OPTIONS FOR GHG MITIGATION IN THE AGRICULTURE SECTOR IN ALBANIA

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1.1 Geographic and climate profile

1.1.1 Geographic profile

The Republic of Albania is situated in South Eastern Europe, in the western part of the Balkan Peninsula with coasts on the Adriatic Sea (sandy) and the Ionian Sea (rocky). The coordinates are 39º 38' E (Konispol) and 42º 39' N (Vermosh) and 19º 16' E (Sazan Island) and 21º 40' N (Vermik village, Korça). Albania has a surface area of 28,745 km^2. Its terrain is mountainous: hilly and mountainous areas represent 77 percent of the country's territory and the average altitude of 708 m is double the European average. It is divided administratively into 12 prefectures, 36 districts, 315 communes and 2,900 villages. The total length of the state border is 1,093 km, of which 657 km are on land, 316 km sea, 48 km river and 72 km lake. To the northwest, Albania borders Montenegro, to the northeast Kosovo*, to the east the former Yugoslav Republic of Macedonia, and to the south and southeast Greece. Owing to the country's rugged relief, rivers are torrential with high erosive power. The rivers Buna, Drini, Mati, Ishmi, Erzen, Shkumbin, Seman and Vjosa flow into the Adriatic Sea; and the Bistrica flows into the Ionian Sea. The rivers that flow into the Adriatic Sea form a number of coastal lagoons and swamps. The rivers of Albania are an important source of hydropower.

1.1.2 Temperature

The climate in Albania is typically Mediterranean. It is characterised by mild winters with abundant precipitation and hot, dry summers. Temperature values vary from 7°C over the highest zones up to 15°C in the coastal zone; in the southwest temperatures can even reach 16°C. In the lowlands, an almost stable distribution of annual mean temperature (12–14°C) can be observed. Annual mean maximum air temperatures vary from 11.3°C in the mountainous zones up to 21.8°C in the lowland and coastal zones, while annual mean minimum temperatures are -0.1°C and 14.6°C respectively.

1.1.3 Precipitation

Total mean annual precipitation over Albania is approximately 1,485 mm/year, although the spatial distribution varies quite widely. The southeast part of the country receives the smallest amount of precipitation (the annual value reaches up to 600 mm), followed by Myzeqeja (part of the western low plains), which receives about 1,000 mm/year. The highest amount of precipitation is recorded in the Albanian Alps, where values reach up 2,800 to 3,000 mm/year. Another area with abundant rainfall is the mountainous southwest zone, where precipitation reaches up to 2,200 mm. Precipitation levels follow a clear annual trend, with the maximum in winter and the minimum in summer. The highest total precipitation (about 70 percent) is recorded during the coldest months (October to March). The richest month in terms of precipitation throughout the territory is November, while the poorest months are July and August. Snow is typical in inland mountainous regions, such as the Albanian Alps and the central and southern mountainous regions. It is rare in the western low plains, especially the southwest Albanian coast.

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* This designation is without prejudice to positions on status, and is in line with UNSCR 1244 and the ICJ Opinion on the Kosovo declaration of independence.

Amounts of precipitation and the precipitation regime are key factors in national electricity production, since the majority of the country's electricity is produced by hydropower plants. It is also very important for the agricultural sector, which is still the country's most important economic activity.

1.2 The role of the agricultural sector in the national economy

The hilly and mountainous areas of Albania are mostly located in the Northern and Central Mountains agro-ecological zone (AEZ), and in the Southern Highlands AEZ. There is also a highly productive coastal plain (Lowlands AEZ and parts of the Intermediate AEZ). The type of terrain, and the change in relief from mountains to coastal areas, result in high rates of soil degradation, while water resources are characterised by powerful, highly erosive river flows. This power has been harnessed for electricity production, with over 95 percent of the country's power being supplied from hydroelectric infrastructure.

1.2.1 Recent trends in Albanian agriculture

Agriculture has traditionally formed the backbone of the Albanian economy. Although the sector has been growing, the pace of growth has been outstripped by that of other sectors, with the result that the contribution of agriculture to GDP declined from 36 percent in 1997 to 21 percent in 2007. However, with almost three-quarters of the rural population earning less than USD 5 per day, the vast majority are poor and highly vulnerable to any event that affects the agricultural sector.

The combined value of agricultural production in 2009 was USD 1.7 billion, which included livestock, field crops and fruit production. As shown in Table 1, livestock farming represents over half the value of production. Field crops account for about one-third of the value of production, and fruit growing makes up the remainder.

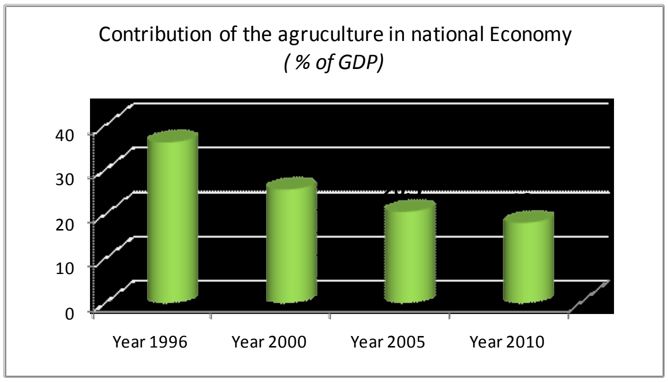
Table 1. Value of agricultural production in Albania, 2009

Description	Value (USD million)
Livestock	913
Field Crops	493
Fruit	250
Total	**1,660**

Although cereal field crops such as wheat and maize are grown extensively and occupy a large percentage of cropping land, their contribution in terms of value is less than 50 percent of the contribution of vegetable field crops, which achieve a higher price. It should be noted that, given the variability of soils, climate, access to water, infrastructure and other inputs, many areas of Albania outside the coastal plain are unsuitable for high-value vegetable production, hence the reliance on more resilient, less input-intensive crops such as wheat, maize and forage in the more mountainous areas. Trends within the field crop sector over the last decade show an overall decline in planted areas, with a substantial decline in the area planted with wheat since 2010.

However, agriculture continues to be one of the most important sectors of the national economy. Its contribution has been decreasing over the years, from an estimated 22.8 percent of GDP in 2005 and 20.5 percent in 2006 to 18 percent in 2010. Rural families continue to be dominant in terms of the national economy: about 50 percent of the population lives in rural areas, and agriculture is their main livelihood. The real mean increase in the rate of agricultural production during the last five years is estimated at around 3 percent per year.

Figure 1. Contribution of agriculture to the national economy (% of GDP)



Although the overall contribution of agriculture to the national economy is decreasing due to the rapid development of newly emerging economic sectors (commerce and services), the national economy will continue to be dominated by agricultural activity. Increased income from crop production, livestock production, agro-industries and the fishery and forestry sectors remains crucial to the country's economic and social development.

The growth rate of the agricultural sector is below the mean national rate due, among other things, to migration from rural areas; land ownership issues; the very limited size of agricultural farms; poorly organised marketing; lack of irrigation and drainage systems; the low level of technologies in use; weak organisation among farmers; and the low level of development of agro-processing. This has resulted in a lack of motivation and a low level of interest on the part of larger investors in agriculture-related activities.

1.2.2 Livestock

Livestock production represents over half the total value of agricultural production. Although the development of animal husbandry has not been encouraged, the number of cattle and small ruminants showed a rapid rise until the last few years. The number of pigs and poultry is increasing, although total livestock numbers expressed as animal unit equivalents is decreasing. The density of livestock per hectare of land is still very high. An overview of livestock production, in terms of number of animals and growth trends, are given in Figures 2 and 3.

