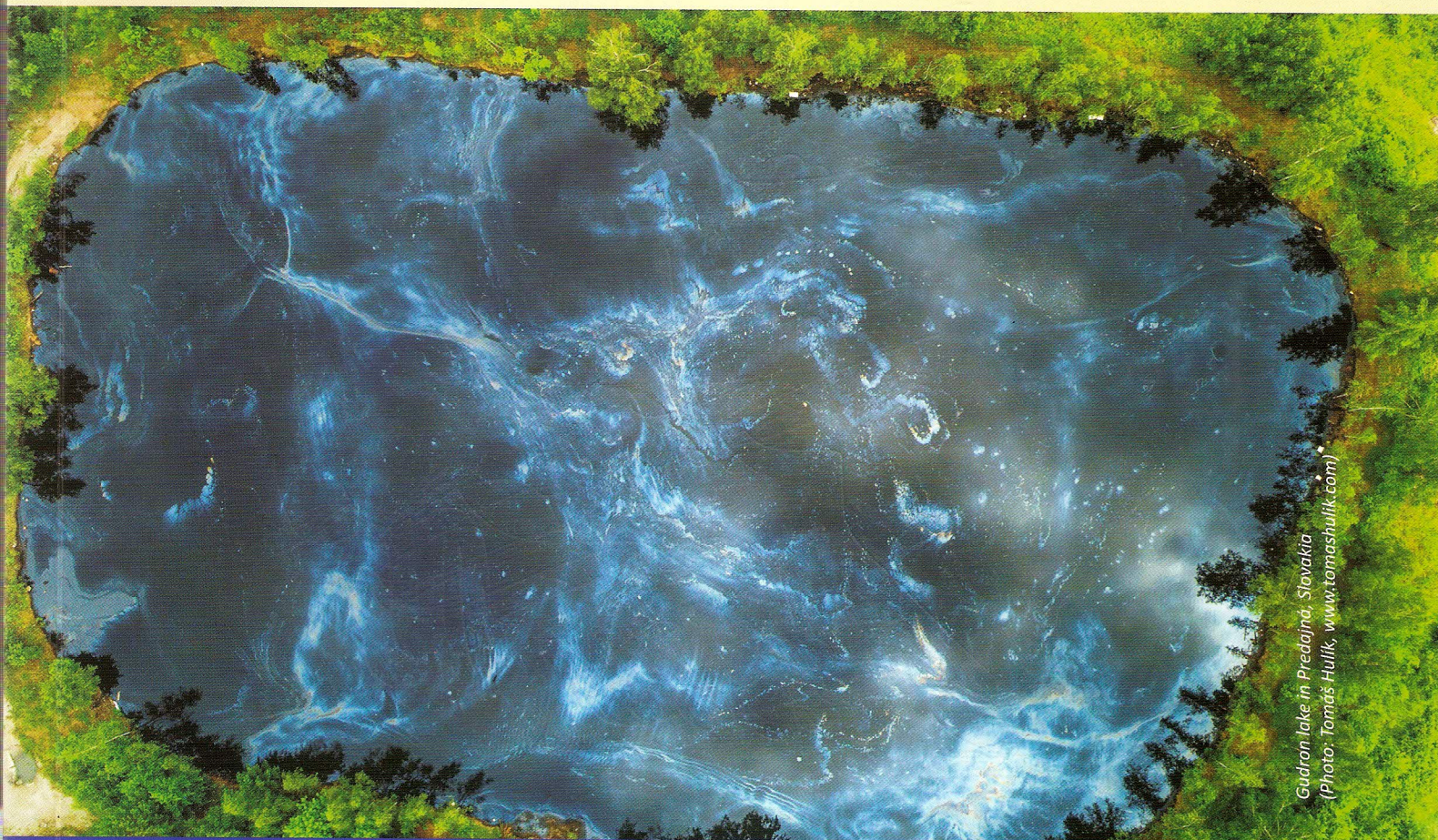


INTERNATIONAL CONFERENCE
CONTAMINATED SITES
ZNEČISTENÉ ÚZEMIA
MEDZINÁRODNÁ KONFERENCIA

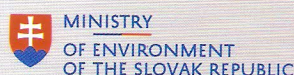
Ministry of Environment of the Slovak Republic
Slovak Environment Agency

INTERNATIONAL CONFERENCE
CONTAMINATED SITES 2022
SENEC | SLOVAK REPUBLIC | 12 – 14 OCTOBER 2022



*Gučron lake in Predajná, Slovakia
(Photo: Tomáš Hulík, www.tomashulik.com)*

CONFERENCE PROCEEDINGS



This publication has been prepared by the Slovak Environment Agency to support the International Conference CONTAMINATED SITES 2022, Senec, Slovak Republic, 12 – 14 October 2022. The conference was organised by the Slovak Environment Agency in the close cooperation with the Ministry of Environment of the Slovak Republic.

