Eva LACZKA – Tibor FARAGO:

Climate Change Policy and Need for Adequate Statistical Information with Special Regard to Agriculture

Nowadays, climate change is a highly debated topic at both national and international forums.

The hazard of the global climate change, its anticipated implications and the necessary response measures have become the most crucial themes for environment related scientific and policy studies. The increasing scientific evidence of this process and of its anthropogenic forcing factors strongly motivated the politicians to face this challenge, to accept the "common but differentiated" responsibility for this emerging global hazard and to agree on the need for the coordinated actions. As a result, the UN Framework Convention on Climate Change (UNFCCC) was adopted in 1992 followed with the Kyoto Protocol five years later. Besides these international legal agreements, the various commitments and provisions included in them, regional and national level strategies and action plans have been developed. All these legal and policy instruments basically deal with two - partially interrelated - areas, namely, with mitigation policies and adaptation policies.

Adequate analytical background is a significant prerequisite for these policy responses for various reasons. Firstly, clear knowledge on the ongoing environmental pressures, primarily in terms of increasing atmospheric concentrations and emissions of the greenhouse gases (GHG), moreover, the detailed information on their natural and man-made sources are needed for improving detection and understanding of the extent of the problem. As there is a multitude of socio-economic activities with such emissions, only a rather punctual description of these activities and their changes can provide good basis for the formulation of effective mitigation policies. Besides the past and ongoing processes and their driving factors, assessment of the expected future behavior of these factors is also needed for the policy-makers. Secondly, the impacts of the global climate change should be described and/or assessed on various time horizons in order to develop the relevant adaptation responses. In this context, the availability of and access to proper statistical information for all related sectors and sub-sectors are significant on both sides of this complex issue, i.e., for the socio-economic activities, which are responsible for the GHG emissions and also for those areas, which are primarily affected by changes of the climatic (and the related environmental) conditions.

The investigation on climate change, its expected national level impacts, the main domestic sources of the GHG-s and the development of various policy options have been dealt with in Hungary since 1980s to a gradually increasing extent. These activities were intensified from the early 1990s in line with the international tendencies.

The anticipated effects of the climate change have to be taken into consideration both on the long and short terms. Already today the negative consequences of the constantly changing and often extreme meteorological and hydro-meteorological patterns are financially significant; the cost of rescue, reconstruction and prevention could be as much as one percent of the GDP. Annually on the long run climate change will adversely effect the environment, the overall health of our society and some key socio-economic sectors.

1. The premise of the Hungarian Climate Change Strategy

The Hungarian climate change related research runs back over 25 years. At the beginning the observation of domestic trends and their relations to global average surface temperature tendencies, furthermore complex data collection for better identification of the trends in climate parameters were in the focus of research.

During the second half of the 1980s the first complex studies about the effects of sustained draughts and extreme weather patterns in relation to expected climate change were done. The first thematic monographs on climate change related national research were published in 1990 and 1991 thanks to the support of the Ministry of Environment in course of preparation for the Rio Summit (UNCED).

Based on the previous research studies, first national general policy studies were developed for the sake to support the position setting for the international negotiations before 1992. From that time period on, the climate change related aspects were increasingly taken into account in various strategic documents and program, such as for instance, in the first National Environmental Program (NEP, adopted in 1997) and in the second NEP, six years later.

A project called „Global climate change: domestic issues and solutions" based on previous studies have been launched in 2003 as a cooperative effort between the Ministry of Environment and Water and Hungarian Academy of Sciences. Scientists and experts involved in the project have tried to predict the future patterns of domestic climate change, and its effects on certain sectors, as well as look for economic, social and political solutions. During the three-year course of this project relevant data, most significant international literature, other research findings, and agreements had been studied and evaluated.

The above mentioned three years' research program on the impacts of the climate change provided an even deeper basis for a new, comprehensive policy paper: the National Strategy on Climate Change that was just recently adopted by our National Assembly.

2. Purpose, fundaments and priorities of the Hungarian National Climate Change Strategy

When looking at the domestic consequences of climate change the globally predicted temperature rise of 2-2,5°C is an acceptable value of reference. The dual purpose system of the strategy covering both the decrease of greenhouse gas emission and adaptation to unavoidable changes had been designed using this scenario.

