A comprehensive conceptualisation framework for assessing metropolitan peri-urban agriculture

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Abstract: Peri-urban agriculture offers multiple benefits for food security, farm viability, environmental stewardship, and landscape and socio-cultural preservation. These are non-commodity outputs insufficiently acknowledged by the free market despite playing an essential role in agricultural development. The double vulnerability of peri-urban agriculture dictated by urban pressure and agricultural systemic changes has led to myopic policy interventions. To address this gap, we propose a comprehensive assessment framework integrating the concepts of multifunctional agriculture, resilience, climate-smart agriculture and alternative food networks to provide a unified evaluation. The framework comprises 21 enabling features across five dimensions derived from the core objectives of the building concepts. The primary purpose of the paper is to address the declining agricultural activity in peri-urban areas and pave a way for policy discussions. The objective is to deliver new insights into how peri-urban agriculture can be re-evaluated, ultimately informing policymakers on a range of issues leading to targeted strategies.

Keywords: multifunctionality; peri-urban agriculture; PUA; assessment tool; policy support; agricultural development.

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1 Introduction

Globally, peri-urban agriculture (PUA) accounts for 60% of irrigated cropland (130 Mha, mega hectares – ha x 10^6) and 35% of rainfed cropland (327 Mha) (Thebo et al., 2014). The importance of peri-urban areas is likely to increase in the context of food security concerns, landscape preservation, resource management, and socio-cultural value (McGregor et al., 2006; Olsson et al., 2016; Opitz et al., 2016). Despite the growing need to consider PUA, planning at the fringe has been a reactive, inert or absent force, usually concerned with urban containment and separation of land uses (Gallent et al., 2006; Paul and Tonts, 2005; Salvati, 2016). The focus has been on implementing statutory regulation to contain or dictate appropriate land uses while passively observing land use change without a coherent landscape view of how different uses integrate, such as agriculture – residential – industry, services – telecommunication – recreation, people – open space (Albrechts, 2004).

At the global level, drivers of change such as climate change, population growth, urbanisation, globalisation of markets, privatisation of agricultural science, and international trade conspire to create unpredictable vulnerabilities in the global food system (Hazell and Wood, 2008). At the national and local level, an interplay between shifts in agricultural policy, demographic changes, and urbanisation are leading to unsustainable farm management and resource use, urban encroachment, and land fragmentation. Farming on the fringe is eroded, affecting farm viability and reducing agricultural jobs and skills. Under these conditions, PUA is subject to a *double vulnerability*, where structural changes in the agricultural sector are exacerbated by proximity to cities, with consequences for the socio-economic structure of PUA (Rojo et al., 2014).

The agricultural sector requires systemic short-term changes that adapt and innovate agriculture and long-term changes that modify and create radically new systems (Campbell, 2009). The purpose of these changes is to limit greenhouse gas (GHG) emissions, protect natural resources and biodiversity, promote sustainable development, and address socio-economic disparities. In peri-urban areas, this new paradigm is driven by the potential benefits offered by PUA. Economically, it can strengthen local employment, job security, long-term investment, and promotion of niche or specialised farming systems with high added value. Coupled with the development of short food supply chains (SFSCs), PUA sustains industries that support agriculture and create linkages between industries that agriculture serves (Carey et al., 2016; Zasada, 2012). Environmentally, PUA could be connected to the urban metabolism, assisting in

reintegrating waste streams (organic waste, wastewater), contribute to biodiversity through conservation and minimal input use farm practices, provide water cycle basins, carbon sequestration, and reduce the urban heat island effect (Paül and McKenzie, 2013). Small-scale farming typical of PUA also favours management practices in line with environmental objectives since lacking economies of scale, farmers opt to produce specialised or organic products that can be sold at higher prices (Wilhelm and Smith, 2018). Socio-culturally, heritage is a fundamental factor in local identity. Various on-farm activities and processing operations offer ways to bring consumers closer to production while embedding PUA in a local context. PUA takes on education, recreation, ethical, quality of life, heritage, and community cohesion values (Brinkley, 2012; Ives and Kendal, 2013).

In this paper, we seek to bring forward a comprehensive framework to inform decision-making for the revitalisation of PUA. We start by reviewing four concepts and introducing the core enabling features across five dimensions: economic, social, environmental, cultural, and institutional. Importantly, this conceptualisation has taken place before the COVID-19 pandemic when PUA might not have attracted much attention. We argue that in Australia (particularly Greater Melbourne), the pandemic has created a fertile ground for utilising the proposed assessment framework given the heightened interest in the value of PUA from State Government and planners (Buxton and Butt, 2019; Clay, 2020; DELWP, 2019). The paper also discusses the boundaries of applying the assessment framework in empirical studies, an important addition to traditional forms of policy assessment.

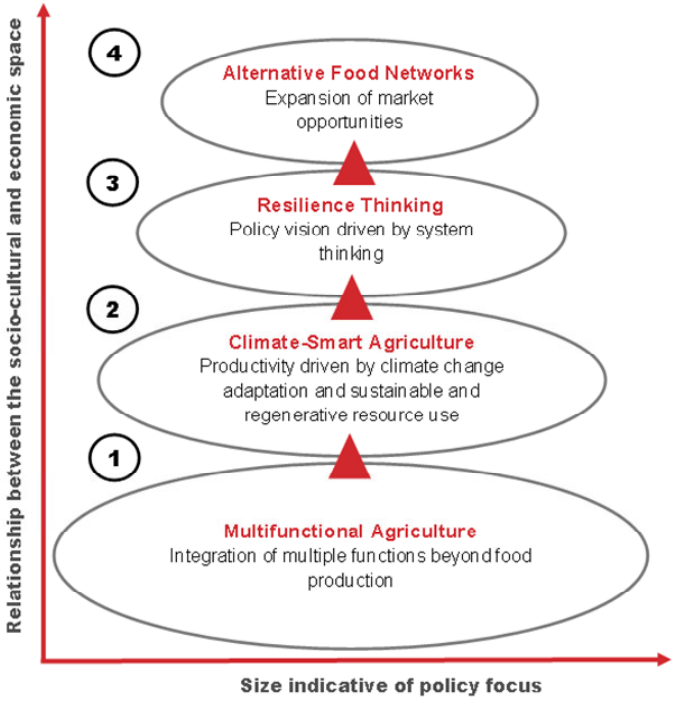
2 The conceptual model of assessing metropolitan PUA

The viability of PUA relies on new economic and planning models that capture and address multiple challenges posed by climate change, population growth, environmental degradation, agricultural debt, globalisation of markets, and competition for resources (land, water, and energy) (Buxton et al., 2016). Delays between measures that manage urban development and natural resources often result in mismanagement of agricultural landscapes at the fringe (Eweg, 2014). The speed of change at different scales is best captured by Steward Brand's (1999) pace layering theory. The fundamental idea is that each layer (decreasing speed of change: fashion, commerce, infrastructure, governance, culture, and nature) operate at a different pace, safely supported by slower layers below and kept innovative by faster layers above. Disequilibrium arises when the hierarchy is not respected, for example, "If commerce is allowed by governance and culture to push nature at a commercial pace, then all-supporting natural forests, fisheries and aquifers will be lost" (Brand, 2018). Moreover, single-focused interventions such as environmental: limiting the use of fertiliser, vegetation management; economic: incentives for carbon sequestration, grants for implementing conservation agriculture; or social: assistance programs, off-farm employment opportunities, have the potential of skewing PUA transformation capability (Klerkx et al., 2012; Wynne et al., 2020).

We argue that four key concepts have significant value for the future of PUA, which together address a range of issues and create the opportunity to integrate often disjointed aspects of agriculture: multifunctional agriculture (MFA), climate-smart agriculture (CSA), resilience thinking (RT), and alternative food networks (AFNs). The relationship

between the four concepts can be represented as occupying different levels of action and intervention in the socio-cultural and economic space (Figure 1).

Figure 1 Key concepts and their structure in the assessment of peri-urban agriculture for sustainable agricultural development (SAD) in metropolitan peri-urban areas (see online version for colours)



Realising the potential of PUA lies in successfully integrating all four layers. This conceptualisation places higher importance on realising ecological rather than economic potential, emphasising the importance of incorporating management practices that depart from industrial forms of agriculture. The pyramidal structure denotes the importance of each concept to agricultural development in peri-urban areas based on aspects of food security, landscape preservation, farmer's livelihoods, and farm viability.