PUBLISHED BY:

Slovak Environment Agency (SEA)
Tajovského 28
975 90 Banská Bystrica
SLOVAKIA
Tel.: + 421 48 4374 164
www.sazp.sk
<https://contaminated-sites2020.sazp.sk/>

EDITORS:

Katarína Paluchová, Slovak Environment Agency
Zuzana Ďuriančíková, Slovak Environment Agency
Beáta Bednárová, Slovak Environment Agency
Elena Bradiaková, Slovak Environment Agency

PROOFREADERS:

The publication has not been proofread.

All images © Authors of the articles and SEA archive

Cover photos: Tomáš Hulík – www.tomashulik.com (1), Envigeo a. s. + Terradron (3), Archive of the SEA (4)

ISBN: 978-80-8213-084-6



Document completed in September 2022.

DISCLAIMER:

The information and views set out in this publication are those of the authors and do not necessarily represent the official views of the Ministry of Environment of the Slovak Republic and the Slovak Environment Agency as well.

ACKNOWLEDGEMENT:

The editors of this document would like to thank all authors of papers for their contribution.

THIS DOCUMENT SHOULD BE CITED AS:

Slovak Environment Agency. International Conference Contaminated sites 2022. Conference Proceedings. Banská Bystrica, October 2022. ISBN: 978-80-8213-084-6.

Available on the Internet: <http://contaminated-sites2020.sazp.sk/>

*The activity has been implemented within the national project
Information and providing advice on improving the quality of the environment in Slovakia.
The project is co-financed by the Cohesion Fund of the EU under the Operational programme Quality of Environment.*

CONTENTS

PROGRESS IN MANAGEMENT OF CONTAMINATED SITES IN THE REPUBLIC OF SERBIA 2021.....	4
THE FIRST NATIONANAL DATABASE OF POTENTIALLY CONTAMINATED SITES (PCSS) IN SLOVENIA AND A MODEL APPROACH FOR DETERMINING PRIORITY TREATMENT	8
INFORMATION SYSTEM OF CONTAMINATED SITES IN SLOVAKIA	12
THE INVENTORY OF CONTAMINATED SITES IN THE CZECH REPUBLIC (NIKM 2019-2021)	16
USE OF INFORMATION SYSTEMS AND SURVEY RESULTS OF CONTAMINATED AREAS FOR THE PURPOSE OF RISK ASSESSMENT AND GROUNDWATER STATUS WITHIN THE MEANING OF THE WATER FRAMEWORK DIRECTIVE	22
THE DRAFT OF THE DEVELOPMENT PRINCIPLES ACCORDING TO THE BUILDING ACT IN RELATION TO THE MINING ACT	25
REMEDIAION FEASIBILITY STUDY OF A FLOODPLAIN OF MORAVA RIVER IN CZECH REPUBLIC CONTAMINATED BY CHLORINATED ETHENES	28
WATER AND SOIL ENVIRONMENTAL RISK ASSESSMENT IN LITHUANIA.....	32
UPDATED RISK ANALYSIS OF THE UNIPETROL LITVÍNŮV LANDFILL AREAS.....	36
REPRESENTATIVE CONCENTRATIONS IN QUANTITATIVE RISK ASSESSMENT	41
USING A NOVEL INDEX TO FIND THE MOST APPROPRIATE AGGREGATION FUNCTIONS FOR COMPOSITE HAZARD RATING OF A WASTE DISPOSAL SITE	45
ASSESSMENT OF WATER RESOURCES CONTAMINATION NEAR LANDFILL USING LWPI MEASURE	49
CURRENT HYGIENIC STATE OF AGRICULTURAL SOILS IN KROMPACHY – RUDŇANY REGION	53
ARSENIC.....	58
LESSONS LEARNED IN REMEDIATION OF THE MOST POLLUTED SITE IN LATVIA – INCUKALNS ACID TAR PONDS	65
PROJECT: HISTORY OF ANTROPOGENIC SEDIMENT CONTAMINATION IN INDUSTRIALIZED RIVER SYSTEMS (GRANT PROJECT: DSGS-2021)	67
REMEDIAION OF A FORMER MINE TECHNOSOL HIGHLY CONTAMINATED WITH AS AND PB USING (IN) ORGANIC AMENDMENTS COMBINED WITH SALIX SPECIES: A 5-YEAR FIELD STUDY	71
MERCURY CONTENTS IN LARGEMOUTH BASS (<i>MICROPTERUS SALMOIDES</i>) FROM THE VALDEAZOGUES RIVER, ALMADÉN HG MINING DISTRICT, SOUTH CENTRAL SPAIN	75
SOIL AND SEDIMENT CAPPING WITH ACTIVE GEOCOMPOSITES FOR SITE REMEDIATION	79
LYSIMETER RESEARCH – NEW EXPERIMENTS.....	84
ELECTRICAL CONDUCTIVITY ESTIMATION IN LYSIMETERIC TEST AT A LANDFILL SITE USING TRANSFER LEARNING APPROACH.....	88
FULL-SCALE APPLICATION IN ITALY OF THE EHC® LIQUID TECHNOLOGY FOR THE COMBINED ISCR AND ERD TREATMENT OF AN AEROBIC AQUIFER IMPACTED WITH TETRACHLOROMETHANE AND CHLOROFORM.....	92

