Ipr(s): intellectual property right(s)
Isf: International Seed Federation
Itpgrfa: International Treaty on Plant Genetic Resources for Food and Agriculture
Nbt(s): new breeding technique(s)
Oecd: Organization for Economic Cooperation and Development
Pbr(s): plant breeder's right(s)
Pluto: PLant varieties in the Upov system: The Omnibus
Ppb: participatory plant breeding
Pvp: plant variety protection
Pvr(s): plant variety right(s)
Ruaf: Research Centre for Urban Agriculture and Food Security
Sdg(s): Sustainable Development Goal(s)
Tgp: Test Guidelines Procedures
Trips Agreement: Agreement on Trade–Related Aspects of Intellectual Property Rights
Ua: urban agriculture
Uaeu: Urban Agenda for the European Union
Un: United Nations
Undp: United Nations Development Programme
Upov: International Union for the Protection of New Variety Plants
Vcu: value for cultivation and use
Who: World Health Organization
Wipo: World Intellectual Property Organization
Wto: World Trade Organization

CHAPTER I

INNOVATION IN URBAN AGRICULTURE
THE ROLE OF PLANT BREEDING

1. Introduction

The products providing primary nutrients and energy source for humans come from agriculture, which is essential for feeding the worldwide population.

According to the data collected by the Food and Agriculture Organization of the United Nations (Fao), by 2050 there are going to be almost 10 billion mouths to feed and there will be a rise in agricultural demand by 50 percent, compared to 2013[1]. In this context, the agriculture of the third millennium is required to boost productivity, and more[2].

(1) Fao, *The future of food and agriculture. trends and challenges*, Fao, Rome 2017, p. x.

(2) Agriculture needs to safeguard biodiversity, face climate change and scarcity of natural resources (soil, water, energy, biological resources) to be used in a sustainable manner. See M. Giampietro, D. Pimentel, *The tightening conflict: population, energy use, and the ecology of agriculture,* Npg Forum Series, 1993, pp. 1–8. Agriculture should also produce food and non–food products meeting the needs and preferences of consumers, as related to taste, nutritional content and texture. Agriculture is also called to play a role in decreasing food waste by placing on the market agrifood products having a longer shelf–life. Moreover, the link between agriculture and human health requires to improve the nutritional outcomes of foodstuffs. In this sense, agriculture and human health are linked to a large extent, since agriculture can lead to a good or poor health status (e.g. malnutrition, chronic diseases). On this last topic, see C. Hawkes, M. Ruel, *The links between agriculture and health: an intersectoral opportunity to improve the health and livelihoods of the poor*, in *Bulletin of the world health organization*, 84(12), 2006, pp. 984–990; M. Lipton, E. de Kadt, *Agriculture–health linkages*, World Health Organization, Geneva 1988.

However, today agriculture represents a sustainability hotspot, which is required to face crucial and difficult challenges to lead the transition towards more efficient and resilient food systems.

One of these challenges is related to the rising urbanisation.

Currently, 55% of the global population resides in urban areas and more than 880 million people live in slums, and by 2050 the number of urban dwellers is expected to increase by an additional 2.5 billion people[3].

Food systems are considerably impacted by the extension of the urbanised world: urbanites consume up to 70% of the global food supply and that the city lifestyle has been related to an higher consumption of processed food with low nutrient value[4].

The fast–growing urbanised world also necessarily elongates food supply chains by widening the physical, social and mental distance between urban and rural areas, consumers and farmers[5], aggravating the pressure to bring food to congested urban areas and preventing the most vulnerable from accessing nutritious food[6].

Nowadays, access to food in large cities is characterised by high spatial and socio–economic inequality[7].

This extension of food supply chains have also affected food safety because the increased frequency, speed and volume of movements facilitate the spread of pathogens[8].

In view of the above, agriculture must be able to revolutionize itself. The current agricultural system based on resource–intensive production and the ever longer food supply chains are not fit for sustainable

(3) Fao, *Fao framework for the Urban Food Agenda*, Fao, Rome 2019, p. 6.

(4) C.A. Monteiro, J.C. Moubarac, G. Cannon, *et al., Ultra–processed products are becoming dominant in the global food system*, in *Obesity review*, 14, 2013, pp. 21–28.

(5) The grown gap between food consumption and production is proved by the fact that most urban consumers do not have a direct contact with the places where their food is produced and the people that produced it, since nearly all food is purchased in stores. This physical distance has increased the social and mental distance between producers and consumers. F.W.A. Brom, *Food, consumer concerns, and trust: food ethics for a globalizing market*, in *Journal of agricultural and environmental ethics*, 12, 2000, pp. 127–139.

(6) Fao, Ifad, Unicef, Wfp And Who, *the state of food security and nutrition in the world 2021. Transforming food systems for food security, improved nutrition and affordable healthy diets for all*, Fao, Rome 2021, p. 99.

(7) Fao, *Fao framework for the Urban Food Agenda*, cit., p. 8.

(8) J.R. Rohr, C.B. Barrett, D.J. Civitello, *et al., Emerging human infectious diseases and the links to global food production*, in *Nature sustainability*, 2, 2019, pp. 445–456.

development: they are causing massive soil consumption, deforestation, chemical contamination of the environment, water shortages, high levels of CO^2 emissions and threats to biodiversity, while almost 800 million people are suffering from hunger[9].

Therefore, in the next few years farmers will be required to contribute to this revolution by promoting new sustainable agricultural systems.

The different characteristics of farming, digitalisation in agriculture and the cultural, social, economic and technological changes to come, as well as climate change, environmental degradation and the need to shift to more environmentally sustainable forms of farming, will affect the farmers of the future.

It is expected that in 2040 there will be a more different agricultural scenario, shaped by the emerging challenges, trends and opportunities, which will develop twelve future farmer profiles[10].

One of them is the "urban farmer", who carries on agricultural activities on urban soil, combining his/her life in the city with the implementation of local food production of, mostly, high value crops.

This person manages to transform urbanisation from a challenge into an opportunity for agriculture.

In terms of sustainability, urban farmers are capable to increase city resilience to crises and reduce urban sprawls, building sustainable urban ecosystems and contributing to urban biodiversity[11].

Urban agriculture (Ua) nowadays represents an emerging trend, including more than 250 projects[12] and actively engaging numerous cities worldwide.

Regarding the scale of the phenomenon, in 1996 it has been estimated that, globally, 800 million people were actively involved in urban and peri–urban agriculture[13].

(9) Fao, *The future of food and agriculture,* cit., p. xi.

