Bottom sediment as agricultural soil additive or mineral fertilizer

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Introduction: This study includes the results of investigation chemical composition bottom sediment from small reservoir in the Dłubnia River in the locality of Zesławice (South Poland, near Cracow). The catchment area in the Dłubnia River is used: 5% forests, 78% cropland and 1,6% grassland. Dam reservoir sediments are composed of contributions from two sources: natural erosion products and agriculture over erosion product. Their accumulation encompasses a number of technical, environmental and economical problems [1]. Sediment can be a potential source of environmental pollution if not managed judiciously. On the other hand some bottom sediment is enriched with organic matter, nitrogen, phosphorus, macro and microelements, and hence, it can be a potential fertilizer supplement or soil conditioner, which could enhance the soil environment [1, 2, 3, 4].

Methods: The investigations were carried out in 2005 – autumn season. The sediments were collected at the depth of: 0-15 cm. Sediment was subjected to most studies routinely used for the evaluation of soil fertility: texture, organic matter, pH_{KCl}, N (Kjeldahl), available macronutrients – P, K (Egner - Reihm method), Mg (Schachtschabel method), cation exchange capacity (CEC), heavy metals - total and soluble forms [5]. Sentiment samples were ground in an agate mortar, mineralized first in a muffle furnace and then in the HNO_3 and $HClO_4$ mixture. Soluble forms heavy metals determination in the 1 mol HCl. In the obtained solutions concentrations of Zn, Cu, Ni, Pb, Cd were assessed using ICP – AES method with JY 238 Ultrace Jobin Yvon Emission apparatus.

Results: *Texture*. The greater part of river basin consists of loess and 80% of surface is strongly eroded. The sediment showed mostly silt texture. Granulometric fraction: sand – 8%, silt - 66%, clay - 26%. *Organic matter and pH.* Content of organic matter was higher then medium interval soils in Poland (2%) and ranged between 2,38% - 2,72%. In sediment pH values was 7,35. *Nitrogen* in sediment has mean levels: 1,03 g N · kg^{-1}, but sometimes exceeds average valoues for mineral soils (0,2 – 4,0 g N·kg^{-1}). *Available P, K,* in sediment has low levels: 0,05 g P · kg^{-1} and 0,07 g K · kg^{-1} however available Mg has high level: 0,12 g Mg · kg^{-1}. *Cationic Exchange Capacity (CEC*). In reservoir, sediment has a relatively uniform exchangeable cation distribution. Ca^{2+} represents more than 89% of total CEC, Mg^{2+}- 3,4%, K^+- 1,6%, Na^+ - 0,4% and H^+ - 5% of total CEC. *Total and soluble forms heavy metals* in bottom sediments present table 1.

Table 1. Contents and assessment of heavy metals in bottom.

Forms	Zn	Ni	Cu	Pb	Cd
	mg · kg^{-1} d.m				
Total	76,3	11,0	12,2	12,8	0,39
Soluble	45,6	2,9	5,5	12,0	0,36
Geochemical Background*	<120	5-90	2-60	3-40	<0,35
IUNG** Criterion	<100	<50	<40	<70	<1

*sedimetary rocks, **Soil Science and Plant Cultivation (IUNG)

Discussion: Heavy metal contents were assessed according to the values of geochemical background stated by Kabata – Pendias and Pendias* [6], and also were based on IUNG criteria** [7] (tab.1). According to Kabata – Pendias and Pendias Zn, Ni, Cu, Pb had natural content only Cd content had to high level. According to IUNG criteria in all samples were detected natural heavy metals content. We have studied the bottom sediments to evaluate their suitability for agriculture use. The sediment compares well or even exceeds the corresponding values for soil in general (organic matter, pH, nitrogen). In spite of low levels available forms P and K this sediment can be use as soil conditioner to improve the physical and chemical conditions of poor quality soils for example sandy, acid soils.

References: [1] Fonseca et al. (2003) *Interrnational Symposium of the Kanazawa University 21 st-Century COE Program* **1**:55-62; [2] Fonseca et al. (1998) *Episodes* **21**:218-224; [3] Mizanur et al. (2004) *Thammasat International Journal of Science and Technology* **9(4)**:1-12;[4] Pelczar et al (1998) *Archives of Environmental Protection* **24(3)**:93-101; [5] Ostrowska et al. (1991) *Wyd. IOŚ, Warszawa* 53 pp; [6] Kabata – Pendias and Pendias (1999) *Wyd. Nauk. PWN, Warszawa* 398 pp; [7] Kabata – Pendias et al. (1995*) PIOŚ i IUNG, Bibl. Monit. Środow.* 42 pp.