ASSESSMENT OF THE SOIL ENVIRONMENTAL QUALITY FROM MITIDJA PLAIN, ALGERIA	158
THE POSSIBILITY OF PLANTING THE FAST-GROWING TREE SPECIES AT THE LANDFILLS OF THE KOLUBARA MINING BASIN.....	161
TRACE ELEMENTS CONTENT IN SOILS AND INDIGENOUS MEDICINAL HERBS IN THE AREA OF HIGHLY DEVELOPED INDUSTRIAL ACTIVITY	165
THE POTENTIAL OF <i>MISCANTHUS X GIGANTEUS</i> FOR REMEDIATION OF SITES CONTAMINATED WITH OIL-PRODUCTS.....	168
RADIONUCLIDES AND DAMAGED SOILS OF EASTERN HERZEGOVINA.....	170
PRODUCTION OF BIOFUELS USING RAW ALGAE (<i>CHLORELA</i>).....	172
INVESTIGATIONS ON THE EFFICIENCY OF SOME BIOPRODUCTS IN BIOLOGICAL CONTROL ASH [UNCINULA NECATOR (SCHW.)] IN HARDHI	176
FISHPOND SEDIMENT AS A FERTILIZER OR FEED SUPPLEMENT	177
ADSORPTION OF HEAVY METAL IONS FROM WATER WITH ENVIRONMENTALLY FRIENDLY SORBENT-BASED ON ELDER TREE CORE	180
MAPPING OF ANTHROPOGENIC CONTAMINATION OF SEDIMENTS OF DAM RESERVOIRS IN THE VÁH RIVER BASIN	182
HISTORY OF ANTHROPOGENIC SEDIMENT CONTAMINATION IN INDUSTRIALIZED RIVER SYSTEMS (GRANT PROJECT: DSGS-2021)	185
SULFIDATED ZERO-VALENT IRON NANOPARTICLES: PROPERTIES, REACTIVITY AND MIGRATION	188
IMPORTANCE OF REGIONAL BASELINE LEVELS IN DERIVED THRESHOLD VALUES: AN EXAMPLE WITH DEEP MARINE SEDIMENTS	191
PLANTS AND MACROMYCETES FROM AREAS AFFECTED BY ORE MINING – BIOCONCENTRATION FACTORS	195
NIKM – DISTRIBUTION OF THE CONTAMINATED SITES ON THE TERRITORY OF THE CZECH REPUBLIC	197
QUICK TEST FOR CASCADING USAGE OF <i>MISCANTHUSXGIGANTEUS</i> BIOMASS CULTIVATED IN THE POST-MINING AND POST-MILITARY SOILS.....	200
ADSORPTION OF FULVIC ACIDS AND THEIR COMPLEXES WITH TRACE ELEMENTS BY CLAY MINERALS	202
PHYSICOCHEMICAL CHARACTERIZATION OF DIFFERENTLY SOURCED BIOCHARS AND THEIR POTENTIAL USE FOR THE PHYTOSTABILISATION OF SOILS POLLUTED BY TRACE ELEMENTS.....	204

FISHPOND SEDIMENT AS A FERTILIZER OR FEED SUPPLEMENT

Daniela Belichovska¹ - Vesna Levkov¹ - Katerina Belichovska² - Natasha Gjorgovska¹ - Suzana Duraku³

¹Institute of Animal Science, Ss. Cyril and Methodius University in Skopje, Blvd. Ilinden 92a, 1000 Skopje, Republic of North Macedonia

