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Adaptations to potential impacts of climate change in the "New Hungary" Rural Development Programme

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Summary: There are evidences that the climate is changing and the effects on agriculture and wildlife are discernible. Spring is occurring earlier and autumn later, all of which have impacts on agriculture and forestry. Climate change is also predicted to result in more frequent droughts, increased flooding in Hungary, but the relationship between agriculture and climate change is more complex. Climate change has physical effects on farming and farm based wildlife. Agriculture needs to adapt to climate change by exploring, which crops and farming systems are best adapted to the changed conditions. Land management also needs to adapt to preserve biodiversity by protecting valuable habitats and species and helping them in the changing environment. With better management, agriculture and forestry can also mitigate climate change by reducing direct greenhouse gas emissions from land use, land use change and forestry, by producing crops as a source of renewable energy and by protecting carbon stored in soils and in manure.

The HRDP comprises of a series of funding based on the following overarching priorities: (i) enhance the environment and countryside, (ii) making agriculture and forestry more competitive and sustainable, (iii) enhancing opportunity in rural areas, whether in the farming sector or the broader rural economy. Actions discussed in this paper are based on the New Hungary Rural Development Programme (2007–2013) and focused on reducing the effects of climate change in rural area. Establishment of agro-forestry systems and integrated pest management help mitigation goals and increase climate change adaptation potential. Minimizing unwanted side effects of agriculture by reducing the use of fertilizer and increasing the safety for environment (soil, water, and air) and human health have positive effects on adaptation potential. Restoration of agricultural production though diversification of agriculture and pastures management, improvement in drainage and irrigation equipment are good examples of adaptation for climate change. Integrated production, which is oriented to controlled cultivation of crops, vine, fruits and vegetables, and improvement of animal rearing conditions to increase production standards and overall welfare are preferred and ecologically sound methods of adaptation.

Key words: Climate change, Rural Development Programme, Adaptation, Hungary

Introduction

Over the last 2,400,000 years the Earth's climate has been unstable, with very significant temperature changes, going from a warm climate to an ice age in as rapidly as a few decades. Collected information indicates a strong correlation between carbon dioxide content (CO_2) in the atmosphere and temperature increase (*Walther* et al. 2002, IPCC, 2007). These changes suggest that climate is very sensitive, even if temperatures have been relatively stable during the last 10,000 years. During this period, global mean temperatures have varied less than 1°C in a century, but anthropogenic emissions of green house gases (GHG) could bring the climate to a state where it reverts to the highly unstable climate of the pre-ice age period (*Baettig* et al. 2007, *Easterling* et al, 2007). Since the beginning of the twentieth century, the global average surface temperature has risen by 0.74°C, although this increase has not been continuous (Jones et al. 1999, *Fischlin* et al. 2007). The linear warming trend over the past 50 years (0.13°C per decade) is nearly twice that for the past 100 years (*Brohan* et al. 2006, Yohe et al. 2007).

Adaptation research is focused on establishing services that enable decision-makers to manage the risks associated with extreme climate conditions and allow communities to adapt to climate change (FAO 2003, *Hitz, Smith* 2004, *Parry* et al. 2005, *Tompkins, Adger* 2005, and HRDP 2007–2013). Improved understanding of the climate system can contribute to enhancing the well-being of society as climate prediction centres have the skills to produce useful climate predictions and information in the coming years (*Brooks, Adger* 2005). Results of adaptation research include maps of potential risks and opportunities, ecological potentials for renewable energy sources, urban management, disease outbreak and accurate climate predictions, but the skills of climate monitoring and prediction must be improved as the world is served by one climate system, which redistributes heat, energy and other atmospheric and oceanic constituents (*Cline* 2007). Mitigation and adaptation requirements cannot be achieved by individual countries alone.

Priorities of the New Hungary Rural Development Programme in 2007 to 2013 period

Objectives established in Regulation (EC) No 1698/2005 aim at the integration of major policy priorities as declared in the conclusions of the Lisbon and Goteborg European Council

meetings. On the basis of these strategic guidelines, Hungary has prepared its national strategy plan as the reference framework for the preparation of rural development programmes. The resources devoted to the priorities depend on the specific situation, strengths, weaknesses and opportunities of each programme area and their contribution to the Lisbon and Goteborg objectives.

