Working Group "BLUE"
Promotion of Low-INput Danube Agriculture in the Mura River Basin (LINDA)

ABSTRACT

Agriculture is one of the major sources of pollution of the surface water and groundwater of the Danube River Basin. Lying at the intersection of three countries – Hungary, Slovenia and Croatia, together with its transboundary groundwater body, the Mura River Basin represents a challenging pilot area with extensive agriculture. This project aims to reduce agricultural water pollution in the Mura River Basin by introducing low-input sustainable agriculture.
The project will: (a) consolidate expert knowledge on low-input sustainable agricultural practices suitable for the Mura River Basin; (b) develop guidelines on the promotion of low-input agricultural practices and (c) promote their adoption by the legislatures of the three participating countries. Capacity building for farmers of the study area will be carried out to ensure the uptake of low-input sustainable agriculture by local farmers. A public outreach component will deal with dissemination of the project outcomes and the importance of low-input agriculture in general.

KEYWORDS

Sustainable agriculture
Agricultural water run-off
Fertilizers
Water pollution
Danube River basin
Mura River Basin
Climate change

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PROJECT RATIONALE

CONTEXT

Danube River stretches onto 10 % of the territory of Continental Europe, being the main water artery for 19 countries, with 60 % of the population depending on groundwater resources for the supply of drinking water [ICPDR]. Improvement and preservation of water quality is therefore of major importance in the Danube region. The key factor affecting the chemical status of groundwater is pollution by nitrates from diffuse sources, such as agricultural activities, non-sewered population and urban land use [ICPDR]. Pressures on surface water bodies can also result from point sources (in particular untreated/partially treated wastewaters), and/or diffuse sources (especially agriculture). Water quality in the Danube river has improved over the last decades, but further improvement is still needed, since most tributaries contain higher concentrations of organic pollutants and nutrients than the Danube itself. Nutrient pollution – particularly by Nitrogen (N) and Phosphorus (P) – can cause eutrophication of surface waters [ICPDR].

The majority of the people of the Danube Region rely on agriculture as the main source of income [ICPDR]. Conventional agriculture practiced in this area pollutes surface water and groundwater through the application of chemical soil additives, e.g. fertilizers and pesticides that significantly impair water quality [ICPDR]. The inefficient use of water for irrigation contributes to deterioration of water quality in the Danube River Basin.

In the conditions of climate change with the resulting changes in weather patterns, soil depletion, water scarcity, increased land and seed fragility, the agricultural systems will need to be adapted to the new climatic conditions to provide enough food and fibre, sources of energy for the growing population [BIAC, 2009]. By 2050 the world population is estimated to reach nine billion people, causing the demand for food to increase by 2.5 times in comparison to the current level [BIAC, 2009].The Danube River Basin will get less precipitation, more frequent heat waves and changes in the seasonal water run-off. Environmentally-friendly agricultural practices will be required to reduce water run-off, optimize irrigation systems and promote organic farming [ICPDR].

PROJECT GOAL AND THE STUDY AREA

Since agriculture is recognized as a major source of pollutants to surface and groundwaters, the project aims to reduce agricultural water pollution in the section of the Danube Region – the Mura River Basin (Figure 1), by promoting low-input sustainable agriculture.

This approach, often referred to as low external input agriculture (LEIA), addresses two main issues, (1) adapting the agricultural system to the environment of the region, including soil, water, climate and biota present at the site; (2) optimizing the use of biological and chemical/physical resources in the agroecosystem [Pimentel D. et al, 1989; Graves A. et al, 2004]. The Mura River Basin covers an area of 13,800 km^2 at the intersection of Slovenia, Hungary and Croatia and represents an important area for neighboring countries due to intensive agriculture.

Affected groundwater body extends through the boundaries of three countries, and therefore, according to the EU Water Framefork Directive (WFD), additional effort should be made for the proper management of shared water resources [Ganoulis, J. et al, 2011]. In case of international boundaries, differences in culture, language, education, institutions and political priorities further complicate management and decision-making not only in the frame of water management, but also from the view of agricultural activities itself, which should be taken into consideration in the management of water resources.