²Faculty of Agricultural Sciences and Food, Ss. Cyril and Methodius University in Skopje, Blvd. 16-ta Makedonska brigada 3, 1000 Skopje, Republic of North Macedonia

³Ministry of Agriculture, Forestry and Water Economy, 1250 Debar, Republic of North Macedonia

daniela.belichovska@istoc.ukim.mk

vesna.levkov.1@istoc.ukim.mk

kbelicovska@yahoo.com

natasha.gjorgovska@istoc.ukim.mk

KEYWORDS

Fishpond sediment, utilization, fertilizer, fish feed

ABSTRACT

Fishpond sediment is rich in organic matter, nitrogen, phosphorus, macro and micronutrients, and therefore it can be used as a fertilizer for crop production and as a supplement in animal feed. Thermally treated sediment from three fishponds was used as a fertilizer in the production of peppers and as a supplement in fish feed. No significant difference was found in yield and quality between peppers fertilized with manure and those fertilized with thermally treated sediment. Furthermore, no significant differences were observed in the fish growth between fish fed with standard fodder mixture and those fed with fodder mixture with thermally treated sediment added.

INTRODUCTION

Global aquaculture fish production has been gradually increasing over the last 40 years. It has been estimated that its annual growth is on average 8.8% (Dròzdž et al., 2020). According to FAO (2014), aquaculture is one of the fastest growing industries, enabling the production of animal proteins worth 66.63 million tons per year. The production of freshwater aquaculture accounts for about 46 million tons/year, and marine about 2.7 million tons/year (FAO, 2016). It is estimated that in the European Union, aquaculture production in 2015 accounted for about 19.7% of total fish production or 1.6 million tons out of 106 million tons worldwide. It is considered that the largest producer of aquaculture fish is China with over 61 million tons or 58% of world production, followed by Indonesia with 15% of world production. The growth rate of aquaculture production is a result of the fish increased consumption due to the growth of the human population, enlarge urbanization and income.

Intensive fish farming and increased aquaculture production result with creation and accumulation of sediment in fishponds. Accumulation of sediment over time will result with a reduction in the depth of the fishponds, a reduction in their volume and limitation of the living space and movement of the fish. On the other hand, sediment accumulation means the accumulation of organic matter that can release toxic compounds such as hydrogen sulfide or nitrites. Also, the decomposition of organic matter by microorganisms can result with oxygen depletion and reduce its presence in the water, which negatively affects fish breeding, their well-being as well as yield and economic benefits (Muendo et al., 2014). Therefore, it is necessary to periodically clean the fishponds from the accumulated sediment. The treatment of the removed sediment is also the subject of a great deal of scientific research, because sediment contains unused organic matter and compounds such as methane (CH₄) or nitrous oxide (N₂O) that affect global warming (Ma et al., 2018). Fish pond sediments may contain undesirable substances such as heavy metals or pathogenic microorganisms,

so its improper treatment and disposal can pose a danger to the environment and cause pollution of surface, groundwater and soil. However, fishpond sediments are also a rich source of nutrients (nitrogen, phosphorus, potassium) and can be used as fertilizers or as soil structure improvers (Rahman and Yakupitiyage, 2006). Due to its high content of organic compounds, it can also be used as a supplement to animal feed.

EXPERIMENTAL PART

Fishpond sediment as a fertilizer

The potential of fishpond sediment to be used as a fertilizer was observed during experimental analyses over pepper production. The sediment collected from the basins of three cold-water rainbow trout ponds in the Republic of Macedonia was first thermally treated at 100°C for 10 minutes and after that was used as fertilizer.

Due to the small quantity of sediment, mini-experiment over an area of 2 m² was made for pepper production. A pepper from the "Kurtovska kapija" variety was taken as a culture. Peppers fertilized with manure in the amount of 5 kg per 2 m² (control) and peppers fertilized with thermally treated sediment in the amount of 2.5 kg per 2 m² (treatment) were compared.

The results showed that in the production of peppers, the sediment as a fertilizer material showed somewhat lower results. On the plot in which manure was used as a fertilizer 12 kg of peppers were produced, while on the plot where sediment was used 10 kg of peppers were obtained. However, considering that the sediment was added in lower amount, it can be concluded that the sediment can yield very good results, and moreover, it is much cheaper than manure. On the other hand, with its extraction from pond wastewater, the environment (water, soil) from pollution is protected. Fishpond sediment beside as a fertilizer can be used to improve the characteristics of the soil (Rahman and Yakupitiyage, 2006). They proved that application of 30% of fishpond sediment improved the soil aggregate stability. The fishpond sediment can also be used in nurseries and green houses.