Axis 1: **Strategic guideline of improving the competitiveness of the agricultural and forestry sector:** Hungarian agricultural, forestry and food-processing sectors have great potential to high-quality and value-added products that meet the demand of consumers. Competitiveness of agriculture is focused on the priorities of knowledge transfer, modernisation, innovation in the food chain, and on the investments in physical and human capital. Key actions in Hungary include restructuring and modernisation of the agriculture, which continue to play an important role in the development of rural areas. Improving the competitiveness and environmental sustainability of Hungarian agriculture and food industry are key elements of the HRDP. There is considerable scope in the rural economy to create new products, to retain more value in rural areas through quality schemes and to raise the reputation of traditionally Hungarian foods. A market-oriented agriculture helps to consolidate the position of sector. Support of advisory services to meet EU standards also contributes to the process of integration. Introduction of new products and processes could significantly contribute to the performance of smaller farm businesses in the coming years. New forms of cooperation facilitate the access to the results of R & D activities. This brings new opportunities for farm businesses, but the realisation of this economic potential depends on the strategic and organisational skills. Encouraging young farmers can play an important role in this respect as long-term sustainability depends on the production of high quality products, while achieving high environmental standards.

Axis 2: **Strategic guideline of improving the environment and the countryside:** Axis 2 of HRDP contributes to preservation and development of high nature value farming and forestry systems to protect natural resources and landscapes in rural areas. The measures integrate environmental objectives and contribute to the implementation of Natura 2000 network and the Goteborg commitment to reverse biodiversity decline. Action in the field of water policy and establishing a framework to meet the new targets for climate change mitigation are also important parts of HRDP. Hungarian farmers respect mandatory standards of EU registration and deliver services focused on specific resources, such as water and soil. In less-favoured areas, sustainable land management practices reduce the risks linked to climate change and desertification. Environmental friendly farming helps to preserve landscapes and habitats, which are important part of the cultural and natural heritage and of the attractiveness of rural areas. Agriculture and forestry are at the frontline of the development of renewable energy and sources for bio-energy installations. Sustainable agricultural and forestry practices contribute to the reduction in GHG emissions and preservation of the carbon sink effect of soil and vegetation. Organic farming represents a holistic approach in this respect and the provision of environmental goods form a basis for growth. In this way, HRDP can make a vital contribution to the attractiveness of rural areas.

Axis 3: **Strategic guideline of improving the quality of life in rural areas and encouraging diversification of the rural economy:** The measures are used to promote capacity building, skills acquisition and help rural areas to remain attractive for future generations. Multifunctional agriculture and diversification of activities are also necessary for sustainable development in both economic and social terms. Developing micro-business on new competencies and crafts build on traditional skills can increase employment, particularly when this is combined with training to promote entrepreneurship, traditional rural practices, environmental services and quality products. Innovative use of renewable energy sources are major element of growth and contribute to creation of new products in rural areas.

Axis 4: **Strategic guideline of building local capacity for employment and diversification:** Support under axis 4 is in the context of a community-led local development strategy building on local needs and strengths, to combine the objectives of competitiveness, environment and quality of life. Integrated approaches safeguard the natural and cultural heritage, raise environmental awareness and promote local services.

Material and methods

There are two main categories of response to climate change (i) climate change mitigation (actions aimed at reducing the causes of climate change) and climate change adaptation (actions aimed at adapting to the climatic changes that are already inevitable). Agriculture and forestry sector is unique in having the ability to produce and to sequester greenhouse gases, as well as to provide biomass-derived renewable energy. Climate change adaptation strategy of the New Hungary Rural Development Programme is discussed in this paper, which addresses topics, such as biodiversity, water quality, irrigation and their role in agriculture, implementation of the Nitrates and Water Framework Directives on farmland, climate change mitigation in agriculture including bio-energy, soil quality, organic farming, landscape management and protection the traditional form of land use.