The overall purpose of the NCCS is to contribute to the national effort of decreasing the chance of a 2-2,5 ºC rise in average temperature; furthermore to help national environmental, social, and economic organizations to prepare for and adapt to the consequences of climate change.

The NCCS defines a triple priority system to deal with and solve the problems of climate change:

- Perception (calling in social and professional partners)
- Mitigation (achievable emission reduction)
- Adaptation (preparing for adaptation)

Although the Hungarian Climate Change Strategy deals with the impact of water management, agriculture, human health, and urban environment on the climate change, this study only focuses on the effects of and issues related to crop farming, animal breeding, forested and green areas.

3. Main characteristics of the Hungarian agriculture

Agriculture has always played a significant role in our country's economy in the past and even today. The size of cultivated agricultural land area is about 63 percent of the total land area, while 5 percent of the active earners are employed in agriculture. The share of agriculture in the Gross Domestic Products (GDP) is about 4 percent, and that of the food industry is more than 6 percent.

In the past fifteen years fundamental changes have taken place as regards the ownership and the structure of agriculture in Hungary. Previously a relatively small number of large-scale agricultural and food-industrial holdings were operating. After the privatisation of the land area, state farms and agricultural co-operatives were subdivided and a large number of small and medium size agricultural units were established.

According to the Farm Structure Survey 2005, 7 900 agricultural enterprises (business units) and 707 thousand private holdings were engaged in agricultural activity in Hungary.

The average size of the productive land area[*] used by agricultural enterprises was 487 hectare; the same value of private holdings was hardly more than 3.4 hectare. While 22 percent of agricultural enterprises used productive land area of size exceeding 300 hectare, 73 percent of the private holdings continued to cultivate productive land area below 1 hectare size.

26 percent of agricultural enterprises and 53 percent of private holdings were involved in animal breeding. 90 percent of the livestock of agricultural enterprises constituted of 2 species (cattle and pigs), in contrast to private holdings, where four species including pigs, cattle, sheep and horses amounted to the same figure.

The attributes of holdings by type of farming are also at variance. In 2005, 74 percent of the agricultural enterprises were engaged in crop farming, 9 percent in livestock farming, and 17 percent in mixed farming. In case of private holdings 47 percent of them were involved in crop farming, 21 percent in livestock farming, and 32 percent in mixed farming.

In 2005 the purpose of production of private holdings were also surveyed. That time 51 percent of the private holdings produced exclusively for own consumption, while the share of private holdings producing for market was only 15 percent. 33 percent of private holdings produced for selling the surplus. Production exclusively for own consumption was mainly

[*] Arable land, kitchen garden, orchard, vineyard, grassland, forest, reed, fishpond

typical for private holdings engaged in livestock farming (78 percent), whereas the share of production for market was the highest in case of crop farming (22 percent).

3.1. Land use – crop production

Crop production accounts for 60 percent of the total agricultural output.

83 percent of the country's area is used as productive land area, while 17 percent is out of agricultural production. The size of agricultural land (arable land, kitchen garden, meadow, pasture land, orchard, and vineyard) totals 5.8 million hectares; 19 percent of the country's area is forest, and 1 percent is reed and fishery.

In 2005, the total size of arable land exceeded 4 million hectares (49 percent). Two thirds of the crops seeded are cereals. In addition to cereals industrial crops (18 percent), forage crops (6.6 percent), potato and vegetables (combined 2.5) are produced.

The total area of orchards is 103 thousand hectares, in which apple is dominant (45 thousand hectares). Over the apple, sour cherry (13 thousand hectares) and plum (9 thousand hectares) are the most common orchard species. The total area of vineyards is about 84 thousand hectares of which 81 thousand hectares of grape were produced for wine making.

11 percent of the country's area is grassland.

3.2. Animal breeding

Animal breeding produces about 40 percent of the total agricultural output.

In the livestock unit composition cattle (42 percent) and pig (32 percent) aggregate the largest share; while poultry (14 percent), sheep (8 percent), and horse (4 percent) stocks are less significant.