(10) A.K. Bock, M. Krzysztofowicz, J. Rudkin, V. Winthagen, *Farmers of the future*, Eur 30464 En, Publications Office of the European Union, Luxembourg 2020.

(11) Ivi, p. 60.

(12) The data refer to the online atlas of urban farming created by the Urban Agriculture Europe project between 2010 and 2016, available at http://www.urban–agriculture–europe.org/online–atlas.html (last access 5 September 2022).

(13) Undp, *Urban agriculture. Food, jobs, and sustainable cities,* United Nations Development Programme, Publication Series for Habitat II, vol. 1, Undp, New York 1996, p. 26.

However, a recent study highlighted that it is difficult to assess the current scale of urban agriculture and, interestingly, suggested that it would require approximately one third of the total urban area to meet the global vegetable consumption of urban residents[14].

In this context, it must be noted that the Milan Urban Food Policy Pact, an international agreement of Mayors signed on 15 October 2015 in Milan, representing one of the most important legacies of Milan Expo 2015 and providing a recommendation for the definition of innovative food policies (including the promotion of Ua), gathers more than 220 cities, representing a total of 400 million inhabitants in six world regions[15].

Following this trend, it has been considered that by 2040 Ua will become a well–established phenomenon, provided that a favourable policy and regulatory environment is created.

2. What is urban agriculture: history and context

Ua is a large industry, consisting of small–scale operators and large agribusinesses located in a "urban" spatial dimension, which is crucial for millions of people throughout the world, capable of providing a source of income and addressing poverty reduction[16], contributing to food security[17], to dietary diversity[18] and, generally, to the socio–economic development of towns, cities and metropolitan areas[19].

(14) F. Martellozzo, J.S. Landry, D. Plouffe, *et al.*, *Urban agriculture: a global analysis of the space constraint to meet urban vegetable demand*, in *Environmental research letters*, 9, 2014 pp. 1–8.

(15) A recent policy brief on the Milan Urban Food Policy Pact may be found at the following website: https://www.milanurbanfoodpolicypact.org/wp–content/uploads/2022/04/Policy–Brief_Mufpp_2022.pdf (last access 10 October 2022).

(16) Specifically, the data show that urban agriculture appears to be playing a role in poverty alleviation in African countries (such as Ghana, Madagascar and Nigeria), not so much in other continents. A. Zezza, L. Tasciotti, *Urban agriculture, poverty, and food security: empirical evidence from a sample of developing countries,* in *Food policy*, 35, 2010, pp. 265–273.

(17) The linkage between UA and food security, in particular on the children nutritional status, has been explored by D. Maxwell, C. Levin and J. Csete, *Does urban agriculture help prevent malnutrition? Evidence from kampala*, in *Food policy*, 23, 5, 1998, pp. 411–424.

(18) It has been shown that being active in Ua increases the dietary diversity of urban households. See A. Zezza, L. Tasciotti, *Does urban agriculture enhance dietary diversity? Empirical evidence from a sample of developing countries,* Fao, Rome 2008.

(19) Undp, *op. cit.*, pp. 3–4.

In this sense, it contributes to the environmental, social and economic objectives of sustainable urban development[20].

Ua occurs within and in the proximity of the boundaries of towns, cities and metropolises, in places that range from household, community and school gardens, to rooftops, vertical and indoor farms[21].

It embraces both traditional agricultural activities, including horticulture, livestock, milk production, aquaculture, fishery and even forestry[22], and innovative production methods such as aquaponics, hydroponics or Led–farming initiatives[23]. The outcomes can be food and non–food products, as well as services, including social and ecological ones.

Even though the term "urban agriculture" may seem an oxymoron[24], it actually breaks the rural–urban divide by making the contrast less sharp: cities are not anymore only hubs of commerce, trade, finance and education, but also the place where agricultural activities, traditionally located elsewhere, are carried on[25].

The proximity between producers and consumers is enhanced through the creation of spaces where urban and rural activities can coexist.

Even if the term is relatively new, having become more common just during the 1990s[26], the concept of Ua is not.

The use of natural resources in urban and peri–urban environments for food production, mainly for self–sufficiency purposes, dates back millennia[27].

(20) R. van Veenhuizen, *Formulating effective policies on urban agriculture*, in *Urban agriculture magazine*, Ruaf, 16, 2006, p. 1.

(21) J. McEldowney, *Urban agriculture in Europe. In–depth analysis*, European Parliamentary Research Service, PE 614.641, 2017.

(22) Fao, *Urban and peri–urban agriculture,* Fao Committee on Agriculture, Fifteenth Session, 25–29 January 1999, Fao, Rome, available at https://www.fao.org/unfao/bodies/coag/Coag15/X0076e.htm. According to Fao, urban forestry has critical environmental functions, besides food and non–food production (e.g., wood). The potential role of perennial woody food–producing species in cities in the context of urban agriculture, called "urban food forestry", is explored in K.H. Clark, K.A. Nicholas, *Introducing urban food forestry: a multifunctional approach to increase food security and provide ecosystem services,* in *Landscape ecology,* 28, 2013, pp. 1649–1669.

(23) J. McEldowney, *op. cit.*, p. 6.

(24) Undp, *op. cit.*, pp. 3–4.

(25) F. Lohrberg, L. Lička, L. Scazzosi, A. Timpe (eds.), *Urban Agricolture Europe*, Cost Action, Jovis, Berlin 2016, p. 16.

(26) The term was sporadically used prior to the 1990s. Fao, Rikolto, Ruaf, *Urban and peri–urban agriculture sourcebook – From production to food systems*, Fao and Rikolto, Rome 2022, p. 9.

(27) J. Green, *Urban agriculture isn't new*, 2012, available at https://dirt.asla.org/2012/05/09/urban–agriculture–isnt–new/ (last access 5 September 2022).

The connection between agriculture and urbanisation started in Neolithic times and it has evolved since then. More than 10,000 years ago, the beginning of domestication of wild plants and the shift to agriculture allowed the humankind to have access to more food with less effort in a permanent place.

The predictability of food facilitated the settlement of the first farming communities, which led to the development of more complex societies and the creation of the first cities.

In the relationship between agriculture and urbanisation, plant breeding, specifically plant domestication, has been the triggering factor: plant domestication led to agriculture, and with agriculture came the earliest urban development.

Originally, the fertility of the land was the main element to determine the place where the cities were to appear: it is not surprising that the earliest example of urbanisation was found in the Fertile Crescent, where some of the first settled farming communities established and food was available within walking distance from the cities.

Later on, in Ancient Rome, the dichotomy between "urban" and "rural" activities started taking roots, but up until pre–industrial times it was quite common for urban residents to have domestic animals, small farms or household gardens within the city.

