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Slovak Environment Agency

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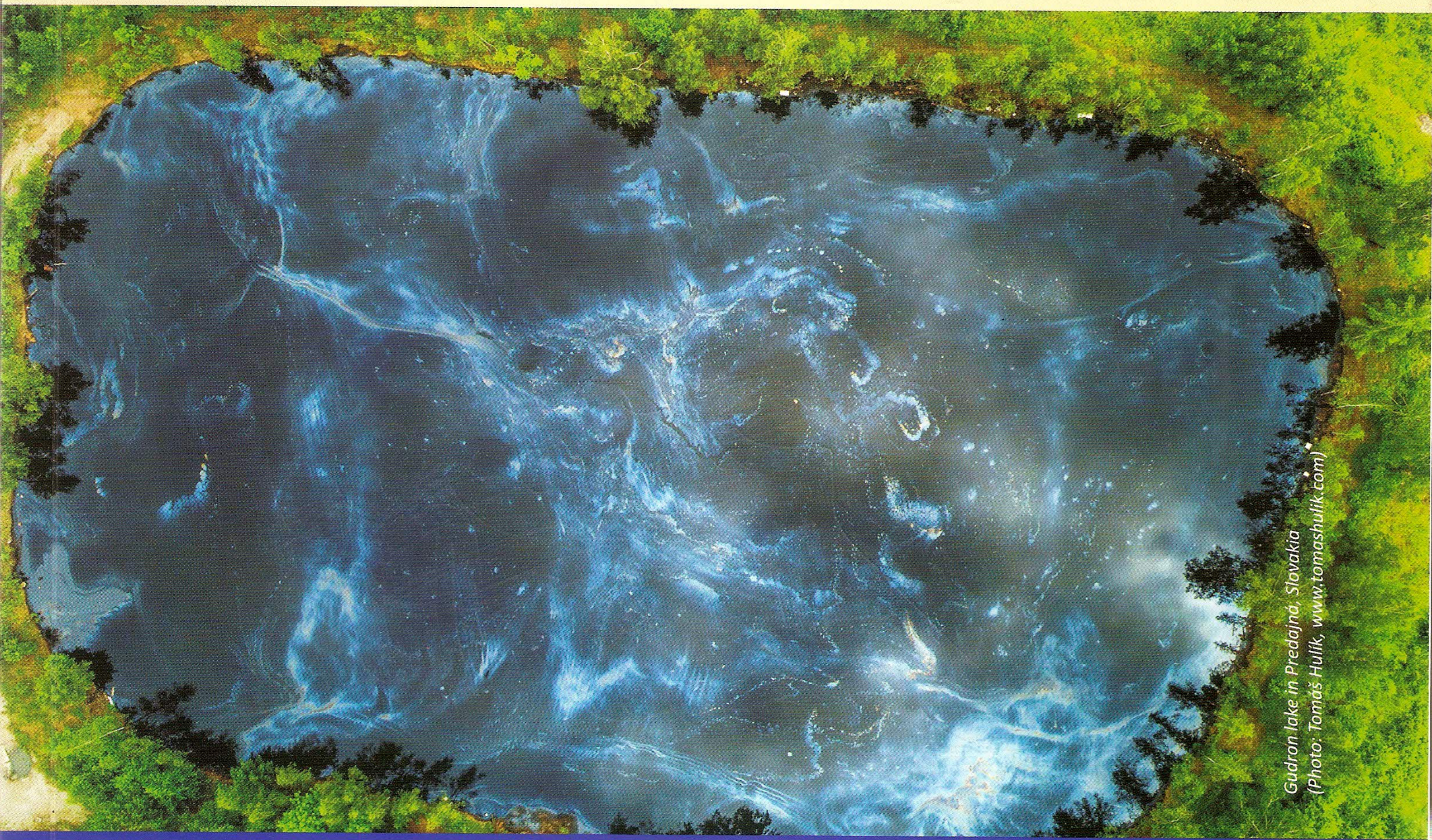

Gudron lake in Predajná, Slovakia (Photo: Tomáš Hulík, www.tomashulik.com)

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CONTENTS

FISHPOND SEDIMENT AS A FERTILIZER OR FEED SUPPLEMENT

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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% (Dròżdż 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 (CH_4) or nitrous oxide (N_2O) 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 observe 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 m^2 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 m^2 (control) and peppers fertilized with thermally treated sediment in the amount of 2.5 kg per 2 m^2 (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, algaecides, 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 (Dròżdż 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 dipper 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.

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