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What does it mean for urban life to see livestock grazing in post-industrial American cities?

Tithi Sanyal,[1,*] Geoffrey Thün[2]

[1] University of Virginia, Charlottesville, VA, USA
[2] University of Michigan, Ann Arbor, MI, USA
* Correspondence: tithi@virginia.edu

Guest Editors: Fabian Neuhaus and Natalie Robertson, University of Calgary, School of Architecture, Planning and Landscape, Calgary, AB, Canada

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Abstract

Until the nineteenth century, American urban dwellers cohabited with livestock and cities formed ecologically diverse spaces. In the late nineteenth century, a series of urban livestock policies coupled with industrial agricultural transformations displaced livestock to urban fringes and rural areas. These developments radically altered human–animal relationships in the urban context, limited economic opportunity and over time have shaped contemporary issues of food access and food justice within cities. Post-industrial cities in the United States, such as Detroit, are characterised by patterns of urban shrinkage and high levels of vacancy. Within this context, urban farming has emerged as a framework and movement to stabilise communities, address local food access and leverage vacancy towards new models of occupation. In 2013, the City of Detroit Urban Agricultural Ordinance was passed to formalise decades of community-driven urban agricultural practices. The ordinance provides guidelines for urban farms and gardens

and for managing allied resources. Deliberation on urban agriculture and livestock ordinances continues today. While existing policies provide a framework for food-based development of neighbourhoods, they remain focused on the incremental scale of existing single-family housing and adjacent vacant plots versus larger assemblages that may participate in the production of new urban collectives and assemblages. Detroit's current context presents opportunities to scale operations via new urban design typologies and socially integrated models that leverage vacancy to construct alternate, collective models of urban life. A speculative urban design proposition for Riverbend Farming Cooperative is presented and proposes a courtyard-based cooperative farming development incorporating permaculture and animal husbandry within a formerly residential superblock as an alternative model of urban development. Through this design speculation, the article reflects upon the social, economic and ecological potentials for cohabiting with livestock and illustrates opportunities and challenges for new models of community development balancing social, environmental and economic interests through new models of agri-urbanism.

Keywords: Urban farming; agri-urbanism; animal husbandry; livestock; FEW Nexus, deindustrialisation; food-based futures; cooperative farming; post-industrial city, Detroit, USA

Introduction

Since the early 1900s, urban dwellers' relationships with domesticated animals and food-supply chains have been externalised to rural America by a range of forces. This externalisation has been shaped by industrialised food production, widespread adoption of synthetic fertilisers and the growing demand for food in cities due to increasing densification.[1] It has also paralleled a shift in how we define the urban and cities as 'human settlement[s] whose inhabitants cannot produce, within the city limits, all of the food that they need for keeping them alive'.[2] Kameshwari Pothukuchi states that the connotation of the term 'urban' in early-twentieth-century texts has been associated with 'non-agricultural' characteristics. Unlike 'housing, health, pollution, jobs, and crime', food has not been conceived of as a critical urban issue and an essential system.[3] This clear separation between the urban and the agricultural has previously been suspended in the context of crises. During the economic depression of 1893 and again during the Second World War, the United States government encouraged backyard farming to offset externalised demand.[4] Current urban crises might again warrant a reconsideration of agricultural activity as an essential dimension of more just cities. Increasingly, advocacy for urban and peri-urban farming practices is amplified by growing concerns over food sovereignty, the environmental footprint of food production and supply chains, inequitable access to healthy food, unhealthy diets and disparities illuminated through the lenses of social and racial justice.[5] This confluence of pressures is perhaps most pronounced in shrinking post-industrial cities like Detroit, Michigan.[6] In Detroit, issues of food access and food justice stem from the city's historical legacies of deindustrialisation, racial segregation, vacancy and economic recession.[7]

Today, the city of Detroit is home to approximately 52 km^2 of vacant land held by the Detroit Land Bank Authority (DLBA). The DLBA provides a powerful municipal lever in shaping the future city relative to the market forces of development. Lands held by the DLBA are assembled for potential release to development interests, a practice that provides the city with the ability to shape future development in ways outside contemporary development practices. In this context, opportunities for urban design, planning and policy development that include regenerative urban farming practices as core components of future urban development are increasingly centred on conversations about urban futures (Figure 1).[8]