Examples of urban agriculture can be found also in pre–Columbian America: in Latin America, Aztec, Mayan and Incan cities were self–sufficient in terms of fruit and vegetable production[28].

Urban agriculture was also the main disposal method for urban wastes before the development of urban sanitation systems, particularly for enriching soils both in urban and rural areas[29].

During the mid–eighteenth century and nineteenth century, the contrast between urbanites and rural farmers settled in.

At the same time, the Industrial Revolution in Europe led to a rise in urban population and an increase in food demand in cities: in such a context, household and community gardens offered an opportunity

(28) E.G., Machu Picchu seems to have been self–reliant in food production. See Undp, *op. cit.*, pp. 28–29.

(29) *Ibidem*. A famous example of biological recycling of city waste products is the Parisian *marais* farming system, where urban vegetable and fruit production was sustained by the use of stable manure produced by the city's horses used for transportation.

for urban residents to become more self–sufficient in terms of food production[30].

Industrialization gave rise also to the Garden City Movement, encouraged by the British urban planner Ebenezer Howard's book "Garden Cities of Tomorrow" published in 1902, which offered a different model of urban areas reconciled with nature in order to provide healthy living conditions for the benefit of the residents, especially the working class.

During that period, many Asian countries were as well supportive of urban agriculture: for example, Chinese cities excelled in achieving partial self–reliance in non–grain foods[31].

In the second half of the twentieth century, the importance of urban agriculture accelerated, especially in low–income countries, where the percentage of residents engaged reached up to 80% in some cities[32].

More recently, there has been another surge of people interested in urban agriculture, in light of the potential in addressing the vulnerabilities of food systems generated or exacerbated by the Covid–19 pandemic[33].

The Fao global survey of 2020, on how city and local governments faced the challenges of food system disruptions associated with the pandemic, revealed that promoting local production and a short supply chain through urban agriculture is one of the key lessons for building back better, which also allows to preserve agricultural land within and around cities[34].

(30) F. Lohrberg, L. Lička, L. Scazzosi, A. Timpe (eds.), *op. cit.*, pp. 18–19.

(31) Undp, *op. cit.*, pp. 34.

(32) Ivi, pp. 25–27. By way of illustration, the data show that in Kampala (Uganda) 70% of the poultry needs in terms of meat and eggs are produced inside the city; in China 90% of the vegetable demand of the 18 largest cities was met through urban production; in the Usa 30% of agricultural product is produced within metropolitan areas; in Singapore 80% of the poultry is produced within the city.

(33) S. Simon, *The 'Covid–trigger': new light on urban agriculture and systemic approach to urbanism to co–create a sustainable Lisbon*, in *Systemic practice and action research*, 2022.

(34) Fao, *Cities and local governments at the forefront in building inclusive and resilient food systems: Key results from the Fao survey "Urban food systems and Covid–19"*, Fao, Rome 2020, p. 15. The respondents also highlighted that, in order to facilitate access in emergency situations, it would be necessary to create local storage facilities for food reserves.

3. Urban agriculture for sustainable development

The literature on the topic has underlined the multiple benefits and opportunities – environmental, economic and social – brought by urban agriculture[35]. These benefits are nowadays coming to light in the 2030 Agenda[36] to achieve its Sustainable Development Goals (Sdgs)[37].

(35) S. Miccoli, F. Finucci, R. Murro, *Towards integrated urban agriculture systems: economic and valuation aspects, XLIII Incontro di studio del Ce.S.E.T.*, 2016, pp. 53–54.

(36) At the international level, the pressure to develop a global strategy in terms of sustainability has been at the heart of the Un Sustainable Development Summit held on 25 September 2015, when more than 150 world leaders adopted the 2030 Agenda for Sustainable Development. The document represents the world's blueprint in this matter and incorporates a follow–up from the Rio+20 Conference on Sustainable Development. It is characterised by its universality, striving for its application at all levels of government and civil society, and by a holistic and cross–sector approach to ensure that all the relevant challenges are addressed together. Specifically, it aims at promoting globally shared prosperity and well–being for the following 15 years, making specific emphasis on the objectives of poverty reduction, fighting inequalities and tackling climate change. For an analysis of the Un 2030 Agenda, see *inter alia* N. Longo, *L'Agenda 2030 ed il principio della sostenibilità nel diritto internazionale*, in *Il diritto penale della globalizzazione*, 3–4, 2017, pp. 297–327; L. Chiussi, *The Un 2030 Agenda on Sustainable Development: talking the talk, walking the walk?*, in *La Comunità internazionale*, 61, 2016. On the critical role of agriculture in the 2030 Agenda, see S. Manservisi, *Il ruolo emergente del diritto agroalimentare tra economia circolare e Sdgs di Agenda 2030*, in S. Carmignani, e N. Lucifero (eds.), *Le regole del mercato agroalimentare tra sicurezza e concorrenza. Diritti nazionali, regole europee e convenzioni internazionali su agricoltura, alimentazione, ambiente*, Editoriale Scientifica, Napoli 2020; S. Carmignani, *Sdgs e agricoltura. Una breve riflessione*, in S. Carmignani, e N. Lucifero, *op. cit.*; Fao, *Food and agriculture: key to achieving the 2030 Agenda for Sustainable Development*, Fao, Rome 2016.

(37) In this sense, Fao, *Fao framework for the Urban Food Agenda*, Rome 2019. For an interesting analysis, see also R. Semenova, K. Wilhelm, *Sustainable development goals addressed by urban farming*, Interreg North–West Europe, 2021. The Agenda addresses the economic, social, and environmental dimensions of sustainable development by setting at its core 17 specific Sdgs, not legally binding, whose implementation and success rely on each participating country policies and programs. Specifically, the 2030 Agenda aims to: 1. end poverty in all its forms everywhere; 2. end hunger, achieve food security and improved nutrition and promote sustainable agriculture; 3. ensure healthy lives and promote well–being for all at all ages; 4. ensure inclusive and equitable quality education and promote lifelong learning opportunities for all; 5. achieve gender equality and empower all women and girls; 6. ensure availability and sustainable management of water and sanitation for all; 7. ensure access to affordable, reliable, sustainable and modern energy for all; 8. promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all; 9. build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation; 10. reduce inequality within and among countries; 11. make cities and human settlements inclusive, safe, resilient and sustainable; 12. ensure sustainable consumption and production patterns; 13. take urgent action to combat climate change and its impacts; 14. conserve and sustainably use the oceans, seas and marine resources for sustainable development; 15. protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss; 16. promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels; 17. strengthen the means of implementation and revitalize the global partnership for sustainable development. On the juridical nature of Sdgs, see M. Montini, *L'interazione tra gli Sdgs ed il principio dello sviluppo sostenibile per l'attuazione del diritto internazionale dell'ambiente*, in *www.federalismi.it*, 9, 2019; R. Pavoni, D. Piselli, *The sustainable development goals and international environmental law: normative value and challenges for implementation*, in *Veredas do Direito*, 13, 2017; M. Montini, F. Volpe, *Sustainable Development Goals: "molto rumore per nulla"?*, in *Rivista giuridica dell'ambiente*, 3, 2015, pp. 489-496.