Fig. 1. Project Area: Mura River Basin (www.wikipedia.com)

Vulnerability mapping in Croatia [Brkić Ž. et al., 2012] revealed high vulnerability of this alluvial aquifer and also a high risk of contamination – one of the highest vulnerability and risk on the whole area of Croatia. The estimated groundwater recharge rate in the Mura River basin, estimated according to the GROWA model (ARSO – Slovenian Environment Agency), reaches not more than 100 mm/year.

Data from 2011 on the Slovenian side indicate excessive pollution with desetilatrazine, nitrates and atrazine. Concentrations for atrazine and desetilatrazine are generally declining, indicating that the ban on the use of products containing these substances has been effective. Despite the decreased use of plant protection products, mineral fertilisers, nutrients and lowering ammonia emissions, still many improvements should be implemented in order to promote more sustainable agricultural practices. Hungarian part of the Mura River Basin practises grain production under excessive use of artificial fertilizers and the use of harmful pesticides (the financial status of farmers makes them buy the cheaper and more harmful pesticides instead of the expensive, but environmental friendly chemicals). The Croatian side of the Mura River Basin is a popular fishing area in addition to agricultural activities.

PROJECT DESCRIPTION

GOAL AND OBJECTIVES

GOAL: *Reduce agricultural water pollution in the Mura River Basin by introducing low-input agricultural systems.*

OBJECTIVE 1: *Consolidation of the existing knowledge on low-input agricultural practices.*

OBJECTIVE 2: *Increased capacity of farmers from the Mura River Basin to apply low input agricultural practices.*

OBJECTIVE 3: *Anchorage of the project outcomes in the legal framework.*

OBJECTIVE 4: *Consolidation and capitalization of the project results.*

The project implementation is planned over a timespan of five years.This amount of time will be required to create an international pool of experts working on the project, consolidate their knowledge into a database, develop

guidelines and anchor them in the legislation of Hungary, Slovenia, Croatia; alongside with capacity-building of farmers and dissemination of the project outcomes onto a wider Danube River basin.

The achievement of the overall goal should contribute to the improvement of the water quality in the Mura River basin, since this impact cannot be achieved by this project alone.

OBJECTIVES, OUTPUTS, METHODS

OBJECTIVE 1:
Consolidation of the existing knowledge on low-input agricultural practices.

Output 1.1. Developed database with field data (on climatic, agricultural parameters, etc.) for continuous research and update
Output 1.2. Developed guidelines on the best low input agricultural systems suitable for the climatic conditions of the Mura River basin.

The project will set up an international panel of experts to consolidate the existing knowledge and suggest the best low-input agricultural systems suitable for climatic conditions of the Mura River basin. This will be done by identifying suitable experts and stakeholder groups. A common GIS database for all three countries will be established, where available spatial data will be gathered, including data about soil properties (soil type and depth), hydrogeological data (groundwater level,), meteorological data (amount of rainfall, air temperature), as well as data of water quality and land use. Additionally data about existing land use and agricultural practices will be collected, which will allow experts to make a comparison and to define the most promising agricultural technicques, depending on the spatial conditions.The guidelines on low-input agricultural practices will be developed in consultation with stakeholders.

Methods applied: chemical analyses of surface and groundwater quality, as well as soil properties; stakeholder analysis.

OBJECTIVE 2:
Increased capacity of farmers from the Mura River basin to apply low input agricultural practices.

Output 2.1. Farmers of the Mura River basin capable to apply low input agricultural systems.

Output 2.2. Collaboration with agricultural extension services units established for provision of consultancy and trainings to farmers of the Mura River basin.

This component aims to build the capacity of farmers in applying low-input agricultural practices. A gender analysis will identify the interests, concerns and needs of male and female farmers in practising low-input agriculture. Agricultural extension services unit will develop a training program and will deliver training to the first group of farmers (10 farmers from each participating country, 30 farmers in total) based on the findings of the gender analysis. It is planned that the first trained group of farmers will become trainers-demonstrators of the low-input agriculture for other farmers in their area. A survey on the farmers' knowledge and application of agriculture before and after the training will be administered to measure the effectiveness.