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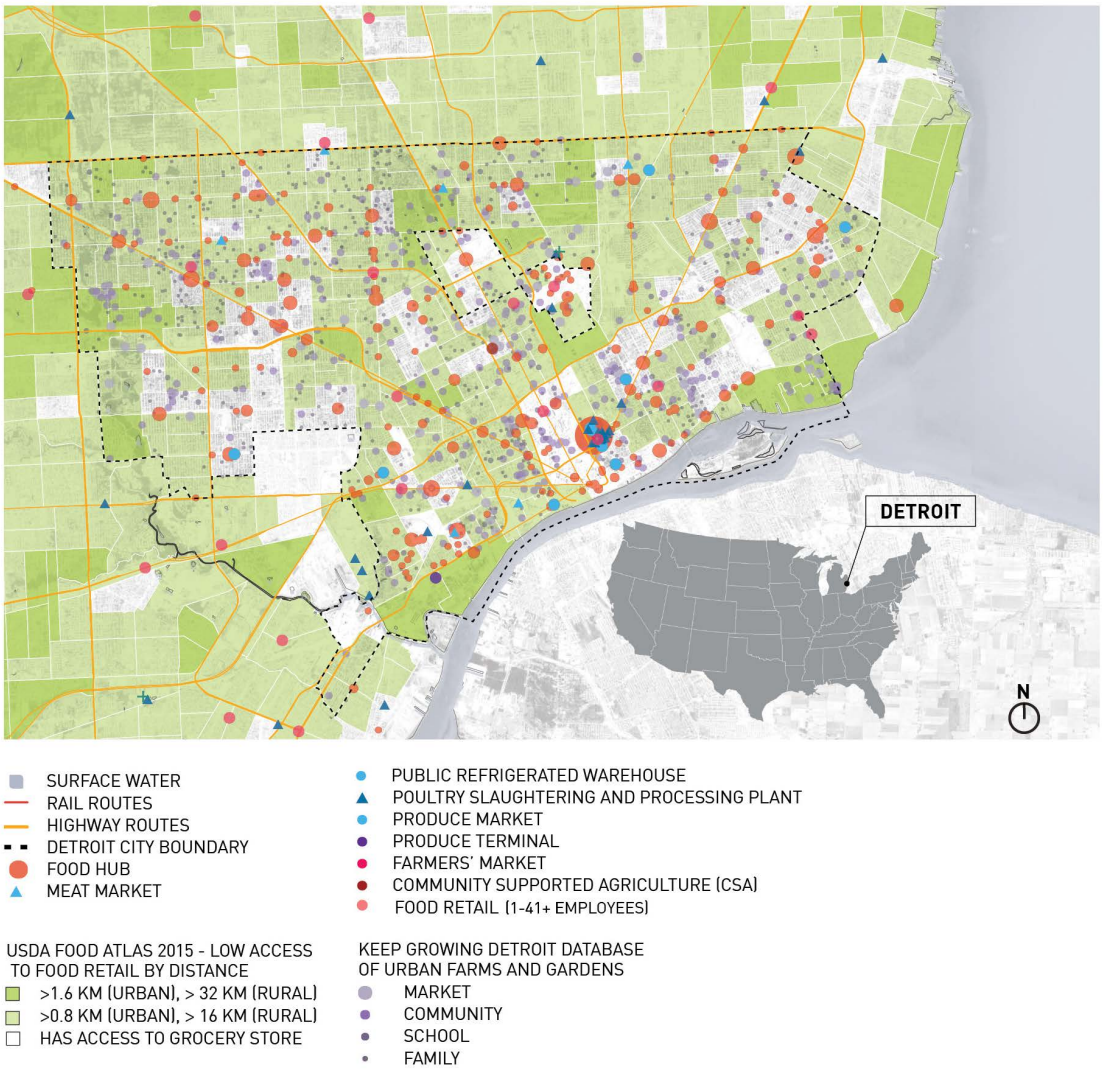
Figure 1. Detroit food access. This mapping overlays areas lacking access to healthy food (as defined by the United States Department of Agriculture [USDA]) alongside locations of a range of typologies of trusted, healthy food sources and urban farming initiatives. Inequity in physical access to healthy food sources is illuminated within the city and points to spatial locations where innovative food-based urbanism might impact on questions of access (Source © RVTR/U-M, 2021). See the section 'Figure sources' for data assembled in the map.



Within the context of active urban farming, the issue of reintroducing livestock into the city is a major point of debate between residents, some of whom resist the perceived nuisance of agrarian practices, and advocates for urban agriculture, who see significant potential in rethinking an urbanism for Detroit through the lens of cultivation and production.[9] There is a need to speculate about and design new models for food-based urban development in the city. Such efforts would address issues of food sovereignty and justice, embedding these principles in the city's physical design. The design of such agri-urbanism can produce new imaginaries for urban living beyond the persistence of existing built form or the business-as-usual models offered by development forces. To advance such visions requires rethinking urban agriculture and livestock ordinances in Detroit and other American cities. What types of urbanism might be structured around a robust reintroduction of agricultural practices within the post-industrial city? What urban forms might enable effective coexistence for multi-species cities and enable scalable agricultural production within post-industrial legacies? How might the inclusion of livestock and a broader, more intensive format of urban agriculture shape a unique urban framework

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for Detroit that simultaneously addresses issues of food access and the production of diverse, new neighbourhood models that centre on cultivation and cultural production?

In parallel with these issues, questions regarding the climate footprint of urban areas have emerged as a significant consideration in shaping future development. One emerging framework that addresses system-wide flows is the Food-Energy-Water (FEW) Nexus, introduced at the 2009 World Economic Forum in Germany, which promotes sustainable resource management in cities.[10] The FEW Nexus provides a social and ecological approach to address complex urban issues by rethinking the 'fundamental needs of human society, production and consumption, demand and supply, and costs and benefits'.[11] The framework provides three guiding principles, which include investing 'in ecosystems to secure FEW provisions', creating 'more with fewer environmental costs' and ensuring 'accessibility to food, water, and energy to all residents'.[12] FEW resources generate a significant amount of greenhouse gas emissions throughout their life cycle. In the field of environmental science, carbon emissions – a key contributor to global warming – are recognised as one of the fundamental ways of measuring the environmental impact of the built environment.[13] Designing and planning for sustainable urban agriculture and animal-husbandry practices require accounting for the FEW demands of humans and livestock and their associated carbon emissions. They also require designing for a sustainable dietary transformation, equitable food access, renewable-energy production, water conservation and greywater treatment, the recycling of food waste and green-mobility adoption for last-mile logistics. Urban agriculture can potentially reduce the environmental footprint of a farm, neighbourhood and a city through synergistic models of food production.[14] An agri-urbanism that can scale urban agriculture practices to include an expanded role for livestock might simultaneously address aspects of food access for underserved communities, produce expanded economic opportunities and through-circularity and more efficient use of FEW systems, and result in reduced carbon footprints for urban development.

In this article, we introduce a history of 'domesticity' in American cities and urban agriculture in Detroit, relative to the current draft of the City of Detroit Urban Agricultural Ordinance.[15] We describe a speculative urban design proposition for Riverbend Farming Cooperative that assembles existing high levels of vacancy and proposes a courtyard-based cooperative farming development centring on animal husbandry. We evaluate the cooperative's projected carbon footprint in parallel with a discussion of its potential collateral benefits to surrounding areas, and discuss the social and ecological implications of cohabiting with livestock in cities. We explore and question opportunities and challenges for urban designers and planners in developing design proposals, zoning laws and policies to address urban agriculture and animal husbandry in post-industrial, shrinking cities as an alternative model to vacancy and abandonment. The model raises systemic questions that might shape the forms and metrics to be utilised, advancing future policy development on urban agriculture and animal husbandry in cities. We argue that future design and policy frameworks require carbon footprint evaluation – defining the size and distribution of facilities and proposing new models of mixed-use zoning. The framework should also include the evaluation of job opportunities, training, education and community engagement with the daily operations of farming and raising livestock.