In particular, urban agriculture offers a promising solution to make cities healthier and more sustainable by aiding in successfully meeting several targets housed under Sdg no. 11, such as target no. 11.7 which refers to inclusive green and public spaces, in particular for women and children, older persons and persons with disabilities, and target no. 11.6 relating to the improvement of air quality and waste management[38].

Urban agriculture is also a strategic tool to achieve Sdg no. 2 "Zero hunger", as it contributes to reach food security by significantly affecting food production and supply.

Over the next few years, achieving food security[39] through sustainable production systems is going to be one of the biggest global challenges, in response to the expected growth of the world's population, living in more urbanised environments[40].

(38) M. Hernandez, R. Manu, *Growing greener cities: urban agriculture and the impact on Sdg 11*, Iisd Sdg Knowledge Hub, 2018.

(39) Fao, *Trade reforms and food security: conceptualizing the linkages*, Fao, Rome 2003, p. 25 et seq.

(40) The concept of food security has significantly evolved during the past years. In 1974, the World Food Summit provided a first definition based only on the availability and price stability of food supply. In 1983, the Fao defined the term focusing on access, both physical and economic. Afterwards, in 1996, the definition provided by the World Food Summit highlighted the multidimensionality of food security, including access, availability, use and stability; whereas in 2001 the State of Food Insecurity led to a definition emphasizing the importance of food demand, safety and access for vulnerable groups, providing the following internationally–accepted definition: «Food security [is] a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life». The growth of the global population will result in an increased food demand and pressure on the ever longer food supply chain, which has been proven to be extremely vulnerable to shocks, from armed conflicts to droughts and pandemics, as was the case for Covid–19. See Fao, Ifad, Unicef, Wfp and Who, *The state of food security and nutrition in the World 2021. Transforming food systems for food security, improved nutrition and affordable healthy diets for all*, Fao, Rome 2021.

UA can also generate a significant economic return[41], and it promotes the professional entrepreneurship of urban farmers, who are called to adapt their business model to the urban environment and its opportunities[42], thus creating jobs and business chances for small–size food and non–food operators; at the same time, it promotes market access for rural farmers (target no. 2.3).

Moreover, urban agriculture contributes to target no. 2.4, ensuring sustainable food production systems and implementing resilient agricultural practices by preserving agricultural land in urban areas and shortening supply chains.

Producing and selling more fresh food within the city itself can also contribute to Sdg no. 13 on climate action: it can be a source of significant environmental benefits in terms of carbon sequestration, increased local biodiversity, waste recycling, temperature moderation and reduced risk of flooding.

Yet, these potential benefits strictly depend on the agricultural methods and practices adopted: urban farmers need to respect the local ecosystem and mitigate climate change by opting for sustainable pest–management practices, energy and resource–efficient facilities and transportation, less packaging, planting sites distant to traffic and polluted areas[43].

In this way, urban agriculture contributes to the overarching goal of reducing human impacts on the climate (target no. 13.2).

In addition, from a social point of view, urban agriculture promotes social cohesion and interaction, health and mental health, well–being and positive life paths, leisure, and educational activities, as well as inclusion and participation of vulnerable and disadvantaged groups, such as elderly, unemployed and migrants[44].

It facilitates access to fresh food in urban areas, especially for vulnerable residents, and improves the health status and quality of life of local dwellers[45], thereby contributing both to Sdg no. 3, "Good health and well–being", and Sdg no. 10, "Reduced inequalities".

(41) J. Zeunert, *Urban agriculture up–scaled: economically and socially productive public green space*, in R. Roggema (ed.), *Sustainable urban agriculture and food planning*, Routledge, London 2016, chapter 7, p. 111.

(42) F. Lohrberg, L. Lička, L. Scazzosi, A. Timpe (eds.), *op. cit.*, pp. 80–81.

(43) Ivi, pp. 13–14.

(44) J. McEldowney, *op. cit.*, pp. 12–13.

(45) S. Miccoli, F. Finucci, R. Murro, *Feeding the cities through urban agriculture. the community esteem value*, in *agriculture and agricultural science procedia*, 8, 2016, pp. 128–134.

The Un New Urban Agenda[46], which is strictly related to the Sdgs of the 2030 Agenda, explicitly considers Ua as a tool for sustainable urban development and states that this phenomenon needs to be supported, in light of the role of small and intermediate cities and towns in enhancing food security and nutrition systems.

In order to do so, the Agenda promotes the coordination of food and agriculture policies in this sector, across urban, peri–urban and rural areas, for example to facilitate food production and marketing, safeguard human health and the environment, maintain the genetic diversity of seeds, maximize efficiencies and minimize waste.

In fact, Ua represents a piece of the puzzle depicting the relationship between food and cities, in light of the potential that urban environments have to trigger a transformation towards more sustainable and resilient food systems. This shift will be achieved by combining the innovation present in cities and their unique assets, with their capabilities to cooperate with rural producers[47].

In this perspective, the above–mentioned Milan Urban Food Policy Pact is emblematic of the role that cities can have in developing urban policies capable to promote sustainable, inclusive, resilient, safe and diverse food systems[48].

Urban agriculture also plays an important role in the European framework[49] in achieving the Eu Green Deal[50] objectives, in particular

(46) This Agenda, adopted on 20 October 2016 at the Un Conference on Housing and Sustainable Urban Development (Habitat III) in Quito, Ecuador, and endorsed by the Un General Assembly on 23 December of the same year, has the purpose, in the broad context of the Sdgs, to provide a framework of actions for sustainable urban development, by establishing principles for the planning, construction, development, management and improvement of urban areas.

(47) Ellen Macarthur Foundation, *Cities and circular economy for food*, 2019, available online at https://pacecircular.org/sites/default/files/2019–03/Cities–and–Circular–Economy–for–Food.pdf (last access 5 September 2022).

(48) In this field, other initiatives exist, such as the Who "Healthy Cities" (1988) and the Fao "Food for the cities programme" (since 2001), as well as international networks (e.g., Cityfood network, City–Region Food Systems, C40 Food Systems Network,) and European ones (e.g., Eurocities food working group, Food Smart Cities for Development, Urbact Thematic Network Sustainable Food in Urban Communities).

