Organic and Urban farming – two sides of a coin of future sustainable and circular food systems

GEROLD RAHMANN[1] , DANIEL GRIMM [1,2] AND ENNO SONNTAG [1,3]

Key words: urban farming, organic farming, circular food system, sustainability, food security

Abstract

Organic and urban agriculture are both innovators of novel and innovative food systems. Organic is more rural and farming related, while urban agriculture is innovation with same targets (healthy and sustainable food production) and apart from farm land (e.g. in-door, balcony, vertical, container, hydro, roof, cellar). Both of these food chain innovation are like-minded but rarely exchange ideas and results. Novel foods (mushrooms, invertebrates, algae) and food habits (vegan, vegetarian, etc.) are popular in urban agriculture. Urban agriculture is very efficient in space (yield per m^2) and nutrients (nearly 100%, closed systems). Organic can learn a lot about those ideas and results. Vis-a-versa, urban agriculture is limited in mass production, usually high-tech related with a lot of energy and technology needs. Urban agriculture food is usually expensive and could learn a lot about food production and chains from Organic. The standards and regulations hinder joint action and marketing. Science can help to identify mutual concepts and joint structures for a modern urban and rural life and links.

Introduction

The global food security and safety was, is and will be a challenge. Enormous increase of productivity in agri- and aquaculture in the last decades is able to feed more than 7,8 billion people (2022) nowadays. Nevertheless, hunger is still prevalent and malnutrition a severe issue in many countries. More than 800 mio people are facing hunger and more than 2 billion malnutrition (FAO 2019). And the challenges are getting bigger, with the global population set to grow up to 9 to 11 billion until the end of the century and the demand for resource-intensive livestock products like meat, eggs and milk increasing (Rahmann et al. 2017). Though a fairer global distribution of food would ameliorate these problems – there is after all enough being produced - an increase of productivity and production is necessary (Rahmann et al. 2021). Since land is more and more limited and land use change more and more difficult, intensification is needed: higher yields per hectare (Rahmann, Grimm, 2020). But this is only one side of the coin. Increasing productivity and production has resulted not only in more food production but also in more environmental damage, such as decreasing soil fertility, biodiversity losses, water pollution, climate impact and low animal welfare. How can this double challenge be solved: food systems, which produce and deliver enough, healthy and affordable food but are also sustainable? Two options and potential synergies of merging both will be discussed in this paper (Rahmann, Grimm, Kuenz, Engel 2021):

- Organic farming: horizontal farming, mainly in rural areas, practiced by farmers
- Urban farming: vertical farming, mainly in urban areas, practiced by non-farmers

Organic farming

Organic farming has led to major advance in terms of environmental sustainability and animal welfare (Sanders, Heß 2019). It is well established (standards and regulations, e.g. EU reg. 848/2018) and widely practiced (globally on about 70 mio hectare in about 130 countries and done by more than 3 mio farmers in 2020). Organic food has left the market niches in important markets like the US and EU (90% of the 120 billion USD sales) (Willer et al. 2022). On the other side, Organic farming is less productive (per hectare) compared to intensive conventional agriculture (round about 25-50% lower yields) (Rahmann, Böhm, Kuhnert 2022).

[1] Thuenen-Institute of Organic Farming, Germany, www.thuenen.de/ol/en/, gerold.rahmann@thuenen.de
[2] University of Kassel, Faculty of Organic Agricultural Science, Germany
[3] Wageningen University, The Netherlands

Nevertheless, several governments, particularly in Europe (EU members) and Asia (e.g. India, Bhutan) have decided to increase the share of Organic farm land. For example, the EU green deal and the farm-to-fork strategy wants to achieve 25% Organic farm land by 2030 (from 8% in 2020). With the global food security problems due to the Russia-Ukraine war (since 24th February 2022), this target is under increasing scrutiny,.