The size of cattle stock was 702 thousand as of December 2006. 34 percent of the farms kept 1-2, 45 percent 3-9, 18 percent 10-99, and 3 percent more than 100 cattle. At that time the size of pig stock was 4 million. 64 percent of the farms kept 1-2, while 0.3 percent kept more than 100 pigs. The sheep stock was 1.3 million. 60 percent of the farms kept 1-9 sheep while the share of big sheep farms (breeding more than 100 sheep) was just 12 percent. The number of chicken was 30.3 million, 58 percent of the farms kept less than 100 chicks. The share of big chicken farms was 20 percent. Number of horses just was 60 thousand.

3.3. Forested and green areas

71 percent of the total 1.9 million hectares of forested area is covered by deciduous, hardwood; 13 percent by softwood; and 16 percent by pinewood. 24 percent of growing stock is oak, 13 percent is turkey oak (Quercus cerris), 12-12 percent is beech and locust, and 10 percent is pine; 42 percent of the forest is older than 40 years.

The green area of settlements covers about 40 thousand hectares. The neatness of public parks and premises greatly vary from settlement to settlement, and even between districts of cities. The size of these areas is constantly decreasing due to continuous real estate developments. However, when well maintained, these areas have a perceptible, positive effect on the microclimate of a given area. Forested areas near settlements provide good facilities for outdoor and sport activities.

4. Interaction between climate change and agricultural production

4.1 The effects of climate change on crop production

In the case of crop farming, a noteworthy effect of climate change is the more frequent extreme weather patterns. Flooding, flesh flooding, inland inundation, increasing wind speed, damages caused by hail, early and late frosts, extreme heat, and droughts are negative effects to be taken into consideration. Due to the uneven changes of seasons, the natural balance of the environment will be disturbed affecting all living creatures from micro-organisms to pests.

The area of Hungary is considered to be prone to droughts. There had been 28 years of droughts in the last century. 40 percent of all insured damages were related to drought which decreased agricultural revenues by 10 percent on average.

Damages caused by hail accounted for one fifth of all insured damages in the last 35 years.

In addition to damages caused by flooding, it has often happened over the last 20 years that years with excess water and rain were followed by droughts. Therefore, extremes in water supply created a serious economic risk. Flood and inland inundation damages combined accounted for 18 percent of all insured agricultural damages. Depending on annual rainfall and flooding, the size of area damaged by inland inundation was around 100-150 thousand hectares of agricultural land.

Erosion damages caused by flesh flooding affected 40 percent of Hungary's agricultural land. Furthermore, erosion had also damaged the infrastructure of industrial and municipal areas.

Extreme winds have negatively affected all agricultural areas. The most common effects caused by high winds are: mechanical damages, soil erosion, crop damages, etc.

In addition to the extreme weather patterns, the dominance and spread of invasion species such as pests and weeds is expected.

4.2 The effects of crop production on climate change

Out of the three most important greenhouse gases – carbon dioxide ($CO_{2)}$, nitrous oxide (N_2O), methane (CH_4) – crop farming significantly contributes to the nitrous oxide and methane emission.

Most of the nitrous oxide comes from the soil, part of it from nitrogen fertilizers (9 percent) and the other, larger part from denitrification (88 percent). These two are closely related since the use of nitrogen fertilizers increases denitrification. The largest methane emitter is also the soil, because methane is generated when organic materials used during cultivation decompose without oxygen.

4.3. The effects of climate change on livestock breeding

The climate change has different effects on animal breeding based on the type of animal kept. While the intensive type of stock is more sensitive to climate change, extensive animal breeding is less seriously affected and damages are moderate. Intensive pig, cattle and chicken farms are more sensitive to climate changes and have significant productivity decrease when experiencing any kind of negative shock.

Traditional extensive type of animals such as the „Hungarian Grey Cattle", „Mangalica Pig", „Racka Sheep", and „Parlagi Chicken" are able to adapt better due to their genome and extensive raising. Therefore in the breeding process, in addition to productivity and quality, it is important to favour species which are able to adapt easier to climate change. Furthermore, farming and animal keeping conditions should be proactively improved.

As a result of climate change, the livestock's water and shade requirement increases which needs extra care and attention. The adaptability could be improved by purposeful breeding.

Extensive or natural animal breeding could be affected by climate change when the grass composition of pasture land changes in favour of xerophilous species with different nutrient content.

4.4. The effects of livestock breeding on climate change

Animal breeding significantly contributes to the carbon dioxide and methane emission.

In case of carbon-dioxide, most of the gas emission (82 percent) is produced during the natural respiration of domestic and wild animals.

