Impact of Climate Change and Adaptation in Agriculture

International Symposium, Vienna, 22-23 June 2009

EXTENDED ABSTRACTS

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September 2009

ISSN 1994-4179 (Print)
ISSN 1994-4187 (Online)

BOKU-Met Report 17

CLIMATE CHANGE IMPACTS AND ADAPTATION OPTIONS IN SERBIA – RESULTS FROM THE ADAGIO PROJECT

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Abstract

The ADAGIO project (adagio-eu.org) was designed to focus on regional studies in order to uncover region-specific problems. In this context, a bottom-up approach is used (along with the top-down one) that employs scientific studies involving regional experts and farmers in the evaluation of potential regional vulnerabilities and adaptation options. Results of the regional studies and gathered feedback from experts and farmers show in general that (increasing) drought and heat are the main factors of agricultural vulnerability not only in the Mediterranean region but also in Central and Eastern Europe. Another important aspect is that the increasing risk of pest and diseases may play a more important role for agricultural vulnerability than assumed before; however, till now this field has been investigated in Europe only sporadically. Another important aspect is that there are increasing regional differences in the crop production potential in Europe due to climate change and that positively or negatively impacted agricultural systems can vary in a relatively small spatial scale depending on the specific limiting environmental conditions such as climate or soil conditions (Eitzinger at al., 2008).

As a partner in the ADAGIO project, the Center for Meteorology and Environmental Predictions at the Department for Physics of the Faculty of Sciences of the University of Novi Sad (Serbia) had the following responsibilities: (a) to suggest measures of adaptation based on the "observed" indicators about climate change in selected regions with intensive agricultural production (Subotica, Novi Sad, Arilje and Slankamen) and (b) to lead the thematic ADAGIO group "Adaptation on occurrence of pests and diseases determined by climate change". We also had the task to provide dissemination of the results obtained in order to raise the level of awareness about potential climate change and its impact on agricultural production. However, the drawback of scientifically based agricultural policy and a low level of agricultural inputs make agricultural production in Serbia particularly vulnerable to climate change and extreme weather events. Unfortunately, awareness about impact of global climate change on the national economy and particularly on agricultural production as its most sensitive part is at the lowest possible level among Serbian politicians and decision-makers. That produces a non-affirmative atmosphere within the scientific community concerning climate change impact research. Therefore, the implementation of the ADAGIO project in Serbia was a hard task with ambiguous results and effects.

During the first project year, a collaborative network was first established including agricultural engineers of different specialties from the University but also from scientific institutes, agricultural advisory services and private companies. We have to emphasise that the selected institutions for the collaborative network are broadly recognized in the agricultural community on the state as well as regional level (Subotica, Novi Sad, Arilje and Slankamen). Secondly, in order to properly address some socio-economic aspects of climate change issue, specialists for rural sociology and sociology of science were involved in the realisation of the second step of the first project year. On the basis of the corresponding methodology we designed a questionnaire for gathering data about the attitudes of experts and farmers towards climate change impact on agriculture production. There were three kinds of questionnaires, those for plant protection, fruit production and agronomy experts and farmers. The questionnaires were sent by regular mail to 921 addresses (experts and farmers) in various places throughout the Vojvodina region. Upon completion, they were returned to be analyzed. Unfortunately, as is common with the sending of questionnaires by regular mail, a relatively small number of addressees actually responded to the survey (73 out of the 375 experts (19.4%) and 195 out of 546 the farmers (36%)). Let us note that this kind of research was the first of its kind in Serbia and that analysis of answers from the questionnaires in some segments had a slightly limited specific weight in the sense of scientific conclusion. However, there was enough evidence to underline some conclusions regarding climate change impact on agriculture in Serbia. Based on the results obtained from the questionnaires, we have concluded that in the last 15 years the following diseases have occurred frequently in the region as a result of climate change impact: powdery mildew of cereals (*Erisiphe graminis*), *Fusarium* head blight, Cercospora leaf spot (*Cercospora beticola*), sunflower blight (*Plasmopara halstedii*) and potato and tomato Alternaria leaf spots (*Alternari solani*), particularly because of dry and warm springs and dry summers with occasional showers. Additionally, a paper by

Jevtic et al. (2009) disusses the appearance of small grains diseases in Vojvodina as a product of climate change.

During the second project year, two project tasks were accomplished (1) climate simulation using a regional climate model (Mihailovic and Lalic, 2009a; Mihailovic and Lalic, 2009b) in order to get a picture of potential climate changes through experiments for the selected time-slice and (2) eight pilot assessments were conducted in order to (i) quantify past, present and future effects of climate change in the north of Serbia (the Vojvodina region) based on the trend of agroclimatic indices (Lalic et al., 2007; Lalic et al., 2008a; Lalic et al., 2008b; Lalic et al., 2009); and (ii) identify feasible potential adaptation measures for the selected regional agricultural systems based on the identified problems. For the climate simulation, we used EBU-POM, a two-way regional coupled model, with the Eta/NCEP limited area model as the atmospheric part and the Princeton Ocean Model as the ocean part (Djurdjevic and Rajkovic, 2009). Both models are well known and have been extensively verified. Eta was the operational model at NCEP for many years and POM is one of the most commonly used models for scientific investigations as well as for operational ocean forecasts. Exchanges of atmosphere fluxes and sea surface temperature (SST) between the two components are done interactively, during integration, using specially designed coupler software. In every physical time step of the atmospheric model (360 seconds), surface atmosphere fluxes needed for the ocean forcing are transferred to the ocean model grid. After that, SST is transferred back onto the atmosphere model grid, serving as the new bottom boundary condition. In this study the simulation domain selected covered the region of Europe. The horizontal resolution was 0.25° in the atmospheric model and 0.2° in the ocean model. The two-way coupled scheme was only applied over the Mediterranean Sea. For the other water bodies (Atlantic Ocean and the Black sea), we used SST from the global model integrations. Here, we present the verification of the present climate integration for the 1961-1990 base period and an analysis of the A1B climate change scenario experiment. CRCM was nested within integrations of the atmospheric ocean global circulation model SX-G.