Methods applied: gender analysis, cross-cultural analysis, surveying.

OBJECTIVE 3:
Anchorage of the project outcomes in the legal framework.

Output 3.1. Dialogue with policy-makers from the Mura River basin established.
Output 3.2. Guidelines on low input agricultural systems suitable for the climatic conditions of the Mura River basin are under consideration by policy-makers.

Communication strategy will be designed to establish an effective policy dialogue and promote the adoption of the guidelines in the legislation of the three participating countries. Legislation analysis of the three countries will be undertaken to identify possible gaps in enforcement of the guidelines and harmonize the implementation of the guidelines by the three countries.

Method: stakeholder analysis; comparative analysis of the legislation.

OBJECTIVE 4:
Consolidation and capitalization of the project results.

Output 4.1. Better informed stakeholder groups (sectoral specialists) on low input agricultural systems suitable for the Mura River basin
Output 4.2. Better informed public of the Mura River basin on the importance of low input agricultural systems and the project outcomes in general.

An internal communication strategy will be designed to ensure an effective, intercultural, multilanguage cooperation of the experts, farmers and project participants.

Methods: stakeholder analysis, mass media content analysis.

LOGICAL FRAMEWORK MATRIX

	Intervention logic	**Performance indicators**	**Sources of Verification**	**Key assumptions**
Project goal	To reduce agricultural water pollution in the Mura River basin by introducing low input agricultural systems.	Pilot farms practise low input agriculture and use little or no fertilizers.	Number of farms/ total area in ha under the low input agriculture.	Farmers are interested to participate in the project through incentives.
Project objectives	**1.** Consolidation of the existing environmental knowledge and low input agricultural systems. **2.** Increased capacity of farmers from the Mura River basin to apply low input agricultural practices. **3.** Anchorage of the project results in the legal framework. **4.** Consolidation and capitalization of the project results.	**1.** International intersectoral cooperation. **2.** Number of farmers practising/total area under low input agriculture. **3.** Guidelines on low input agriculture adopted by policy-makers. **4.** Wider group of project stakeholders and the public are informed and/ or practise low input agriculture.	**1.** Cooperation agreements, meeting programs, minutes. **2.** Documents of agricultural departments. **3.** Official statement from policy-making bodies on the adoption of the guidelines. **4.** Surveys; documents of agricultural deparments	**1.** International experts will be able to cooperate and communicate productively. **2.** The types of agricultural systems practised in the Mura River Basin are specified in the documents of agricultural departments or can be found on the maps. **3.** Open and productive cooperation with policy-makers possible.

Project outputs	**1.1.** Developed database with field data (on climatic, agricultural parameters, etc.) for continuous research and update **1.2.** Developed guidelines on the best low input agricultural systems suitable for the climatic conditions of the Mura River basin.	**1.1.** Database structure developed; data consolidated and put into the database; **1.2.** Guidelines developed.	**1.1.** Database. **1.2.** Guidelines.	
	2.1. Farmers of the Mura River basin able to apply low input agricultural systems. **2.2.** Collaboration with agricultural extension services units established for provision of consultancy and trainings to farmers of the Mura River basin.	**2.1.** Number of farmers who took the trainings. **2.2.** Inter-institutional cooperation agreements signed; training programs developed.	**2.1.** Participation lists, training programs. **2.2.** Cooperation agreements.	**2.2.** Productive inter-institutional and international cooperation established; active participation by farmers.
	3.1. Dialogue with policy-makers from the Mura River basin established. **3.2.** Guidelines on low input agricultural systems suitable for the climatic conditions of the Mura River basin are under consideration by policy-makers.	**3.1.** Participation of policy-makers **3.2.** Guidelines on the low input agricultural systems submitted to policy-makers.	**3.1.** Attendance lists, agendas, minutes. **3.2.** Guidelines; an official statement on the obtainment of the guidelines.	
	4.1. Better informed stakeholder groups (sectoral specialists) on low input agricultural systems suitable for the Mura River basin. **4.2.** Better informed public of the Mura River basin on the importance of low input agricultural systems and the project outcomes in general.	**4.1.** Representatives of stakeholder groups participate in the project activities. **4.2.** 50% increase in the knowledge on low input agriculture/ project outcomes by the public.	**4.1.** Event documents -programs, participant lists, etc. **4.2.** Surveys.	