(49) A. Berndt, D. te Boekhorst, *Urban agriculture and Facce–Jpi White Paper*, 2022.

(50) In December 2019, the Commission presented its European Green Deal, which is an integral part of the Eu strategy to implement the Un 2030 Agenda and the Sdgs. The Green Deal is a growth strategy setting out policy initiatives with the purpose to lead the transition towards a more sustainable, just and inclusive Eu economy and society, and to achieve climate

through its Farm to Fork (F2f)[51] and Biodiversity[52] Strategies which are interlinked in light of the close relationship between sustainable food systems and biodiversity conservation.

The F2f Strategy explicitly refers to urban food systems as a field where more research is warranted. The document highlights the im-

neutrality by 2050. According to it, to mainstream sustainability in all EU policies, it is fundamental to mobilize research and foster innovation: new technologies and sustainable solutions across sectors are critical in achieving the objectives of the Green Deal. The European Green Deal (Com/2019/640 final) is available at https://eur-lex.europa.eu/legal-content/EN/TXT/?Uri=CELEX%3A52019DC0640&qid=1667597509377 (last access 5 September 2022). For a legal analysis of the Eu Green Deal, see P. Lattanzi, *Il "New Green Deal", la Pac 2021–27 e la sostenibilità nelle produzioni alimentari*, in P. Borghi, I. Canfora, A. Di Lauro, L. Russo, (eds.), *Trattato di diritto alimentare italiano e dell'Unione europea*, Giuffrè, Milano 2021, pp. 705 e ss; D. Bevilacqua, *Il Green New Deal (Gnd) e la regolazione pubblica*, in *Rivista giuridica dell'ambiente*, 19, 2021; Ead., *Lo sviluppo sostenibile e il Green New Deal: tratti comuni, differenze, problematiche*, in *Rivista giuridica dell'Ambiente*, 21, 2021; G. Galasso, *Green Deal, sviluppo sostenibile e responsabilità*, in G. Pisciotta Tosini (ed.), *Lezioni di diritto agrario contemporaneo*, Giappichelli, Torino 2021; L. Ferraris, *Green Deal e agricoltura, la vera sfida e a livello globale*, in *Il diritto dell'Agricoltura*, 1, 2020; P. Pinto, *Il "Green Deal": un modello europeo di sostenibilità?*, in *Il Diritto dell'agricoltura*, 3, 2020.

(51) The F2f Strategy aims at making food systems fair, healthy and environmentally-friendly, by facing the main challenges preventing the achievement of sustainability in the agri-food sector. To this purpose, the Strategy identifies three main objectives, which can be observed in the light of the three dimensions of sustainable development: to make the environmental and climate impact of the food supply chain neutral or positive; to guarantee products that are healthy, nutritious, respectful of the environment and of animal wellness; to guarantee economic availability of food and equity and competitiveness in the food supply chain. To achieve these results, the Strategy identifies different macro political goals – which can be divided into one horizontal goal and four vertical goals that correspond to the different passages of the food supply chain – and addresses legislative and non-legislative measures to each one of them. The F2f Strategy (Com/2020/381 final) is available at https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?Uri=CELEX:52020DC0381&from=En (last access 5 September 2022). For an analysis of the F2F Strategy and of its structure see P. Lattanzi, *Il "New Green Deal", la PAC 2021–27 e la sostenibilità nelle produzioni alimentari*, cit., pp. 705–711. See also H. Schebesta, J. Candel, *Game-changing Potential of the EU's Farm to Fork Strategy*, in *Nature Food*, 1, 2020; F. Venturi, *The Farm to Fork Strategy. A comprehensive but cautious approach to "multidimensional" Food Sustainability*, in *Rivista quadrimestrale di diritto dell'ambiente*, 1, 2020.

(52) The Biodiversity Strategy for 2030 (Com/2020/380 final) is available at https://eur-lex.europa.eu/legal-content/En/Txt/Html/?uri=Celex:52020DC0380&from=En (last access 5 September 2022). For a legal analysis of the Biodiversity Strategies, see among others P. Lattanzi, *Il "New Green Deal", la Pac 2021–27 e la sostenibilità nelle produzioni alimentari*, cit., p. 711; M. Biscosi, *Two Parallel Discourses and a New Path for Policy-Making: The Biodiversity Strategy for 2030*, in *Rivista quadrimestrale di Diritto dell'ambiente*, 1, 2021; M. Brunori, *Which pathways for agrobiodiversity in the new Cap reform?*, in *Diritto agroalimentare*, 2, 2020, p. 277.

portant role of research and innovation in this field to accelerate the transition to sustainable, healthy and inclusive food systems.

In the Biodiversity Strategy Ua can play a critical role in enhancing sustainable and biodiverse urban environments and greening urban spaces. Indeed, this Strategy promotes "A new Eu Nature Restoration Plan" to reverse biodiversity loss also by greening urban and peri-urban areas[53] in consideration of its benefits, especially for mental health, as lockdowns during the Covid-19 pandemic have shown. For this reason, the Strategy invites Eu cities to adopt "Urban Greening Plans".

In addition, it must be noticed that, since 2016, the Eu framework has supported the implementation of the New Urban Agenda, which has the same vision of the Urban Agenda for the Eu (Uaeu)[54].

Even though the Uaeu in its original version did not explicitly mention the role of food or agriculture in urban environments, significant changes in this sense are expected.

The Agenda will be soon reviewed in light of the New Leipzig Charter[55], which recognises the role of Ua for a new model of "productive city" and states that «small-scale businesses, low-emission-manufacturing and urban agriculture can be stimulated to re-integrate production into cities and urban areas, enabling and promoting new forms of mixed-use neighbourhoods»[56], and the Ljubljana Agreement[57], which added the topic of "food" to the existing list of Uaeu priority themes.

In this sense, urban agriculture can be included among the many strategic tools that the Eu aims at promoting to achieve the objectives of the Green Deal. However, in the future, it will be crucial to under-

(53) European Commission, *The Biodiversity Strategy*, cit., pp. 12–13.

(54) This document was launched in May of the same year with the Pact of Amsterdam and represents a multi-level tool to promote cooperation among Member States, the Commission, EU cities and other stakeholders to better regulate, fund and know urban needs and practices, in order to stimulate growth, cohesion and innovation.

(55) This document was adopted on 30 November 2020 at the informal meeting of Eu ministers responsible for urban and territorial development and intends to guide the next phase of the Urban Agenda for the Eu.

