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5.0 Introduction

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'Urban metabolism' is a concept that relates to the movement, circulation and dislocation of material resources in the city, and to the social, political and economic processes that govern these flows. To take the analogy with human metabolism: we know that age, climate, physical activity and emotions impact on the ability of our body to digest and metabolise food as much as the quality and quantity of the food we eat, and the speed at which it is ingested. Both human and urban metabolisms refer implicitly to a notion of health: changing human metabolism can be disruptive, carry discomfort and lead to more serious diseases such as obesity, cardiovascular disease and diabetes. Similarly, urban metabolism can be related to overconsumption and depletion of natural resources, pollution, natural disasters, the creation of toxic and obesogenic environments. Ultimately, as we will show later in this section, urban and human metabolisms are part of a continuum that is shaped daily (among other things) by agro-ecological relations and that can be shaped by Urban Agriculture.

In this section we present the outcomes of discussions among an interdisciplinary group of academics, practitioners and policy makers that looked at the relation between urban agriculture and urban metabolism from two different perspectives, but engaged with the challenge of bridging the gaps between them.

The first perspective, which is predominantly used among physical scientists (ie. soil and water scientists, biologists and ecologists), is known as 'industrial ecology'; the second one, more popular among social scientists (i.e. geographers, planners and sociologists), is known as 'political ecology'.

From an industrial ecology perspective, urban agriculture is analysed for its potential beneficial impact on the flow of water, carbon and more in general for the provision of 'ecosystem services': for example the diversion of run-off water for urban irrigation, potentially reducing flood risk in urban areas; the reduction of food carbon footprints by sourcing locally, requiring less packaging and reducing organic waste; or the improvement of urban micro-climate provided by plant transpiration. This perspective is also looking at the human risk associated to growing food in cities due to the existence of polluted soil, water and air which can be absorbed by plants and enter the food chain, and it reflects on the opportunities for fito-remediation. More in general it explores the potential for closing 'loops' of resources needed for food production (i.e. by sourcing all locally and disposing locally) and it paves the way to establish a 'circular economy' by increasing the re-use and recycling of organic waste, contributing to and strengthening sustainable production.

A political ecology perspective, on the other side, is looking more closely at the decisions that influence these flows, which have origins in social, political, cultural and economic spheres. For example, cultural perceptions of what is 'dirt' and 'waste' can impact negatively on recycling and composting organic waste at the household level, therefore reducing the effective potential of urban agriculture to close nutrients loops. The availability (or scarcity) of land, or constraints to its cultivability is also often determined politically and regulated through planning regulation, zoning, and the land tenure system, and these largely limit the possibility for Urban Agriculture (i.e. banning animal breeding, or the cultivation of street verges, urban greens and even private front gardens). State or local regulation is also often at the origin of a system of rules that govern the management of water (i.e. access to fresh water), waste (i.e. possibility to use dry toilets in urban environments and disconnect from mains), and nutrients (possibility to move or keep ownership of own organic waste): all factors that can prevent Urban Agriculture from flourishing and impacting significantly on the 'metabolic rift', which is the break in the ecological exchange between humans and the natural environment (see chapter 5.2).

To bridge the gap between the two perspectives and to provide an overview of the ways in which urban agriculture contributes to re-shape the urban metabolism we have elaborated a conceptual model . This is represented in figure 1, and is referred to, informally, as 'the egg'. The egg does not represent an existing geographical entity: it is not a representation of the city. It is instead a way to capture the complexity of the multiple links and relations that bind together food systems, agricultural production, urban space and green infrastructure management, public health, education, economic relations, citizenship and human rights.

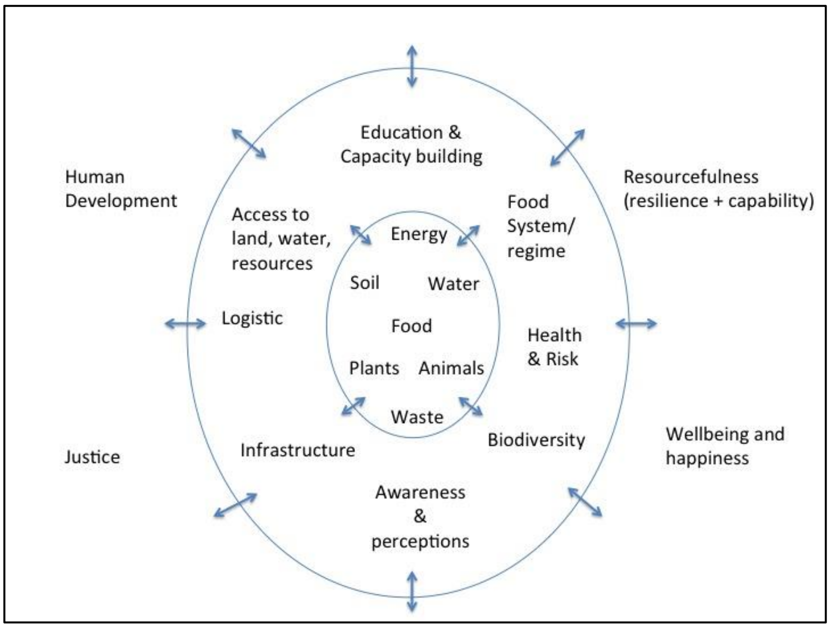

Figure 5.0.1 – A conceptual model for the integration of metabolic perspectives (Source: authors' own elaboration)