Figure 2. Number of dairy and non-dairy cattle, 1990–2010

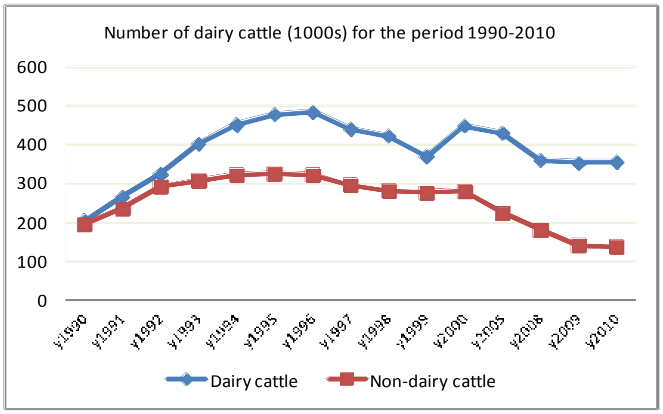
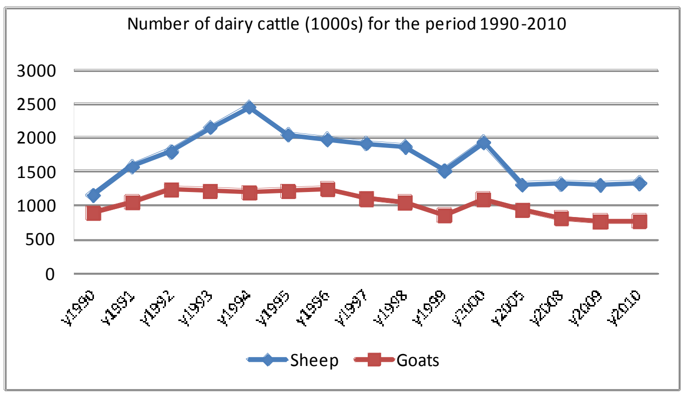


Figure 3. Number of sheep and goats, 1990–2010



1.3 GHG inventory in Albania

The first GHG emissions inventory by sources and sinks for Albania (for 1994) was carried out as part of Albania's First National Communication (FNC) during the period 1998 to 2002. Attempts to improve the quality of the GHG inventory have been made under the Global Environment Facility (GEF) regional project "Building Capacity to Improve the Quality of the GHG Inventories in Eastern Europe and CIS", which used key sources and the IPCC Good Practice Guidance as cost-effective approaches to improve the quality of data inputs.

Albania's second national GHG inventory considers three direct GHGs (CO_2, CH_4 and N_2O) and indirect GHGs (CO, NOx, SOx and NMVOCs). In addition, estimates of HFC_8, PFC_8 and SF_6 were included (although they were not reported under Albania's FNC). Estimates for the Second National Communication (SNC) regarding the GHG inventory include the year 2000 and the entire 1990–2000 period. Revised estimates were also made for the 1994. All the activity data concerning each sector are national. The main activity data source/provider was the Albanian Institute of Statistics (INSTAT), although it did not provide activity data for GHG inventory purposes according to the IPCC guidelines. Default emission factors from the IPCC Revised Guidelines (1996) were used. Most of the activity data are characterised by variability after the 1990s, at which point the country started to develop rapidly.

Because the SNC is the country's current document for GHG inventory and other related analyses, most of the data presented in this report are taken from that document. Total GHG emissions in Albania in 2000 were 7,619.90 Gg. The main contributing sector was energy (44 percent), followed by agriculture (27.12 percent), land-use change and forestry (21.6 percent) and others (wastes, solvents etc.) (7 percent). (See Figures 4 and 5.)

Figure 4. GHG emissions in Albania, 2000

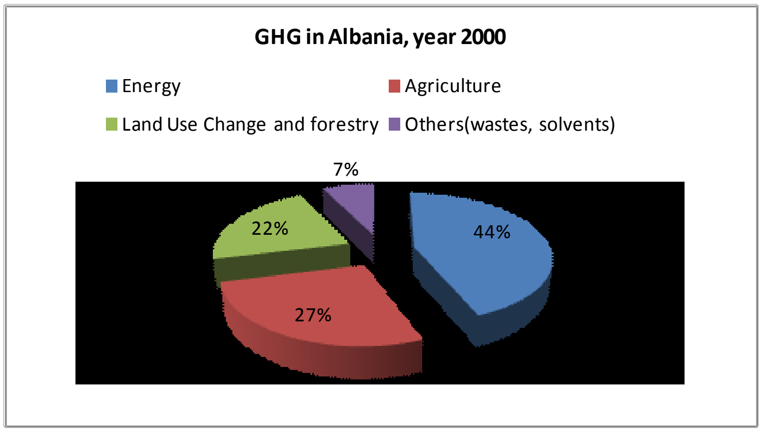
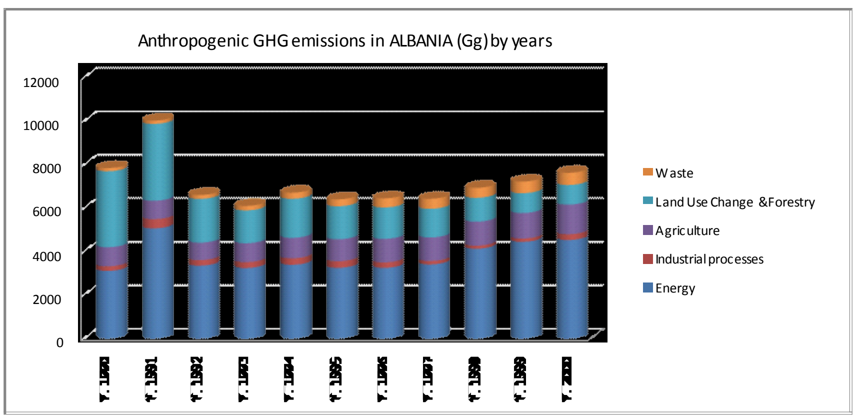


Figure 5 Anthropogenic GHG emissions in Albania by year and sector



1.3.1 Measures to mitigate climate change in the agricultural sector (SNC)

Albania is exposed to the effects of climate change, and since agriculture is one of the sectors that will be strongly affected by these changes, certain mitigation measures are provided in the framework of the SNC for this sector.

The following mitigation measures were identified for the agricultural sector:

- Crop rotation
- Perennial crops (including agro-forestry practices) and reduced bare fallow frequency
- Use of improved grazing systems with higher quality forage
- Reversion and afforestation of abandoned areas
- Better understanding of crop fertiliser needs
- Adoption of a good manure nutrient management plan
- Voluntary agreements (e.g. soil management practices that enhance carbon sequestration in agricultural soils)
- Determination of amount of manure produced
- Introduction of liquid manure systems

- Supporting programmes for technology transfer in agriculture
- Improved animal genetics and reproduction
- Improved timing of manure application
- Use of manure as a nutrient source
- Application of compost
- Separation, aeration or shift to solid handling or storage management systems
- Installation and use of anaerobic digesters for reduced CH_4 emissions from livestock waste
- Management practices to increase soil carbon stocks, including reduced tillage and crop residue return
- Increasing the digestibility of forages and feeds
- Soil testing

In the case of most of these measures, implementation has already begun but there are no exact data on how implementation is progressing.

1.4 GHG emissions

The contribution of GHG emissions from the agricultural sector is illustrated in Figures 6 and 7. The sources of CH_4 emissions are mainly enteric fermentation and manure management. Cattle are the main contributors of CH_4 emissions from enteric fermentation, followed by sheep. Emissions of N_2O from crops are mainly produced as a result of the application of nitrogenous fertilisers. Emissions of CH_4 and N_2O from crop management are insignificant and are the result of the burning of agricultural residues.

Figure 6. Annual CH_4 emissions from enteric fermentation and manure management

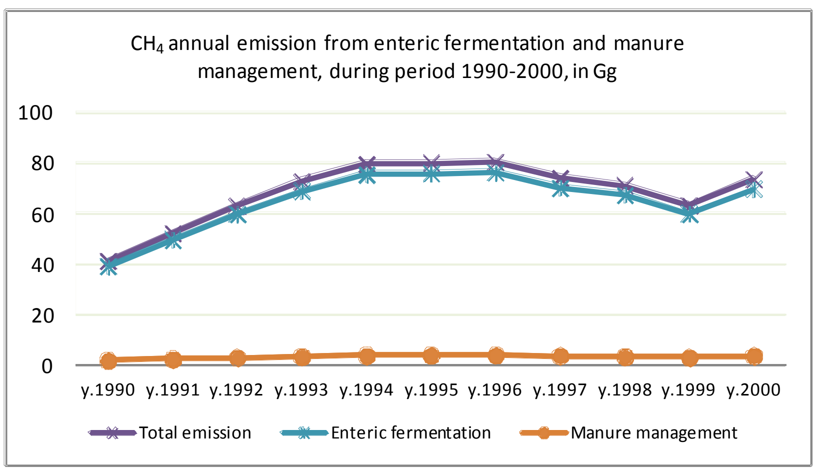
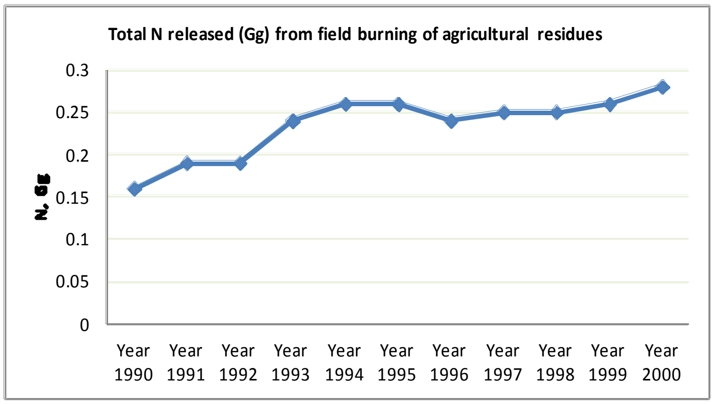


Figure 7. Total N released (Gg) from the field burning of agricultural residues



1.5 Agriculture and livestock and climate change

The agricultural sector is one of the main branches of the national economy. The main drivers are livestock production and arboriculture.

