Agricultural Systems xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

Agricultural Systems

journal homepage: www.elsevier.com/locate/agsy

Participatory systems approaches for urban and peri-urban agriculture planning: The role of system dynamics and spatial group model building

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ARTICLE INFO

Article history:
Received 4 October 2015
Received in revised form 18 August 2016
Accepted 30 September 2016
Available online xxxx

Keywords:
Urban agriculture
System dynamics
Spatial group model building
Participatory processes
Planning
Christchurch

ABSTRACT

Urban agriculture has become an important research theme in recent years. Over the past decade, a number of different, diverse value chains have been established in the urban areas of developed and developing countries alike, with increasing convergence in their motivations related to food security and livelihoods development, particularly for poor and disadvantaged segments of society. However, for urban agriculture to be sustainable as a livelihoods and resilience strategy will require decision-support tools that allow planners and participants alike to jointly develop strategies and assess potential leverage points within urban food value chains. In this paper, we argue that system dynamics (SD) models combined with participatory approaches have important roles in bridging this gap, though these will need to be adapted to the spatial influences that exist in urban settings. We first review elements of urban agriculture and some of the policy challenges faced in this growing phenomenon. We follow this by motivating the role of SD models in the context of urban agriculture and note their potential utility in overlaying quantitative models of urban food value chains alongside their land-use characteristics, highlighting the dynamic feedbacks between intensive processes within changing urban food systems and extensive processes associated with land-use and planning. From this background, we introduce the concept of spatial group model building (SGMB), which adapts standard group model building concepts to account for both the spatial context of urban agriculture and enables a spatially sensitive, participatory approach to qualitative and quantitative model building. We provide a qualitative proof-of-concept of SGMB principles and techniques in the context of describing the setting and dynamic issues facing organic urban agriculture value chains in Christchurch, New Zealand. Our approach fills an important space between participatory GIS practices and the development of complex spatial system dynamics models, infusing systems thinking principles to participatory processes, while showing a way to enhance the future development of quantitative spatial system dynamics models more generally.

1. Introduction

Urban agriculture is an important research theme in both developed and developing countries even though it has existed long before it became a target of contemporary research. In modern history, urban agriculture began in various forms, most of which responded to the same issue – a lack of food. Typical examples of urban agriculture in the 19th century and the beginning of the 20th century include urban allotment gardens for poor urban workers during the Industrial Revolution, urban gardens in American cities during the Great Depression, and urban agriculture campaigns during the two world wars (Viljoen et al., 2005). These examples highlight that urban agriculture primarily developed and thrived the most in times when food insecurity was a serious societal issue, whether caused by economic or political reasons.

Over the second half of the 20th century, urban agriculture evolved in the form of allotment gardening and community gardens that were motivated by social and leisure pursuits rather than food security ones. However, in the decades following the publication of Rachel Carson's (2002) *Silent Spring* in which the author vividly described the negative environmental impacts of industrial food production, there has been a gradual shift in the nature of urban agriculture. In this context, urban agriculture has more recently evolved as a means of localizing food production and shortening the food supply chain (Viljoen et al., 2005), while remaining a leisure activity for some, combining safe food production with social and health benefits. At the same time, in light of the financial crisis of the past decade, the importance of urban agriculture in some developed countries as a source of food is rising. In countries facing serious economic austerity measures, such as Greece,

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http://dx.doi.org/10.1016/j.agsy.2016.09.022
0308-521X/

where unemployment rates have increased to over 27% (Skordili, 2013a, 2013b), urban agriculture has become a natural response as a means for food security and employment, just as it did in the 19th and 20th century. Recent initiatives in urban Greece include the "potato movement"[1] (Morgan, 2013), urban beekeeping,[2] and vegetable gardening.[3]

In the urban areas of developing countries, a number of different, diverse value chains have been established, including inter alia "safe vegetables" in Hanoi, Vietnam (Moustier et al., 2005); potatoes in Khartoum (Fadul, 2010); and numerous urban-based horticulture markets in Tunis (Toumi and Vidal, 2010), Yangon (O'Shea and Soe, 2010), and Quito (Dueñas, 2010). These markets have been driven increasingly by issues of food security, particularly for poor and disadvantaged segments of society (Ellis and Sumberg, 1998; Mougeot, 2005). According to a 2005 report of the U.N. Food and Agriculture Organization (FAO) (cited in Brown, 2009 – pp. 158–160), about 700 million urban residents worldwide received food from urban and peri-urban farms. For example, about 650 ha of land around Dar es Salam, the capital of Tanzania, supplies fresh vegetables to city residents, while some 4000 farmers intensively farm small plots of land in urban and peri-urban areas. Other examples include Hanoi, Viet Nam, where 80% of its vegetable supply comes from farms in and immediately adjacent to the city; Kolkata, India where about 18,000 tons of fish per year are produced from managed wastewater fish farms near the city; and the approximately 8000 microgardens that have been established in Caracas, Venezuela through a government sponsored project assisted by FAO (Brown, 2009).

