

**CENTER FOR FISHERY AND APPLIED HYDROBIOLOGY “LITTLE DANUBE”,
EXPERIMENTAL SCHOOL ESTATE “RADMILOVAC”:
SYNERGY OF RESEARCH, ECONOMY AND SOCIETY**

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Abstract

In every society, initiators and promoters of the development are individuals, teams or institutions with a vision, good ideas, seriousness, but above enthusiasm to work hard. They trace the road and drive activities related to research and/or economy. In the Serbian aquaculture sector such institutions is the Faculty of Agriculture and its Center for Fishery and Applied Hydrobiology (CEFAH) (or the “Little Danube”), which operates within the Experimental school estate “Radmilovac”. The Center started to be established in 2007. Unlike other similar Centers built by state resources intended for research and scientific work, the “Little Danube” was created much more as a result of enthusiasm of a group of researchers and their readiness to cooperate with national and international institutions, but also by enthusiasm of individuals ready to financially or materially help some of the Center’s programs. The Center’s activities are directed towards improving and developing the research and economy in aquaculture. Today the Center in “Radmilovac” and its laboratories located in the building of the Faculty of Agriculture represent an education and research polygon for aquaculture development. The education part is aimed at all levels: from pre-school and elementary school level by educational visits to the “Little Danube”, where they get to know different fish species and other aquatic organisms, their culture, fishing, fishing tools; to PhD level students and researchers that increase their knowledge and skills in the Center. CEFAH is a scientific polygon: in its aquaria, tanks, RAS systems, as well as in a number of earthen ponds a range of various experiments in different areas of aquaculture are carried out and knowledge is transferred directly in aquaculture economy. The development of Serbian aquaculture is directly affected by the connection of the Center with the economy through realization of biotechnology projects, fish selective breeding programs, and experiments.

Key words: *aquaculture, CEFAH, economy, research, Serbia*

Introduction

Besides teaching and research, a duty of teachers and teaching assistants working in applied sciences is to contribute to the development of the corresponding economic sector. By linking research and economy a way is paved from faculties and institutes towards reinforced economy.

On the other hand, prerequisite as material basis for research are made: fruitful interaction between research and economy leads to the improvement of both research and economy by creating symbiotic relation between the two.

Bearing this in mind teachers and researchers of the Fishery research group from the University of Belgrade, Faculty of Agriculture, in 2006 started with the creation of the Center for Fishery and Applied Hydrobiology (CEFAH) in order to establish a research and education polygon for aquaculture development, and thus contributing to this agricultural branch reinforcement.

Unlike other similar Centers built by state resources intended for research and scientific institutions, the “Little Danube” was created much more as a result of enthusiasm of a group of researchers and their readiness to cooperate with national and international institutions, but also enthusiasm of individuals ready to financially or materially help some of the Center’s programs (Table 1). From the very beginning of its establishment as integral part of research capacities of the Faculty of Agriculture in the area of fishery, CEFAH became a Center for research, dissemination of results, education, and professional activities in the area of fishery and applied hydrobiology, contributing to development of this sector in Serbian economy.

Although in Serbia aquaculture is not one of the main agricultural activities, it is one of the rare animal (cultured and domestic) production type that doubled production in the past 10 years (Marković et al., 2011; Marković and Poleksić, 2011). It should be mentioned that on the global level aquaculture production has been increasing in the past decades (Subasinghe et al., 2009), and aquaculture growth is 8.8% greater than any other food production sector. This is an additional stimulant for efforts to improve Serbian aquaculture.

About the Center

CEFAH occupies a surface area of 13 ha. It consists of upper, middle and lower part linked by the riverbed of the “Little Danube”.

The upper Center’s part occupies 6 – 7 ha. It was established by creation of 3 wetlands for natural purification of wastewater that arrive on the territory of Radmilovac from the illegal settlement. The built pipeline directs the partly purified water downstream of the school estate. The upper part of the riverbed of the “Little Danube” was created by cleaning and natural setup of the polluted creek “Šugavac” in the area covered by woody and bushy vegetation. Because of the lack of resources and other difficulties this part of the Center is not fully operational; it functions mainly for investigation of the natural process of water purification through wetlands.