At 0.2 hectares, the average amount of agricultural land per capita is the smallest in Europe, even though the amount of agricultural land more than doubled between 1950 and 1990 due to the draining of marshland, terracing, the cultivation of forests and pastures, and the establishment of new irrigation schemes.

Agriculture is more developed in the Lowland and Intermediate AEZs, where agriculture is more developed than in the four other zones, since the land is mostly fertile. Livestock feed is based on forage cultivation and grazing. For sheep and goats, migration to summer and winter meadows is practised in two directions: within and outside the home tract.

1.5.1 Agricultural policy and legal framework

Until 2002, agricultural development was guided by the Strategy for Agricultural Development (the "Green Strategy"), although this strategy did not take into consideration the impact of climate change on agriculture and livestock production. In 2002, a strategic document for the agricultural sector was included as part of the national strategy for socioeconomic development, a framework document aimed at the reduction of poverty in Albania.

Agriculture is also considered as a priority in the national Stabilisation and Association Process in the context of EU integration.

The Agriculture and Food Sector Strategy (2007–2013) defines five priorities:

- Financial support for farms and agricultural and agro-processing businesses
- The management, irrigation and drainage of agricultural land
- The marketing of agricultural and processed products
- Improving the level and quality of technologies, information dissemination and the level of knowledge among farmers and agro-processors
- Improving food quality and the safety of agricultural and agro-processed products

Improving the quality of agricultural products is fundamental to increasing the competitiveness of the agricultural sector. Some of these priorities will have implications for mitigation options. Policies related to quality will focus on:

- Promoting advanced technologies: seeds, seedlings, fertilisers, pesticides, water and machinery

- Promoting new techniques and methods for cultivation and animal breeding, including integrated pest, plant, farm and animal management, referred to collectively as good agricultural practices
- Preparing standards for agricultural or agro-processing products according to EU norms and improving the effectiveness of their implementation
- Promoting post-harvest operations, including standardisation and packaging
- Promoting the appellation of agricultural or agro-processing products according to geographical origin
- Promoting the safety of agricultural or agro-processing products

The National Strategy for Development and Integration 2007–2013 (NSDI) recognises that Albania has a relatively low impact on the global environment due to its low per capita GHG emissions, although several measures for climate change mitigation and adaptation are already included in the strategy:

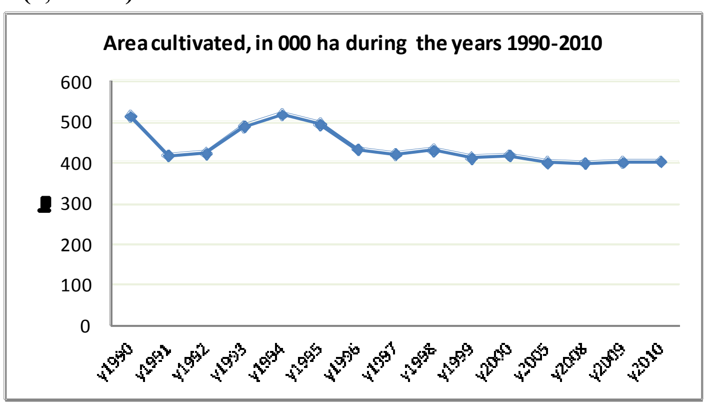
- Forest protection (the management of forests and pastures, reforestation, combating illegal logging)
- Improvement of agriculture (management, technology, investment in irrigation and drainage infrastructure)

There is no direct recognition of vulnerability to climate change or of adaptation measures in the NSDI, although several measures (e.g. agricultural infrastructure, the diversification of electricity production) do promote climate change adaptation.

1.5.2 Agricultural development

As a result of the intensification of agro-technical measures, wheat yields have increased progressively two- to fivefold, and maize yields five- to eightfold, compared to 1962. For this reason, climate change impacts have not been so apparent in terms of crop yields. Figure 8 shows the changes in the amount of agricultural area cultivated between 1990 and 2010.

Figure 8. Cultivated area (1,000 ha) between 1990 and 2010



Average per capita land ownership is around 0.2 ha, which means that there is no real incentive for cultivation and that a large amount of arable land is underutilised, with grazing as the main activity.

1.5.3 Forecast GHG emissions from energy in the agricultural sector (baseline)

The following key factors affect the agricultural sector in Albania:

- farms are small and land is very fragmented;
- there are agricultural land ownership issues;
- the work is demanding, there is low use of machinery, and the distribution system for agricultural products is disorganised and ineffective;
- there is insufficient access to loans; and
- there is an insufficient amount of agricultural machinery.

The fall in the contribution of agriculture to GDP is mainly due to insufficient access on the part of small, private farms to agricultural machinery, and to the inefficiency of machinery on small and fragmented plots.

Because of high rental prices for agricultural machinery, many farmers still work manually or use draught animals. The agricultural sector therefore consumes little energy and has low energy intensity. In the baseline scenario it is projected that energy intensity will increase, although not to the level of intensive agriculture.

1.5.4 Approach to scenario development

Owing to changes in cattle breeding patterns in Albania, the emission factors used for calculating methane release are slightly different between 1994 and 2000. For both categories of small ruminant species (sheep and goats), the selected emission factor used was 5[1]. For poultry, no emission factor has been established.

1.5.5 Conversion factors

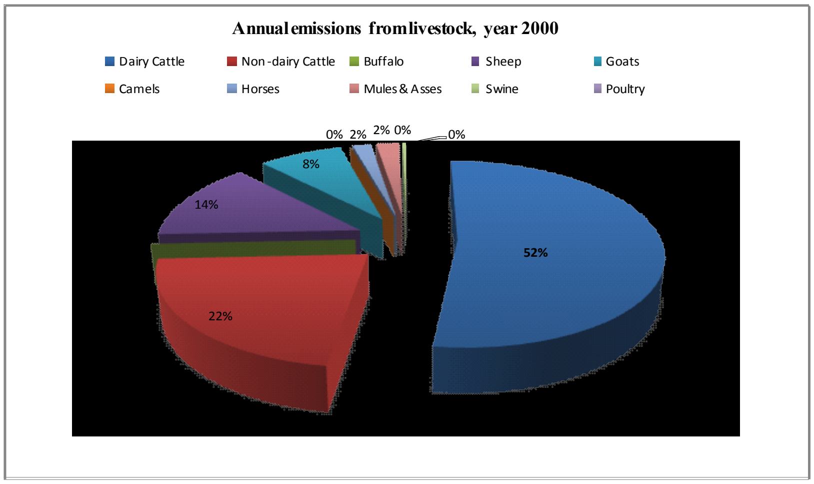
Average methane conversion factors (MCF) were established after assessing manure management practices for each animal category in Albania. Dairy cattle farms in Albania are small (on average 2 to 2.5 heads/farm). The use of liquid systems for manure management that generate high quantities of methane are therefore almost non-existent. The MCF was selected based on the IPCC Guidelines for National GHG Inventories..

1.5.6 CH_4 emissions from the agricultural sector

In 2000, livestock production was responsible for emissions of 73.74 Gg of CH_4 from enteric fermentation and manure management. The main contributors were dairy cattle (52 percent) and non-dairy cattle (22 percent), followed by sheep (14 percent) and goats (8 percent) (see Figure 9). Emissions from enteric fermentation were 69.88 Gg (approximately 95 percent) and from manure management 3.86 Gg (approximately 5 percent). During the 1990–2000 period, the contribution of mules and asses was 2 percent and that of horses 2 percent (see Figure 9).