Urban farming

Urban agriculture, though in principle an old concept, has in recent decades become a new trend, with a new image (Padilla 2018). Until today, most urban agriculture takes place in the form of backyard and homestead gardening, as well as intensive animal husbandry (indoor dairy, pigs, chicken husbandry without farm land) (Lee-Smith et al. 2019). But these "old fashioned" and in many cases unsustainable urban food systems are dying out due to bad image and decreasing policy support (emissions). But novel and disruptive new urban food systems arise. Usually, they are not driven by farmers and not supported by policies but done by activists, socio-ecological groups and start-ups, mainly in "Western" countries, like North America, EU, Japan, Australia, New Zealand and Korea. Nevertheless, there is potential for less developed areas as well (de Bon, Parrot, Moustier 2009) and particularly in food security crises (Gantner 2022).

Urban farming activists and start-ups invent and implement novel food production systems in urban, open spaces (organic backyard gardening) (Rahmann 2021), in or on private or commercial buildings and even in bioreactors and "food factories" (Castillo 2021). In-door, balcony, roof-top, cellar, container and wall-based food production has a positive image as sustainable and innovative. Large scale, fully automated food production factories are the latest innovations. Most of these new urban food systems produce mainly plant-based food, though there is an opportunity for integrating other organisms, such as fish, in the case of aquaponics, or mushrooms and algae. These approaches are highly space and resource efficient (nutrients and water), more circular than conventional and organic land-based food systems but, on the other side, capital intensive, as a lot of technology and energy is needed. Urban farming has not left the niche yet, but the market is there and the potential is high.

Indoor farming in factories can be very space efficient. E.g., an aquaponic factory near Copenhagen produces vegetables without any GHG emissions and nearly 100 % nutrient efficiency, with no water contamination. The production is 250 times more efficient in water and 200 times more efficient in space compared to farm land-based production in Denmark (Castillo 2021). Novel food like algae show even better results (Ullmann, Grimm 2021). Urban land use change towards increasing urban farming is on the go (Lohrberg 2001). Urban farming in-door has still production and technical challenges (disease control, ligthing systems, automatisation) as well as high costs.

Discussion

Organic and Urban farming are two sides of the coin of sustainable farming of the future. They have similar targets but different historical backgrounds, approaches and focus. While Organic farming is famers and rural based on sustainable land use, urban farming is start-up and activists generated novel food production without farm land. Both systems have their potential and appreciation by consumers. Organic is regulated and already has a large market. But urban farming is still heterogenous and without market relevance and regulations.

Both can learn from each other. Organic can give orientation in standards and the development of regulations, food quality and holistic approaches of food systems. Urban farming, thanks to its heterogeneity, is highly innovative and can open the mind to "think different" and "out of the box", producing food without farm land, in urban areas and with high or low technology. Both together would be an excellent chance to produce solutions for future food security and safety challenges. But there are still high walls of different opinions, resource efficiencies, strategies, knowledge, and markets. The scientific discussion can help to overcome those problems for an even better sustainable food systems in the future.

Table 1. Comparison of conventional, organic and urban farming

Parameter	Conventional farming	Organic farming	Urban farming
Space efficiency	medium	low	very high
Energy efficiency	medium	low	very low
Nutrient efficiency	low	medium	very high
Water efficiency	high	high	low
Capital intensity	high	low	very high
Labour intensity	medium	high	very high
Knowledge capacity	low	medium	very high
Skill capacity	high	high	very high
Ecological impact	high	medium	very low
Food security impact	high	medium	low
Food sovereignty impact	medium	high	low

References

Castillo P (2021) Carbon-neutral vertical farming. https://atlasofthefuture.org/project/nordic-harvest-vertical-farm/

De Bon H, Parrot L, Moustier P (2009) Sustainable urban agriculture in developing countries. A review. Agron Sustain. Dev 30 (2010) 21-32 DOI: 10.1051/agro:2008062

FAO (2019) The state of food security and nutrition in the world 2018: building climate resilience for food security and nutrition. Food & Agriculture Organization, Rome

Gantner C (2022) Vertical farming gegen die Lebensmittelkrise. https://www.zdf.de/nachrichten/panorama/lebensmittel-vertical-farming-100.html, visited on 18.6.2022