'Domesticity' and livestock in American cities

The urban population of the United States exists in a post-domestic society. In *Hunters, Herders, and Hamburgers,* Richard Bulliet defines domesticity as the daily 'social, economic, and intellectual engagement' with domestic animals, excluding pets, asserting that post-domesticity is distancing people, 'both physically and psychologically, from the animals that produce . . . food, fibre, and hides. Thus, never witnessing the births, sexual congress, and slaughter of animals'.[16] A post-domestic society consumes 'animal products in abundance, but psychologically, its members experience feelings of guilt, shame, and disgust when they think of industrial processes imbedded in animal products'.[17] This was not always the case. In the eighteenth and nineteenth centuries, American city dwellers cohabited with livestock. In the book *Animal City: The domestication of America*, Andrew Robichaud describes American cities as 'ecologically diverse spaces, invariably made up of a multitude of domesticated, semidomesticated, and undomesticated species'.[18] In the early nineteenth century, American families brought animals such as cows and horses to growing industrial cities. With the subsequent increase in urban populations, emerging economies, single-zoning land-use practices and the densification of urban form, raising animals became a contentious issue in terms of time, space and hygiene.[19]

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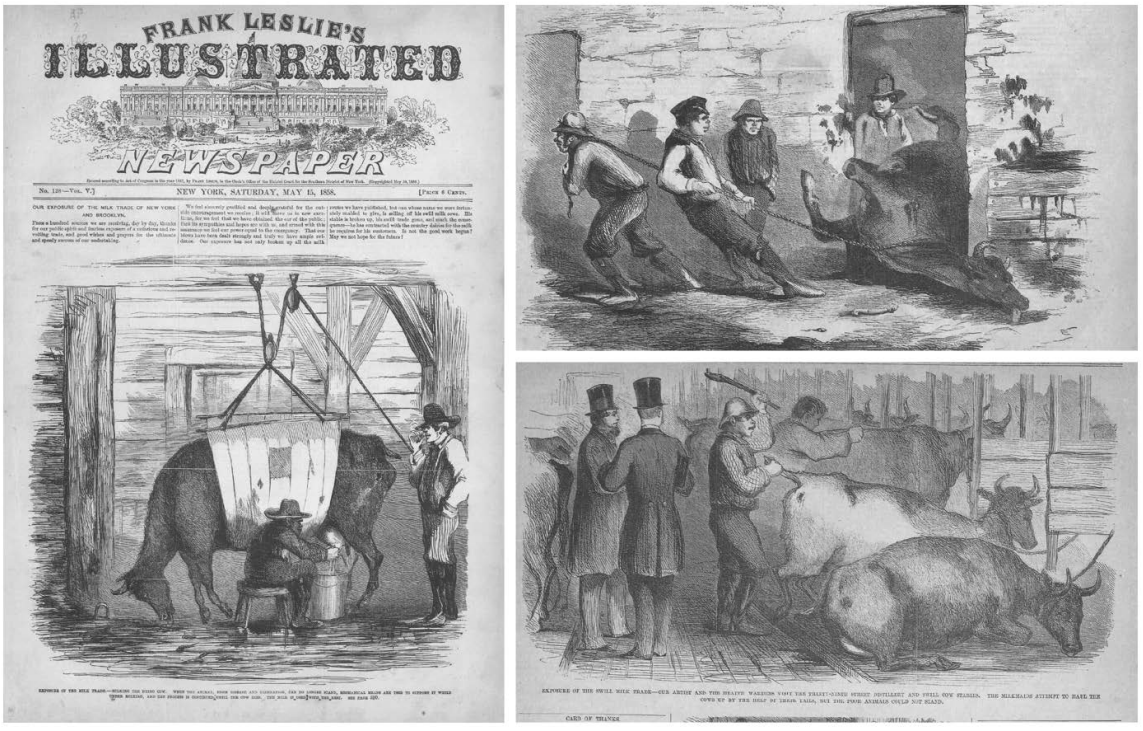
The late nineteenth century witnessed the creation of a series of new urban livestock policies and laws in metropolitan cities, including New York, Boston and San Francisco, that prescribed and limited livestock's participation in the city.[20] These regulations were focused on issues of health and safety surrounding animals and urban dwellers, questioning how to interface with livestock in terms of life and death. Civil unrest attended the debates around animals in cities. Following the civil war, San Francisco witnessed angry resident attacks on butchers and hog farmers, contributing to the creation of stringent rules for removing livestock, slaughterhouses and other 'nuisances' from the city.[21] Infrastructures coupling railroads and refrigeration enabled the displacement of slaughterhouses and other animal-processing practices to the urban fringes. As early as 1869, a shipment of dressed beef was sent from Chicago to Boston.[22] The late 1860s saw the rise of anticruelty activism and parallel campaigns in urban centres. Newspaper articles such as those in *Frank Leslie's Illustrated Newspaper* (1858–66) depict the crowded conditions of cow stables, livestock abused for milk production and urban cattle dangers on the street in New York City (Figure 2).[23]

Figure 2. Livestock abused for milk production. Captions from the newspaper: (Left) 'Exposure of the milk-trade . . . When the animal, from disease and ulceration, can no longer stand, mechanical means are used to support it while under milking, and the process continued until the cow dies. The milk is used with the rest'; (Top right) 'Exposure of the milk-trade—dragging out a dead cow, just after milking, from the stables with the distillery, corner of Flushing Avenue and Skillman street, Brooklyn . . . '; (Bottom right) 'Exposure of the swill milk-trade—our artist and the health wardens visit the Thirty-Ninth Street distillery and swill cow stables. The milkmaids attempt to haul the cows up by the help of their tails, but the poor animals could not stand.' *Frank Leslie's Illustrated Newspaper* 8–29 May 1858 (Source: University of Virginia Library Special Collections).