2.1 Multifunctional agriculture

The concept of MFA is not new. It was introduced following the Rio Earth Summit in 1992 to describe agricultural activity under the broader framework of sustainable development that incorporates food security and environmental, economic and socio-cultural functions (FAO, 1999). Wilson (2007) provides a detailed theoretical conceptualisation of MFA and defines it within the productivist/non-productivist boundaries along a spectrum of *weak* to *strong multifunctio*nality. *Weak multifunctionality* is a conventional farming system with few links between environmental protection, social capacity, economic viability, and institutional support. Such a system would be embedded in global commodity markets, would focus on industrialisation, intensification, surplus production, commercialisation, concentration,

high specialisation or monoculture production, and would be driven by large corporate involvement and investment (Ilbery and Bowler, 1998). *Strong multifunctionality* is based on multiple links between economic, socio-cultural and environmental aspects. It is characterised by links that provide income, employment, and activities embedded in the local and regional context. The supply chain is shifted towards shorter food miles, less intermediate processing, and greater control for the farmer on the final price. *Strong multifunctionality* entails changes in mental concepts of 'agriculture' and 'farming' to envision processes that go beyond productivist ideas of provision of food and fibre. These farming systems are likely to be less connected to the global market (Wilson, 2008).

MFA is the foundation of the assessment framework as it integrates different functions provided by and resulting from agricultural activity. Environmental functions address both positive and negative externalities of agricultural production, focus on conservation practices that reduce climate change impacts. Economic functions capture primary production and products and services with broad economic effects for the farm business and the local community. This includes goods for the food market, foods of distinctive quality and services such as tourism, social care, education, and energy. Socio-cultural functions account for the viability of rural communities, cultural values and people's livelihoods. It captures social, ethical and cultural functions (Renting et al., 2005).

MFA has both farm and landscape level applicability. At the farm level, traditional farming practices can be expanded through activities of broadening, regrouping, and deepening described by van der Ploeg et al. (2002). At the landscape level, MFA seeks to redefine the agricultural landscape through novel business models and more diverse employment arrangements, responding to emerging socio-cultural needs and expectations, and use of resources based on conservation, preservation, and biodiversity objectives (Marsden, 2003). MFA has been widely integrated with regional and national policies in the European Union and it is gaining popularity in the USA, China, Canada and across Africa (Fagioli et al., 2017; Leakey, 2017; Song et al., 2020). Supporters of MFA are also actively influencing the World Trade Organisation trade regime, attempting to incorporate the non-production benefits of MFA to promote more equitable agricultural development and global economic growth (Moon, 2012). In Australia, MFA has not been extensively applied or discussed, however, Holmes (2006) acknowledges the unique character of peri-urban areas and the *commodification of the rural idyl*. MFA can serve to mediate the opposing forces of amenity-oriented and production-oriented of peri-urban areas.

2.2 Climate-smart agriculture

The transition towards SAD is imperative given the need to increase food production by 70% to feed over 9 billion people by 2050 (Godfray et al., 2010). It plays a central role in assisting the sustainable development goals, directly or indirectly through the channels created by food production (FAO, 2018). CSA has three objectives (Campbell et al., 2014):

- to increase agricultural productivity in line with supporting incomes, development, and food security
- to increase adaptive capacity from farm to national level

- to support practices that decrease GHG emissions and turn agriculture into a carbon sink.

CSA focuses on improving productivity and enhancing the ability to manage weather extremes and long-term climate variability. This demands trade-offs between technological investment, management practices, and policies, which are often poorly understood. In this sense, CSA is limited in addressing possible impacts on ecosystem services, biodiversity, demand for food, water, materials, energy, and political and socio-economic dynamics (Neufeldt et al., 2013).

If the first level of the model is concerned with functionality, the second level is operational. Reverting to ecological principles of farm management will be essential for the adaptation of agriculture to climate change and reducing environmental impacts associated with fertiliser use, weed and pest control, water use and pollution, and loss of biodiversity. Operating within natural carrying capacity is likely to result in long-term economic viability and productivity, an important aspect since small-scale PUA often lacks economies of scale to attract political and financial support. Thus, the second level (CSA) has implications for the levels above (RT and AFN).

2.3 Resilience thinking

The broad scope of RT is to provide a practical roadmap for building capacity to withstand unexpected change and continue to enhance ecosystem and human services fundamental for wellbeing and environmental integrity. Resilient agriculture is based on the interplay of persistence, adaptation, and transformation at appropriate scales and moments. It embraces uncertainty and builds redundancy through a wide range of management practices, experimentation, and resources (Bennett et al., 2014). The most useful framing of RT is the ability to absorb shocks, or a system's ability to return to its initial structure, function, identity, and feedback after a shock, also termed *ecological resilience* (Holling, 1973). RT is also compatible with transformational adaptation since it promotes the creation of new systems, better integrated with *low-regret* strategies able to respond to drivers of change, particularly climate change (Rickards and Howden, 2012). RT is formulated on seven principles with transformational capacity able to disrupt the current path dependency: maintain diversity and redundancy; manage connectivity; manage slow variables and feedbacks; foster complex adaptive systems; encourage learning; broaden participation; and promote polycentric governance (Biggs et al., 2015).

RT represents a powerful model of engagement and democratic decision-making. While changes in population and land use have slowly displaced agricultural businesses at the fringe, the overall productivity of peri-urban farming has not been undermined (Butt, 2013). However, likely future disturbances to natural and human systems have the potential to disrupt agricultural production in many regional areas. The policy space has generally been slow to react to change since institutions are bureaucratic and formal actors reinforce the existing development pathway, even if suboptimal (Potter et al., 2008). Often, small-scale peri-urban farms have displayed remarkable agility to adapt despite slow or absent governmental action.

RT occupies the third level since institutional changes are much slower than farm-based changes. Given current institutional jurisdictions, resources, capabilities, and responsibilities, a high level of stakeholder participation remains challenging to manage

(Clark, 2006). However, the rural-urban dichotomy and blurred jurisdictions make peri-urban areas ideal laboratory spaces for testing new institutional arrangements between public, private, and community organisations.

2.4 Alternative food networks

AFNs represent a new dimension of rural development able to assist the transition from productivist agriculture to MFA regimes. AFNs are closely related to practices such as organic farming, high-quality production, Fair Trade, and direct selling of local and premium specialty foods. AFNs are driven by perception changes that *quality* is not represented by price alone but also by the various social and material dimensions associated with the *moral economy* – environmental impacts and welfare (Goodman et al., 2011). The definition of *quality* reflects that agricultural production is intertwined with embeddedness, trust, local, and fairness and includes aspects of SFSCs, convention theory, and social embeddedness (Murdoch et al., 2000). SFSCs are based on allowing small producers the opportunity to shift food production in ways that allow the producer to capture a higher proportion of value-added (Marsden et al., 2000). The convention theory highlights that specific values, norms, and institutional or organisational forms are creating the AFNs. AFNs unveil their hybrid nature through five conventions attributed to the quality of food products – commercial (price), domestic (products with attachments to place and traditions), industrial (efficiency), public (trademarks, brands), and ecological (production impacts) (Thevenot, 1998). The economic nature of AFNs development is embedded and mediated by social interactions beyond the sphere of business. It goes on to encompass the importance of social connection and reciprocity facilitated by respect, sociability, friendship, acknowledgment, and recognition (Sayer, 2001).

The success of AFNs relies on an effective understanding of the social environment such as how residents spend their time, economic and demographic profile, thus leading to ANFs that consider agreed definitions of *quality*, redefined ways that goods and services are assessed, restored functional trading engagement, agreed prices and redefined customary food networks (Le Velly and Moraine, 2020; Mancini et al., 2021).

AFNs occupy the fourth level in the assessment tool since their realisation at a larger scale depends on the existence of the levels below. Farmers are likely to respond to market and policy conditions by adopting different on-farm management practices. When the signals revolve around *productivism* and favour large-scale production, the non-commodity outputs (NCOs) – landscape preservation, species and ecosystem diversity, soil, water, and air quality, conservation, water use, food security, animal welfare, farm viability, and cultural heritage – are often not valued by the market. AFNs connect concerned customers with farmers who seek better prices for their produce, which usually also incorporate NCO (Whatmore and Clark, 2006). Creating an economic channel for valuing small-scale production and associated NCOs is critical for PUA.