[1] IPCC - Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories

Figure 9. Annual emissions from livestock, 2000

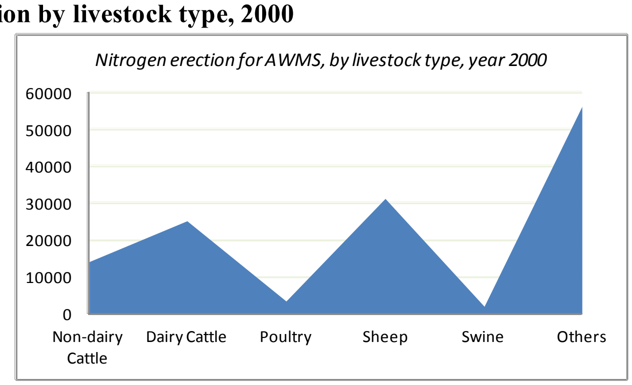


1.5.7 N_2O emissions from the agricultural sector

Emissions of GHGs from livestock waste come from several managed and unmanaged sources. Since the number of farms with cattle and other animals is small, it appears that manure from animals is not managed. Livestock waste is simply deposited in the surrounding environment, resulting in direct or indirect emissions of N_2O and CH_4 from manure in pastures, fields or paddocks (in aerobic conditions).

Unmanaged livestock waste deposited in pastures, fields or paddocks results in N_2O emissions from the nitrogen added to the soil. When added to soil, nitrogen provides the initial substrate for the natural cycle of nitrification and de-nitrification. A byproduct of this cycle is N_2O, thus the more nitrogen is added to the soil, the more N_2O is released into the atmosphere. Some nitrogen from livestock waste leaches into groundwater and surface runoff, creating additional N_2O emissions. Figure 10 shows the amount of nitrogen excreted by livestock type.

Figure 10. Nitrogen excretion by livestock type, 2000



The principal sources of nitrogen gas emissions are pastures and meadows in which large numbers of animals from livestock farms graze free rather than being kept in stables. This also includes large areas of agricultural land that are used as pastures rather than being cultivated.

Table 2. Number of animals (x 1,000 head)

Livestock type	Number of animals (1,000) during the 1990–2010 period														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2005**	**2008**	**2009**	**2010**
Dairy cattle	205	266	324	402	451	478	483	440	423	370	448	430	360	353	355
Non-dairy cattle	195	235	292	307	323	325	323	297	282	277	280	225	181	141	138
Sheep	1,159	1,580	1,796	2,155	2,460	2,050	1,982	1,921	1,872	1,518	1,939	1,312	1,321	1,309	1,337
Goats	895	1,055	1,234	1,220	1,194	1,220	1,250	1,105	1,051	860	1,104	941	820	772	775
Horses	36	39	44	55	62	69	74	69	65	63	63	53	43	38	35
Mules a asses	78	106	124	129	139	145	152	155	156	142	141	96	70	76	63
Swine	95	88	90	95	98	99	98	89	83	82	103	147	161	160	164
Poultry	1,985	2,065	2,539	2,855	3,642	3,951	4,108	4,456	4,862	5,023	5,291	4,671	5,000	5,138	5,245
Totals	**4,648**	**5,434**	**6,443**	**7,218**	**8,369**	**8,337**	**8,470**	**8,532**	**8,794**	**8,335**	**9,369**	**7,875**	**7,956**	**7,987**	**8,112**

Figure 11. Number of animals during the 1990–2010 period

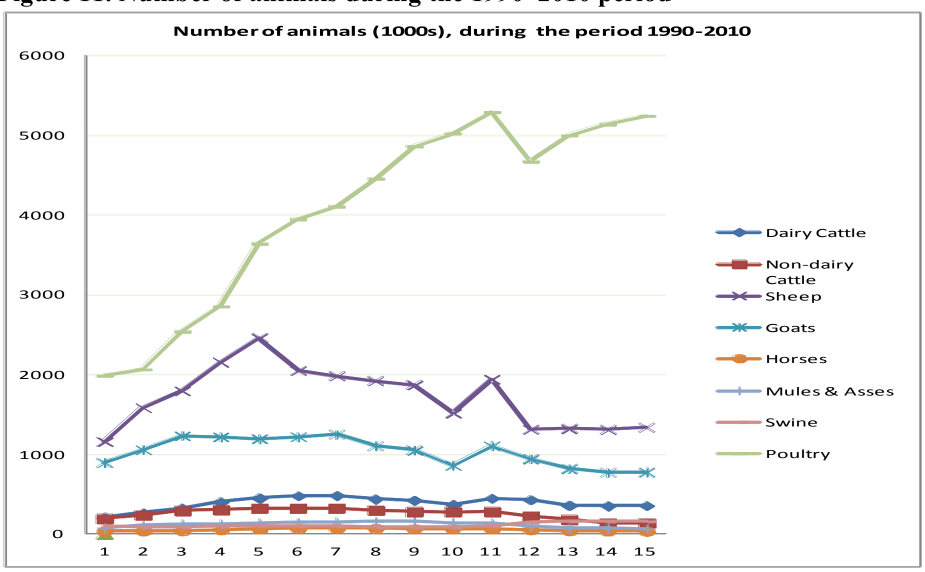


Table 2 and Figure 11 show that the number of cattle, the main contributors of CH_4 to global warming potential, remains almost the same between the reference year 1994 and 2000. The number of small ruminants decreased by around 0.6 million head by 2000 compared to the reference year 1994. Even after 2000, there has been an apparent decline in the number of head of livestock. Table 3 shows the change in livestock numbers for 2010 compared to 2000.

Table 3. Changes in numbers of livestock for 2000 and 2010

Livestock type	Number of animals (x 1,000)		Change in the number of livestock (%)
	2000	2010	
Dairy cattle	448	355	-20.8
Non-dairy cattle	280	138	-50.7
Sheep	1,939	1,337	-31
Goats	1,104	775	-29.8
Horses	63	35	-44.4
Mules and asses	141	63	-55.3
Swine	103	164	59.2
Poultry	5,291	5,245	-0.87
Totals	**9,369**	**8,112**	

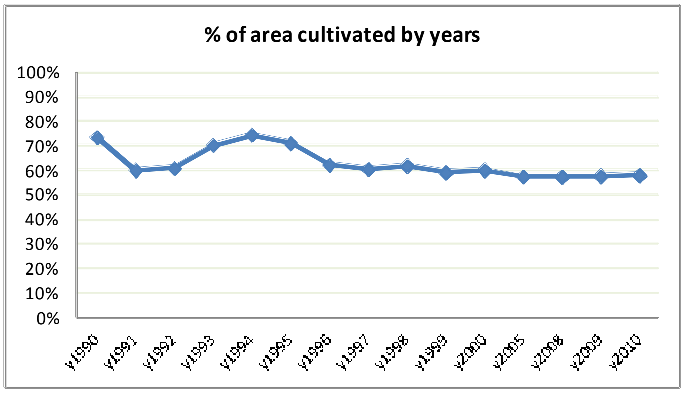
Because of the reduction in the number of head of livestock, the contribution made by livestock to GHG emissions is also lower.

As shown in Table 4, the production of forage increased by 172 percent over the 1990–2000 period, and between 1994 and 2000 increased by 124 percent. Along with the increase in maize production, this was caused by the growth in the number of animals. Production of vegetables and melons is also gradually increasing. Production of other crops (wheat, rye, barley, oats, soy, sugar beet, tobacco and sunflowers) has decreased owing to high levels of imports, small farms (of between 1 and 1.2 ha) and the low level of agricultural mechanisation.

Table 4. Annual crop production

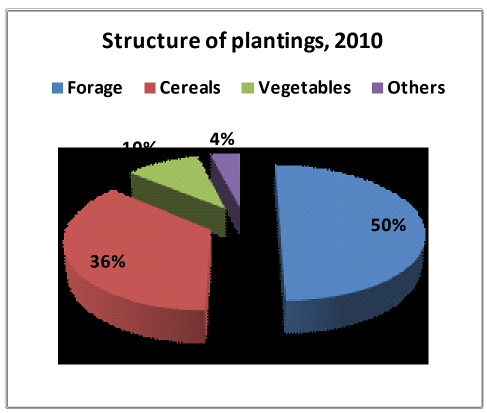
Crops	Annual production (Gg)										
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Rye	2	1	1	3	4	4	3	3	3	3	2
Maize	138	129	156	176	193	216	214	195	189	206	206
Barley	4	3	6	4	9	7	3	4	3	3	2
Oats	4	3	5	18	20	13	13	12	13	13	16
Wheat	644	297	252	464	420	405	271	388	395	272	341
Vegetables/melons	615	362	565	580	590	685	785	572	605	610	620
Forage	2,755	2,148	2,991	3,237	3,800	3,800	3,970	3,672	3,844	4,494	4,730
Sugar beet	54	58	46	27	60	67	74	51	56	40	42
Tobacco	17	7	12	13	4	6	6	8	7	7	6
Potatoes	112	86	79	101	89	134	132	127	145	162	161
White beans	18	13	25	23	18	25	25	20	23	26	25
Sunflowers	11	5	3	2	1	2	2	2	3	3	3
Soya	5	3	2	1	0	0	0	0	0	1	1
Total	**4,379**	**3,115**	**4,143**	**4,649**	**5,208**	**5,364**	**5,498**	**5,054**	**5,286**	**5,840**	**6,155**

Figure 12. Cultivated area as a percentage of total agricultural area



As shown in Figure 12, approximately 40 percent of agricultural land remains uncultivated. The structure of planting is shown in Figure 13. Around 50 percent of the cultivated area is used to grow forage.