Adaptations Objectives of the New Hungary Rural Development Programme

1. / Emissions of greenhouse gases in Hungary

Agriculture and forestry currently account for about 12–15% of total greenhouse gas emissions in Hungary. The focus is on methane (CH_4) and nitrous oxide (N_2O) emissions. Agriculture accounts for around 33% of methane

emissions and 70% of nitrous oxide emissions. About 77% of this methane comes from enteric fermentation in the digestive system of animals and 22% from manure management. The nitrous oxide emissions arise from manures and artificial fertiliser. Methane and nitrous oxide have global warming potentials that are 21 and 310 times greater than carbon dioxide. Emissions of carbon dioxide (CO_2) are from direct energy use, such as diesel in tractors, gas to heat and electricity in livestock buildings. Although agriculture is responsible for around 10–11% of GHG emissions, the sector can help to mitigate CO_2 emissions from other sources through carbon sequestration in soils and timber.

Carbon dioxide, the most important greenhouse gas is produced largely by combustion of fossil fuels. *Between* 1985 and 2007, total GHG emissions fell by 35% in Hungary. Much of this decline has come from the energy sector *(Figure 1)*. Emissions have fallen continually except for waste management. Energy sector including the transport accounted for over 75% of GHG emission. Agriculture is responsible for a very small share of CO_2 emissions. Agricultural practices are significant sources of methane and nitrous oxide, which are important contributors of climate change, but emissions of this sector have also declined since 1985.

The main objective of the HRDP is the improved understanding of the management of greenhouse gas emissions from soils under different forms of land use and disturbance regimes. Carbon dioxide emissions associated with the land use, land-use change and forestry are presented in *Figure 2*. The most important sink of CO_2 in Hungary is forestry, but in many years agricultural activities also contribute to CO_2 sequestration. The main objective of the HRDP is the improved understanding of the management of greenhouse gas emissions from soils under different forms of land use and disturbance regimes.

Methane emissions have declined considerably over the last 30 years. Emissions from agriculture increased up till the mid 1980s, then stabilised. Emissions have declined by about 24% in the early 1990's, mainly as a result of reduced livestock numbers *(Figure 3)*. Agricultural emissions of nitrous oxide have fallen in 1990s, probably due to reductions in fertiliser use. The level of emissions is now 50% as it was 30 years ago. However, the emissions from manure management have stabilized and from agricultural soils have increased slightly since 1994 *(Figure 4)*. Contribution of agriculture to total nitrous oxide emissions is between 65 and 75%.

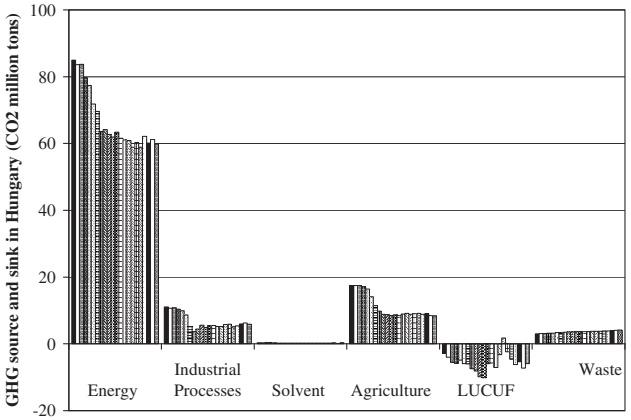

Figure 1: GHG source and sink in Hungary between 1985 and 2007 (million tons)

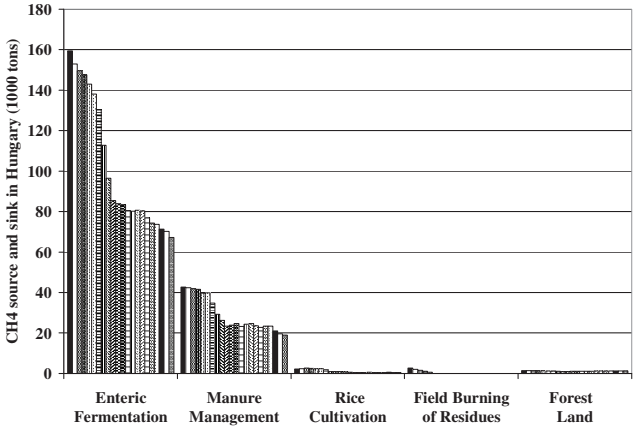

Figure 3: CH_4 source and sink in Hungary between 1985 and 2007 (1000 tons)