Throughout the eighteenth and nineteenth centuries, burgeoning American metropolitan cities implemented stricter rules to prevent overgrazing and limited private ownership of domesticated animals. The US Supreme Court holding in *Village of Euclid v. Ambler Realty Co.* (1926), Ohio, led to the formation of a zoning ordinance that separated residential from industrial and commercial uses. Its framework was later emulated by many American cities. Detroit's zoning ordinance (1984), like that of many other American cities, restricted agricultural use in certain parts of the city or in the peri-urban area.[24] The ordinance did not restrict urban gardens and backyard farming by residents but prohibited

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commercial agricultural practices within the city limits, which included animal husbandry. This radically altered human–animal relationships, local businesses and industries that relied on animal husbandry within cities.[25] The removal of livestock from the city specifically targeted the poorer sections of society who depended on them for food security and livelihoods. Thus, 'the city could present itself as a more prosperous area that might attract more wealthy residents'.[26]

Today, most states in the US have laws regarding the ownership of livestock. While this legislation is tailored towards rural settings, policymakers working on urban micro-livestock ordinances need to coordinate with the state and seek its approval for variances. Public-health and disease-prevention mandates prioritise statutory regulations regarding the interstate movement of animals, slaughtering of animals, sale of animal products and registration and permits for livestock keepers. Many states also provide exemptions for animals raised for self-sustaining diets and hobbyists, but these focus primarily on rural areas and exclude the possibility of similar justifications for urban areas.[27]

Urban agriculture and the question of raising livestock in Detroit

Urban gardening and agricultural initiatives in Detroit can be traced back to the economic depression between 1893 and 1897. Under the leadership of Mayor Pingree, the city established the first vacant-lot-cultivation programme – often referred to as 'The Potato Patch Farms', 'The Detroit Experiment' or 'Pingree potato patches' – to support unemployed labourers.[28] In its first year the programme raised $3,600 – predominantly through subscriptions, an estimated $14,000 worth of produce and 180 hectares (450 acres) of donated land. Its self-reliant nature reduced the financial burden on taxpayers and philanthropists. The success of the programme motivated other cities to form vacant-lot-cultivation associations, including Philadelphia, Buffalo, New York City and Boston.[29] In the 1970s, Mayor Coleman Young introduced the Farm-A-Lot Program to provide garden resources and permits to lease city-owned vacant lots for urban gardening and agricultural purposes. The Farm-A-Lot Program was instrumental in developing a framework for urban agriculture at the city scale.[30]

Today, urban agriculture in Detroit is characterised by the growing of a limited range of crops dependent on the adoption of viable agricultural systems, land tenure and area, growing-season length and climate, soil conditions, moisture and irrigation, pest control, pollination and the availability of capital and labour. This is a growing sector with over 1,350 urban farms and gardens associated with communities, markets, schools and families located within the city limits (Figure 1).[31] Urban agriculture in Detroit is invariably seen as a tool for healing contaminated land; reducing carbon emissions; building communities, cultures and identities of place; supporting food and related health education; catering to local food demands; strengthening the city's economic resilience; aiding equitable distribution and access to food; and for redefining rights to the city, its land and services.[32] The productivity of existing urban agriculture, understood through metrics that assess what amount of the city's dietary needs are provided by these farms and gardens, is under-studied and difficult to evaluate. This is due to variation in farming type and a lack of data collection on outputs. Limitations on livestock inclusion within urban farming practices remain a significant barrier to meeting food needs and limit economic potential. Rather, these practices have been historically recognised for their social, educational and economic impact in the city.[33] Urban gardening and urban agriculture programmes in the United States have been seen as a 'pervasive strategy to improve American urban conditions'.[34] They have been a vehicle to build morale and community, experiment with ways to integrate nature into the city, combat rising food prices and improve nutrition.[35] Urban gardening programmes for youth, especially, have provided opportunities for young adults to earn an income, contribute to their community and neighbourhood, and develop new skills. These programmes inculcate 'a civic mindedness to nurture a community open space', keep children engaged and safe, and prevent juvenile delinquency.[36] While these social benefits have been studied and discussed by various scholars, they have not been assessed through a comprehensive quantitative or fiscal lens when evaluating the potential benefits of urban agriculture.

Many grassroots initiatives and organisations in Detroit aim to produce self-reliance in terms of food security for the local constituencies with whom they are affiliated. Many aspire to become fiscally sustainable or profitable. Most remain reliant upon the subsidy of local philanthropic organisations that recognise the collateral social benefits of urban agriculture beyond their material and fiscal productivity as 'farms'. Under the leadership of Malik Yakini, the Detroit Black Community Food Security Network (DBCFSN) was formed to advance a 'food security movement' across the city's 77.9 per cent Black

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residents, advancing and improving local health outcomes, independence from externally owned supply chains and low-quality food retailers, and producing entrepreneurial food-related opportunities for local communities.[37] This organisation has led a series of initiatives to form a local food system centring on the needs of Black residents in the city through food production, distribution and sales, education and policy change. Some of their initiatives include the D-Town Farm (the largest urban farm in Detroit), the formation of the City of Detroit Food Security Policy, the formation of the Detroit Food Policy Council, the Food Warriors Youth Development Program, Food N' Flava (an education programme for food self-reliance and Black food sovereignty), the Detroit Black Farmer Land Fund and the Congo Beehives Coalition. The DBCFSN is currently working on the development of the Detroit People's Food Co-op to bridge the gap between small-scale farms and commercial food-distribution networks.[38] The co-op intends to create greater connectivity between producers and purchasers, specifically by building economic opportunities for the vertical integration of food enterprises and empowering Black-owned growers and businesses.[39]

In terms of animal husbandry, many residents and community organisations have shown interest in raising livestock or legalising this practice in the city. While many residents, especially non-farmers, are concerned about issues pertaining to disadvantages – including euthanasia, noise, odour, pests, sheltering and waste – advocates believe that the benefits of having livestock outstrip the inconveniences if practised correctly.[40] Urban agriculture advocates argue that owning livestock is a step towards food security. They also seek a closer connection to their food and to community building.[41] Seeing and raising urban livestock informs people, especially the next generation, where their food comes from and the labour required to raise animals with care.[42] It is an active way of rejecting the controlled animal-feeding operations used in industrial processes without having to make the radical transformation from animal-based to plant-based diets.[43] Atieno Kasagam, a Detroit resident raising livestock, states that 'the practice of raising food and livestock at a scale that is healthy is about freedom and self-sufficiency'.[44] Raising livestock as part of urban agriculture practice builds agency for residents in shaping the future of their neighbourhood. Malik Yakini states that 'in American society in general, there's this idea that farming is kind of low-class, or not desirable . . . Typically, people don't encourage their children to grow up to be a farmer. Also, throughout the world, people view urban life as being superior or more sophisticated than rural life. [Urban livestock] challenges people's notions of what a city is. Part of the pushback is because people don't feel like there should be animals in a city, and somehow that's beneath them or going backwards'.[45] To scale both the productive capacity of urban farming and address food-access needs, new typologies of urban farming are required, accompanied by legislation that permits a more diverse configuration of production. New models of agri-urbanism are needed that include livestock and enable a diversity of farming types linked to an expansion of economic opportunities.