Figure 13. Structure of planting, 2010

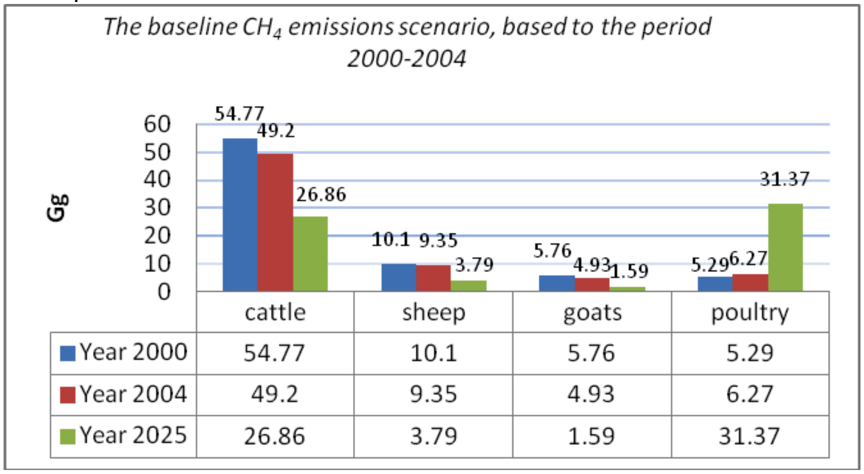


1.6 Development of the revised baseline GHG emissions scenario

Under the SNC, GHG emissions scenarios are calculated up to 2025. Enteric fermentation is the major contributor to methane (CH_4) emissions from agricultural activities, with about 69.88 Gg or 95 percent in 2000, while manure management systems contribute only 3.76 Gg (or 5 percent).

The baseline emissions scenario for CH_4 for 2000–2025 is based on the change in the number of animals in the 1994–2004 period, as shown in Figure 14.

Figure 14. Baseline CH_4 emissions scenario



The trend was calculated using the following rates:

- Cattle: -1.55 percent/year
- Sheep: -2.7 percent/year
- Goats: -1.1 percent/year
- Poultry: +23.72 percent/year

The baseline emissions scenario for N_2O is based on the area of cultivated land and crop production. Considering existing data and agricultural strategies, the area of cultivated land is expected to remain almost the same while crop production is expected to increase due to better production practices and the use of quality inputs. Figure 15 shows the baseline N_2O emissions scenario for the 1994–2025 period.

Figure 15. Baseline N_2O emissions scenario

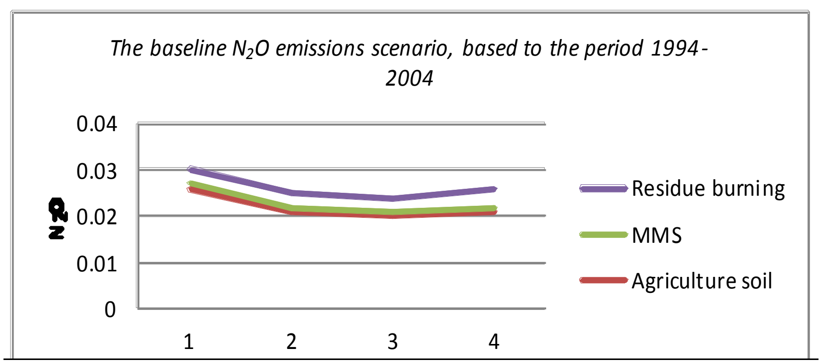
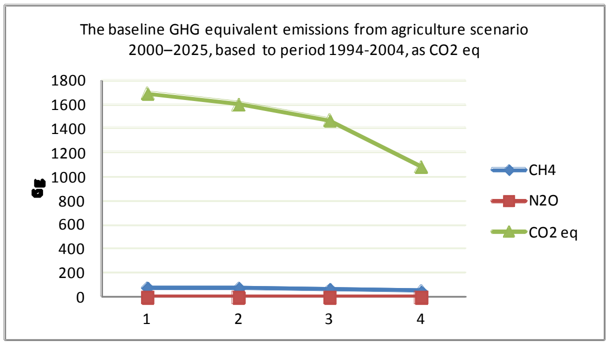


Figure 16 shows CO_2 equivalent emissions calculated from CH_4 and N_2O emissions. The decrease in emissions by 2025 (in CO_2 eq) is primarily due to the reduction in CH_4 emissions from enteric fermentation as a result of the lower number of animals on livestock farms. It is assumed that the number of animals will continue to fall in the coming years and that measures will be taken to improve pasture management and forage digestibility by ruminants.

Figure 16. Baseline GHG equivalent emissions scenario from agriculture



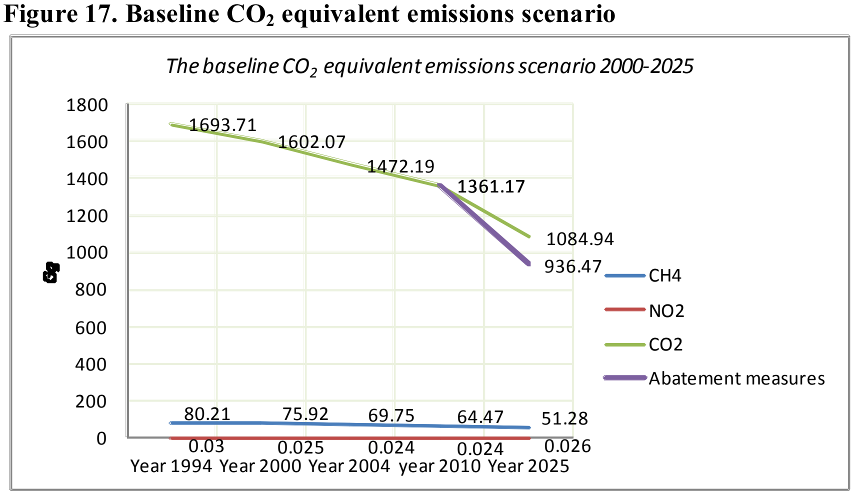
1.7 GHG abatement scenario for the agricultural sector (2000–2025)

The most feasible measures that will contribute to the abatement of GHG emissions from the agricultural sector include crop rotation practices and the use of perennial crops; improved grazing systems; and the afforestation/reforestation of abandoned areas.

Bearing in mind that enteric fermentation and manure management are the main contributors to CH_4 emissions from agriculture, the use of improved grazing systems with higher-quality forage will greatly contribute to the abatement of CH_4 emissions from agriculture. Emissions of CH_4 from enteric fermentation in ruminant and non-ruminant animals are dependent on the animals' digestive systems and the amount and type of feed consumed. Emissions of CH_4 from domestic ruminant animals can be reduced if producers use improved grazing systems with higher-quality forage, since animals grazing on poor-quality pasture produce more CH_4 per unit of feed consumed. Confined feeding utilising balanced rations that properly manage the digestion of high-energy feeds can also reduce direct emissions, but can increase indirect emissions from feed production and transportation. The CH_4 produced in animal waste disposal systems can provide an on-farm energy supply, and the CH_4 utilised in this way is not emitted into the atmosphere. The level of penetration of this measure will depend on the area covered by the intervention and the number of animals involved.

The predicted CH_4 emissions and GHG emission baseline and abatement scenarios for the agricultural sector are shown in Figure 17.

Figure 17. Baseline CO_2 equivalent emissions scenario



2 Mitigation options (literature overview)

The agricultural sector is having to adapt to the significant impacts of climate change, while at the same time ensuring sufficient food for a growing population. Addressing climate change and food security issues and meeting trade commitments present both challenges and opportunities for the agri-food sector.

Agriculture is one of the few sectors that can contribute to both the mitigation and sequestration of carbon emissions. Accounting for agriculture's carbon footprint is vital, particularly if agriculture is included in GHG emissions reduction commitments. However, the range and variability of estimates, and the complexity and uncertainty of accounting for indirect land-use change, remain to be resolved.

