ASSESSING THE REUSE POTENTIAL FOR ORGANIC WASTE PRODUCTS IN URBAN AND PERI-URBAN AGRICULTURE

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ABSTRACT

Integrated approaches to environmental sanitation and urban agriculture could contribute to mitigating some of the urban challenges. Yet, city authorities do not recognise urban agriculture as a food production and organic waste reduction strategy. Information on urban and peri-urban organic material and nutrient flows is missing and tools to assess these flows are scarce. Based on nutrient balances, which have been developed for nutrient management purposes in agriculture, the paper suggests a conceptual approach for integrated nutrient management in urban and peri-urban areas. Different components of the conceptual approach are presented and discussed. Focus is placed on the methodological aspects of assessing the biophysical waste reuse potential. Advanced city planning instruments such as remote sensing and geographical information system could be combined with existing nutrient management approaches from agriculture. Besides the biophysical aspects, socio-economic and policy aspects should form integral parts as well.
Keywords: *GIS, nutrient balances, remote sensing, urban agriculture, urban planning, urban waste.*

INTRODUCTION

A holistic approach to environmental sanitation and urban agriculture could help to mitigate some of the urban challenges, such as the lack of adequate environmental sanitation services and food security. Human waste, organic municipal solid waste and organic waste from industry, in particular from food industry, are valuable and easily accessible fertilisers containing significant amounts of nutrients for food and non-food crop production. Yet, city authorities generally do not recognise urban agriculture as a strategy for improving food security and reducing human and organic municipal solid waste disposal problems. Cities have to look modern and free of traditional rural practices. Agriculture is by definition not practiced in cities (Drescher et al., 2000). Hence, urban and to a certain extent also peri-urban agriculture belong to the informal sector and no official authority is dealing with informal activities.

Given the above mentioned constraints ways have to be found to convince policy makers and urban planners of the importance of urban agriculture as a food security and waste reuse strategy. Policy makers and urban planners usually do not have a well distinct picture of the potential and limitations of urban and peri-urban agriculture. For instance, information on the urban and peri-urban organic material and nutrient flows, including production, consumption, disposal and reuse is scarce (Drechsel and Kunze, 1999; Baumgartner and Belevi, 2001). There is a need for more quantitative knowledge on the potential for organic waste reuse in urban and peri-urban agriculture (Allison et al., 1998). Dulac (2001) identifies the challenges of future research in the need for a comprehensive and strategic approach to planning and management of urban waste. Planning tools should look at the flows of material and nutrients including geographic and socio-economic information.

INTEGRATED NUTRIENT MANAGEMENT IN URBAN AND PERI-URBAN AGRICULTURE

Such a new planning approach could be based on nutrient balances, which have been developed for nutrient monitoring and management purposes on agricultural fields and farms. In agriculture nutrient balances have become widely adopted tools to meet environmental targets (Öborn et al., 2003). Goodlass et al. (2003) reported that farmers perceived nutrient balances generally as positive. The nutrient balances represent a useful way of raising awareness of environmental problems and improving environmental performance. Scoones and Toulmin (1998) recognise the potential contribution of balances to the policy process. Participatory nutrient balance analysis can encourage the discussion among farmers, scientists and policy makers in the process of negotiation.

Unlike rural areas where most of the land belongs to agriculture and forest, the urban and peri-urban environment is fragmented, diverse and highly dynamic. Therefore, estimating nutrient balances in this environment requires an understanding of the development processes in urban and peri-urban agriculture and environmental sanitation. The presented conceptual approach is divided into six steps that should allow accessing the necessary information and data (Figure):

1. The importance of the urban and peri-urban agriculture in the selected city is assessed and the spatial distribution of open land (e.g. farmland, parks) and their vegetation cover in different administrative units are characterised and analysed.
2. The different farming systems that have evolved in the city are described and the most important systems regarding nutrient management (e.g. animal manures, mineral fertilisers) are identified and spatially located.
3. The administrative sub-division(s), which represent well the different farming systems regarding the relative importance of the material/nutrient flows and the share on farmland are selected and nutrient balances of the respective systems are estimated.
4. The spatial distribution of (industrialised) livestock production units is described and the amounts of waste products (liquid and solid manures) produced within the different administrative units of the selected urban and peri-urban area are assessed.
5. The different waste products produced by the urban and peri-urban population (e.g. human waste and organic municipal solid waste) and the (food) industry in the urban and peri-urban area are characterised, quantified and spatially located within the different administrative units.
6. Nutrient balances over different administrative units and levels are estimated considering the steps one to five.