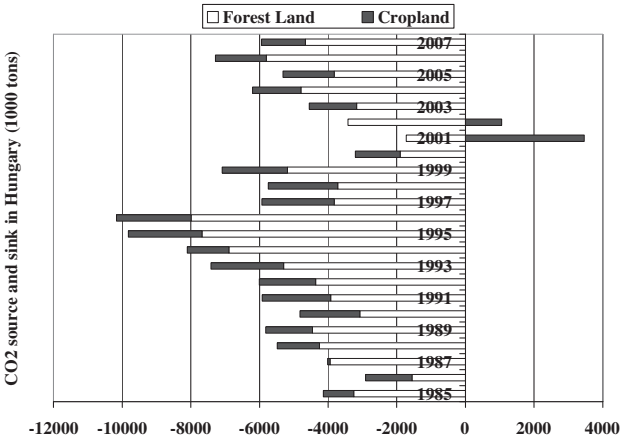

Figure 2: CO_2 source and sink in Hungary from LUCUF (1000 tons) between 1985 and 2007

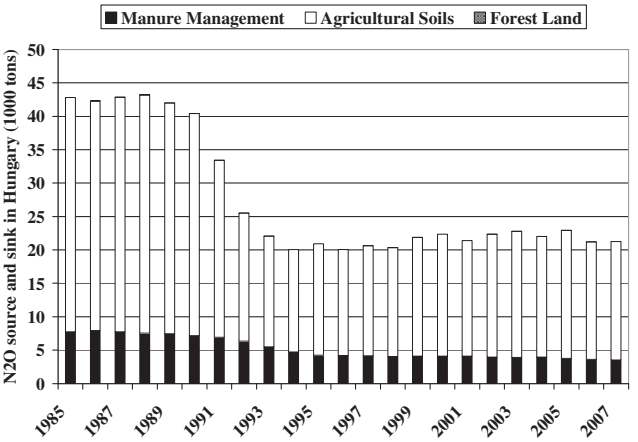

Figure 4: N_2O source and sink in Hungary between 1985 and 2007 (1000 tons)

2. / Adaptation activities in Hungary

Agriculture is central to facilitate the process of adaptation by habitats and species, especially through the provision of ecosystem services, which is increasingly important and valued by society. At present, many valuable habitats are fragmented and surrounded by intensively managed farmland with semi-natural habitat. To improve the resilience of valuable habitats and allow species to migrate in the face of changing climate, this isolation needs to be reduced and the environmental quality of the isolation matrix improved. Some of the species benefit from climate change including plants characteristic of dry grasslands. However, species that are already at the edge of their range, such as those characteristic of wetland conditions and mountain regions may face local extinction. HRDP helps agriculture; forestry and land management sector to play its full part in tackling climate change and promote resource efficient farm management. It assists the production of non-food crops to substitute fossil fuels and ensures the development of ecological farming. Forestation and to a certain extent agro-forestry systems improve landscape value and support climate change goals. Water-saving production techniques, such as diversified crop rotations are also contribute to climate change adaptation operations and have effects on competitiveness of farming.

The first objective of HRDP is the development of agricultural infrastructures to improve the overall performance and competitiveness of the agricultural holdings through modernization of production and introduction of new processes and technologies. Eligible investments include assets used for agricultural production and for environmental protection. These measures contribute to the mitigation of green house gases and adaptation to climate change. Extensive pastures management, diversification of grass species and improvement of drainage, irrigation equipment are good examples for climate change adaptation. Measures include rehabilitation of existing and construction of new draining facilities, as well as investments in irrigation equipment and rehabilitation of existing networks. Development of water storage capacity, installations for waste water treatment are well focused in the HRDP, similarly to water-saving production techniques, such as diversified crop rotations, introduction new crops, irrigation practices, and integrated pest management, which also contributes to climate change adaptation.