(56) See p. 3 of the New Leipzig Charter available at https://futurium.ec.europa.eu/en/urban-agenda/library/new-leipzig-charter-and-implementing-document (last access 5 September 2022).

(57) This document has been adopted by the Eu Ministers responsible for Urban Matters on 26 November 2021 and it is available at https://ec.europa.eu/regional_policy/sources/docgener/brochure/ljubljana_agreement_2021_en.pdf (last access 5 September 2022).

stand how to achieve the necessary integration across all Eu policy areas in order to strengthen the potential for urban agriculture[58].

4. Definitions and typologies of urban agriculture

Currently, a unique legal definition and specific regulation of this phenomenon do not exist.

In general, Ua has been defined in contrast to rural agriculture by identifying the characterising elements that are present or absent in it, in terms of farm and farmer types, livelihood, products, cropping calendar, production factors, farmer organization, social and environmental context, availability of research and credit services, market and land security[59].

During the years, Ua has been examined as a concept that embraces distinct considerations in four different fields: the economic, social and environmental ones, and that of food security[60].

The difficulties to provide a single definition may be connected to the fact that UA is context dependent[61] and has a dynamic nature, which exists within heterogeneous situations, locations and socio–political conditions, and it embraces many forms, going far beyond gardening.

Nevertheless, in recent years a number of attempts have been made in literature, having different nuances and focusing on distinctive aspects of UA: the spatial dimension, the generated outputs, the nature of the actors, the scale of implementation and the market dimension.

One of the most widely cited interpretations has been provided by Mougeot, who describes Ua as

(58) J. McEldowney, *op.cit.*, p. 1. The author underlines that at the Eu level the coordination between the different policies regarding urban agriculture is still limited, as proven by the fact that, for example, the Common Agricultural Policy - Cap (2014–2020) neither directly addresses nor allocates specific funds to urban farming. The main criticality was that, for some aspects, urban agriculture may not have a sufficient agricultural nature to obtain support under Pillar I of the Cap while, for others, it is not considered sufficiently rural to secure support under the rural development programmes. Same considerations can be made for the new Cap.

(59) Fao, Rikolto, Ruaf, *op. cit.*, pp. 12–13.

(60) J. McEldowney, *op. cit.*, p. 9.

(61) C. Delgado, *Contrasting practices and perceptions of urban agriculture in Portugal*, in *International Journal of Urban Sustainable Development*, 10, 2, 2018, pp. 170–185.

> the industry located within (intra–urban) or on the fringe (peri–urban) of a town, a city or a metropolis, which grows and raises, processes and distributes a diversity of food and non–food products, (re–) using largely human and material resources, products and services found in and around that urban area, and in turn supplying human and material resources, products and services largely to that urban area[62].

In this attempt to describe Ua, the spatial element is particularly significant: the larger urban system is included in the definition, from intra– to peri–urban, thus including the areas in proximity of a town, a city or a metropolis.

The focus is also on the production and market dimension of the phenomenon, which embraces the entire food and non–food chain: Ua products and services should be both locally–sourced and, at least partially, locally–supplied and oriented towards urban dwellers. Consequently, attention is given both to the economic and social aspects of Ua.

Adornato refers to the same space location but, unlike Mougeot, takes into consideration an even broader perspective, considering socio–economic as well as environmental impacts of Ua as

> a localized activity within an urban and peri–urban area that aims to produce and distribute a wide variety of food products and services, using relevant amounts of human and material resources of that area and concurrently giving relevant amounts of products and service to that area»[63],

also specifying that UA «has a fundamental role in the process of sustainable, agricultural and urban development»[64].

According to the aforementioned legal scholar, Ua has this crucial function because of its multifunctional and multi–ideal contribution capable of developing new models in economic and social terms, based on the principles of solidarity and subsidiarity[65].

(62) L.J.A. Mougeot, *Thematic Paper 1: urban agriculture: definition, presence, potentials and risks*, in N. Bakker, *et al.* (eds.), *Growing cities, growing foods: urban agriculture on the policy agenda*, Feldafing 2000, p. 10.

(63) F. Adornato, *Pulsa la vita nel diritto*, in *Rivista di diritto agrario*, 2013, 3, pp. 490–522.

(64) F. Adornato, *Problemi giuridici dell'agricoltura urbana*, in *Intersezioni*, 2015, 66, pp. 1–5.

(65) *Ibidem.*

A different point of view is offered by Roggema, concisely outlining Ua as «the growing, processing and distribution of food or livestock within and around urban centres with the goal of generating income»[66].

In this case, even though the spatial dimension is the same as Mougeot and Adornato, the emphasis is put exclusively on the economic or market–oriented perspective, and the considered output is limited to food products, ignoring services and non–foodstuff.

An even shorter definition of Ua, which does not take into consideration any of its goals or socio–economic impacts, refers to it as «the production of food and non–food plants, as well as husbandry, in urban and peri–urban areas»[67].

In addition to the literature on the subject, other definitions of Ua come from international and intergovernmental organizations and associations.

According to the description by the United Nations Development Programme (Undp) in 1996, Ua can be defined as

> an industry that produces, processes and markets food and fuel, largely in response to the daily demand of consumers within a town, city or metropolis, on land and water dispersed throughout the urban and peri–urban area, applying intensive production methods, using and reusing natural resources and urban waste, to yield a diversity of crops and livestock[68].

Reference is made to the "metropolitan–intensive agriculture", where the emphasis is not on the average farmer, who could be a small–scale operator or a large agribusiness, but on the methods adopted, which have the purpose of making the best use of space and other limited resources. In this context, intensive UA has a higher outcome per unit of production in comparison to rural agriculture.

In 2006, the Research Centre for Urban Agriculture and Food Security (Ruaf) conceived Ua in contrast with rural agriculture, with regard to the spatial dimension where the activities are run. This makes Ua a

(66) R. Roggema (ed.), *Sustainable urban agriculture and food planning*, Routledge, London 2016, p. 3.

(67) R. Santo, A. Palmer, B. Kim, *Vacant lots to vibrant plots: a review of the benefits and limitations of urban agriculture*, Johns Hopkins Center for a Livable Future, May 2016, p. 1.

(68) Undp, *Urban agriculture. Food, jobs, and sustainable cities,* cit., p. 3.

crucial part of the urban ecosystem, having socio–economic, environmental, and political impacts on such a complex system.

