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Urban food systems: socio-technological innovation for cities to tackle the zero waste challenge

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Cities currently manage food waste in a quite inefficient manner: Food waste and food industry co and by products, despite their high nutrient value, are only to a small extent recycled and returned to farm soil and therefore, does not contribute to closing nutrient cycles and to supporting sustainable food production. Food waste related resource use and environmental pollution can no longer be justified in the context of global warming and increasing pressure on the planet's limited boundaries. Cities today are acting as laboratories for socio-technological innovations in food waste prevention and valorization, yet coherent concepts and strategies involving the different actors are missing.

This work aims to: *i*) review high potential socio-technological innovations in food waste prevention and valorization *ii*) extract research questions contributing to fostering and accompanying cities' breakthrough strategies towards zero waste sustainable food systems, specific to different urban settings worldwide (covering both industrialized and unindustrialized areas). Twenty experts related to disciplines of industrial ecology, urban metabolism, urban farming, aquaculture systems, waste recovery, food science, law, ethics, system innovation and foresight studies were organized as a working group following a foresight study approach. Expert panel and literature review have shown that innovative approaches in urban food waste prevention and management are abundantly experimented in a lot of cities worldwide (for example in Canada, the USA, UK, France and other European countries). They use manifold tools (regulation, technology, social innovation etc.) both in food waste prevention and valorization. Food system actors involved are as different as business and catering companies, civil society, NGOs and municipalities. Experts have identified 9 main categories for socio-technological innovations: 1) Education of public and training of professionals 2) Simplification of supply chain specifications, 3) Collaborative use of data, flow monitoring and smart sensors, 4) Regulation, taxation and financial tools, 5) Gradual withdrawal of food from market, selling off, stock clearance, on-site processing and donations, 6) Breakthrough manufacturing and packaging technologies, 7) Urban practices such as shared gardens, swapping and food give-and-take, 8) Biomass valorization and biorefinery, 9) Good Samaritan law and distribution of responsibility between stakeholders.

These nine innovative approaches are discussed on the base of their expected high impact potential and transferability. Most of them are new, tested small-scale and have not yet been subject of in-depth analysis of performances, forces and drawbacks. Technological and cultural challenges remain to be overcome, for example the analysis of "big data" to support alignment of supply and demand, the mutual share of information and joint planning of food supply, and societal acceptance of new technologies. Overall, data on food waste flows in cities are challenging to obtain. In a next step we are going to run fieldwork in four cities (Dakar, Chicago, Antananarivo and Montpellier) to contribute to closing this data gap and to progressing on the urban metabolism approach applied to food systems.