PROJECT APPROACHES

The project pilot area would be the Mura River Basin which is part of Slovenia, Croatia and Hungary. Therefore we have to take in account the different languages, cultures and attitudes. *Cross-cultural and interdisciplinary approaches* will be applied to develop an effective communication process within the internal (within the project experts, farmers and other participants) and external (with policy-makers and the public) communication strategies in all of those three countries. Information from the perception studies and technology transfer will be used to set up effective communication with farmers.

The project will use *participatory approaches* to solicit feedback from the experts and stakeholders on the introduction of low-input sustainable agricultural practices in the Mura River Basin suitable for this area based on environmental, agricultural, social and economic considerations. Economic considerations will include not only private costs and benefits from the agricultural production, but also the social costs and benefits. The project aims to propose a system of measures (taxes, ecosystem payments, etc.) to promote low-input sustainable agriculture.

Participant simulation in decision-making method will be used to discuss and forecast the outcomes of the project stakeholder suggestions and decisions. This method should aid in a comprehensive view of the issue under discussion and increase the sense of ownership of the problem and its solution by the project stakeholders.

Gender-sensitive approach will be used throughout the project activities: if possible, equal representation of male and female experts, stakeholder representatives, farmer participants in the project activities; interests and needs of both genders will be solicited and taken into account when designing project activities and outcomes.

The project value added is in the replication of its outcomes and approaches along the entire Danube River Basin. The project results will be consolidated and widely shared with stakeholders and policy-makers of the Danube River Basin.

LINKAGES TO THE ICPDR AND HORIZON 2020 CHALLENGES

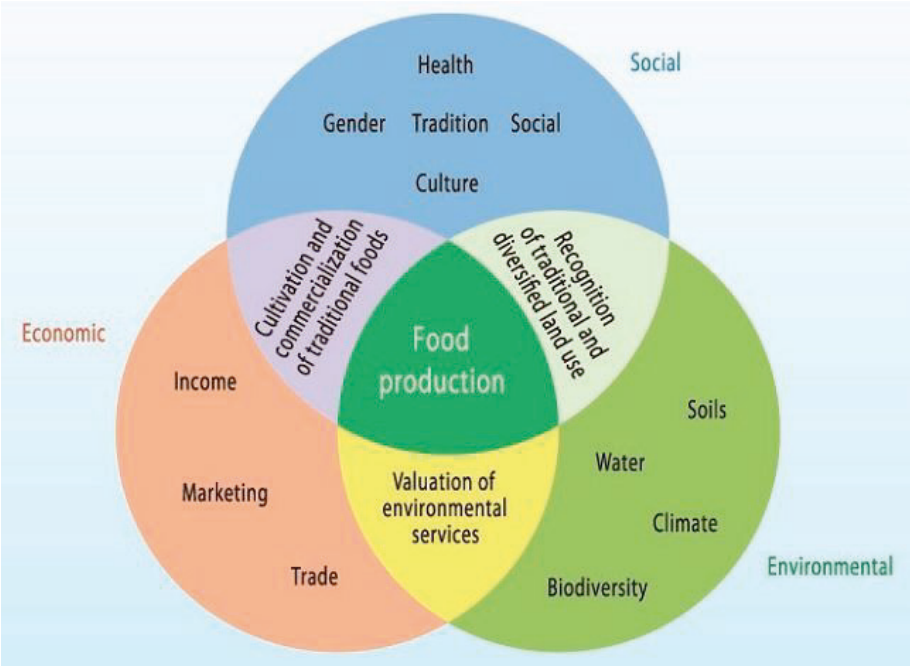
The project addresses the Horizon 2020 challenge of food security and sustainable agriculture. By 2050 the world population is estimated to reach nine billion people, causing the demand for food to increase by 2.5 times in com-

parison to the current level [BIAC report, p.1]. Reducing the negative impact of agriculture on the environment and decreasing the inputs required for agricultural production should contribute to food security and sustainability.