There are options to reduce GHG emissions in agriculture using currently available technologies, and significant mitigation can be achieved through improved cropland and grazing land management; the restoration of degraded lands; and land-use change (e.g. agro-forestry). Emissions from livestock production can be reduced through improved nutrition and the better management of manure. Improving animal fodder can also play a significant role in GHG emissions reductions.

In addition, crop and pasture land can sequester significant amounts of carbon, therefore contributing to offsetting emissions from other sources while improving soil quality and health.

Opportunities for mitigating GHG emissions from agriculture fall into three broad categories, based on the underlying mechanism. (This section draws largely from Smith et al., 2007a). This section draws largely from that study.)

- **Reducing emissions:** Agriculture releases into the atmosphere significant amounts of CO_2, CH_4 and N_2O (Cole et al., 1997; IPCC, 2001a; Paustian et al., 2004). Fluxes of these gases can be reduced by the more efficient management of carbon and nitrogen flows in agricultural ecosystems. For example, practices that deliver added nitrogen more efficiently to crops often reduce N_2O emissions (Bouwman, 2001); while managing livestock to make the most efficient use of feeds often reduces the amounts of CH_4 produced (Clemens and Ahlgrimm, 2001). The approaches that best reduce emissions depend on local conditions and therefore vary from region to region.
- **Enhancing removals:** Agricultural ecosystems hold large carbon reserves (IPCC, 2001a), mostly in soil organic matter. Historically, these systems have lost more than 50 Petagrams (Pg) of carbon (Paustian et al., 1998; Lal, 1999, 2004a), but some of this lost carbon can be recovered through improved management, thereby withdrawing atmospheric CO_2. Any practice that increases the photosynthetic input of carbon and/or slows the return of stored carbon to CO_2 via respiration, fire or erosion will increase carbon reserves, thereby sequestering carbon or building carbon sinks. Many studies worldwide have now shown that significant amounts of soil carbon can be stored in this way, through a range of practices suited to local conditions (Lal, 2004a). Significant amounts of vegetative carbon can also be stored in agro-forestry systems or other perennial plantings on agricultural lands (Albrecht and Kandji, 2003). Agricultural lands also remove CH_4 from the atmosphere by oxidation (although to a lesser degree than forests: Tate et al., 2006), but this effect is minor compared to other GHG fluxes (Smith and Conen, 2004).
- **Avoiding (or displacing) emissions:** Crops and residues from agricultural lands can be used as a source of fuel, either directly or after conversion to fuels such as ethanol or diesel (Schneider and McCarl, 2003; Cannell, 2003).

Many practices have been advocated to mitigate emissions through the mechanisms cited above. A practice will often affect more than one gas, by more than one mechanism, and sometimes in opposite ways, thus the net benefit depends on the combined effects on all gases (Robertson and Grace, 2004; Schils et al., 2005; Koga et al., 2006). In addition, the temporal pattern of influence may vary among practices or among gases for a given practice: some emissions are reduced indefinitely, other reductions are temporary (Six et al., 2004; Marland et al., 2003a). The most important options are described in the following sections.

2.1 Cropland management

Often intensively managed, croplands offer many opportunities for practices that reduce net GHG emissions. Mitigation practices in cropland management include the following partly overlapping categories:

Agronomy: Improved agronomic practices that increase yields and generate higher inputs of carbon residue can lead to increased soil carbon storage (Follett, 2001). Examples of such practices include using improved crop varieties; extending crop rotations, notably those with perennial crops that allocate more carbon below ground; and avoiding or reducing the use of bare (unplanted) fallow (West and Post, 2002; Smith, 2004a, b; Lal, 2003, 2004a; Freibauer et al., 2004).

Nutrient management: Nitrogen applied in the form of fertilisers, manures, biosolids and other sources is not always used efficiently by crops (Galloway et al., 2003; Cassman et al., 2003). The surplus nitrogen is particularly susceptible to the emission of N_2O (McSwiney and Robertson, 2005). Practices that improve nitrogen use efficiency include adjusting application rates based on the precise estimation of crop needs (e.g. precision farming); using slow- or controlled-release fertiliser forms or nitrification inhibitors (which slow the microbial processes leading to N_2O formation); applying nitrogen when least susceptible to loss, often just prior to plant uptake (improved timing); placing nitrogen more precisely into the soil to make it more accessible to crop roots; and avoiding nitrogen application in excess of plants' immediate requirements (Robertson, 2004; Dalal et al., 2003; Paustian et al., 2004; Cole et al., 1997; Monteny et al., 2006).

Tillage/residue management: Advances in weed control methods and farm machinery now allow many crops to be grown with minimal tillage (reduced tillage) or without tillage (no-till). These practices are now increasingly used throughout the world (Cerri et al., 2004). Since soil disturbance tends to stimulate soil carbon losses through enhanced decomposition and erosion (Madari et al., 2005), reduced-tillage or no-till agriculture often results in soil carbon gain, although not always (West and Post, 2002; Ogle et al., 2005; Gregorich et al., 2005; Alvarez, 2005).

Water management: Expanding the cultivated area (where water reserves allow) or using more effective irrigation measures can enhance carbon storage in soils through enhanced yields and residue returns (Follett, 2001; Lal, 2004a).

Agro-forestry practices: Agro-forestry is the production of livestock or food crops on land that also grows trees for timber, firewood or other tree products. It includes shelter belts and riparian zones/buffer strips with woody species. The standing stock of carbon above ground is usually higher than the equivalent land use without trees, and planting trees may also increase soil carbon sequestration (Oelbermann et al., 2004; Guo and Gifford, 2002; Mutuo et al., 2005; Paul et al., 2003). However, the effects on N_2O and CH_4 emissions are not well known (Albrecht and Kandji, 2003).

Land cover (use) change: One of the most effective methods of reducing emissions can often be to allow or encourage the reversion of cropland to another land cover, typically one similar to the native vegetation. The conversion can occur over the entire land area ("set-asides"), or in localised spots such as grassed waterways, field margins or shelterbelts (Follett, 2001; Freibauer et al., 2004; Lal, 2004b; Falloon et al., 2004; Ogle et al., 2003).

2.2 Grazing land management and pasture improvement

The following practices reduce GHG emissions and enhance removals:

Grazing intensity: The intensity and timing of grazing can influence the removal, growth, carbon allocation and flora of grasslands, thereby affecting the amount of carbon accrual in soils (Conant et al., 2001, 2005; Freibauer et al., 2004; Conant and Paustian, 2002; Reeder et al., 2004). Carbon accrual on optimally grazed lands is often greater than on ungrazed or overgrazed lands (Liebig et al., 2005; Rice and Owensby, 2001).

Increased productivity (including fertilisation): As in the case of croplands, carbon storage in grazing lands can be improved by a variety of measures that promote productivity. Alleviating nutrient deficiencies by fertiliser or organic amendments, for example, increases plant litter returns and, as a result, soil carbon storage (Schnabel et al., 2001; Conant et al., 2001).

Nutrient management: Practices that tailor nutrient additions to plant uptake, such as those described for croplands, can reduce N_2O emissions (Dalal et al., 2003; Follett et al., 2001).

Fire management: On-site biomass burning (not to be confused with bio-energy, where biomass is combusted off-site for energy) contributes to climate change in several ways. Firstly, it releases GHGs, notably CH_4 and, and to a lesser extent, N_2O (the CO_2 released is of recent origin, is absorbed by vegetative regrowth, and is usually not included in GHG inventories). Mitigation actions involve reducing the frequency or extent of fires through more effective fire suppression; reducing the fuel load by vegetation management; and burning at a time of year when less CH_4 and N_2O are emitted (Korontzi et al., 2003).

Species introduction: Introducing grass species with higher productivity or carbon allocation to deeper roots has been shown to increase soil carbon. For example, establishing deep-rooted grasses in savannahs has been reported to yield very high rates of carbon accrual (Fisher et al., 1994), although the applicability of these results has not been widely confirmed (Conant et al., 2001; Davidson et al., 1995).

2.3 Management of organic/peaty soils

To be used for agriculture, these soils require draining, which aerates the soil, favouring decomposition and therefore high CO_2 and N_2O fluxes. Methane emissions are usually suppressed after draining, but this effect is far outweighed by the pronounced increases in N_2O and CO_2 (Kasimir-Klemedtsson et al., 1997). Emissions from drained organic soils can be reduced to some extent by practices such as avoiding row crops and tubers; avoiding deep ploughing; and maintaining a shallower water table. However, the most important mitigation practice is to avoid the draining of these soils in the first place, or to re-establish a high water table (Freibauer et al., 2004).