In terms of the sources, the methane emission is probably the most complex. Methane emission coming from the fuel consumption of agriculture is not significant (0.05 percent). Soil emits the largest quantity of methane because it is generated when organic materials used during cultivation decompose without oxygen. Animal breeding also has a significant contribution to methane emission, since the digestion and respiration of livestock produces 31 percent of the total methane emission. Methane coming from the digestion and respiration of wild animals is insignificant (1.5 percent).

4.5. The interaction between climate change and forested, green areas

As a result of global warming, spring budding could happen 40 days earlier which in addition to other consequences could have unforeseeable effects on disease control.

Climate change could negatively affect all domestic forests. If the frequency and length of droughts will increase, then more frequent and severe pest damages are likely to happen. New, less known, or „long forgotten" pests will damage the forested and green areas.

Even in currently favourable areas, decreased rainfall during growing seasons will lead to less growth which will lower the amount of carbon-dioxide absorbed. The shortage of precipitation will also hinder the planting and replanting of forests.

According to expert studies, forested areas first stricken by increased temperatures will be forests in the Great Plain, forests of turkey oak and pendunculate oak in the Transdanubian region, and beech.

In addition to the decreased amount of wood lumbered, higher temperatures could lead to frequent forest fires, especially if they are caused intentionally or by negligence. Higher occurrence of fires negatively influences the structure of vegetation and production site, as well.

The situation of existing or potentially creatable green areas in terms of endangerment is similar to the forested areas, whereas these areas are very important to compensate for the „heat islands" developing in urban areas.

5. Adaptation

5.1. Crop production

The NCCS proposed to decrease nitrous oxide and methane emissions by introducing water efficient and soil preserving growth methods.

Better breeding techniques, proper species selection and cultivation methods could decrease the adverse effects of crop farming to climate change. The strategy proposes the proper funding of cross breeding.

Development and implementation of cultivation methods serving better adaptation (precise pest control and fertilization, efficient watering equipments, methods preventing inland inundation and drought damages) are also considered to be effective tools according to the strategy.

Further research should be done to find out how energy crop production will influence climate change.

In order to limit the spread of invasion species successfully, the strategy suggests including relevant research in the agricultural policy.

5.2. Livestock breeding

The principal objective of adaptation is the technological improvement of livestock keeping and breeding.

The preference of breeds which are more able to adapt to different conditions improves cost efficiency and the genome of livestock. The development of information and insurance support system is a prerequisite of a production method which could capitalize on the advantages of climate change.

According to the NCCS, in addition to the suppression of invasion species, quality and productivity should be in the focus of breeding. Based on the results of different adaptation researches, selection of breeds more able to adapt to climate change could be an efficient tool.

According to the NCCS, governmental subsidies and improved extensive animal breeding conditions are essential in order to increase the number of native species. In the case of intensive animal breeding, development of technologies based on renewable energy could decrease the adverse effects of climate change.

The environmentally sound treatment of manure and the use of renewable and green energy sources are important issues when it comes to sustainable animal breeding.

As stated in the NCCS, the first step towards the environmentally friendly production is the development of a tender procedure which subsidizes the collection and utilization of biogas.

5.3. The effect of forested and green areas on climate change - adaptation

The vegetation cover, in particular, the forest covered land areas play an extremely important role in the natural carbon cycle. Forests act as sinks of the atmospheric carbon dioxide and changes in their sink capacities influence the atmospheric concentration of this greenhouse gas (GHG) to a large extent. Forestation, reforestation, deforestation and better forest management are all taken into consideration in this regard and all these activity areas are subjects to the international cooperation and to the national climate change policies. In Hungary, the sink capacities of various forest areas have been investigated for quite a long time (field measurements and analytic studies) and the derivation of the relevant parts of the national emission inventories have significantly improved due to these research activities and the improved statistical information.

Forests should also be considered as a key climate change impact area where first of all the expected adverse effects have been estimated and those measures were identified which lessen the vulnerability of the forest cover to the anticipated changes in the climatic conditions.

According to the NCCS regulations applying to forests, energy and sewage treatment plantations should be dealt with separately and individually. Establishing an information system monitoring climate change would be the first step towards this goal.