Detroit's urban agriculture and livestock ordinances

In 2013, the City of Detroit adopted the Urban Agriculture Ordinance to formalise existing urban agricultural practices at varying scales, avoid guerrilla gardening while being socially accepted, resolve unclear land ownership, prevent detrimental impacts of agricultural practices, protect the 'physical environmental, public health and general welfare', regulate the sale of products, mitigate disputes between farming practices and neighbours and support a long history of local food activism in the city.[46] The ordinance provides a comprehensive framework for urban agricultural practices by defining different types, scales and systems of gardening and farming; the overall permit-approval process; and related authorities having jurisdiction. It outlines basic standards for urban agriculture including site-plan requirements, property setbacks and height requirements, maintenance regimes, guidelines for farming equipment and instruments, standards for using farm products, prohibition, sales, waste management, lighting, signage, neighbour consent, drainage, restroom facilities and composting.

Currently, there is action across various constituencies to advance a livestock ordinance that would allow farmers to own certain micro-livestock such as hens, ducks, honeybees, rabbits and goats. The city also allows other animals, such as horses and turkeys, through special request permits. The ordinance supports raising domesticated animals for urban agricultural practices only and is limited to specific zoning parameters for land use. The substance of these ordinances, however, consists of metrics assembled in the abstract – often imagined as a set of spatial accommodations and negotiations

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that might occur between adjacent neighbours, each of whom is imagined as living within existing detached, single-family housing, potentially adjacent to a vacant lot, and is thus limited to family scale micro-farming operations. While existing patterns of land division, tenure and occupation will no doubt shape and undergird those of future occupations, the on-the-ground realties of Detroit's urban agriculture scene operate within a context of new formats of land assembly; scalable, socially integrated models; and the stark reality that for the majority of the city's vast and vacant physical footprint, traditional development pressures and the dominance of single-family detached dwellings will not shape the future of transformation the way that they have in the past.

In a report for the American Planning Association discussing urban micro-livestock ordinances in the United States, Jaime Bouvier presents a series of case studies of community organisation-led work that resulted in the amendment of city zoning ordinances. These community organisations comprised residents who were either illegally raising or wanting to raise micro-livestock but were prohibited by zoning ordinances. Some of the case studies mentioned in the report include the Mad City Chicken in Madison, Wisconsin; the New York City Beekeepers Association; and Seattle's Goat Justice League.[47] As in Detroit, the report shows many cities now have permits and ordinances to keep certain livestock. For instance, South Portland, Maine; Cary, North Carolina; Ypsilanti, Michigan; and Littleton, Colorado allow beekeeping and Loveland, Ohio and Carl Junction, Missouri permit a specific number of pygmy goats in residential backyards.[48]

These legal frameworks are defining new ways of addressing questions of rights, access, security and cohabitation with livestock. The scale of operations referred to in the majority of ordinances remains reflective of relatively small-scale plots with single ownership, corresponding to plot sizes supporting the single-family, detached homes that dominate the US real-estate market. Alternate models of land tenure, subdivision and ownership need to be explored to evaluate the potential for urban agriculture and animal husbandry to scale in urban contexts. Such models are more urgent in contexts where cities are shrinking and the existing urban fabric is characterised by vacancy and abandonment. Such alternative models of land use will require urban agricultural policies to move beyond the normalisation of existing, illegal farming practices and enable the testing and prototyping of different scales and types of urban agriculture in the city.

Urban design speculation on food-based futures

Detroit's history of deindustrialisation, surplus land and community-led agrarian urbanism has been imagined by multiple authors as a context for testing different modes of urban agriculture, both in terms of traditional farming practices and advanced technical food-system planning.[49] While an extensive body of literature has catalogued the magnitude and severity of food insecurity in Detroit, current urban agriculture practices and urban gardening, the role of grassroots organisations and philanthropic supports active in the city, there is little speculation about, or work to develop, new models of urban design that might shape food-centred urbanism, and specifically how such design propositions might inform food policy.[50] Today, most urban agriculture initiatives remain limited to small, individually owned and operated plots or small aggregations of distributed properties constrained by law to produce only basic plant-based products as commodities – untethered from an idea of urbanism that might be assembled around them. Such approaches do not form a new model of urbanism, nor do they have the capacity to scale economically. However, there may be lessons from a previous era of urban design thinking that can help to shape an agri-urban imaginary.

In 'Notes toward a history of agrarian urbanism' and 'Agrarian urbanism and the aerial subject', Charles Waldheim assembles a historical overview of the ways in which modern urban designers ranging from Frank Lloyd Wright to Ludwig Hilberseimer and Andrea Branzi advanced models for urban development that eschewed high density and organised settlement patterns.[51] These design propositions interlaced agricultural production as a counternarrative to the increasingly subdivided and densified models that characterise the contemporary city – while producing new forms of urbanism. Waldheim argues that Wright's *Broadacre City* (1934–5), Hilberseimer's *New Regional Pattern* (1945–9) and Branzi's *Agronica* (1993–4) position landscape and 'agricultural production as a formative element of the city structure, rather than being considered adjunct to, outside of, or inserted within traditional urban forms'.[52] In Broadacre City, Wright designed logistic infrastructure conforming to the Jeffersonian

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grid as the fundamental ordering system. Each residential parcel allows for a single-family home with either a subsistence garden or a small-scale farm. In *The Disappearing City*, Wright confirms that

> all of these units [will be] so arranged and so integrated that each citizen of the future will have all forms of production, distribution, self-improvement, enjoyment, within a radius of a hundred and fifty miles of his home now easily and speedily available by means of his car or plane. This integral whole composes the great city that I see embracing all of this country – the Broadacre City of tomorrow.[53]