The implementation of the conceptual approach will raise further questions. Some are briefly discussed hereafter and present ideas of how to address the encountered problems:

In developing countries, urban development takes place in a partially uncontrolled way, in particular in peri-urban areas. City planning instruments such as master or structural plans with thematic or cadastral maps might be available for specific parts of the city (e.g. the city centre) but not for the highly dynamic and diverse peri-urban areas. In these contexts, remote sensing and geographic information system could play a key role in analysing the spatial distribution of open and farm land.

Different types of farming systems may have developed, (i) crop production, (ii) animal production, (iii) aquaculture and mixed farming systems with combinations of i, ii, and iii. An exploratory farming system survey in the urban and peri-urban area can provide a first overview on the different types of farming systems. The analysis of the most important farming systems and their distribution allows the selection of a specific administrative sub-division, which well represents the different types of systems. Detailed investigations of the nutrient flows in the different systems will allow to assessing the actual state of nutrient management and the impact on the environment. Analysing a large number of samples for each farming system should allow identifying patterns for nutrient management. The patterns of each farming system and their relative importance in the administrative sub-division provide information on the nutrient balance situation of the administrative sub-division.

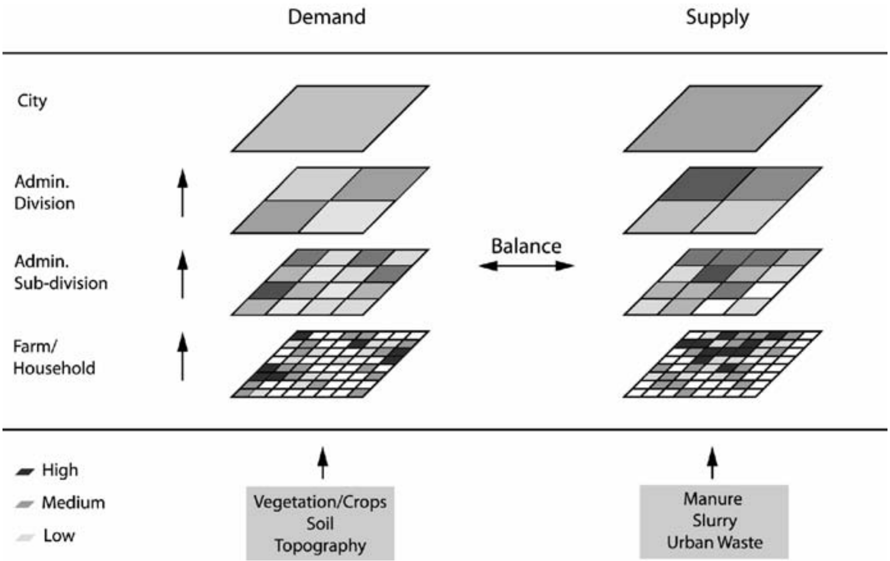

***Figure 1**. Conceptual approach to integrated nutrient management in urban and peri-urban agriculture.*

Unlike traditional mixed farming systems, industrialised livestock production systems are often disconnected from soil and closely situated to meat markets. Hence, industrialised livestock production is expected to be dense in peri-urban areas. Waste products generated in these units are valuable organic fertilisers, but affect negatively the environment if discharged untreated to water streams. Usually industrial livestock production depends strongly on hygiene and health standards. Therefore, the identification of the production units may base on secondary data from veterinary, farm extension and pollution control departments.

Waste products generated by urban and peri-urban population are expected to be diverse. Solid waste from public markets and organic waste from (food) industry differs in terms of composition from household solid waste. The nutrient content of wastewater differs according to the type of sanitation system (e.g. sewage, septic tank, dry toilette system). The different waste products, the amounts produced and the location can be assessed using census and secondary data from public administration.

Combining remote sensing data on open land, information on patterns for nutrient management on farms and data on waste from industrial livestock production as well as waste produced by the urban and peri-urban population, nutrient balances over different sub-divisions and on the next higher administrative level could be estimated. Information on the supply and the demand of waste products over different administrative units and levels of the city should allow developing waste management scenarios.

OUTLOOK

Assessing the biophysical potential as such may not yet convince policy makers and planners of the necessity and usefulness of urban and peri-urban agriculture as food security and organic waste reduction strategy. Economic and social aspects are critical in understanding patterns of soil fertility management in the respective contexts, over time, and from one farmer to another (Soones and Toulmin, 1998; Matthews, 2000). Whether waste is going to be used depends very much on economic factors such as land, transportation and costs of fertiliser (Furedy et al., 1997). The approach should thus also include socio-economic information to analyse the cost/benefit of organic waste reuse in comparison with present practices such as conventional wastewater treatment, landfilling and incineration. Interpretation of results from the biophysical and economic assessments should be critical considering social, cultural as well as policy aspects.

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