3 Enabling features for re-igniting PUA

The assessment framework incorporates five dimensions on which agriculture depends: economic, social, environmental, cultural, and institutional. The enabling features are those characteristics needed to transition agricultural practice and policy from a narrow

focus on production to a holistic multifunctional role. It is recognised that the presence of all enabling features is far from realistic and often features overlap with more than one concept. However, each feature captures an essential aspect required to transform PUA. Each of the proposed enabling features emerge from the main objectives of the guiding concepts described in the previous section. For future empirical application, the assessment tool is also given a scale of assessment based on the multifunctional spectrum described by Wilson (2007). At this point, the theoretical conceptualisation proposed does not require detailed information regarding how each feature would be marked since it is important to develop suitable indicators empirically, which is beyond the scope of this paper. The broad characteristics of the scale are summarised in Table 1. Weak multifunctionality and productivist mode could be considered overlapping, however, the distinction is made since the Australian context requires further separation from large-scale agriculture specific of regional areas that are not fully productivist.

Table 1 The characteristics of the multifunctionality spectrum scale

Strong multifunctionality	*Moderate multifunctionality*	*Weak multifunctionality*	*Productivist mode*
• High level of complexity and innovative business models with varying degrees of diversification or specialisation	• Aspects of environmental protection are included into production	• Conventional farming systems with few links between environment, social capacity and economic prospect	• Industrial farming system focused on monocultures and high specialisation
• Focus on improving income and employment	• Focus on farm viability in the short term with several diversification or specialisation strategies	• Focus on capital building	• Focus on shareholder satisfaction
• Activities embedded in local and regional context	• Activities reflecting market fluctuations	• Activities reflecting the commodity market	• Environmentally degrading practices with negative socio-cultural outcomes
• Short supply chains and less intermediate processing	• Regional and national supply chains with connections to local food markets	• Part of conventional, corporate-driven sup[ply chains	• Serving the global food market, often managed by foreign investment
• Highest control over final prices	• Some control over final prices	• Low control over final prices	• Driven by corporate involvement and investment
• Changes in mental concepts of ‘agriculture’ and ‘farming’	• Awareness about novel practices and activities, including experimentation	• Corporate and mechanistic concepts of ‘agriculture’	• Strongly positioned to alter nature and operate agriculture as industry

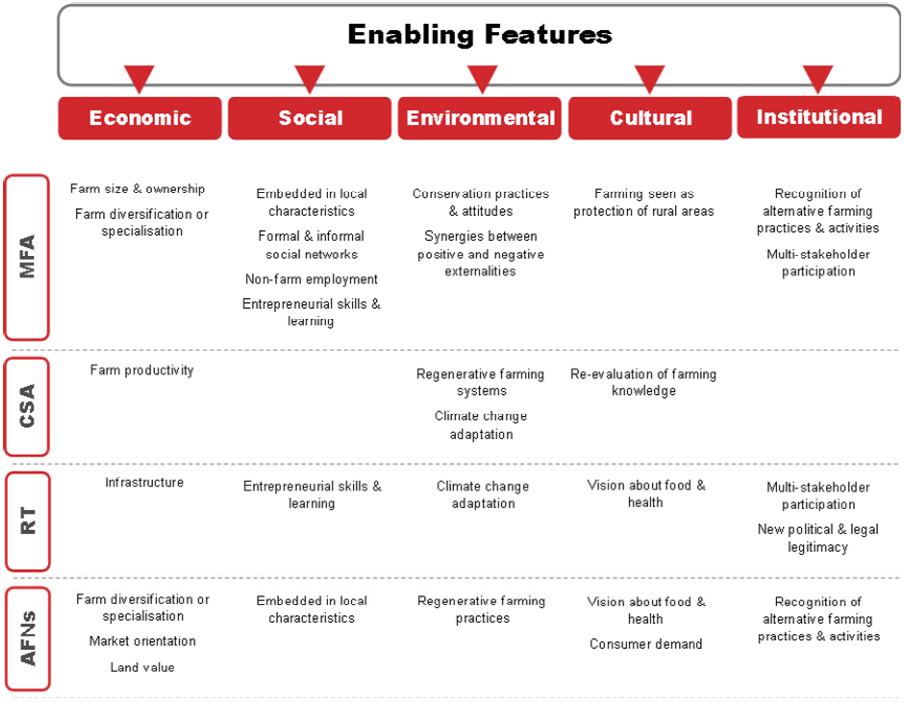
Source: Holmes (2008) and Wilson (2007)

Table 1 The characteristics of the multifunctionality spectrum scale (continued)

Strong multifunctionality	*Moderate multifunctionality*	*Weak multifunctionality*	*Productivist mode*
• Limited connectivity with the global capitalistic market	• Embedded in conventional supply and distribution systems with opportunities for direct marketing	• Embedded in globalist capitalist market with few links to regional and local context	• Highly dependent on the bio-economy and technology with little focus on socio-economic aspects
• Institutional support and opportunities for diversification and collaboration	• Interest for agricultural support from institutions through various initiatives and programs targeting environmental and economic outcomes	• Top-down technology-driven innovation with support from institutions for large-scale farming	• Institutional and research support for large-scale agriculture and corporate-driven research and development
• Agriculture supported by multiple peri-urban actors fostering a coherent vision of food and health	• Several links between social, cultural and economic dimensions	• Practices of surplus production, commercialisation, economies of scale	• Lacking support from local actors

Source: Holmes (2008) and Wilson (2007)

Figure 2 Dimensions and enabling features informing the assessment tool (see online version for colours)



Economic enabling features relate to increased small-scale farming economic viability while supporting the transition towards a resilient agricultural sector. Social enabling features relate to facilitating the expression and uptake of diversified farming systems with relevance for the local community and economy. Environmental enabling features relate to agricultural practices in line with sustainable and circular resource use and consideration of the environment, animals, and people. Cultural enabling features relate to the recognition of the role of peri-urban farms in maintaining traditions and the landscape. Institutional enabling features relate to support, leadership, and promotion of local agriculture through policy with long-term strategies for peri-urban transformation (Figure 2).

3.1 Economic enabling features

Farm production and broader market and infrastructure characteristics seek to balance high land competition in the peri-urban context while supporting the transition toward strong multifunctionality. The defining features are *farm size* (understood as the value of sales) and *ownership* (family farm, multi-stakeholder, and corporate-managed), *farm strategies of diversification or specialisation*, *farm productivity*, *infrastructure* (transport, utilities, internet, education resources), *market orientation*, and *land value*.

Farm size and ownership represent the transitional speed rather than potential (Wilson, 2007). Their financial and decision-making structure influences whether the farmer can set aside land for conservation, invest in technology, employ more people, diversify production, or incorporate NCO. It is expected that larger-scale family-owned farms are better equipped to become multifunctional. However, smaller-scale peri-urban farms have multiple opportunities to transition to strong multifunctionality through the prevailing milieu of enhanced niche markets, consumer potential, and landscape value (Gallent et al., 2006). To successfully diversify or specialise, farmers must be prepared to make specific investments in certification, advertising or operation to reach potential consumers. The motivation to transition often relates to the capacity of the farmer to manage the complexity of diversified systems and it is not purely an environmental motivation (van der Ploeg et al., 2009).

The compounded decisions influence farm productivity and the various production systems that can be employed. Strategies that respond to managing uncertain conditions at different temporal scales (seasonal, market or weather conditions) and spatial scales (farm, landscape, regional/national level) are connected with larger environmental, ethical, cultural, and social motivations and needs (Greiner et al., 2009; Kragt et al., 2017). Thus, PUA becomes ideal for testing multifunctional objectives. Moreover, urban areas offer a diverse consumer base with different levels of preferences and disposable income that encourage small-scale peri-urban farmers and other actors to create new niches, enlarge existing niches, or create new business models. The ‘shortness’ between producers and consumers transmits particular information about the products that create specific relationships of trust, value, meaning, and desirability (Marsden et al., 2000; Zoll et al., 2018). Peri-urban areas also benefit from connectivity, community services, and resource access that offer peri-urban farmers the possibility to adopt different practices, diversify their farm activities or incorporate NCO while grounding AFNs. It is likely that novel resources, such as recycled irrigation water, will play an important role in securing the resilience of PUA and should be viewed as a means of supporting agriculture in the future.

The vision of a productive and economically viable agricultural landscape on the fringe has to consider the impact of land value on the willingness and ability of farmers to continue farming. There is no denying that high land value prompts farmers to sell to developers and finance their retirement, thus reducing incentives to engage in agricultural activity. The attractiveness to convert to other land uses, particularly residential, is high compared with other land uses and in the absence of governmental leadership, land fragmentation is likely to continue (Cavailhès and Wavresky, 2003). PUA has a unique multifunctional potential due to proximity to urban centres, opportunities to sell to various markets and potential to expand into social farming (providing services for people with disabilities, mental illnesses, and the elderly) or recreational and educational activities (Rogge et al., 2016). Through AFNs, the value of agricultural land can be re-evaluated based on economic viability, environmental enhancement, and landscape preservation, which are rarely considered in neoclassical economics (Baldi et al., 2019). The inherent ability of peri-urban farmers to respond to change and manage their economic viability through a wide range of interventions (Buxton and Butt, 2019) has also been evident during the pandemic. Building on this inherent economic resilience of peri-urban farms is a crucial aim of the assessment tool. Agriculture is one of the most relational economic activity and PUA can further capitalise on the next competitive frontier of shared value, where local food systems that supply cities are increasingly seen as an alternative to global food networks (Paluszak and Paluszak, 2021; Porter and Kramer, 2019).