While Wright's vision frames infrastructures of mobility as connecting disparate programmes separated by great distance, his framework explicitly defines a continuous form of urbanism that links and connects those aspects typically defined as urban or rural – thus, Broadacre City redefines a model for how we may imagine the city today. In his New Regional Pattern, Hilberseimer draws upon garden city principles and prioritises walkability. He designs for a 'Smaller scale Settlement Unit, a semiautonomous collective comprising housing, farming, light industry, and commerce'.[54] The proposal presents a 'self-sufficient pedestrian social unit in the form of a cooperative live/work settlement'.[55] Hilberseimer points to a much more compact version of urbanism that couples and creates adjacencies between the multiple forms of production, commerce and dwelling, and that also resists the binary classification of urban and rural into a more continuous condition. He juxtaposes patterns of difference as a proposition of urbanism and a replicable pattern of settlement. In *Agronica*, Branzi's proposition pivots on the argument that new forms of communication and computation disrupt the necessity to separate functions dictated by the mechanical age, and that functions might exist independently of the built form that accommodates them. He argues that 'work' may occur independently of functional typology (house, office, factory).[56] Branzi's proposal offers an 'incomplete vision' but hinges on the principles of differentiation and juxtaposition, in which new models of urbanism arrive adjacent to existing forms of the city and its periphery. Here, combinations previously impossible to imagine coexist simultaneously through the 'coincidence of production and consumption of food products, residential spaces interspersed with agricultural or research activities, technical systems of movement at the service of transport and residence'.[57] While the precedents of Wright and Hilberseimer conjure up an imaginary of an urban expanse, set explicitly within a hybrid figuration of settlement that couples the conditions of urban and rural towards an alternative model of continuous and varied urbanism, they are conceived of against a tabula rasa of greenfield conditions. Branzi's work asserts the possibility of imagining new, combinatory models of the urban and constitutes a useful framework for imagining alternative urban frameworks wherein the city is formed at once through the persistence of historic built form coupled with vast areas of vacancy and an absence of economic pressure to drive development.

Looking to Detroit – its powerful context(s) of urban agriculture-based, bottom-up organisations, its specific contexts of overscaled, unsustainable infrastructures, the global imperative to decarbonise cities and the urgency of producing a just and inclusive urban environment that builds capacity, new models of ownership and potential pathways for economic growth – how might scalable urban agriculture frameworks inform new models for urban development in post-industrial cities? Against the backdrop of Detroit's various urban systems and planning contexts (Figure 3) – its exuberant culture and enthusiasm for urban agriculture-based practices (cultural and practical) and leveraging the potential of the DLBA to make vacant land available for new 'prototypes' of urban development – we suggest that a scaling of practices already active in the city might point a way towards desirable pathways forward. Through the work of the Riverbend Farming Cooperative, we propose models that amplify policies of the Detroit Sustainable Action Agenda developed by Detroit's Office of Sustainability. The agenda defines ten policy goals:

1. Increase access to healthy food, green spaces and recreational opportunities.
2. Improve air quality and reduce exposure to pollution.
3. Advance equity in access to economic opportunity.
4. Reduce the total cost of housing, including utilities.
5. Improve the health-and-safety performance of existing and new housing.
6. Transform vacant plots into safe, productive, sustainable spaces.
7. Reduce the waste sent to landfill.
8. Make it easier and safer to get around Detroit without a personal vehicle.
9. Enhance infrastructure and operations to improve resilience to climate impacts.
10. Reduce municipal and citywide greenhouse gas emission.[58]

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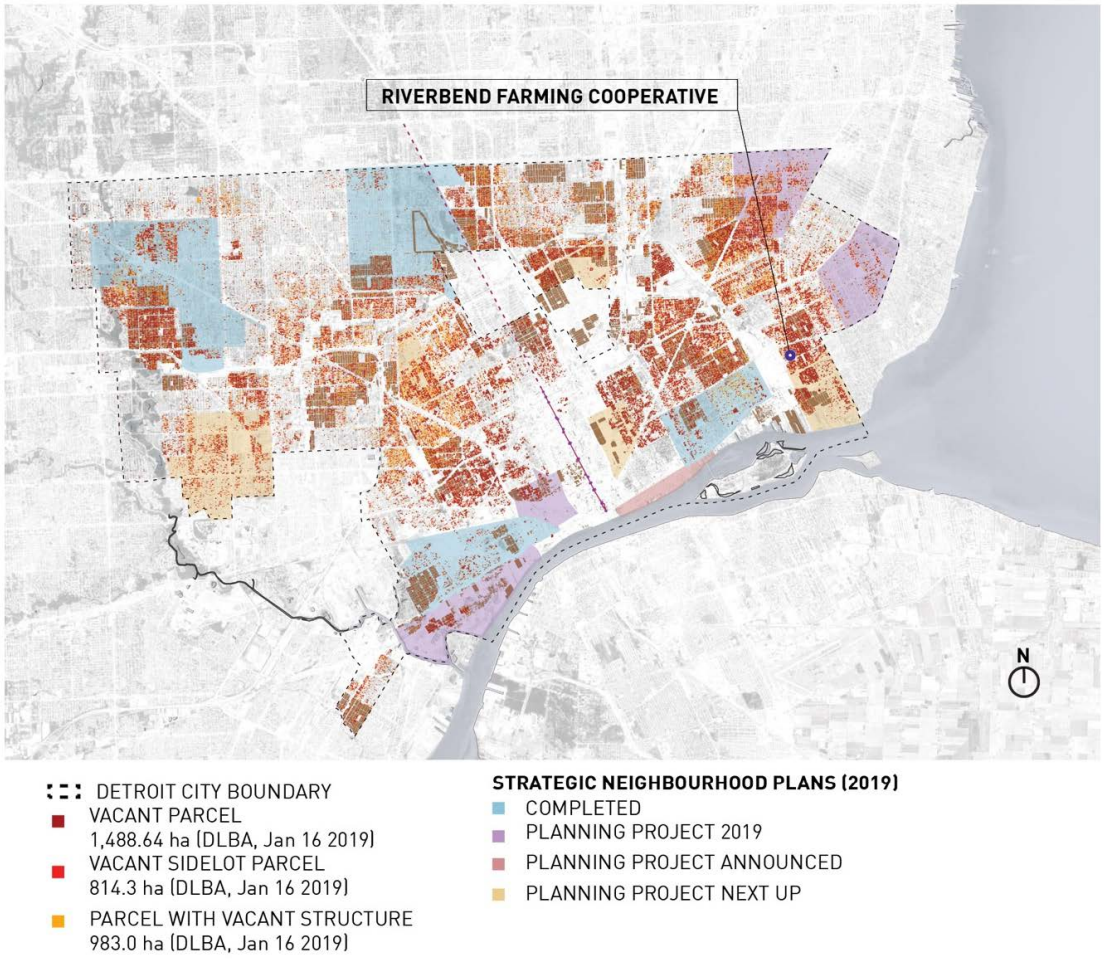
In addition to advancing equitable food access and other social dimensions of urban agriculture, the proposal aims to reduce domestic energy demand and carbon emissions per household; to design for sustainable dietary transformation; to integrate renewable-energy production, water conservation and greywater treatment; and to increase the utilisation of food waste and the adoption of green mobility – all as a means of introducing sustainability and carbon-reduction metrics to the list of benefits currently recognised by urban agriculture advocates. The work centres on urban agriculture beyond small, crop-based operations in order to incorporate and leverage the multiple benefits of livestock-inclusive farming practices. It offers a model of new physical urban typologies, carbon-footprint reduction and vertical economic integration through the development of urban agriculture at a scale incorporating livestock into a framework for mixed-use, collective living.