Actions under arable farming include the development of technology in storage and drying, while actions under horticulture include investments in environmentally sound machinery, equipment, built technology and construction measures in order to improve efficiency of irrigation equipment by modernisation of existing irrigation systems and save water. Actions also include establishment and reconstruction of water saving irrigation plants, modernising irrigation-network, which serves the needs of producers. Actions of HRDP include development of new water-management facilities to aid delivery, distribution and control of water and facilitate professional treatment of wastewater generated within agricultural and horticultural holdings. Flood prevention and management measures and preventive actions against adverse effects of climate-related extreme events are important task in the coming years. Adaptation potential of agri-food sector is also increased by storage and processing of wastewater and biological waste. Construction, reconstruction and modernization of farm buildings are important part of climate change adaptation operations and increase efficiency of production.

Integrated crop production scheme promotes environmentally friendly plant production, which includes soil protection and adequate land cultivation in order to conserve soils, surface and ground waters actions, establishments and improved management of wetland habitat. Integrated pest management scheme includes rational nutrient management, integrated plant production, crop rotation and land cultivation to conserve soil. Plant protection activities should be carried out on the basis of forecasts and documented plant protection. Integrated production is oriented to cultivation of arable crops, vine, fruits and vegetables with ecologically safer methods, which minimize unwanted side effects by reducing the use of fertilizer and plant protection products and increasing the safety for environment (soil, water, and air) and human health.

Climate change represents a risk for the countryside due to the more frequent occurrence of extreme weather conditions, which threaten both agricultural production and the property of rural inhabitants. HRDP takes these risks into account and it contributes to the fulfilment of objectives of VAHAVA programme on the mitigation of climate change impact. Adaptation goals are well expressed in the conservation of genetic resources, which includes (i) the protection of biotopes of semi-natural and natural grasslands, (ii) the protection of biotopes of selected bird species, (iii) taking care of endangered species and local varieties.

Setting up and use of advisory services, training and demonstration projects are important part of adaptation to climate change. Training young people for environmental stewardship can make an important contribution to adaptation objectives in the coming years. Developing a communications strategy to communicate climate change issues to land managers is well focused in the HRDP. Support granted to farmers and forest holders for the utilization of professional advisory services is an important part of climate change mitigation and adaptation goals and contribute to maintenance of good agricultural and environmental condition, which assist diversification of the local economy. In the HRDP, considerable support is available for upgrading local infrastructure with investment in telecommunications, transport, energy and water networks assist local services, traditional rural practices and high quality local products.

Discussion and results

The effects of climate change on agriculture and wildlife are discernible. Drought is occurring earlier and frost later, with a consequent change in the growth cycle. Agriculture itself needs to adapt to climate change, by coping with different

conditions and exploring which crops and farming systems are best adapted to the changed conditions. It is also likely, that there will be reduced availability of water in the vegetation period. Climate change suggests a pattern of drier summers, but water consumption remains very high. These problems are particularly accentuated in the drought zone of the Great Hungarian Plain. Due to the expected deficit in rainfall and loss of soil fertility, the spring crops are the most vulnerable to climate change, which will impose irrigation and additional ameliorative actions during the vegetation period for compensating the lack of soil humidity. Regions, where rainfalls are insufficient for normal plant growth even in the present climate conditions, will suffer more from the effects of climate change.

Climate change may result unforeseen floods and drought disasters in Hungary. The native ability of species to adapt to the changing environmental conditions needs to be supported. Extreme weather events like increasing temperature, humidity changes, drought, and floods could result in extinction of species and deterioration of habitats. Prevention and coping with the potential impacts of climate change is important, especially in cases, when adaptation ability of species is limited. Approximately 40% of the total budget of the HRDP is devoted to this priority. In line with the statement of VAHAVA project on potential impacts of climate change, HRDP helps the overall aim of sustainable development. Based on the need to control emissions contributing to climate change, highlights the responsibility of land owners, as providers of environmental goods and other public services.

One of the main objectives of climate change adaptation in Hungary is to lower the extent of water erosion and prevent water outflow from cultivated land. Agri-environmental measures supporting organic farming, integrated agriculture and environmental protection are important chapters of climate change adaptation in agriculture. With conservation of biodiversity, natural and cultural heritage of landscape, the potential impacts of climate change on agriculture are also reduced. The HRDP seeks to change the management practices in agriculture and improves the connections between environmental, social and economic aspects of rural development.

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