Grimm D, Kuenz A, Rahmann G (2020) Integration of mushroom production into circular food chains. Org Agric. https://doi. org/10.1007/s13165-020-00318-y

Kuenz A, Grimm D, Rahmann G (2020) Versatility of algae – exploring the potential of algae for nutrient circulation. Org Agric. https://doi.org/10.1007/s13165-020-00308-0

Lee-Smith D, Prain G, Cofie O, van Veenhuizen R, Karanja N (2019) Urban and peri-urban farming systems. In: Farming systems and food security in Africa. DOI:10.4324/9781315658841-16

Løes AK (2020) Feeding the reactors: potentials in re-cycled organic fertilisers. Org Agric. https://doi.org/10.1007 /s13165-020-00314-2

Lohrberg F (2001) Stadtnahe Landwirtschaft in der Stadt- und Freiraumplanung. Diss University of Stuttgart.

Neuhoff D, Kwesiga J (2021) Para-organic intensification of fu- ture farming as alternative concept to reactor-based staple food production in Africa. Org Agric. https://doi.org/10.1007 /s13165-020-00326-y

Padilla M et al. (2018) Urban farming in the city of tomorrow. Fraunhofer Institute, IAO, Stuttgart. https://publica.fraunhofer.de/handle/publica/299209

Rahmann G (2020) Farming is back in town. Biowelt 2020, page 54

Rahmann G et al. (2021) Innovative, sustainable, and circular agricultural systems for the future. Org Agric 10(1). https://doi.org/10.1007/s13165-021-00356-0

Rahmann G, Grimm D, Kuenz A, Hessel E (2020) Combining land-based organic and landless food production: a concept for a circular and sustainable food chain for Africa in 2100. Org Agric 10(1):9–21. https://doi.org/10.1007/s13165-019- 00247-5

Rahmann G, et al. (2017) Organic agriculture 3.0 is innovation with research. Org Agric 7(3):169–197. https://doi.org/10.1007 /s13165-016-0171-5

Rahmann G, Grimm D (2020) Food from 458 m2 – calculation for a sustainable, circular, and local land-based and landless food production system. Org Agric. https://doi.org/10.1007 /s13165-020-00288-1

Rahmann G, Böhm H, Kuhnert H (2022) Auswertung der einschlägigen Studien der vergangenen fünf Jahre sowie der Forschungsergebnisse des TI hinsichtlich der Frage, wie sich die Pro- duktivität des ökologischen Landbaus bezogen auf die Fläche im Vergleich zu dem konventionellen Landbau darstellt. Thünen-Institute, Trenthorst/Braunschweig. Answer to the German government regarding the impact of the Ukraine war on agriculture transformation towards 30% Organic land share. Pp13

Sanders J, Heß J (eds) (2019) Leistungen des ökologischen Landbaus für Umwelt und Gesellschaft. 2. überarbeitete und ergänzte Auflage. Braunschweig: Johann Heinrich von Thünen-Institut, 398 p, Thünen Rep 65, DOI:10.3220/REP1576488624000

Ullmann J, Grimm D (2021) Algae and their potential for a future bioeconomy, landless food production, and the socio- economic impact of an algae industry. Org Agric. https://doi.org/10.1007/s13165-020-00337-9

Willer H et al. (2022) The world of Organic agriculture – Statistics and emerging trends 2022. IFOAM/FiBL, Bonn/Frick. http://www.organic-world.net/yearbook/yearbook-2022.html

Research for Organic Agriculture to tackle future challenges

ISOFAR international scientific workshops

at the 2nd International Organic Expo October 1-3, 2022

in Goesan, South Korea

Proceedings

ISOFAR
International Society of Organic Agriculture Research

c/o Thuenen-Institute of Organic Farming
Trenthorst 32
23847 Trenthorst
Germany
www.isofar.online
info@isofar.online

ISOFAR
International Society of Organic Agriculture Research

2022 IFOAM-Goesan
International Organic EXPO Industry Fair