Figure 3. Riverbend Farming Cooperative location in Detroit. Map of Detroit, compiling 1,489 hectares (ha) and 814 ha of vacant parcels and side plots respectively and Detroit Planning and Development Department's (PDD) vision 2018–19, 'Targeted Multifamily Housing Areas'. The strategic neighbourhood plans by PDD aim to build 'a healthy and beautiful Detroit' through 'inclusionary growth, economic opportunity, and an atmosphere of trust'.[59] (© RVTR/U-M, 2021). See the section 'Figure sources' for data assembled in the map.



Riverbend Farming Cooperative: design prototype for cooperative farming

This work forms part of a larger project exploring different design prototypes for urban agricultural integration into urban design in order to assess the impact of these types of development on the

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carbon footprint of neighbourhood areas in Detroit. Some of the prototypes were undertaken through consultation with local stakeholders; others were more speculative, undertaken as experiments to indicate possibilities beyond those in which active community efforts were already under way. In each case, an iterative design process was adopted to assess configurations of built form and programme, and the areas afforded for differing types of food production (urban agriculture, technical food systems such as hydroponics and aquaponics, food-production areas, related commercial spaces and mixed-use occupancies). In parallel, a variety of sustainable systems components were designed and assessed to reduce carbon dioxide equivalent (CO_2-eq) footprints for the overall development. These included solar-energy production, biogas production, stormwater retention and reuse, high-performance building systems for new construction and electrified car-share integration. A strategy of circular systems integration, such as kerbside recycling and the conversion of biowaste to energy and compost, was paired with the operations of urban agriculture systems and the waste stream generated across the proposed development. Across design iterations, an assessment of the interactions between food, energy, water, waste and mobility systems was evaluated in terms of the net CO_2-eq footprint per resident of the resulting scheme. Balanced considerations regarding the plausibility of built form and density were paired with efforts to maximise local food production and minimise resource consumption to arrive at a final proposal configuration and composition.[60]

The Riverbend Farming Cooperative is designed through the lens of intensive agricultural production for an existing, high-vacancy neighbourhood on the eastern side of Detroit. The existing 27.4 ha area is sparsely populated by single, detached homes and an existing estimated population of 99 residents (Figure 4). The project assembles a series of adjoining, vacant lots along Mack Avenue to be redeveloped as a collective living-and-farming 'superblock' structured as a food-and-housing cooperative (Co-op). Currently, 84.86 per cent of the superblock is held by the City of Detroit, the DLBA and Detroit Public Schools Community District. The additional, privately held lands are acquired through joint agreement, ownership benefits and collective fiscal agreements. Existing residents gain new housing and an equity share in the resulting cooperative operation. The cooperative adopts permaculture farming techniques as a method of sustainable, organic food production.[61] The proposed design anticipates a population of 544, with an average household size of four – accommodating a wider range of familial types and dwelling configurations than the existing single-family housing stock. A continuous, mixed-use perimeter strip of residential, educational, commercial and farming-support programmes that wrap around the superblock, forming a courtyard used for a variety of urban farming activities, has been proposed. The perimeter of the courtyard reinforces the existing street address while buffering exposure to farming activities from the existing residential fabric and adjacent properties. This strategy provides an active exterior face to the existing public domain that may assist in generating future development opportunities for surrounding real-estate parcels. Additional spaces accommodated by the perimeter allow for commercial and educational programmes, forming access gateways for the public: a farmers' market, farm store, food-innovation hub and community commercial kitchen, farm storage, retail-food venues, an education centre and kindergarten – all operated by the cooperative. The proposal contains multi-unit housing and a farming area, which includes open-field farming, greenhouse structures and grazing for animal husbandry. The urban farm alone can produce 94 jobs, which include greenhouse cultivation, open-field farming and animal husbandry. Within the design schema, additional jobs related to food are produced via food innovation, processing and retail, along with educational programmes that centre on experiences with animals, soil and plants as an alternative means to cultivate community building, youth engagement and science, technology, engineering and mathematics (STEM) educational opportunities.

Unique to the proposal is a focus on encounters with domestic animals. While the form of the perimeter block and courtyard offers a spatial interface with the surrounding city and its publics, it also produces an alternative world in the interior. Here, residential spaces overlook the farm and its operations as a view and vista of daily life. The productive landscape is understood as a place in which one cohabits with both plants and domestic animals. Descending into the landscape affords an entirely alternative domain for the urban dweller. Circular systems are understood as living systems, in which energy and water are recycled to support new life, and soil is a thing that is produced, reproduced and reproduces. Animal by-products provide sustenance and populate the landscape – both in the growing landscape of the farm, through fertilisation and the removal of pests, and in the production of the project's social perimeter. Here, eggs and milk are upcycled into more complex foods, served to and purchased by visitors from surrounding neighbourhoods. School children enter the farm to meet species

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they have never seen before. Economic, educational and social spaces form a realm of interaction between residents, animals and visitors. Biotic processes and processing are not things that happen elsewhere and food is not something that arrives in a box retrieved from a nearby service station. Beyond the qualitative descriptions of this world, they contribute to the quantitative performance of many of the project's technical systems.