Middle part of the “Little Danube” connects the upper and the lower part made from the riverbed of the river Danube model. It is still out of use for the same reasons similar to the upper part.

The main part of the CEFAH is its lower part that occupies approximately 5.5 ha. In this area are located: central building with 2 halls, aquarium building, summer classroom, fisherman’s home – fishery museum, a pile-dwelling, a small zoo with aquatic birds, 26 ponds, lower part of the Little Danube with accumulation lake, a peninsula, and the island. The central building consists of: rooms for spawning preparation and spawning, a laboratory, an area with computers for equipment operations monitoring and video surveillance, a room for water preparation (chemical and biological purification), warehouse, washroom, and changing room.

In Hall 1 (surface area of about 90 m²) there are 60 tanks, and a Zuger egg incubation system with water supply and outlet; in Hall 2 (surface area of about 90 m²) there are 9 tanks (8 with small RAS, Recirculating Aquaculture System), and 72 experimental aquaria, as well as a system for water supply and water drainage. The aquarium building (surface area 78 m²) is equipped with a holding construction with 32 aquaria (500L volume each) with filters for water purification and aeration, a cold chamber for cold water fish, a decorative pool and equipment for film projection. CEFAH equipment is modern and includes a robot system for fry feeding, computer system for dissolved oxygen monitoring in the tanks and in experimental fish basins, tagging equipment, RAS systems, video surveillance etc. The water supply for the tanks, aquaria, experimental fish ponds, as well as for the “Little Danube” stream is from springs of 120 – 136m depth. Three deep wells and a system of pumps and pipelines distribute water to each segment of the Center.

CEFAH vision: to use the space of the legacy that will, therefore, always be the property of younger generations, to establish a modern equipped Center for education and research in which new knowledge and skills will be generated and acquired, and to give contribution to development of knowledge, science, economy, better and healthier human society, humanely relationship between people and mankind, and the environment.

Table 1. *List of international and national projects and programs that contributed to establishment and maintenance of the CEFAH*

| Project or activity | Types of work | Funds from | Period of realization |
|---|---|---|------------------------------|
| Scientific cooperation between Serbia and Norway concerning planning and establishing a genetic improvement program for carp in Serbia, and to transfer knowledge within genetics and selective breeding – a project between Faculty of Agriculture, UB, and AKVAFORSK, Institute of Aquaculture Research, As, Norway | Work on experimental fish farm building, terrain drainage, reconstruction of the central building and Hall 1, equipment purchase | Government of the Kingdom of Norway | 2006 – 2007 |
| Building of the summer classroom | Building of the summer classroom | CEFAH team, funds from different sources | 2007 |
| Project FP7 “Reinforcement of Sustainable Aquaculture“ (ROSA) | Equipment purchase | European Commission | 2008 |
| | Reconstruction of Hall 2 and infrastructure building; well drilling and equipment for water supply of the fish farm | Ministry of Science Education and Technological Development of the Republic of Serbia | 2008 – 2010 |
| Project “From Šugavac to the Little Danube” | Cleansing of the terrain of the Šugavac creek, installation of pipeline for drainage of the partly purified waste water from the upstream located settlement, naturally shaped riverbed, drilling of 2 wells, and mounting of equipment for pumping and distribution of water for the new riverbed of the Little Danube | Fund for environmental protection of the Republic of Serbia | 2011 |
| | Building and equipment of the wooden cabin – public aquarium; building of the fisherman’s cabin, purchase and mounting of the plastic pipeline 300 m long, building of two small bridges | Secretariat for environmental protection of the city of Belgrade | 2011 |
| | Provision of 765 m concrete tubes Ø 1200 mm, with shipping to “Radmilovac” | Grocka municipality | 2010 – 2011 |
| Upgrading of the experimental fish farm | Building of 16 experimental ponds | Donation of particulars | 2011 |
| Building of the stone basin in the upper part of the riverbed | Building of the stone basin (surface area 60 m ²) | Donation of particulars | 2011 |