Ruaf provides a rich definition of Ua as

> the growing of plants and the raising of animals within and around cities. The most striking feature of urban agriculture, which distinguished it from rural agriculture is that it is integrated into the urban economic and ecological system: urban agriculture is embedded in – and interacting with – the urban ecosystem. Such linkages include the use of urban residents as labourers, use of typical urban resources (like organic waste as compost and urban wastewater for irrigation), direct links with urban consumers, direct impacts on urban ecology (positive and negative), being part of the urban food system, competing for land with other urban functions, being influenced by urban policies and plans, etc. Urban agriculture is not a relic of the past that will fade away (urban agriculture increases when the city grows) nor brought to the city by rural immigrants that will lose their rural habits over time[69].

In this case, the definition does neither explicitly refer to services as outcomes of Ua, nor indicates the actors involved.

According to the Cost Association, an international non–profit association of academics and professionals in the areas of urban development and agriculture aiming at enhancing European cooperation in science and technology, the key issue of the Ua definition is in the spatial and functional elements since it

> spans all actors, communities, activities, places and economies that focus on biological production in a spatial context which – according to local standards – is categorized as "urban". Urban Agriculture takes place in intra– and peri–urban areas, and one of its key characteristics is that it is more deeply integrated in the urban system compared to other agriculture. Urban Agriculture is structural embedded in the urban fabric; it is integrated into the social and cultural life, the economics and the metabolism of the city[70].

Therefore, the local context and functional dimension of Ua are underlined, as a piece of the socio–cultural and economic system of a city.

During the 1990s, Fao provided two different definitions of this phenomenon, depending on its "urban" or "peri–urban" perimeter.

(69) Ruaf, *Urban agriculture: what and why?,* Ruaf Foundation Web Page, 2006, as cited by C. Delgado, *op. cit.*, p. 170.

(70) F. Lohrberg, L. Lička, L. Scazzosi, A. Timpe (eds.), *op. cit.*, p. 21.

The distinction is framed in the following terms: urban agriculture referred to «small areas (e.g. vacant plots, gardens, verges, balconies, containers) within the city for growing crops and raising small livestock or milk cows for own–consumption or sale in neighbourhood markets»; whereas, «peri–urban agriculture [...] refers to farm units close to town which operate intensive semi– or fully commercial farms to grow vegetables and other horticulture, raise chickens and other livestock, and produce milk and eggs»[71].

It is important to highlight that the two definitions differ not only in relation to the spatial location where the activities take place, whether within cities or in their proximity, but also in terms of farm size, which is supposed to be smaller and marginally market–oriented in the case of urban agriculture, in sharp contrast to peri–urban agricultural activities characterised by a commercial dimension and, thus, not carried out on an amenity basis.

Recently, Fao has revised its definition of Ua, offering again two definitions, but this time the difference concerns their length.

In this case urban and peri–urban agriculture is addressed as a whole and the Fao approach is explicitly inspired by the definitions suggested over the past thirty years.

As stated in the short and concise definition, which is limited to the essence of the phenomenon, «urban and peri–urban agriculture can be defined as the production of food and other outputs and related processes, taking place on land and other spaces within cities and surrounding regions»[72].

The long definition encompasses a more comprehensive socio–economic, political and environmental perspective, enlarging the Ua dimensions and goals, according to which

> urban and peri–urban agriculture can be defined as practices that yield food and other outputs from agricultural production and related processes (transformation, distribution, marketing, recycling ...), taking place on land and other spaces within cities and surrounding regions, involving urban and peri–urban actors, communities, methods, places, policies, institutions, systems, ecologies and economies, largely using and regenerating local resources to meet the changing needs of local population while serving multiple goals and functions[73].

(71) FAO, *Urban and peri–urban agriculture,* cit.
(72) Fao, Rikolto, Ruaf, *op. cit.*, p. 11.
(73) *Ibidem.*

It is interesting to notice that, in this definition, the functional scope is expressly broadened by encompassing recycling as a new urban activity in the Ua framework, and it clearly indicates a series of stakeholders involved.

Despite the sharing of certain elements, all the above–mentioned descriptions frame Ua in a distinctive way and shed light on different dimensions and perspectives: in any case, the spatial element appears to be the key feature of Ua whose perimeter, depending on which definition we analyse, can been limited to the built–up city or extended to its periphery.

In this publication the term "urban agriculture" is meant to include both intra– and peri–urban areas.

Nevertheless, it is important to underline that the innovation generated by UA is not solely related to the location where the agricultural activities take place, but it also refers to benefits of various nature linked to it. In fact, the analysed literature shows that Ua is a source of benefits that go beyond the production and distribution of food to intra– and peri–urban areas.

These advantages encompass the social, economic and environmental dimensions of the urban ecosystem to the advantage of the community: they range from direct benefits in terms of urban and environmental security, as well as greening of cities, to indirect ones such as the promotion of short supply chains, the fostering of social cohesion, not to mention personal and collective wellbeing[74].

With regard to the typologies of Ua, Cost systematised Ua by recognising two distinctive categories: urban gardening and urban farming[75].

The former refers to «agricultural activities with generally low economic dependence on material outputs while using the production of food for achieving other, mostly social, goals»; whereas the latter encompasses «intentional business models taking advantage of proximity to the city by offering local or regional agricultural products or services»[76].

(74) P. Lattanzi, *Coltivare le città: percorsi agricoli sussidiari,* in *Servitium «Sora nostra matre terra»*, 240–241, Viator, Milano 2019, p. 92.
(75) F. Lohrberg, L. Lička, L. Scazzosi, A. Timpe (eds.), *Urban agricolture europe*, Cost Action, Jovis, Berlin 2016, p. 22.
(76) *Ibidem.*

Urban gardening can be performed on an individual (e.g. family and allotment gardens) or collective basis (e.g. educational, therapeutic and community gardens).

In case of urban farming, two types of operators can be identified depending upon the chosen business strategy: on the one hand, there are farms providing on–site services (e.g. therapeutic and educational farms); on the other hand, there are local food and non–food farms, orientating their production to local markets, and environmental farms, adopting environmentally friendly practices, for example by being involved in biodiversity conservation or flood prevention(77).

Lastly, on the basis of its scale, Ua can be disaggregated into micro, meso and macro production (the latter being more regulated than micro and meso), and, in relation to the ownership of the land, Ua can be categorised as private, corporate or public(78).

5. Challenges and limitations of urban agriculture

Urban agriculture faces also several challenges and limitations.
One of the most significant challenge lies in the low availability of plant reproductive material adapted to the characteristics of the urban environment(79).

In this sense, plant breeding is required to develop plant varieties capable to meet the demands and needs of urban producers, having also the characteristics required for sustainable agricultural productions in urban environments, e.g. pest and stress resistance.

The gap in terms of entrepreneurial skills and competence is found

(77) Ivi, pp. 22–28.

