applied during summer and autumn, prior to ploughing. Complexes of NP and NPK type fertilizers would be applied before or during sowing, the maximum rate being 50 kg/ha. Organic and chemical fertilizers would only be spread using terrestrial mechanized means, localized and in an even manner.
13. Reduction by 10-20% of the chemical fertilizer's amount, for the case of localized application using the F6-8 fertilizing machine.
14. Unilateral nitrogen fertilization is forbidden and no un-wrapped organic or chemical fertilizer amount should be allowed to be stored on the soil, not even on a temporary basis.
15. Only authorized pesticides (herbicides, insecticides, fungicides) should be used in the way specified in their authorisation. Field spreading only using terrestrial means is advisable too.
16. All chemicals, including their wrappings should only by deposited in specially designated places, previously approved by the Environmental Protection Agency.
17. Grazing should be performed in dry soils conditions and over – winter. It is preferable to graze only with sheep and young cattle. The desired range of stocking rate is of 1.5 – 2.0 livestock units per hectare.