3.2 Social enabling features

Stimulating and improving PUA is achieved through aligning production with skills, knowledge building capacity, and affirmation of local opportunities and potential. Social enabling features are *embedded in local characteristics*, *formal and informal social networks*, *non-farm employment*, and *entrepreneurial skills and learning*.

Embeddedness, in the sense of social connections, reciprocity, and trust between actors of the AFNs, forms strong local agricultural markets and enables multifunctionality (Hinrichs, 2000). Horizontally integrated farming communities have a positive contribution to social cohesion and reflect the community's needs while contributing to farm income and employment (van der Ploeg and Renting, 2000). Discourses and trends relating to AFNs emerge from cultural, historical, and political processes and in peri-urban areas are tied to the value of eating fresh, local foods, and the agro-political agenda (Jarosz, 2008). To achieve a greater level of embeddedness, collaborative rather than competitive values should permeate the local farming community. While each actor in the PUA space has different needs to pursue, greater transparency, dissemination, and debate are needed to ensure a fair and equitable direction for future PUA development. Through formal social networks, influential stakeholders can skew decision making and leave the needs of the many unaddressed. For this reason, informal social networks can be a stronger medium for change and inspiration to adopt MFA. However, a weak market sector results in limited opportunities for creating social networks with farmers being more concerned with building their specific market channels (Sutherland et al., 2017). To create strong embeddedness, consumers also have to be engaged in this space and their values around food must be reflected and considered more broadly. Otherwise, if the sense of community is not

strong, local food systems will not last, as shown in a case study in peri-urban Reggio Emilia, Italy (Mancini et al., 2021).

Farmers are equipped to respond to short-term changes in the agricultural sector. However, a particular set of skills is needed to identify and respond to long-term changes and emerging challenges. Creating and evaluating their business strategy, networking and utilising contacts, and recognising and realising opportunities represent skills aligned with knowledge-intensive and experience-based MFA practices (Morgan et al., 2010). Ultimately, learning to adapt to change, uncertainty, and unpredictability by combining different types and sources of knowledge, appear to be critical for building resilience (Folke et al., 2003).

Last, but not least, non-farm employment opportunities play an important role in the decision to enter farming, with some farming enterprises more readily able to succeed. For example, beef and broiler farming are more compatible with off-farm work than horticulture and dairy farming (Gillespie and Mishra, 2011). The complex space of decision making in peri-urban areas is influenced by available non-farm employment since it makes part-time farming potentially more attractive (Kristensen, 2016). Non-farm employment is a viable means of creating financial resilience and acquisition of soft skills through exposure to influences outside the farm.

3.3 Environmental enabling features

The *nature as measure* principle, where land ecology is given agency in decision making regarding both intensity and capacity of agricultural landscapes to withstand use, can have an important contribution to agricultural production and health (Jackson et al., 1991). Enabling features ensure environmental functions aim to support soil productivity, resource availability, and maintain diversity. These features are *conservation practices and attitudes*, *synergies between positive and negative externalities*, *regenerative farming system*, and *climate change adaptation*.

Usually, the lack of conservation practices does not arise from a lack of knowledge but from market forces that dictate market preferences and prices (Stoorvogel et al., 2004). However, ecosystem disservices resulting from agricultural production can have high costs to humans, both locally (pollution of drinking water) and globally (climate change) (Power, 2010). Experience has shown that minimising ecosystem disservices does not come at the cost of productivity. Practices such as conservation tillage, crop diversification, legume intensification, and integrated pest management have performance rates comparable with high-input, intensive agriculture (Badgley et al., 2007). Producing according to PUA scale and resource base while reducing negative externalities enables strong multifunctionality. Productive peri-urban areas create alliances between the city and the countryside on the basis that the sustainability of the city depends on the environmental, productive and landscape quality of the surrounding peri-urban and beyond (Novelli and Giau, 2010).

An all-encompassing approach is regenerative agriculture. The goal is the production of nutritious food while improving soil quality and biodiversity by actively building soil structure and communities, encouraging and fostering plant diversity, and integrated livestock-crop systems practices (Rhodes, 2017). Currently, the costs, entrepreneurial and knowledge skills required to establish ecological infrastructure are high and limited (Nicholls et al., 2016). The challenges of addressing climate change impacts and building resilience to future extreme weather events, shifts in seasonal rain, higher temperatures

and possible diseases and pest outbreaks are the primary focus of CSA. Peri-urban areas should be viewed as significant production areas in light of reducing productive agricultural zones in regional areas in the future as shown by climate modelling (Romeijn et al., 2016; Sposito et al., 2013). It is expected that farm and landscape level adaptation practices will be more important than national adaptation policy, proving critical to building the resilience of PUA (Mandryk, 2016). Moreover, it is important to also consider the distribution side. Shocks to the transport or energy system as a result of extreme weather events or health crisis as a pandemic can greatly impact a community (Bene, 2020; FAO, 2008). As a result, focusing on producing locally and encouraging the uptake of on-farm renewables are attributes of strong multifunctionality.

3.4 Cultural enabling factors

Transcending the productivist agriculture ideology begins by dismantling socio-cultural perceptions about agriculture. Enabling features in achieving this include *farming seen as protection of rural areas*, *re-evaluation of farming knowledge*, *vision about food and health*, and *consumer demand*.

In general, a coherent vision of farming seen as 'protection of rural areas' emerges when farmers already engage in MFA activities or other forms of sustainable agricultural practices and public awareness about food quality, preservation of rural landscape, and focus on food quality, is present (Wilson, 2007). This cultural dimension takes shape once agriculture is no longer perceived as a marginal economic activity. Given particular tensions between urban and rural land uses in peri-urban areas, it is essential to foster a culture of appreciation for agricultural activity. As long as farmers have to fight to make their voices and needs heard, there will be a fragmented and reactive development of PUA. The reinvigoration of PUA communities is often based on exceptional businesses driven by determined innovators (Marques-Perez and del Río, 2016).

Moving away from productivism, farmers would continuously expand their farming knowledge and inspire new generations of farmers, while making use of their social networks to create a community of farmers, not merely competitors in the marketplace. Climate change, awareness of environmental pollution, public discourse on issues of health, limited access or use of natural resources are just a few reasons why farming knowledge should be part of the multifunctionality spectrum. This should also be supported with the right policy and education frameworks. Moreover, traditionally, the transfer of knowledge from research and technology has been passed down in a top-down fashion, farmers being given advice, often disconnected from their needs and circumstances (Rydin and Holman, 2004). Bottom-up transfer of knowledge plays a vital role in the effectiveness of both policies and broader recognition of the role of agriculture in local economic development. Agricultural production has ramifications across other realms than farmer's livelihoods and rural development, mainly wellbeing, health, equity, natural environment, and consumers' choice. Addressing farmer mental health is also at the core of cultural features since, in a productivist agricultural model, rural debt and hardship predispose farmers to higher rates of mental health issues, including suicide (Fraser et al., 2005).

A new vision of the role of agriculture arises from four intertwined aspects of food production: moving away from Fordist regime of production, push for food quality, re-evaluation of supply chains and the rise of farm-gate sales; and the importance of local food branding (Kampers and Fresco, 2017). Consumer demand is a significant driver for

change in agricultural practice. Pride is given to the place, scale, space, and relations between producer and consumer (Goodman et al., 2011). As a result, consumers place greater importance on products that are chemical-free, environmentally friendly, free-range, hormone and antibiotic-free, non-genetically modified, more nutritious, cruelty-free, and locally sourced (Lawson et al., 2017).

3.5 Institutional enabling features

Critically important for future PUA development is a public and business sector ready to experiment with and support multifunctionality. Institutional enabling features fall under three categories: *recognition of alternative farming practices and activities*, *multi-stakeholder participation*, and *new political and legal legitimacy*.