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|---|--|---|------|
| Project "Improvement of production capacities of the carp (<i>Cyprinus carpio</i>) by feeding and selective breeding programs" - TR 31075 | Equipment purchase for maintenance of the land area of the farm | Ministry of Science Education and Technological Development of the RS | 2012 |
| Project: Final regulation of the educational area "Little Danube" | Building of the outside WC, repair of the summer classroom, classroom equipment | Ministry of Science Education and Technological Development of the RS | 2012 |
| Work on upgrading and on arrangement of the Center's area | Building of the small Zoo for aquatic birds, building of the path, fencing of the Center's area, equipment purchase | CEFAH team, funds from different sources | 2013 |
| Work on upgrading and on arrangement of the Center's area | Building of a pile-dwelling on the accumulation lake, building and arrangement of small decorative spaces of the Center, building of manholes in the water supply system | CEFAH team, funds from different sources | 2014 |

Education and research programs of the CEFAH are important for the aquaculture economy in Serbia

The Center is an education polygon where new knowledge about fishery waters, plants and animals inhabiting aquatic environment, aquatic organisms' culture, fishery, etc. is acquired. It is intended for all generations: from pre-school and primary school children learning through visit to the Center about different fish species and other aquatic organisms, their culture, fishing methods, fishing gear; to PhD students and scientists generating new knowledge and skills. Particularly important significance of the Center is in the field of practical teaching for students of bachelor, master, specialisation and PhD level. They have a possibility to exercise theoretical lessons learnt and gain practical experience and skills in nearly all fishery activities (spawning, selective breeding, stocking, fish harvesting, feeding, recreational and professional fishery...). By gaining new knowledge and skills students are trained to enter fishery economy sector after completion of studies.

Particular value of the CEFAH is its modern equipment that enables a wide range of research: abiotic and biotic environmental factors in the ponds, in the lower part of the "Little Danube", as well as in experimental, controlled conditions in aquaria and tanks. In the Center, a research is carried out resulting in master, specialization and PhD theses (Poleksić et al., 2013, Marković et al., 2014). It is important to emphasize that due to Center's modern equipment students of different study levels learn the experiment planning, set-up, realization, and results interpretation. This is of utmost importance for their future training for research and in fishery economy.

An important activity of the Center is the realization of experiments in the frame of national and international research projects with the objective of improving the fishery science, and thus the fishery economy. Since inclusion of producers in research projects is increasing in both international and national calls for projects, the results of the CEFAH research projects are quickly transmitted and applied in the economy (Todorčević et al., 2014).

Production doubled in the area where Carp were fed with extruded added (Marković et al., 2012). This is primarily a result obtained by researchers of the CEFAH of the Faculty of

Agriculture. One of the important programs of the Center, developed together with the Center, is the program of selective breeding (Spasić et al., 2010). Its full application in Serbian aquaculture is expected in 4 to 5 years. Besides the carp selection, 3 years ago selective breeding of the rainbow trout started and the results are expected to be applied in 3 to 4 years. An important Activity of the Center is bringing the new knowledge to professionals in the fishery sector through organization of workshops and seminars for fish producers and other users of fishery waters, as well as through individual education visits of producers to the Center. It is worthwhile to mention that the Faculty of Agriculture and the scientists of the CEFAH organize from 2003, every second year, an International Conference that became regionally important and hosted the most important world aquaculture scientists and professionals. That way there is a direct impact on technology improvement on fish farms and on the contribution to aquaculture development in Serbia.

Conclusions

Building, equipping and establishing the Center for Fishery and Applied Hydrobiology (CEFAH) ("Little Danube") on the Experimental School estate "Radmilovac" of the Faculty of Agriculture in Belgrade has created a material basis for improvement of knowledge in the aquaculture sector for all generations, primarily students. This will contribute to development of the fishery economy in the coming future. The Center's particular importance is the fact that a range of research activities have already contributed to the development of Serbia's aquaculture sector, primarily in the area of carp breeding technology enhancement by the use of extruded feed, one of the main factors that contributed to the twofold increase of fish production in the last decade in Serbia. Another important program realized in CEFAH is the selective breeding of carp and rainbow trout that will provide a foundation for quality fry production for stocking in Serbian farms. Networking of the Center with companies, primarily fish farms and feed production companies through research projects and expert collaboration, education, and dissemination activities, represents a solid basis and prerequisite for a symbiotic relations and thus sustainability of the CEFAH and its further valuable influence on aquaculture development in Serbia.

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