Preserving or even increasing the size of forested and green areas could help to improve adaptability. The review and aggravation of biodiversity preservation requirements

and the incorporation of adaptation strategies to the national forest program are important issues which should be addressed.

Issues of climate change requiring special emphasis:

- forest management taking forest dynamics and constant stock capital into account;
- planting species suitable for the new conditions resulted by climate change;
- analysing the impact of energy source plantations.

Preservation and expansion of green areas in urban regions, creation of new green areas with species native in warm South-European regions are important aspects of the climate change strategy.

6. Main characteristics of the Hungarian System of Agricultural Statistics

Regular agricultural statistical reporting looks back to nearly 200 years of history in Hungary. Agricultural surveys of the first half of the 19th century covered only some indicators of production. A vital change took place in 1895 at the time of the first agricultural census, when the data collection covered all agricultural units in the country. An attempt to conduct crop production statistics was made in the framework of censuses of 1895 and 1935.

After World War II, the Hungarian Statistical Office was restructured, including the system of agricultural statistical surveys. Though certain reports were made regular and were done more often than earlier, the census remained awaited for long. Although the issue of joining the global agricultural census of FAO was raised in the fifties, the survey was postponed. Since the investigation of some particular issues could not be put off, an orchard census was conducted in 1959, followed by the census of agricultural machines and equipment in 1960, and the nationwide vineyard census in 1965. Without the regional divisions of the Hungarian Central Statistical Office created in 1952, the surveys mentioned above could not have been completed.

In the sixties the structure of Hungarian agriculture underwent a radical transformation as a consequence of the rapid growth of collective farms. With the stabilization of accounting and reporting system, detailed and accurate statistical information was available on state farms and co-operatives, while no reliable data were available on the private holdings destined to be phased out.

The first full-scale agricultural census of the 20th century took place in 1972. The surveys provided information on a number of earlier unknown features of agriculture, specifically with respect to small-scale production.

In the second half of the 20th century, the 10-year censuses became regular; moreover, information such as the vital statistics of small-scale producers was collected in 1976 and 1986 in the framework of the livestock census to satisfy the needs of domestic institutions and the five-year reporting to FAO.

The findings of the agricultural census 1991 took a snapshot of Hungarian agriculture at the time of the change of the political and economic system. The agricultural census 2000

mirrored the pre-accession condition of Hungarian agriculture in accordance with the methodology and standards of the EU System of Agricultural Statistics.

Apart from the censuses, one should also take into consideration the regular agricultural surveys. The annual regular surveys are built in each and every case on the results and data of the preceding agricultural census. The key feature of these surveys is that they typically covered the forms of business that were deemed dominant in agricultural production.

The changes of System of the Agricultural Statistics have always reflected the structural changes of the Hungarian agriculture. Up to 1990, only state enterprises and co-operatives were obliged to report data and in case of households, data collections only concerned their livestock. From 1957, beside the annual livestock survey, representative livestock surveys were conducted on households in every four months. Only censuses provided data for land use and crop production of the previously mentioned units.

In the nineties, fundamental changes have taken place as regards the ownership and the structure of agriculture in Hungary. Over the previous decades, a relatively small number of large scale agricultural and food-industrial holding were existing. In the early nineties, the land area of state farms and co-operatives was subdivided and a large number of small and medium size agricultural units were established on which far less data were available. Therefore, since 1991 the land use and crop production of the households have become subject to sample surveys. Nowadays, the Agricultural Censuses and surveys cover 99 percent of the output of agriculture.

The Hungarian Central Statistical Office conducts 15-20 agricultural statistical surveys each year. These surveys belong to two distinct groups: agricultural production statistics, and the surveys to meet the needs of the Economic Accounts for Agriculture.

7. Existing data sources – problems

The examination of the impacts of climate change in Hungary has a 25-year history. Nevertheless, a general characteristic of the research is that the examinations cover only certain sub-regions or sectors, not covering the whole territory of the country or the whole economy.

For instance, the Corvinus University of Budapest works on a database, which will provide data on the interaction between vineyards and climate change. The Hungarian Academy of Sciences examines local impacts of climate change in some selected settlements as well as factors influencing climate change.

In the last two years, the work has been accelerated; for the coordination of researches a new project “Environment-Risk-Society” was established. What is more, during two years, 299 publications have been published concerning climate change in thematic brochures designed for that purpose.