One of the roles of Local Government is to facilitate new business models and networks that underwrite trust and reciprocity. In peri-urban areas, this recognition can be highly instrumental as it will ensure the protection of farmland against urban sprawl. The peri-urban local governments need to balance opposing forces and their efforts are not always clear-cut. There is a fragmented vision, often driven by politics and top-down pressures as dictated by higher tiers of government. Thus, coordination between governmental bodies and a common vision can create a meaningful change for PUA through relationships between farming, planning strategies, legitimacy, and investment opportunities. Thus, multi-stakeholder collaboration is required, often with benefits such as internalising negative externalities, both financial and environmental, promoting economic democracy, co-producing sustainably from common natural resources for local communities, and knowledge dissemination (Gonzalez, 2017).

However, institutions are characterised by a level of inflexibility when it comes to new collaborations. Clark (2006) concludes that central institutions need to possess clarity with regards to the aim of each collaboration and roles must be clearly defined to avoid confusion. Their role has to be defined in terms of facilitators and not dictate measures. New political and legal legitimacy of contracts, agreements, and responsibilities would help to promote more institutional flexibility. As local agriculture transitions beyond production activities and towards the production of NCO, the future farmer will be characterised by different attributes. As a result, institutions need to know how to react and adjust to the role of agriculture and the farmer under broad sustainable development objectives, while ensuring the resilience and persistence of new forms of agricultural activities (Rønningen et al., 2004).

Importantly, resolving the urban-rural conflict of land management can have important implications for activating PUA. Measures such as establishing land banks for fair and rational use, minimising urban sprawl, nationalisation of land, and mandatory land acquisitions are known measures for increasing land supply. Reducing land demand can also be controlled through land price control, land tax, and land use regulation. For example, short-term land commissions have been adopted in Sydney to control house prices and land use change (Ahani and Dadashpoor, 2021).

4 The boundaries and consideration of applying the assessment framework

Agricultural production is likely to face multiple challenges in the future. The ability to build resilience lies in realising opportunities for innovation, alternative practices, and collaborations. PUA could play a significant role in addressing food security, particularly as regional areas will be impacted by climate change, more likely to suffer from the conversion of land for energy production (renewable or biofuels), land degradation, and decreasing rural population (Lawrence et al., 2013).

Firstly, the starting point for utilising the assessment framework is that economic rationale is not sufficient for responding to emerging challenges. An evaluation of socio-cultural, environmental, and institutional dimensions greatly enhances the prospect and viability of PUA. Moreover, food production will likely become central to long-term resilience and through appropriate planning, PUA can have a significant contribution to food security, healthy diets, and economic development (Gunilla and Olsson, 2018). The presence or absence of features described should be interpreted as how far PUA pushes for strong multifunctionality. For example, the absence of consumer demand despite high-value, niche production does not impede the integration of agriculture with cultural values. Policymakers and other decision-makers could view this absence as an indication of missing links and roll-out projects that address a lack of engagement from local consumers or the absence of appropriate market networks.

Secondly, the assessment framework emphasises NCO, often appreciated socially and culturally but not reflected in the price of commodities or supported by policy. The proposed hierarchy of concepts aims to re-orientate priorities that build on the strengths of the existing system, encouraging knowledge sharing, and highlighting points of intervention. The inherent multifunctional character of agriculture acts as a driver for change and introduces elements that broaden production, diversity, collaboration, and learning. These are important elements for building resilience and they increase support for PUA. The assessment framework is useful for peri-urban areas that seek to revitalise agriculture; therefore, the economic dimension is a prerequisite and cannot be substituted by other dimensions. However, the conceptualisation offers the possibility of transitioning economic reasoning towards *strong* multifunctionality. Areas that display a cultural or social appreciation for locally sourced food but lack agricultural production will have a limited multifunctional character.

Thirdly, it is crucial to maintain essential ecological services that support socio-economic systems. Changes imposed by land fragmentation, residential living encroachment and structural changes in the agricultural sector can shift PUA into a different regime that can be irreversible. Loss of agricultural land is accompanied by loss of knowledge, experimentation opportunity, heritage, and landscape value. The principal assumption of the assessment framework aligns with regenerative practices, CSA, and the re-evaluation of farming knowledge and it is considered that any future development of agriculture departs from industrial agriculture, which has proven to have multiple negative impacts (Clay, 2013). Due to the nature of ecosystem interconnectivity, interactions should be analysed well beyond the farm level and be integrated with regional natural resource management. Once agricultural production promotes and supports ecosystem services, the separation between the two is no longer necessary. Moreover, the additional element of urban ecology and urban agriculture can be reintegrated. Peri-urban areas that currently lack agricultural production, as viewed

through the rural lens, could become pockets of urban agriculture. For those areas, the assessment framework can act as a guide for required features.

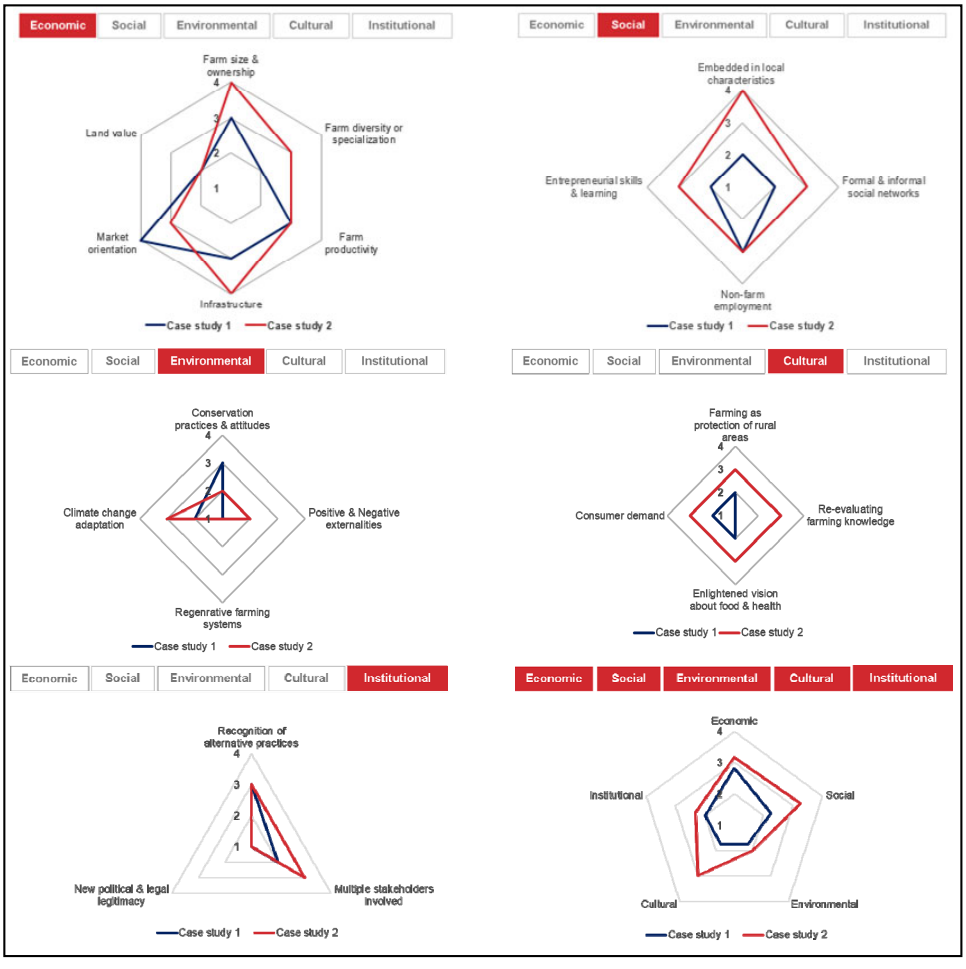
Fourthly, novel governance structures based on principles of resilience need to redefine human action and behaviour to ensure agricultural landscapes respond to change and enable sustainable use of resources. Land competition between urban and rural uses is unlikely to be solved under the current policy direction. Incorporating place-based value and new eco-economic perspectives is better suited to address this competition. The assessment framework is useful as long as it aligns with broad development directions of agricultural resilience and urban containment. On the issue of policy, peri-urban areas have usually been dominated by highly contested, fragmented, and rigid planning, as well as mounting political pressure to continue urbanisation that perpetuate a narrow framing of land value regarding agriculture (Buxton et al., 2016; Parsons, 2017; Willey, 2004). In an empirical assessment, case study peri-urban areas would receive a score for each dimension and an overall score. This would identify weak expressions of PUA and would offer policymakers a picture of possible intervention points (initiatives, programs, grants or policy directions to support and sponsor). As a result, the future vision for PUA should be formulated around ambitious goals, strong leadership, understanding of emerging threats, and reasonable planning horizons.