In the last project year, we considered based on our results some urgent local adaptation measures that could be used immediately in crop production in Serbia, particularly in its northern part (Vojvodina): (a) a more reliable weather forecast before or during the growing season help farmers and the extension service staff to take appropriate measures and (b) preventive measures, such as determining the planting rate on the basis of available soil moisture, successful control of diseases, pests or weeds, nitrogen dose used for top dressing, etc.. Proposed measures to be used in fruit growing in the same region are: (a) to grow tolerant cultivars and to avoid growing fruits in regions with significant environmental risks; for example, growing peaches at higher altitudes and not in the lowlands of Vojvodina. It has been noticed that in years with frost damage the peach orchards affected the most were those bellow 170 m altitude. Advantage should be given to cultivars that have been locally selected or have been introduced a long time ago, because they are supposed to be more adapted to the environmental conditions. It is also of great importance for fruit trees to enter dormancy well prepared, as this provides assurance that they will be able to withstand low winter temperatures. Anti-frost sprinklers can also be installed, while small fruits growers can use agrotextiles or can grow plants in protected spaces such as small and large polytunnels, glasshouses etc. The list of adaptation measures will be extended after analysis of all the results of the project.

Identification and demonstration of dissemination strategies were foreseen as the last activities of the project. During the whole project, a lot of time was spent on consideration and planning of this segment. Unfortunately, several attempts to organise meetings with farmers and decision-makers had no success. Obviously, implementation should go through the media and teaching curricula in order to improve the knowledge of future producers and decision-makers about climate change impact on agricultural production. After 30 months of step-by-step project realisation, we can conclude that all research and assessment goals have been achieved, while their implementation in agricultural practice and policy is the hardest task, which requires more time than was anticipated by the project.

Keywords: climate change, impact, agriculture

References:

Djurdjevic, V., Rajkovic, B., (2009): Verification of a coupled atmosphere-ocean model using satellite observations over the Adriatic Sea, Ann. Geophys., 26, 1935–1954.

Eitzinger, J., Kubu, G., Alexandrov, V., Utset, A., Mihailovic, D.T., Lalic, B., Trnka, M., Zalud, Z., Semeradova, D., Ventrella, D., Anastasiou, D. P., Medany, M., Altaher, S., Olejnik, J., Lesny, J., Nemeshko, N., Nikolaev, M., Simota, C., Cojocaru, G., (2008a): Adaptation of vulnerable regional agricultural systems in Europe to climate change – results from the ADAGIO project. 8th Annual Meeting of the EMS/7th ECAC (Amsterdam, The Netherlands, 28 September- 3 October 2008). Abstracts, Vol. 5: EMS2008-A-00066.

Jevtić, R., Telečki, M., Lalić, B., Mihailović, D.T., Malešević, M., (2009): Climate Change Impact on Small Grains Diseases Apperance in Vojvodina Region, In: Environmental modeling and measurement, (Eds. D.T. Mihailovic and B. Lalic), Nova Science Publishers, Inc., New York. (In Press).

Lalic, B., Dubrovsky, M., Mihailovic, D.T., (2007): Calculation of agrometeorological indices using different GCM scenarios, Abstracts of Seventh Annual Meeting of the European Meteorological Society (EMS), October 1-5, San Lorenco El Escorial, Madrid (Spain).

Lalic, B., Mihailovic, D.T., Jevtic, R., Jasnic, S., (2008a): Assessment of climate change impact on plant disease and pest occurrence in Vojvodina region, 8th Annual Meeting of the EMS/7th ECAC (Amsterdam, The Netherlands, 28 September- 3 October 2008). Abstracts, Vol. 5: EMS2008-A-00468.

Lalic, B., Mihailovic, D.T., Malesevic, M., (2008b): Estimating winter wheat yield and phenology dynamics using Met and Roll weather generator. In: Environmental, Health and Humanity Issues in the Down Danubian Region. Multidisciplinary Approaches. Proceedings of the 9th International Symposium on Interdisciplinary Regional Research, University of Novi Sad, June, 21-22 2007 (Eds. D.T. Mihailovic & M. Vojinovic-Miloradov). World Scientific, New York, London, Singapore, 25, 233-244. ISBN 978--1-60692-033-6.

Lalic, B., Mihailovic, D.T., Malesevic, M., 2009: Introduction of crop modelling tools into Serbian crop production: Calibration and validation of models. In: Support Water-Management Decision-Making Under Climate Change Conditions. (Eds. Angel Utset Suastegui). Nova Science Publishers, Inc., New York. (In Press) ISBN: 978-1-60692-033-6.

Mihailovic, D.T., Lalic, B., (2009a): Land-air parameterisation scheme (LAPS): A toll for use in agrometeorological modelling. In: Support Water-Management Decision-Making Under Climate Change Conditions. (Eds. Angel Utset Suastegui). Nova Science Publishers, Inc., New York. (In Press) ISBN: 978-1-60692-033-6

Mihailovic, D.T., Lalic, B., (2009b): Coupled land-air parameterization scheme (LAPS) and non-hydrostatic mesoscale model (NMM) for use in agricultural planning. Időjarás, 113, No. 1–2, 13–22.