Tropical plants of constructed wetlands for wastewater treatment on looking at human and social sciences

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INTRODUCTION

We propose a synthesis of the plant taxa experimented in constructed wetlands (CWs), bringing to the fore their complementary values and the cultural and social importance of the choice of plant species. A geohistorical analysis of archaeological and historical data reveals the antiquity of the use of wetland plants, especially in tropical and subtropical areas (Nicholas, 1998). The development of some civilisations at the beginning of history was based on some macrophytes. Nowadays, the use of tropical wetland plants has evolved in line with the cultural, social and economic dynamics, especially following globalization. According to the United Nations Development Programme, "in dryland India, biodiversity related products usually account for about 20% of the incomes of poor rural people. But during droughts they account for more than 40% because cultivated crops fail" (UNDP, 2003: 124). With regards to cultural geography and ethnobotany, the role of spontaneous flora can be looked as determining the social and cultural integration of such ecotechnologies for wastewater treatment. This characteristic implies to advocate taking biodiversity into account in order to respect the whole values devolved upon the macrophytic plants. Macrophytes diversity is rarely considered in the development of CWs techniques, whereas it has been demonstrated that macrophytes diversity improves the functioning and services provided by wetlands (Engelhardt and Ritchie, 2001). It has even been pointed out that plant diversity can improve CWs efficiency (Zhanga et al., 2010). But the choice of macrophytes species for CWs is linked to the type of system, and so to the quality of the effluents which have to be treated (Vymazal, 2007). In the previous decade, the number of taxa experimented in CWs has been on the constant increase, answering a request of adaptation related to the geographical spread of that technology.

RESULTS AND DISCUSSION

According to 77 references, 226 planted or spontaneous taxa appeared in CWs of different parts of the world. Four species are more used and so more studied than any others: *Eichhornia crassipes*

(Mart.) Solms. (in 27 references, so 35.5% of them), *Phragmites australis* (Cav.) Trin. ex Steud. (19 references – 24.6%), *Typha latifolia* L. (9 references – 11.6%) and *Pistia stratiotes* L. (8 references – 10.3%). We can notice that the genus *Typha* (*T. angustifolia* L., *T. domingensis* Pers., *T. elephantina* Roxb., *T. latifolia* L., *T. orientalis* C. Presl. and *T. sp.*) appeared in 21 references about CWs (27.2% of the total). Whereas the two helophytes, i.e. *P. australis* and *T. latifolia*, originate from temperate zone, the two floating species are common in intertropical zone. But they are all considered as invasive in several regions (Gopal and Sharma, 1979). Among these 226 plants, 76 are found in India (33.6%), and 67 in Tamil Nadu (29.6%). In Pondicherry area, tropical India, ecotechnologies for wastewater treatment are spreading, mainly because of Auroville influence. In that area, about 40 CWs sites treat wastewater from domestic, industrial and even medical origins, and a total of 12 species are used. But, whereas some of them are indigenous species (e.g. *Arundo donax* L.), the most used are exotic (e.g. *Pistia stratiotes* L., *Salvinia molesta* D.S. Mitch.), and thus, considered as a threat for natural ecosystems. Furthermore, traditional economic uses of spontaneous wetland plants are locally important, except for the exotic species. Non-native species are mainly planted for aesthetic features. However, in Auroville, when CWs plants are harvested, which does not occur in every site, they are used for different purposes: animal fodder, mulch against erosion, compost for agriculture, whenever they are not burnt. In Tamil Nadu and Pondicherry region studied areas, most of the wetland plants have several kinds of utilisations. They can be used in a "traditional way" as food, beverage, fodder, medicine, handicraft, construction material etc. From a "modern" viewpoint, vegetal matter is considered as potential energy and bio-fertilizer resource. Moreover, woody species of wetlands seem not to be widely used in CWs, whereas many are a key-resource. A single example, the palmyra *Borrasus flabellifer* L., commonly found in and around south-eastern India's natural and manmade wetlands, is considered to have more than 400 different uses.

CONCLUSION

Thus, choosing to plant local macrophytes species in CWs can be considered as an asset for the development of CWs, since it can be a part of global development projects which integrate cultural, social and economic characteristics. But, because of the ability of some macrophytes to accumulate toxic elements, human utilisation of CWs macrophytes has to be managed considering health damage potentiality. Spontaneous macrophytes diversity has to be appreciated for its key-role in the development of CWs in developing countries, not only from an ecological point of view, but also from cultural, social, sanitary and economic views.

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