Lastly, some peri-urban areas might display a lack of opportunities for the future development of agriculture. The assessment framework does not infer bias towards protecting agriculture, rather capitalises on existing features to drive change. Ultimately, urban development might be the desirable outcome. However, in line with multifunctional landscapes, urban development or other non-agricultural land uses should consider broader sustainable outcomes and answer the main criticism that current planning lacks flexibility and vision (Hedblom et al., 2017).

In practice, the assessment framework would rank each enabling feature according to the multifunctionality spectrum and would generate an overall score (by averaging). Each enabling feature will be assessed through an indicator and will be conducted by policy-makers as part of land use decision-making analysis. The overall ranking would highlight dimensions that need further policy or market intervention while building on existing programs or initiatives in other dimensions, creating integrated actions with transformative and resilient outcomes. At the same time, the assessment framework can be used to compare different regions with various degrees of multifunctionality and learn the specifics of what elements are present to create resilient and sustainable farming systems that can be translated from one place to the other. Figure 3 indicates how the ranking helps visualise the applicability of the assessment framework (does not take into account indicators as they can only be defined on a case-by-case scenario).

The proposed broader conceptualisation is designed to build on the strengths of PUA and underline its fundamental structure and functionality while turning weaknesses into opportunities. The extensive number of features allow for detailed evaluation. The conceptual assessment tool supports a development pathway in line with ecological modernisation, complex adaptive systems, small-scale family-based farming, and polycentric governance.

Figure 3 Hypothetical ranking exemplifying the applicability of the assessment tool in comparative empirical studies (see online version for colours)



Note: The bottom right corner graph represents the overall rank of each dimension.

5 Conclusions

The challenges of future food production require a critical evaluation of the role and value of PUA to food security, farm economic viability, landscape preservation, and socio-cultural significance. The conceptualisation proposed represents the starting point to fostering broader changes to practices and policy in peri-urban areas. Encompassing 21 enabling features, the assessment framework considers a wide range of aspects that have transformational potential and it is based on four highly directional and established concepts. It proposes a re-orientation of priorities and realising agricultural economic benefits by incorporating sound ecological principles. Less tangible roles of PUA are also captured by integrating aspects of farming knowledge, networks, branding, and stewardship. We argue that it is imperative to redefine the role of peri-urban farming in

relation to food security while exploring opportunities to improve the carbon, water, and nutrients cycles, farm diversification, and connect food production with local food networks. The conceptual assessment framework is intended to start guiding policymakers in how to implement specific PUA pathway development analysis. Peri-urban areas relevant for assessment need to an agricultural profile and display a high urban pressure that has not dislocated farming completely.

Some of the limitations of this conceptualisation lie in data availability for defining indicators (proxies might need to be used), possible duplication where features overlap, insufficient flexibility from a policy perspective (particularly concerning multiple tiers of government), and lack of multi-stakeholder engagement. We suggest that the next step of research builds on this conceptualisation by selecting a case study and formulating relevant indicators based on set objectives. The ranking is a useful methodology as it allows decision-makers to easily allocate values based on expert judgements and data.

References

Ahani, S. and Dadashpoor, H. (2021) 'Land conflict management measures in peri-urban areas: a meta-synthesis review', *Journal of Environmental Planning and Management*, Vol. 64, No. 11, pp.1909–39.

Albrechts, L. (2004) 'Strategic (spatial) planning reexamined', *Environment and Planning B: Planning and Design*, Vol. 31, No. 5, pp.743–58.

Badgley, C., Moghtader, J., Quintero, E., Zakem, E., Chappell, M., Aviles-Vazquez, K., Samulon, A. and Perfecto, I. (2007) 'Organic agriculture and the global food supply', *Renew. Agric. Food Syst.*, Vol. 22, No. 2, pp.86–108.

Baldi, L., Bertoni, D., Migliore, G. and Peri, M. (2019) 'How alternative food networks work in a metropolitan area? An analysis of solidarity purchase groups in Northern Italy', *Agricultural and Food Economics*, Vol. 7, No. 20.

Bene, C. (2020) 'Resilience of local food systems and links to food security – a review of some important concepts in the context of COVID-19 and other shocks', *Food Security*, Vol. 12, No. 4, pp.805–22.

Biggs, R., Schlüter, M. and Schoon, M.L. (2015) *Principles for Building Resilience: Sustaining Ecosystem Services in Social-Ecological Systems*, Cambridge University Press, Cambridge.

Brand, S. (1999) *The Clock of the Long Now: Time and Responsibility*, Basic Books, Phoenix.

Brand, S. (2018) 'Pace layering: how complex systems learn and keep learning', *Journal of Design and Science*, MIT Press, https://jods.mitpress.mit.edu/pub/issue3-brand/release/2 (accessed 17 January 2020).

Brinkley, C. (2012) 'Evaluating the benefits of peri-urban agriculture', *Journal of Planning Literature*, Vol. 27, No. 3, pp.259–69.

Butt, A. (2013) 'Exploring peri-urbanisation and agricultural systems in the Melbourne region', *Geographical Research*, Vol. 51, No. 2, pp.204–18.

Buxton, M. and Butt, A. (2019) *The Future of the Fringe: The Crisis in Peri-Urban Planning*, CSIRO Publishing, Melbourne.

Buxton, M., Carey, R. and Phelan, K. (2016) 'The role of peri-urban land use planning in resilient urban agriculture: a case study of Melbourne, Australia', in Maheshwari, B., Vijay, P.S. and Thoradeniya, B. (Eds.): *Balanced Urban Development: Options and Strategies for Liveable Cities, Springer Open*, pp.153–170, Water Science and Technology Library, Springer Open, Switzerland.

Campbell, A. (2009) *Paddock to Plate: Policy Propositions for Sustaining Food and Farming Systems*, Australian Conservation Foundation, The Future Food and Farm Project Propositions Paper, Melbourne.

Campbell, B.M., Thornton, P., Zougmoré, R., Asten, P. and Lipper, L. (2014) 'Sustainable intensification: what is its role in climate smart agriculture?', *Current Opinion in Environmental Sustainability*, Vol. 8, pp.39–43.

Carey, R., Larsen, K., Sheridan, J. and Candy, S. (2016) *Melbourne's Food Future: Planning A Resilient City Foodbowl*, The University of Melbourne [online] http://www.ecoinnovationlab.com/ (accessed 23 November 2019).

Cavailhès, J. and Wavresky, P. (2003) 'Urban influences on periurban farmland prices', *European Review of Agricultural Economics*, Vol. 3, No. 3, pp.333–57.

Clark, J. (2006) 'The institutional limits to multifunctional agriculture: subnational governance and regional systems of innovations', *Environment and Planning C: Government and Policy*, Vol. 24, No. 3, pp.331–49.

Clay, J. (2013) *World Agriculture and The Environment: A Commodity-By-Commodity Guide to Impacts and Practices*, Island Press, Washington, USA.

Clay, L. (2020) 'Planners say pandemic shows farmland on city fringes is crucial', *The Age* [online] https://www.theage.com.au/politics/victoria/planners-say-pandemic-shows-farmland-on-city-fringes-is-crucial-20200505-p54pxs.html (accessed 3 February 2021).

Department of Environment, Water and Planning (2019) *Protecting and Supporting Melbourne's Strategic Agricultural Land*, by DELWP, Capire Consulting, Melbourne.

Eweg, R. (2014) 'Towards sustainable metropolitan agriculture', in Roggema, R. and Keeffe, G. (Eds.): *Why We Need Small Cows, Ways to Design for Urban Agriculture*, pp.295–309, VHL University of Applied Sciences, Velp.

Fagioli, F.F., Rocchi, L., Paolotti, L., Słowiński, R. and Boggia, A. (2017) 'From the farm to the agri-food system: a multiple criteria framework to evaluate extended multi-functional value', *Ecological Indicators*, Vol. 79, pp.91–102.

FAO (1999) 'Cultivating our futures: the multifunctional character of agriculture and land', paper presented to *FAO/Netherlands Conference*, Maastricht, The Netherlands, 12–17 September [online] http://www.fao.org/docrep/x2777e/X2777E00.htm#TopOfPage (accessed 6 September 2020).

FAO (2008) *Climate Change and Food Security: A Framework Document*, Food and Agriculture Organization of the United Nations, Rome.

FAO (2018) *Transforming Food and Agriculture to Achieve the SDGs: 20 Interconnected Actions to Guide Decision-Makers*, Technical Reference Document, Food and Agriculture Organisation of the United Nations, Rome.