Although the above mentioned publications deal with certain fields of environment, economy and society as well, they basically examine the interaction between climate change and the agriculture, for instance:

- importance of adapting soil cultivation methods in soil protection practice;
- effects of climatic conditions on maize production;
- impacts of climate change on winter wheat growth.

This is the reason why this paper focuses on the interaction between climate change and the agriculture while observing data sources.

According to national experience, the following main groups of indicators could be mentioned:

- meteorological data;
- physical parametres of surface;
- data on environmental elements;
- production data;
- emission data;
- immission data.

The output of agricultural production is basically determined by the changes of weather year by year. In case of examinations, it is necessary to take into account the changes of temperature, sunshine duration, quantity and distribution of precipitation etc. It is important to know in which season the crop production was stricken by drought. Fortunately, a 100-year long meteorological time series is available in Hungary.

Data on land use according to cultivation methods, results of crop production (sown area, amount of yield, average yield) are available since the year of 1895. The same length of time series is available for the number of livestock.

Nowadays, data are available on annual basis concerning crop production and on four-month basis concerning livestock. The weakness of data collections is that they cover neither the species of crops and animals nor the quantity characteristics of the production. Furthermore, it is considered as another weakness that the sample surveys can provide reliable data only at regional level.

The only exception is the full scope basic survey on vineyards and orchards carried out in 2001 that accounted the types of grapes and fruits, as well as the cultivation methods of the plantations.

Concerning irrigation, soil cultivation (nutrient supply), supply of manure and fertilizer, use of pesticides and production methods, only some aggregated data were available in the past few decades in Hungary. In order to solve this problem, basic changes are foreseen in the EU Member States. In 2010, the data collection of the Farm Structure Survey (FSS) will cover the production methods providing information for the evaluation of interactions between agriculture and climate change.

The production methods module is going to gather information on farming such as

- tillage methods;
- soil conservation, actions against erosion and nutrient leaching;
- landscape features, parameters;

- animal grazing;
- animal housing;
- nutrients;
- manure storage and treatment facilities;
- plant protection;
- irrigation.

The production method module of the FSS will be implemented linked to the agricultural production data by holdings. Therefore, the above mentioned survey data could become the most important input of climate change researches in the forthcoming years.

Estimated data on energy use of agriculture are available only at regional level. The quality of estimation can be developed by using administrative data sources. Measurement of energy efficiency of agriculture as well as involving renewable energy sources in the production are to be elaborated.

The operation of forestry statistics is the responsibility of the Ministry of Agriculture and Rural Development in Hungary. The aim of the Ministry is to record forest assets, forestation and yield, to describe the quantity and quality characteristics of timber stock, to provide detailed and updated information for the climate change research.

Hungary has been collecting data on green areas for 15 years; HCSO is responsible for it. The annual statistics is based on administrative data of local authorities, measuring green area within the territory of settlements. Regarding climate change research's needs, the weakness of data collection is the lack of information on the type of plant species within the green area and on cultivation methods applied.

As regard the emission data, under the UNFCCC, a complex methodology was elaborated in order to arrive at consistent and comparable national GHG emission inventories. The responsibility for compilation of emission inventory is delegated to the Ministry of Environment and Water. HCSO contributes with data of industrial and agricultural production. One of the most problematic areas in this regard is the derivation of emission factors for various soil types and plant species. Concerning soil types as well as the plant species, the Ministry of Agriculture and Rural Development is responsible for data collection. Measurement of immission is joint responsibility of the Ministry of Environment and Water and the Ministry of Public Health on certain environmental elements (air, soil, inland and ground water). 30-40 parameters of the environmental elements are observed by measurement point networks several times a year. In order to support the analysis of immission data, statisticians develop and provide mathematical statistical methods. Examination of the correlation between emission and immission data is to be elaborated.

8. Conclusion

The examination of the impacts of climate change in Hungary has a 25-year history. In the past two years, the work has been accelerated and the Hungarian Climate Change Strategy has been developed and accepted. Almost 300 publications have been released concerning climate change.

In order to coordinate the work, a forum was established; the main tasks of this forum are to compile the list of indicators, to define the existing data gaps, to elaborate methodology and definitions. Clear division of labour between the national statistical institutes, ministries and professional bodies is also required.