The egg model comprises three levels: key elements that materially constitute urban agriculture are shown at the core. Emancipatory social processes that should be the ultimate goal of human actions (i.e. sustainable human development, justice, wellbeing) are placed on the external layer, to indicate that they frame (or should do) social and physical processes. In the middle ring we have identified the processes and interactions that shape metabolic flows (and with them Urban Agriculture) and determine whether or not, in certain context, these will produce the emancipatory practices indicated in the outer layer. Urban Agriculture is made of, unfolds through, and impact on all of them.

Recognising that the stock of natural elements and biophysical resources within urban areas are under enormous duress, yet are central to any hope of mending the metabolic rift, the heuristic figure places these at the centre. Issues surrounding the availability and bio-chemical quality of soil are especially important for urban agriculture given that soil remains the dominant medium for plant growing (although nutrient film and other synthetic materials can be important substitutes in indoor schemes), but an industrial legacy of toxic contamination or other pollutants might prevents its immediate utilisation for food growing. Similarly, the management of water in urban areas presents significant challenges particularly for the largest cities. For the extent of impermeable surfaces in urban areas presents difficulties for the replenishment of groundwater and invariably demands that the freshwater requirements of the city are met through complex infrastructure harnessing sufficient and secure supplies up to hundreds of kilometres away. At the same time, cities build and maintain additional infrastructure designed to deal with grey water comprising storm water and industrial and domestic effluents. Here the matter of scale becomes a salient variable, because addressing these challenges at the city-wide, macro-scale presumes technical solutions must be found at a comparable level. This inevitably results in concentrating decision-making in the hands of civil engineering and planning authorities who are regarded as the sole locus of professional expertise capable of addressing such large-scale problems. Yet, as we reduce the scale of these challenges so a widening array of potential solutions come into sharper relief. This is especially evident as we examine the management of both solid and liquid wastes. Separation at source enables potentially valuable, nutrient-rich organic fractions – with appropriate management such as composting - to be utilised as inputs for food growing. The challenge here is not technical: it is a question of scale and of local participation.

After highlighting the circulation and links between the core elements (energy, water, soil, etc.) mobilised through Urban Agriculture, chapter 5.1 addresses exactly the potential of recovering these nutrient-rich fractions. The authors explore the extent to which a skilful recycling of urban organic waste can lead to the production of soil and growing substrate with the potential to (at least partially) emancipate urbanites from land ownership, bypass the problem of growing in potentially contaminated soils, and efficiently turn unused sealed lands into growing sites.

Placing biophysical resources and ecosystem services at the centre of our model demonstrates just how important these are to the quality of urban life, to human health and well-being. It is becoming increasingly recognised that green space is vital to urban areas for a multitude of reasons: from shading, carbon capture, air quality and reducing the urban heat island effect, to a range of human benefits. These include psychological (mood enhancement); physiological improvements, such as the encouragement of more physical activity in the presence of nature (cardiovascular and skeletal strengthening); community benefits that arise from greater social interaction as a consequence of individuals being outdoors; or educational, enabling people to re-learn important skills in food growing, seasonality and natural processes. It is in this context that Urban Agriculture clearly demonstrates potential for multi-functional, multi-attribute performance that engages people to enhance the quality of the built environment. This is why, in our view, Urban Agriculture has moved from being a fringe matter to one that has the power to reshape our cities.

Chapter 5.2 provides precisely a reflection on why the intersection between urban agriculture and urban metabolism is a fertile ground to rethink the urban condition, and identify models of urbanism that not only accommodate urban agriculture, but recognise it as a core element needed to deliver a resourceful, emancipatory, healthy and socially just city. In this chapter we discuss some of the processes and interactions listed in the ring (figure 5.0.1), such as infrastructural elements, biodiversity, education, access to land and health, and explain why their regulation via policy/direct action or other forms of agency is crucial to deliver the emancipatory processes listed in the third/outer layer of the conceptual model.

Chapter 5.3 delve into practical examples of farming and gardening practices in urban environments, and interrogate them from both, the industrial and political ecology perspective of metabolism. Taking example from European case studies explored during the life of the COST Action (Michel Bidaux Farm, in Geneva) and cases studies explored by Tornaghi (2014) during a Short Term Scientific Mission in the Netherlands (in particular case studies from Rotterdam), this chapter highlights opportunities and constraints to the access and re-use of nutrients and to the relocalisation of agricultural production in urban areas, bridging reflections on the availability of material resources, with the analysis of regulatory mechanism (ring) that enable more or less socially empowering and economically virtuous practices of recycling.

References to 5.0

Tornaghi, Chiara: *The metabolism of public space and the creation of food commons,* Brussels, COST, 2014, accessible at: http://www.urbanagricultureeurope.la.rwth-aachen.de/files/stsm_end_of_mission_report_tornaghi_final.pdf