2.4 Restoration of degraded lands

Carbon storage in these soils can be partly restored by practices that reclaim productivity, such as re-vegetation (e.g. planting grasses); improving fertility by nutrient amendments; applying organic substrates such as manures, biosolids and composts; reducing tillage and retaining crop residues; and conserving water (Lal, 2001b, 2004b; Bruce et al., 1999; Olsson and Ardö, 2002; Paustian et al., 2004).

2.5 Livestock management

Practices for reducing CH_4 and N_2O emissions from this source fall into three general categories: improved feeding practices; the use of specific agents or dietary additives; and longer-term management changes and animal breeding (Soliva et al., 2006; Monteny et al., 2006).

Improved feeding practices: Methane emissions can be reduced by feeding with more concentrates, normally to replace forage (Blaxter and Claperton, 1965; Johnson and Johnson, 1995; Lovett et al., 2003; Beauchemin and McGinn, 2005). Other practices that can reduce CH_4 emissions include: improving animals' diets (Machmüller et al., 2000; Jordan et al., 2006c); improving pasture quality, since this improves animal productivity and reduces the proportion of energy lost as CH_4 (Leng, 1991; McCrabb et al., 1998; Alcock and Hegarty, 2006); and optimising protein intake to reduce nitrogen excretion and N_2O emissions (Clark et al., 2005).

Longer-term management changes and animal breeding: Increasing productivity through breeding and better management practices, such as a reduction in the number of replacement heifers, often reduces methane output per unit of animal product (Boadi et al., 2004).

2.6 Manure management

Methane emissions from manure stored in lagoons or tanks can be reduced by cooling; using solid covers; mechanically separating solids from slurry; or capturing the CH_4 emitted (Amon et al., 2006; Clemens and Ahlgrimm, 2001; Monteny et al., 2001, 2006; Paustian et al., 2004).

2.7 Bioenergy

Agricultural crops and residues are increasingly seen as sources of energy to replace fossil fuels. A wide range of materials have been proposed for use, including grain, crop residue, cellulosic crops (e.g. switchgrass, sugarcane), and various tree species (Edmonds, 2004; Cerri et al., 2004; Paustian et al., 2004; Sheehan et al., 2004; Dias de Oliveira et al., 2005; Eidman, 2005).

Table 5 gives a summary of the measures described above.

Table 5. Summary of possible mitigation measures in AEZs

Measures/options	Examples	AEZ where practices can be implemented			
		LAEZ	IAEZ	NCMAEZ	SHAEZ
Cropland management	Agronomy	+	+	+	+
	Nutrient management	+	+	+/-	+/-
	Tillage/residue management	+	+	+	+
	Water management (irrigation/drainage)	+	+	+	+
	Agro-forestry	+	+	+/-	+/-
	Land-use change	+	+	+/-	+/-
Grazing land management/pasture improvement	Grazing intensity	+/-	+/-	+	+
	Increased productivity (e.g fertilisation)	+	+	+	+
	Nutrient management	+	+	+	+
	Fire management	+	+	+/-	+/-
	Species introduction (legumes)	+	+	+	+
Management of organic soils	Avoiding drainage of wetlands	+	-	-	-
Restoration of degraded lands	Erosion control, organic amendments, nutrient amendments	+/-	+	+	+
Manure management	Improved manure storage	+	+	+/-	+/-
	Anaerobic digestion	+	+/-	+/-	+/-
	Efficient use as nutrient source	+	+	+	+
Bioenergy	Energy crops; solids, liquids, biogas, residues	+	+	+	+

LAEZ – Lowland Agro-ecological Zone; IAEZ – Intermediate Agro-ecological Zone; NCMAEZ – Northern and Central Mountains Agro-ecological Zone; SHAEZ – Southern Highland Agro-ecological Zone.

3 Analysis of conditions and gaps and the need to widen mitigation options in Albania

The Government of Albania has included the Millennium Development Goals (MDGs) into its national planning monitoring and evaluation system. In this context, climate change strategy and related indicators have successfully been addressed in the newly adopted National Energy Strategy, which is a part of the National Strategy for Socio-Economic Development (NSSED). The objectives of the Strategy for the Development of the Agriculture and Food Sector are in line with the action plan developed in the framework of the Stabilization and Association Agreement; the MDGs; the objectives of the Decentralistion Strategy, through the transfer to local government level of management responsibilities for natural resources such as land, forests, water etc.; and the objectives of other sectoral strategies such as the Rural Development Strategy. Regarding livestock production, the strategy aims to consolidate achievements to date by creating new production chains in order to implement a purebred livestock programme; increasing the production of combined livestock feedstuff; and carrying out qualitative production and marketing checks. The legal framework with respect to the agricultural sector, directly or indirectly related to emissions released into the atmosphere, is relatively young.

The new Strategy for the Development of the Agriculture and Food Sector opens the way to improving the existing legislation and developing new laws aimed at regulating agricultural activities, which in turn will reduce environmental impacts. This includes the Law on Land Protection; the Law on Purebreed Reproducers and Purebred Livestock Herds; and the regulatory framework for livestock feedstuff inspection, the certification of animals with purebreed value on the market, and the provision of minimum standards for pet breeding.

In order to respond to future challenges for agriculture by addressing climate change and increasing food security, a coherent policy approach is needed to:

- ensure a stable policy environment that sends clear signals to consumers and producers about the costs and benefits of GHG mitigation/sequestration activities;
- disseminate good management practices in the agriculture and forestry sectors;
- invest in agriculture, forestry, energy efficiency etc. to develop new technologies for reducing GHG emissions and increasing productivity;
- build capacity to better understand and measure the impact of climate change on agriculture and to monitor progress relative to national and international climate change goals;
- facilitate adaptation by increasing producer resilience to climate change while ensuring compensation for the most vulnerable groups; and
- implement selected key mitigation technologies based on specific AEZs and site conditions.

Albania needs to develop tools to analyse the design and implementation of cost-effective policies, allowing the agricultural sector to adapt to and mitigate climate change and facilitating the exchange of experiences among countries on policies addressing climate change in agriculture.

3.1 Mitigation measures implemented in Albania

Albania has taken steps in different sectors towards adaptation to, and the mitigation of, climate change impacts. In 2009, the country prepared its Second National Communication (SNC) to the Conference of Parties under the United Nations Framework Convention on Climate Change. The SNC presents the situation in terms of GHG emissions from various sectors for the 1990–2000 period; the sources of those emissions; and measures/recommendations for abatement/mitigation by sector.

In 2009, the World Bank launched a programme for selected Eastern European and Central Asian countries to enhance the ability of these countries to mainstream climate change adaptation into agricultural policies, programmes and investments. In this framework, in 2011 the consultancy firm Industrial Economics Incorporated (IEc) produced the study “Reducing the Vulnerability of Albania’s Agricultural Systems to Climate Change”. This report includes a menu of climate change adaptation options for the agriculture and water resources sectors, along with specific adaptation actions tailored to four AEZs in Albania.

In 2011, the Albanian Government launched a national programme to increase the area planted with nuts and pomegranates with the aim of developing/renewing the traditional cultivation of these crops, which are considered to be a national asset. The goal of the programme is to plant nuts and pomegranates on an area of 32,000 ha throughout the country.

The Albanian Government aims to increase the area of land planted with olive trees by 60,000 ha (or 20 million olive trees) over the coming four to five years in the Lowland and Intermediate AEZs.

Albania is among the first countries to sequester carbon on eroded land. The project “Assisted Natural Regeneration of Degraded Lands in Albania” focuses on the reforestation of degraded lands by promoting the natural regeneration of vegetation that will result in improved biomass accumulation, reduced soil degradation, improved water quality, the conservation of biodiversity and, ultimately, improved livelihoods for poor rural households. The project encourages a participatory approach within the community in order to reach common agreement on the selection of sites and their protection from grazing; and to facilitate the implementation of the necessary interventions. The Biocarbon Fund, a public–private initiative administered by the World Bank, reached an agreement with the Albanian Government to purchase emission reductions achieved as a result of carbon sequestration activities, estimated at about USD 1.04 million. Actual net removal by sinks is estimated at 450,000, tCO_2eq over the 20-year project period.