Folke, C., Colding, J. and Berkes, F. (2003) 'Synthesis: building resilience and adaptive capacity in social-ecological systems', in *Navigating Social-Ecological Systems: Building Resilience for Complexity and Change*, pp.352–87, Cambridge University Press, Cambridge, UK.

Fraser, C.E., Smith, K.B., Judd, F., Humphreys, J.S., Fragar, L.J. and Henderson, A. (2005) 'Farming and mental health problems and mental illness', *International Journal of Social Psychiatry*, Vol. 51, No. 4, pp.340–9.

Gallent, N., Bianconi, M. and Andersson, J. (2006) 'Planning on the edge: England's rural – urban fringe and the spatial-planning agenda', *Environment and Planning B: Planning and Design*, Vol. 33, No. 3, pp.457–476.

Gillespie, J. and Mishra, A. (2011) 'Off-farm employment and reasons for entering farming as determinants of production enterprise selection in US agriculture', *The Australian Journal of Agricultural and Resource Economics*, Vol. 55, No. 3, pp.411–28.

Godfray, H.C.J., Beddington, J.R., Crute, I.R., Haddad, L., Lawrence, D., Muir, J.F., Pretty, J.N., Robinson, S., Thomas, S.M. and Toulmin, C. (2010) 'Food security: the challenge of feeding 9 billion people', *Science*, Vol. 327, No. 5967, pp.812–8.

Gonzalez, R.A. (2017) 'Going back to go forwards? From multi-stakeholder cooperatives to open cooperatives in food and farming', *Journal of Rural Studies*, Vol. 53, pp.278–90.

Goodman, D., DuPuis, E.M. and Goodman, M.K. (2011) *Alternative Food Networks: Knowledge, Place and Politics*, Routledge, New York, 0415671469.

Greiner, R., Patterson, L. and Miller, O. (2009) 'Motivations, risk perceptions and adoption of conservation practices by farmers', *Agricultural Systems*, Vol. 99, Nos. 2–3, pp.86–104.

Gunilla, E. and Olsson, A. (2018) 'Peri-urban food production as means towards urban food security and increased urban resilience', in *Routledge Handbook of Landscape and Food*, pp.197–212, Routledge.

Hazell, P. and Wood, S. (2008) 'Drivers of change in global agriculture', *Philosophical Transactions of the Royal Society of London, Series B, Biological Sciences*, Vol. 363, No. 1491, pp.495–515.

Hedblom, M., Andersson, E. and Borgström, S. (2017) 'Flexible land-use and undefined governance: from threats to potentials in peri-urban landscape planning', *Land Use Policy*, Vol. 63, pp.523–527.

Hinrichs, C.C. (2000) 'Embeddedness and local food systems: notes on two types of direct agricultural market', *Journal of Rural Studies*, Vol. 16, No. 3, pp.295–303.

Holling, C.S. (1973) 'Resilience and stability of ecological systems', *Annual Review of Ecology and Systematics*, Vol. 4, pp.1–23.

Holmes, J. (2006) 'Impulses towards a multifunctional transition in rural Australia: gaps in the research agenda', *Journal of Rural Studies*, Vol. 22, No. 2, pp.142–60.

Holmes, J. (2008) 'Impulses towards a multifunctional transition in rural Australia: interpreting regional dynamics in landscapes, lifestyles and livelihoods', *Landscape Research*, Vol. 33, No. 2, pp.211–23.

Ilbery, B.W. and Bowler, I. (1998) 'From agricultural productivism to post-productivism', in Ilbery, B. (Ed.): *The Geography of Rural Change*, pp.57–87, Longman, London.

Ives, C.D. and Kendal, D. (2013) 'Values and attitudes of the urban public towards peri-urban agricultural land', *Land Use Policy*, Vol. 34, pp.80–90.

Jackson, W., Bormann, F. and Kellert, S. (1991) 'Nature as the measure for a sustainable agriculture', in *Ecology, Economics, Ethics: The Broken Circle*, pp.43–58, Yale University Press, New Haven, CT, USA.

Jarosz, L. (2008) 'The city in the country: growing alternative food networks in Metropolitan areas', *Journal of Rural Studies*, Vol. 24, No. 3, pp.231–44.

Kampers, F.W.H. and Fresco, L.O. (2017) *Food Transitions 2030*, Wageningen University & Research, Wageningen.

Klerkx, L., van Mierlo, B. and Leeuwis, C. (2012) 'Evolution of systems approaches to agricultural innovation: concepts, analysis and interventions', in Darnhofer, G.D.I. and Dedieu, B. (Eds.): *Farming Systems Research into the 21st Century: The New Dynamic*, Springer, Dordrecht.

Kragt, M.E., Dumbrell, N.P. and Blackmore, L. (2017) 'Motivations and barriers for Western Australian broad-acre farmers to adopt carbon farming', *Environmental Science & Policy*, Vol. 73, pp.115–23.

Kristensen, S.B.P. (2016) 'Agriculture and landscape interaction-landowners' decision-making and drivers of land use change in rural Europe', *Land Use Policy*, Vol. 57, pp.759–63.

Lawrence, D., Richards, C. and Burch, D. (2013) 'The impacts of climate change on australia's food production and export', in Farmar-Bowers, Q., Higgins, V. and Millar, J. (Eds.): *Food Security in Australia: Challenges and Prospects for the Future*, pp.173–186, Springer, USA.

Lawson, A., Cosby, A., Bez, N. and Williams, J. (2017) *Australian Organic – Market Report 2017*, Australian Organic Ltd, Nundah, Queensland, Australia.

Le Velly, R. and Moraine, M. (2020) 'Agencing an innovative territorial trade scheme between crop and livestock farming: the contributions of the sociology of market agencements to alternative agri-food network analysis', *Agriculture and Human Values*, Vol. 37, No. 4, pp.1–14.

Leakey, R. (2017) *Multifunctional Agriculture – Achieving Sustainable Development in Africa*, Elsevier Science, London, UK.

Mancini, M.C., Arfini, F., Antonioli, F. and Guareschi, M. (2021) 'Alternative agri-food systems under a market agencements approach: the case of multifunctional farming activity in a peri-urban area', *Environments*, Vol. 8, No. 7, p.61.

Mandryk, M. (2016) *Integrated Assessment of Farm Level Adaptation to Climate Change in Agriculture: An Application to Flevoland, The Netherlands*, Doctor of Philosophy thesis, Wageningen University, Wageningen.

Marques-Perez, I. and del Río, B.S.G. (2016) 'Identifying functionality of peri-urban agricultural systems: a case study', in Samer, M. (Ed.): *Urban Agriculture*, pp.61–88, InTech, London, UK.

Marsden, T.K. (2003) *The Condition of Rural Sustainability*, Royal van Gorcum, Assen., Netherlands.

Marsden, T.K., Banks, J. and Bristow, G. (2000) 'Food supply chain approaches: exploring their role in rural development', *Sociologia Ruralis*, Vol. 40, No. 4, pp.424–38.

McGregor, D., Simon, D. and Thompson, D. (2006) *The Peri-Urban Interface: Approaches to Sustainable Natural and Human Resource Use*, Earthscan, London, New York.

Moon, W. (2012) *Conceptualizing Multifunctional Agriculture from a Global Perspective*, Southern Agricultural Economics Association Annual Meeting, Birmingham, AL.

Morgan, S.L., Marsden, T.K., Miele, M. and Morley, A. (2010) 'Agricultural multifunctionality and farmer's entrepreneurial skills: a study of Tuscan and Welsh farmers', *Journal of Rural Studies*, Vol. 26, No. 2, pp.116–29.

Murdoch, J., Marsden, T.K. and Banks, J. (2000) 'Quality, nature, and embeddedness: some theoretical considerations in the context of the food sector*', *Economic Geography*, Vol. 76, No. 2, pp.107–25.

Neufeldt, H., Jahn, M., Campbell, B.M., Beddington, J.R., DeClerck, F., De Pinto, A., Gulledge, J., Hellin, J., Herrero, M., Jarvis, A., LeZaks, D., Meinke, H., Rosenstock, T., Scholes, M., Scholes, R., Vermeulen, S., Wollenberg, E. and Zougmoré, R. (2013) 'Beyond climate-smart agriculture: toward safe operating spaces for global food systems', *Agriculture & Food Security*, Vol. 2, No. 12.

Nicholls, C.I., Altieri, M.A. and Vazquez, L. (2016) 'Agroecology: principles for the conversion and redesign of farming systems', *Journal of Ecosystem and Ecography*, Vol. S5, No. 1.