The project contributes to improving the sustainability of the Danube River Basin by reducing the water inputs in agriculture and reducing the surface and groundwater pollution by chemical soil additives. This should safeguard the Danube's Water resources for the future generation; ensure naturally balanced waters from free excess nutrients and toxic chemicals and lead to healthy and sustainable river systems.

The project also follows the EU Strategy for Sustainable Bioeconomy that focuses on sustainable use of resources, smart growth and low emissions economy, among other aspects of sustainability. Bioeconomy is oriented at the creation of public goods, the use of agro-ecological methods, low input agricultural systems, "social innovations in multi-stakeholder collective practices and joint production of knowledge" [Schmid et al., p.95]. The bioeconomy approach views farmers not only as "commodity producers but also providers of quality food and managers of the eco-system" [Schmid et al., 2012, p.95].

Fig. 2. Interconnectedness of the Different Roles and Functions of Agriculture.
Source: IAASTD, Global Summary for Decision Makers (http://www.agassessment-watch.org/)



PROJECT MANAGEMENT

The project management will be carried out by a coordination team, that will be responsible for coordination of work among the project partners and implementing institutions-organizations. Coordination team will carry out an overall supervision and monitoring of the project progress, and will serve as a link among the project partners/ implementing organizations and the funding agency.

PROJECT PARTNERS

JOINT RESEARCH CENTER (JRC): HTTP://EC.EUROPA.EU/DGS/JRC/

JRC is deeply embedded in the European Research Area and the EU legislative process. The centre focuses on research in different study areas in, particular, climate change and rural development. The JRC has developed AGRI4CAST (Crop Production Forecasts and Climate Change Impact). This system is able to monitor crop vegetation growth (cereal, oil seed crops, protein crops, sugar beet, potatoes, pastures, rice) and include the short-term effects of meteorological events on crop productions and to provide yearly yield forecasts on European crops. One more action is named SUSTAG (Sustainable Agriculture and Rural Development: the socio-economic dimension) this action focuses on the institutional, social, economic aspects of farming and rural economies, particularly in the context of the Common Agricultural and Rural Development Policy. It concentrates on the two themes: i) Typology of rural areas and indicators of sustainable rural development in the enlarged EU; ii) Modelling of rural economies and assessment of policy impacts.

THE UNIVERSITY OF ZAGREB, FACULTY OF AGRICULTURE, DEPARTMENT OF FIELD CROPS, FORAGE AND GRASSLAND: HTTP://WWW.AGR.UNIZG.HR/

Faculty is dedicated to make students competent to become promoters of development of modern sustainable agriculture according to the needs of Croatian society and targeted national development. The scientific research activities are carried out by Faculty departments, at their laboratories and experiment stations, as well as in sites off the faculty compound used for this purpose. Main research objectives are to enable the transfer of knowledge and scientific results to the business sector, and to participate in their application.

THE UNIVERSITY OF MARIBOR, FACULTY OF AGRICULTURE AND LIFE SCIENCES, CHAIR OF ORGANIC AGRICULTURE, FIELD CROP, VEGETABLE AND ORNAMENTAL PLANTS: HTTP://FK.UNI-MB.SI

The University aims to promote partnerships with businesses, governmental and non-governmental and other institutions in society to enrich university teaching, research and creative activity; prepare educated, engaged citizens; strengthen democratic and ethical values, and civic responsibility; address critical societal issues; respect ecological and environmental issues; promote sustainability in development; and contribute to the public good.

HUNGARIAN ACADEMY OF SCIENCES, CENTRE FOR AGRICULTURAL RESEARCH: HTTP://WWW.AGRAR.MTA.HU/

Research centre carries out basic and applied research and development in agricultural sciences. Scientific institutes making up the research centre are involved in research in the following fields: veterinary science, crop production, plant breeding and agronomy, plant protection, soil science and agricultural chemistry.

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