3.2 Other required actions

- *The translation of strategies and legislation into programmes and projects*: Continuous support from the state budget, local government budgets and donors is crucial to ensuring and expanding implementation.
- *Low-carbon (or low-emissions) sectoral development strategies*: The strategy for the development of the agriculture and forestry sector should have a greater focus on the restoration of degraded forests, afforestation, reducing deforestation, and sustaining soil CO_2 content and ensuring its increase. Such strategies should also include climate change mitigation and adaptation measures. Technological improvements, energy efficiency and renewable energy should also be integral aspects of these strategies.
- *National climate action frameworks or plans for each sector*: Realistic plans need to be developed, based on the specific conditions in Albania. In order to be effective, these plans must also be supported by an appropriate budget. The following requirements can be identified in the agriculture and forestry sector: improving the legislative base; introducing/developing mitigation technologies; strengthening national and local capacities for carbon financing; and improving awareness of the application of mitigation measures. In all sectors, the preparation of low-emission development strategies and appropriate mitigation actions is required.
- *National initiatives to coordinate policy on climate change and mitigation/adaptation options, including agriculture*: There is a need for the harmonisation and synergy of sectoral strategies and the respective legal basis. The annual budgets of the different sectors must include funds for planning and implementing mitigation measures.
- *Support to farming initiatives*: Such support might include financial incentives and regulations for improving land management, maintaining soil carbon content, and ensuring the efficient use of fertilisers and irrigation. Financial incentives might also be introduced to increase forest area, reduce deforestation, maintain and manage forests, ensure land-use regulation and enforcement, and promote the use of bio-energy and the cultivation of crops for energy.
- *Capacity building*: Required activities include: expanding extension service capacity; encouraging the consolidation of farmland into larger holdings to facilitate more substantial investments in on-farm technology; and encouraging private sector efforts to adapt to climate change. It is also important to promote and implement best management practices in agriculture and forestry. Capacities should be strengthened at national level to map and assess with greater accuracy crop suitability and the functionality of existing drainage capacity, particularly in flood-prone areas, and new drainage capacity standards should be considered. Other institutional capacity improvements should focus on identifying drought-tolerant varieties of seeds and temperature-tolerant livestock on the current international

market for adoption in Albania; as well as on training farmers in the more efficient use of water and adaptation and mitigation measures in the agriculture sector.

3.3 Barriers to mitigation options in agriculture

- The major barriers limiting mitigation options in agriculture are: damage to irrigation and drainage systems; lack of permanent financial support; trade policies; the country's rugged mountainous terrain; the absence of an agro-processing industry in the country; and poverty. In the forestry sector, the barriers are: the negative balance between growing and logging; low energy efficiency in the use of timber; steep terrain, degraded land and poor soils; lack of investments for new planting and forest improvement; and lack of support for forest planting.
- The current agricultural extension service is institutionally far reaching but not oriented towards ameliorating climate change risks. Albania employs 250 extension service personnel, who work in 100 small offices throughout the country. Despite this, the service has little or no capacity to advise on mitigation in agricultural systems.
- Many farms are small and have limited resources for adaptation investments and little opportunity for the broad implementation of mitigation options. The total number of farms is gradually decreasing, mainly due to migration and farm mergers, but the average size remains small (at 1.2 ha per family) and parcel ownership may be fragmented (0.2 ha per parcel). Production on most small farms cannot be mechanised due to financial constraints.
- Agricultural research capabilities are expanding but have few connections to extension. The Agricultural Technology Transfer Centres, or ATTCs, conduct agricultural research and gather information. However, these agricultural research institutes have not yet focused on climate change as a major risk to agricultural production, and could be more effectively coordinated with the extension service. Research could be better focused on leveraging advances in seed varieties and farming practices, and on coordinating with the extension service to demonstrate results locally, particularly among small-scale farmers.
- Agricultural markets are limited. Farms in Albania are mostly subsistence farms that produce for family consumption and have no market links. Most farmers operate as individuals, and organised activities in terms of marketing and other areas are very limited. A few entrepreneurial landowners are developing businesses (for vegetable and fruit production, especially grapes) aimed at wholesale markets, and the number of such producers is gradually increasing.
- Under an incentive-based system, such as a carbon market, the amount of money farmers receive is not the market price but the market price less brokerage cost. This may be substantial and the proportion is increasing as the amount of carbon involved diminishes, creating a serious entry barrier for smallholders.
- Property rights, landholdings, and the lack of clear single-party land ownership in the country may hinder the implementation of management changes.
- The implementation of agricultural GHG mitigation measures may allow the expanded use of fossil fuels, and may have some negative effects through emissions of sulphur and other pollutants (Elbakidze and McCarl, 2007).
- Agricultural mitigation practices may influence non-agricultural ecosystems. Practices that diminish productivity in existing cropland (e.g. set-aside land) or divert products to alternative uses (e.g. bio-energy crops) may encourage the conversion of forests to cropland elsewhere. Conversely, increasing productivity on existing croplands may

"spare" some forest or grasslands (West and Marland, 2003; Balmford et al., 2005; Mooney et al., 2005). The net effect of such trade-offs on biodiversity and other ecosystem services has not yet been fully quantified (Huston and Marland, 2003; Green et al., 2005).

- Agricultural practices for climate change mitigation can have both negative and positive effects on water conservation and water quality. Measures promoting efficient water use (e.g. reduced tillage) provide potential benefits. In some cases, however, practices could intensify water use, thereby reducing stream flow or groundwater reserves (Unkovich, 2003; Dias de Oliveira et al., 2005). High-productivity, evergreen, deep-rooted bio-energy plantations generally have higher water consumption than the land cover they replace (Berndes, 2002; Jackson et al., 2005). Some practices may affect water quality through the enhanced leaching of pesticides and nutrients (Freibauer et al., 2004; Machado and Silva, 2001).

4 Suggestions for decision makers

At national level, the most appropriate focus for the consideration of policy and institutional capacity measures that are valuable in themselves, or that are essential to ensuring that farm-level and private sector actions are applied to their best advantage, are:

- Increasing access among farmers to technology and information through farmer education, both in general and specifically in relation to climate change adaptation. This will support better agronomic practices at farm level, including the implementation of more widespread demonstration plots and access to better information on best management practices and the availability of high-yield crop varieties. It will also support measures with a focus on maintaining yields during extreme water stress periods, which are likely be become more frequent as a result of climate change.
- Improving the dissemination of hydrometeorological information to farmers. The collection and dissemination of climatological information to farmers is currently adequate.
- Improving the collection and dissemination of information on soil types, drainage potential and crop suitability. This would be in parallel with measures to improve drainage infrastructure; and to focus drainage efforts on areas with the greatest potential for yield increases. Crop modelling at a more specific level, linked to spatial soil information, could be a powerful tool for targeting infrastructure investments. This measure is more appropriate for the Lowland AEZ.
- Considering national policy measures to further consolidate farm holdings. On-farm adaptive capacity is limited by the generally small size of Albanian farms.
- Encouraging private sector involvement for efficient adaptation to climate change. The government should focus on putting in place policies that enable the private sector to effectively assist in adaptation and mitigation options, for example testing seed and livestock varieties for their suitability for the Albanian climate, terrain and soil conditions; and making recommendations for the expansion of best varieties while allowing the private sector to provide those varieties.
- Introducing nationally appropriate mitigation actions (NAMAs), which are instruments for establishing country commitments to reduce GHG emissions, including emissions

from agriculture. Developing countries such as Albania can seek financing for such activities.

- Using plantations for bio-energy. These may reduce nutrient leaching and soil erosion and generate additional environmental services such as soil carbon accumulation; improved soil fertility; the removal of cadmium and other heavy metals from soils or waste; and improved biodiversity values. They may also increase nutrient recirculation; aid in the treatment of nutrient-rich wastewater and sludge; and provide biodiversity habitats in the agricultural landscape (Berndes and Börjesson, 2002; Berndes et al., 2004; Börjesson and Berndes, 2006).
- Supporting the modernisation of livestock farms and the dairy industry through agriculture policy measures, which means supporting an increase in specialised farms, improving productivity, and improving consumer communication strategies in order to boost consumption of local milk products.
- Carrying out a policy analysis based on a statistical database in order to formulate appropriate policy measures. The developed database should contain all the data necessary for this purpose, requiring the establishment of several registers and an animal identification system, which is currently lacking.
- Formalising the production of and trade in agricultural and livestock products, through government efforts to improve the business environment. This will create better opportunities and provide greater incentives for investments in the agriculture and livestock sector.
- Training staff working in the agricultural sector (e.g. extension service), given that climate change represents a new issue in the agricultural sector.
- Undertaking feasibility studies on the applicability of proposed measures, and analyses of the gaps/needs in the country’s agricultural sector.
- Producing guidelines for agricultural practices in a changing climate (crop selection/substitution, conservation tillage etc.), and for afforestation/reforestation in a changing climate.
- Compiling, consolidating and implementing a national policy on organic agriculture, thus allowing synergies with relevant institutions and other development policies.

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