Novelli, S. and Giau, B. (2010) 'Conservation, enhancement and promotion of the greenbelt land around Asti: a peri-urban Agricultural Park', in Galli, M., Lardon, S., Marraccini, E. and Bonari, E. (Eds.): *Agricultural Management in Peri-Urban Areas – The Experience of An International Workshop*, pp.57–68, Felice Editore, Chezzano (PI).

Olsson, E.G.A., Kerselaers, E., Søderkvist, K.L., Primdahl, J., Rogge, E. and Wästfelt, A. (2016) 'Peri-urban food production and its relation to urban resilience', *Sustainability*, Vol. 8, No. 12, p.1340.

Opitz, I., Berges, R., Piorr, A. and Krikser, T. (2016) 'Contributing to food security in urban areas: differences between urban agriculture and peri-urban agriculture in the Global North', *Agriculture and Human Values*, Vol. 33, No. 2, pp.341–58.

Paluszak, J.W. and Paluszak, G. (2021) 'The urban and peri-urban farms (UPFs) relational model: the case of greater Poland Voivodeship, Poland', *Agriculture*, Vol. 11, No. 5, p.421.

Parsons, S. (2017) *Land Value and the Value of Land: Understanding the Determinants of Land Use Transition in Melbourne's Peri-Urban Region*, Doctor of Philosophy (PhD) thesis, RMIT University, Melbourne.

Paül, V. and McKenzie, F.H. (2013) 'Peri-urban farmland conservation and development of alternative food networks: insights from a case-study area in metropolitan Barcelona (Catalonia, Spain)', *Land Use Policy*, Vol. 30, No. 1, pp.94–105.

Paul, V. and Tonts, M. (2005) 'Containing urban sprawl: trends in land use and spatial planning in the metropolitan region of Barcelona', *Journal of Environmental Planning and Management*, Vol. 48, No. 1, pp.7–35.

Porter, M.E. and Kramer, M.R. (2019) 'Creating shared value', in Lenssen, G.G. and Smith, N.C. (Eds.): *Managing Sustainable Business*, pp.323–46, Springer, Berlin/Heidelberg, Germany.

Potter, R.R., Binns, T., Elliott, J.A. and Smith, D. (2008) 'Conceptualising development: meanings of development', in Potter, T.B.R.B., Elliott, J.A. and Smith, D. (Ed.): *Geographies of Development: An Introduction to Development Studies*, Pearson Education Limited, Harlow, England.

Power, A.G. (2010) 'Ecosystem services and agriculture: tradeoffs and synergies', *Philosophical Transanctions of the Royal Society B*, Vol. 365, No. 1554, pp.2959–71.

Renting, H., Oostindie, H., Laurent, C., Brunori, G., Rossi, A., Charollais, M., Barjolle, D., Prestegard, S., Jervell, A., Granberg, L. and Heinonen, M. (2005) *Multifunctionality of Activities, Plurality of Identities and New Institutional Arrangements*, Synthesis report (final report), Multagri Project., FRA.

Rhodes, C.J. (2017) 'The imperative for regenerative agriculture', *Science Progress*, Vol. 100, No. 1, pp.80–129.

Rickards, L. and Howden, S.M. (2012) 'Transformational adaptation: agriculture and climate change', *Crop & Pasture Science*, Vol. 63, No. 3, pp.240–50.

Rogge, E., Kerselaers, E. and Prové, C. (2016) 'Envisioning opportunities for agriculture in peri-urban areas', in *Research in Rural Sociology and Development*, Vol. 23, pp.161–89, Emerald Group Publishing Limited, Metropolitan Ruralities, UK.

Rojo, M.S., Moratalla, A.Z., Alonso, N.M. and Jimenez, V.H. (2014) 'Pathways towards the integration of periurban agrarian ecosystems into the spatial planning system', *Ecological Processes*, Vol. 3, No. 13.

Romeijn, H., Faggian, R., Diogo, V. and Sposito, V.A. (2016) 'Evaluation of deterministic and complex analytical hierarchy process methods for agricultural land suitability analysis in a changing climate', *International Journal of Geo-Information*, Vol. 5, No. 6, p.99.

Rønningen, K., Flø, B. and Fjeldavli, E. (2004) *The Legitimacy of a Multifunctional Agriculture*, Centre for Rural Research Norwegian University of Science and Technology, World Congress of Rural Sociology, Paper No 6/04, Norway.

Rydin, Y. and Holman, N. (2004) 'Re-evaluating the contribution of social capital in achieving sustainable development', *The International Journal of Justice and Sustainability*, Vol. 9, No. 2, pp.117–33.

Salvati, L. (2016) 'Neither urban nor rural: urban growth, economic functions and the use of land in the Mediterranean fringe', *Research in Rural Sociology and Development*, Vol. 23, pp.19–37, UK.

Sayer, A. (2001) 'For a critical cultural political economy', *Antipode*, Vol. 33, No. 4, pp.687–708.

Song, B., Robinson, G.M. and Bardsley, D.K. (2020) 'Measuring multifunctional agricultural landscapes', *Land*, Vol. 9, No. 8, p.260.

Sposito, V.A., Faggian, R., Romeijn, H. and Downey, M. (2013) 'Expert systems modeling for assessing climate change impacts and adaptation in agricultural systems at regional level', *Open Journal of Applied Sciences*, Vol. 3, No. 6, pp.369–80.

Stoorvogel, J.J., Antle, J.M., Crissman, C.C. and Bowen, W. (2004) 'The tradeoff analysis model: integrated bio-physical and economic modeling of agricultural production systems', *Agricultural Systems*, Vol. 80, No. 1, pp.43–66.

Sutherland, L-A., Madureira, L., Dirimanova, V., Bogusz, M., Kania, J., Vinohradnik, K., Creaney, R., Duckett, D., Koehnen, T. and Knierim, A. (2017) 'New knowledge networks of small-scale farmers in Europe's periphery', *Land Use Policy*, Vol. 63, pp.428–39.

Thebo, A.L., Drechsel, P. and Lambin, E.F. (2014) 'Global assessment of urban and peri-urban agriculture: irrigated and rainfed croplands', *Environmental Research Letters*, Vol. 9, No. 11, p.114002.

Thevenot, L. (1998) 'Innovating in 'qualified' markets: quality, norms and conventions', paper presented to *Systems and Trajectories of Innovation Conference*, Institute of International Studies, University of California, Berkeley.

van der Ploeg, J.D. and Renting, H. (2000) 'Impact and potential: a comparative review of European development practices', *Sociologia Ruralis*, Vol. 40, No. 4, pp.529–543.

van der Ploeg, J.D., Laurent, C., Blondeau, F. and Bonnafous, P. (2009) 'Farm diversity, classification schemes and multifunctionality', *Journal of Environmental Management*, Vol. 90, Supplement 2, pp.S124–S31.

van der Ploeg, J.D., Long, A. and Banks, J. (2002) *Living Countrysides: Rural Development Processes in Europe: The State of the Art*, Elsevier, Amsterdam.

Whatmore, S. and Clark, N. (2006) 'Good food: ethical consumption and global change', in Clark, M.D. and Sarre, N.P. (Eds.): *A World in the Making*, pp.363–412, The Open University, Milton Keynes.

Wilhelm, J.A. and Smith, R.G. (2018) 'Ecosystem services and land sparing potential of urban and peri-urban agriculture: a review', *Renewable Agriculture and Food Systems*, Vol. 33, No. 5, pp.481–94.

Willey, S. (2004) 'The merits of merit-based planning appeals: observations from Australia', *International Planning Studies*, Vol. 9, No. 4, pp.261–81.

Wilson, G.A. (2007) *Multifunctional Agriculture: A Transition Theory Perspective*, CABI, Wallingford.

Wilson, G.A. (2008) 'From weak to strong multifunctionality: conceptualising farm-level multifunctional transitional pathways', *Journal of Rural Studies*, Vol. 24, No. 3, pp.367–83.

Wynne, L., Ruoso, L-E., Cordell, D. and Jacobs, B. (2020) ''Locationally disadvantaged': planning governmentalities and peri-urban agricultural futures', *Australian Geographer*, Vol. 51, No. 3, pp.377–97.

Zasada, I. (2012) *Peri-Urban Agriculture and Multifunctionality: Urban Influence, Farm Adaptation Behaviour and Development Perspectives*, Doctoral Dissertation thesis, Technische Universit, Munchen.

Zoll, F., Specht, K., Opitz, I., Siebert, R., Piorr, A. and Zasada, I. (2018) 'Individual choice or collective action? Exploring consumer motives for participating in alternative food networks', *International Journal of Consumer Studies*, Vol. 42, No. 1, pp.101–10.