According to Boyd and Massaut (1999) fish pond sediments can accumulate different kind of risk substances such as fertilizers, heavy metals, oxidants, coagulants, pesticides, osmoregulators and probiotics. The substances with highest risk of contamination are heavy metals, algacides, herbicides and insecticides. The authors emphasized that some of the microorganisms such as *Bacillus* sp., present in the sediment, can have a positive impact, because these bacteria can increase the decomposition of organic matter and can reduce the concentration of nitrogen. But care must be taken to avoid presence of pathogenic bacteria which can enter the fish ponds with low quality water or poorly treated waste water (Dròzdž et al., 2020). The risk in using fishpond sediment as a fertilizer also represents medicaments used for treating or supplementing the fish. Those are different kinds of antibiotics or therapeutics that can have negative effects on environment and living organisms or can have toxic effects on fish, consumers and aquatic environment especially if they are used in excessive quantities. It is considered that fishpond sediment composition can be treated more as a resource than as a waste.

When considering the sediment from fishponds as a fertilizer a care should be taken about the availability of the nutrient compounds. For example, phosphorus in fishpond sediments can be in different forms: water soluble, less soluble or insoluble form. Phosphorus can be adsorbed on the mud and can't be available. Potassium ions can be released in the pond water or part of the potassium could leach to deeper layers of the pond sediment, while the organic matter of the fishponds could improve soil physical and chemical condition, can improve soil texture by forming soil aggregations. Soil aeration could also be increased that helps soil to improve its infiltration. That is good for reduction of soil surface erosion and losses of its nutrients (Muendo et al., 2014).

Fishpond sediment in fish diet

In order to investigate the effect of including fishpond sediment in the fish diet, fish fed a standard fodder mixture from Macedonian origin (control) and fish fed a fodder mixture supplemented with 20% recycled fishpond sediment (treatment) were examined. 100 rainbow trout (*Oncorhynchus mykiss*) individuals with an initial weight of 120 g were tested.

The results showed that for the production of 1 kg of fish meat in the control treatment where fish fed with commercial feed, 2050 g of food were consumed, while in the treatment where the daily amount of food was combined with sediment in a quantity of 1650 g commercial feed + 400 g recycled sediment, 995 g of fish meat were produced. The difference was insignificant, but given the fact that the fish feed was reduced by 400 g, it can be concluded that in the production of fish meat there was a great saving in food without a significant decrease in the yield.

With this type of diet where thermally treated sediment was included, the production of fish meat becomes cheaper, since thermal processing of waste material has low energy consumption which is not higher than 2% of the price of fish food, which means that the production of fish meat is at least 16-18% cheaper.

Recycled fishpond sediment can be successfully used in agriculture in the production of peppers and in animal husbandry as a partial replacement of fish diet.

REFERENCE LIST

- [1] Boyd, C.E., Massaut, L., 1999: Risk associated with the use of chemicals in pond aquaculture. *Aquacult. Eng.*, 4, 113-132.
- [2] Dròzdź, D., Malińska, K., Mazurkiewicz, J., Kacprzak, M., Mrowiec, M., Szczypiór, A., Postawa P., Stachowiak T., 2020: Fishpond sediment from aquaculture production – current practices and potential for nutrient recovery: a Review. *Int. Agrophys.* 34, 33-41.
- [3] FAO, 2014: The state of world fisheries and aquaculture. Food and Agriculture Organization of United Nations.
- [4] FAO, 2016: Fishery and Aquaculture Statistics. Yearbook.
- [5] Ma, Y., Sun, L., Liu, C., Yang, X., Zhou, W., Yang, B., Schwenke, G., Liu, D.L., 2018: A comparison of methane and nitrous emission from inland mixed-fish and crab aquaculture ponds. *Sci. Total Environ.* 637-638, 517-523.
- [6] Muendo, P., Verdegem, M.C.J., Stoorvogel, J.J., Milstein, A., Gamal, E., Duc, P.M., Verreth, J.A.J., 2014: Sediment accumulation in fish ponds; Its potential for agricultural use. *Int. J. Fisheries Aquatic Studies*, 1(5), 228-241.
- [7] Rahman, M.M., Yakupitiyage, A., 2006: Use of fishpond sediment for sustainable aquaculture-agriculture farming. *Int J Sus Dev Plann*, 2, 192-202.
- [8] Thi Da, C., Tu, P.A., Livsey, J., Tang, V.T., Berg, H., Manzoni, S., 2020: Improving productivity in integrated fish-vegetable farming system with recycled fish pond sediments. *Agronomy*, 10(7), 1025.