A particularly successful example of urban agriculture in a developing country is the case of Havana, Cuba. The first steps in the implementation of urban agriculture in Cuba started in the late 1980's when scientific institutions together with the Ministry of Defense initiated governmental programs to reduce Cuba's dependence on oil and food imports (Koont, 2009). The fall of the Soviet Union triggered the development of urban agriculture in Cuba, as the loss of the Soviet market led to a 60% decline in food availability in Havana between 1991 and 1995 (Novo and Murphy, 2000). What makes Cuba an outstanding example of urban agriculture is its organization. Since the very beginning, urban agriculture was supported by formal authorities. New technologies and scientific research to support agricultural production were developed and the results disseminated to those practicing urban agriculture. New public policies were also promulgated to accelerate the development of urban agriculture, best characterized by the motto: "We must decentralize only up to a point where control is not lost, and centralize only up to a point where initiative is not killed." (Koont, 2009, p. 66). Such an approach facilitated a unique symbiosis of grass-root movements combined with a system of formal centralized leadership and the strong support of scientists and researchers (Koont, 2009). Moreover, it promoted organic agricultural production since industrial chemical fertilizers and pesticides were unavailable (Koont, 2009).

Despite the spontaneous emergence of urban agriculture across various contexts, especially recently in developed countries, there has generally been a significant disconnect between those that drive and organize urban agriculture and those that regulate and manage it. Without any formal support, urban agriculture in both developing and developed countries has mostly been a bottom-up process, typically initiated by individuals or non-governmental organizations rather than by governments or facilitated by planners. Indeed, while attitudes towards urban agriculture have been shifting among planners over the past 15 years (Lovell, 2010; Morgan, 2013, 2015), the mainstreaming of a policy consensus to facilitate urban agriculture remains lacking, as does knowledge at a planning level to support it (Pothukuchi and Kaufman, 2000). Given the important role that urban agriculture can play from a livelihoods and social cohesion perspective, the question is thus how to support and mainstream urban agriculture as a strategy that could be used not only as a reaction in times of crises but also as a livelihoods strategy that can enhance the resilience and sustainability of urban areas and populations. More specifically, what types of systemic planning tools are available to integrate planners and practitioners in a process of joint learning that can guide the development of urban agriculture more effectively?

In this paper, we identify tools that can better analyze urban agriculture and provide policy guidance that bridges the gap between planners and practitioners. In particular, we develop and apply the qualitative aspects of a participatory process that better accounts for the broader system associated with urban agriculture as part of the planning process, particularly the roles of space (both physical and metaphorical) and policy feedbacks. In the following sections, we review the role that qualitative and quantitative system dynamics can provide as an important laboratory that conceptualizes a process of joint learning and policy planning that can enhance the resilience and sustainability of urban agriculture over time.

A novel contribution in our paper is the development of a participatory process that we term "spatial group model building" (SGMB). SGMB incorporates the nuances of spatial drivers and influences (primarily related to physical space, such as land-use patterns or the location of specific actors) within a group model building session that may significantly influence the perceptions associated with phenomena found in complex systems (cf. Vennix, 1996; Hovmand, 2014). We will argue that such a process could potentially remedy some of the gaps identified with incorporating space within traditional system dynamics models (BenDor and Kaza, 2012) and improve the applicability of systems models in urban agriculture more specifically. It further fills an important research space between participatory geographic information services (GIS) practices and the development of complex spatial system dynamics models, adding analytical rigor and the concepts of systems thinking to participatory processes and enhancing the development and validity of quantitative spatial system dynamics models more generally. We provide an example of the SGMB approach in the context of organic urban farming in Christchurch, New Zealand through the convening of a focus group to pilot the process. In particular, we highlight some of the qualitative insights of the system, key dynamic issues revealed from the SGMB process, and the means by which it enhances our understanding of urban agriculture systems.

2. Urban agriculture: role, definition, and scale

In order to successfully integrate urban agriculture into food system planning, it is important to first define its role within the system. Urban agriculture should not try to replace rural agriculture, as certain products are virtually impossible to be produced in urban settings, such as bulk cereals (Lovell, 2010). Also, some types of agricultural production might not be appropriate in certain locations because of the climate, which might require environmentally inappropriate solutions such as heated greenhouses or extensive irrigation (Born and Purcell, 2006). Urban agriculture should thus complement rural agriculture (Mougeot, 2000) and focus on products that are location appropriate and avoid products that can be produced more sustainably elsewhere.

It is also important to clarify the meaning of "urban" in this context. If we rely on the definition of urban as "within the built environment" (De Zeeuw et al., 2011, p.1), it will constitute only a very small part of the food system and will eliminate the areas around the city that are neither urban nor rural. To avoid such simplification, FAO has introduced the term urban and peri-urban agriculture (UPA) that broadens the scope of urban-related agricultural activities by including areas on the urban periphery. We propose to use the definition of peri-urban

[1] http://inhabitat.com/greece-potato-movement-directly-connects-farmers-consumers-during-the-debt-crisis/.
[2] http://www.cafebabel.co.uk/society/article/urban-farming-cultivating-utopia-in-greece.html.
[3] http://www.theecologist.org/campaigning/food_and_gardening/1193541/greeks_reclaim_the_land_to_ease_the_pain_of_economic_austerity.html.

Please cite this article as: Rich, K.M., et al., Participatory systems approaches for urban and peri-urban agriculture planning: The role of system dynamics and spatial group mode..., Agricultural Systems (2016), http://dx.doi.org/10.1016/j.agsy.2016.09.022