(78) According to the authors, ownership is private when owned by individuals with fully assigned property rights; corporate when owned by shareholders and characterised by collective decision–making; and public when owned by government and managed for social outcomes. L.J. Pearson, L. Pearson, C.J. Pearson, *Sustainable urban agriculture: stocktake and opportunities*, in *International journal of agricultural sustainability*, 8, 1–2, 2010, p. 8

(79) For insights on the state of the art and the advantages in planning genetic improvement for plants for urban destinations, see S. Farinati, A. Betto, F. Palumbo, F. Scariolo, A. Vannozzi, G. Barcaccia, *The new green challenge in urban planning: the right genetics in the right place*, in *Horticulturae*, 8, 761, 2022.

to be another element capable to hold urban agriculture back, as well as the irreversible conversion of land to urban use(80).

The limitations concern social, economic and food security aspects and range from the rising contrasts between social goals and profitability, between the higher price associated with such activities and the vulnerability of low–income residents, from the lack of cooperation with traditional farmers, the dependency on public funding, to the potential health risks in terms of pollution, waste dumps or soil contamination(81).

Given this scenario, researchers have suggested to lower the expectations on the role of urban agriculture in providing food and jobs for local communities while generating income for farmers: outside support is needed to achieve these purposes, otherwise urban farmers are pursuing goals which are unattainable(82).

As a matter of fact, urban agriculture should not compete with rural agriculture, which is fundamental to feed the cities, but cooperate with it by focusing on activities where it can better serve the market, the citizens and the environment (e.g. producing fresh foods from high–value crops, shortening the supply chain)(83).

Furthermore, another important challenge is linked to the fact that food production within cities does not necessarily guarantee sustainability: the key–issue concerns the practice of industrial farming methods in urban agriculture, including the massive use of chemical products and the major consumption of fossil fuels.

Short–distance transportation is a poor indicator to assess the sustainability of local food systems(84). Even though the concept of "local food" is often associated with "environmentally friendly production" and "small–scale farms", this linkage may not be so tight.

(80) J. McEldowney, *op.cit.*, p. 1. In particular, the author identifies *«four key "real world" challenges»:* tensions between "traditional farmers" and "new style" farmers; pressure on open space and farmland; skills and competences gap; legislation. See also R. Santo, A. Palmer, B. Kim, *op. cit.*

(81) The nature of the mentioned benefits, challenges and limitations are from an entirely European perspective, derived from case studies. J. McEldowney, *op. cit.*, pp. 19–22.

(82) S. Daftary–Steel, H. Herrera, C. M. Porter, *The unattainable trifecta of urban agriculture*, in *Journal of agriculture, food systems and community development*, 6, 1, 2015, pp. 19–32.

(83) Fao, *Urban and Peri–Urban Agriculture,* cit.

(84) G. Edwards–Jones, L. Milà i Canals, *et al., Testing the assertion that 'local food is best': the challenges of an evidence–based approach*, in *Trends food science & technology*, 19, 2008, pp. 265–274.

Another challenge is related to the exposure to soil, water and air pollutants, carrying the risk of possible health and environmental hazards. This is the reason why support must be given to a low–input, ecological and organic Ua.

It follows that a decisive factor in determining the sustainability of urban agriculture is undoubtedly the use of technologies to improve ecological conditions, and the choice of plants adapted to the local environment[85].

One of the most critical constraint lies in the legislation itself which, in the absence of a clear legal framework, obstructs urban agriculture and it is considered to hinder innovation and the development of local initiatives.

For example, the current regulatory framework does not provide specific legal measures intended to promote innovation in the context of Ua, such as the breeding of new "urban" plant varieties.

In this context, a crucial challenge is to ensure that privately financed breeding programmes can recoup expenses and have a return on investments, in order to develop further innovation in plant varieties. In fact, due to limited funding and structures, public programmes do not often have the capacity to deliver finished cultivars to the market[86].

Therefore, the legislator should promote and support plant breeding for Ua, as long as it is able to shift its objectives by developing plant varieties adapted to urban environments, taking into account the peculiarities and unique conditions of doing sustainable agriculture in the city.

It is indeed necessary to "urbanise" plant breeding to meet the demands, interests and needs of urban producers, in order to promote Ua and to face the sustainability challenges of the third millennium.

6. What is plant breeding: in a nutshell

Plant breeding represents the cornerstone of human life as we know it, as well as a scientific landmark and a socio–cultural milestone.

(85) F.C. Coelho, E.M. Coelho, M. Egerer, *Local food: benefits and failings due to modern agriculture*, in *Scientia agricola*, 75, 1, 2018, pp. 84–94.

(86) M.R. Colley, W.F. Tracy, E.T. Lammerts van Bueren, *et al.*, *op. cit.*

In particular, plant breeding involves the scientific and creative pro cess leading to the development of new plant varieties possessing a set c desired characteristics, including plant domestication, which encompass es the conscious selection on a phenotypic basis of wild crops having th desirable visible traits, more suitable for the need of a certain society.

The path of humankind hit a turning point more than 10,000 yea ago with the beginning of domestication of wild plants and the shift t agriculture, allowing men and women of the Neolithic to have access t more food with less effort in a permanent place.

Therefore, plant breeding pre–dates civilization[87]: the predictabilit of food availability allowed an increase in population, while the set tlement of the first farming communities enabled the creation of th world's first cities and the development of more complex societies. Thi is when the relationship between "agriculture" and "urbanisation" start ed, thanks to plant domestication.

The existing genetic variability springs from the ongoing process c wild plants domestication, started by the first farming communities and cultivation of selected crops, inevitably influenced by human inter vention and surrounding environments[88].

Plant domestication is based on the long–term activity of wild plant selection, fitting certain social and cultivation requirements. Pigna an Morandini state that the domestication process «implies the stable ac quisition (and therefore the inheritance by the progeny) of a suite o traits, which are collectively defined as the domestication syndrome which mark the difference between the crop and its wild ancestors».

This represented a fundamental transition point in agriculture sinc it marked the time when gatherers became farmers.

Consequently, beyond its scientific value, plant domestication ha a great historical and socio–cultural significance: «crops are marvelou organism on which we ultimately depend, or have depended, for mos of our history, for food, feed, fiber, flower, fuel and fun (consider bever ages such as wine, beer, tea or coffee, for instance)»[89].

(87) D. Duvick, *Plant breeding, an evolutionary concept*, in *Crop science*, 36, 3, 1996, p 539.

(88) G. Pigna, P. Morandini, *Domestication of new species*, in R. Pilu, G. Gavazzi (eds.) *More food: road to survival*, Bentham Science, Sharjah 2017.

(89) *Ibidem.*