Figure 4. Riverbend Farming Cooperative context. Mapping indicates site perimeter, ownership of the proposed lands to be assembled and spatialisation of existing local actors whose practices are supportive of proposed development values and whose interests are reflected in the perimeter programmes developed (Source © RVTR/U-M, 2021). See the section 'Figure sources' for data assembled in the map.

Environmental, social and economic systems overview

The cycles of production between sustainable and renewable technologies, the operation of the farm's productive landscape and animals, and the dwelling spaces for residents constitute a system of flows that we quantify as a means of evaluating systemic performance. As part of the project's design, we utilise FEWprint (v 8.5), a carbon-accounting tool developed with partners from the Delft University of Technology, to assess the sustainability of urban design proposals integrating urban food production. The FEWprint is designed to evaluate the environmental impacts (in total and per capita CO_2-eq) of existing urban areas in comparison with proposed design scenarios through the lens of residential demand and consumption of food, energy, water, waste and mobility resources with a target of self-sufficiency within design proposals, neighbourhoods and the city.[62]

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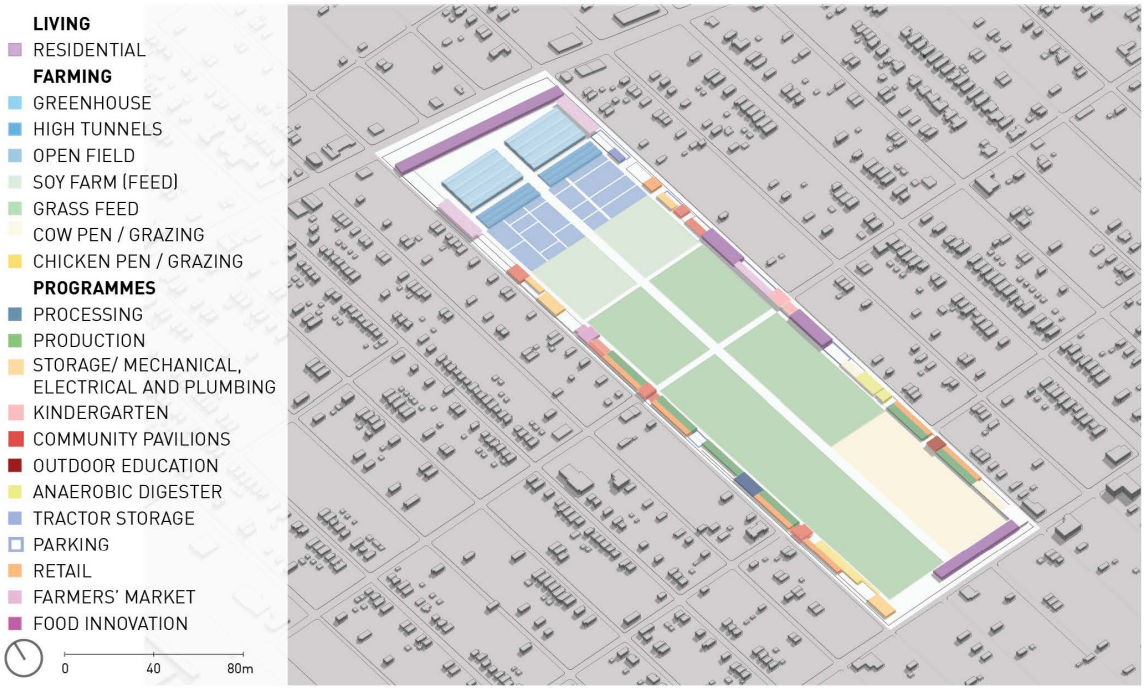
The Riverbend proposal design reduces per capita carbon emissions from 11,409 to 1,114 kg per year through a combination of the proposed sustainable systems' performance, the reduction and reuse of waste streams, the reduction of externalised energy flows and the offsetting of embodied energy in food produced and consumed, and water conservation within the complex. The total food produced in this neighbourhood is 257 tonnes per year. The design scheme (Figure 5) meets 100 per cent of vegetables, fruits, pulses/legumes, starchy roots, milk, cheese and eggs, and 32 per cent of nuts and seeds required by the residents of the Co-op. These data anticipate more healthy eating practices based on a Lancet diet, utilised here as a proxy for an improvement in the healthy eating practices of residents who now have access to sources of healthy food.[63]

Figure 5. Design proposal programme configuration and overall site systems programming for Riverbend Farming Cooperative (Source © RVTR/U-M, 2021).



In addition to the social-programming adjacencies outlined above, local energy production is prioritised. The site design generates 1,787 MWh per year of electricity from rooftop solar panels and 3,970 MWh per year of geothermal energy to fulfil 100 per cent of the thermal demand from both urban farming and residential use. The site collects 20,362 m^3 of rainwater from the rooftops of homes, greenhouse structures and commercial sections of the design. The rainwater collected is utilised for urban farming practices and diverted from the central processing system. A small-scale anaerobic digester of 450 m^2 is proposed, with containers holding 79.5 m^3 of food and animal waste. The digester generates 25,193 m^3 per year of biogas energy and 68 tonnes per year of digestate, including 100 per cent of residential organic waste on site as a nutrient rich fertiliser for reuse.

In terms of animal husbandry, the urban farm is designed for 13 cows and 302 chickens. The open field includes a grazing area of approximately 22,000 m^2 for the cows, 604 m^2 for chickens and an additional feed-production area of 97,000 m^2. The grazing and feed production on the site fulfils 40 per cent of the feed for the cows and 59 per cent for the chickens. The proposal reinforces the socioeconomic values of a cooperative model for food through its ecological and environmental considerations. It does so in terms of the economic potential: along with job creation, the design and its urban framework provides opportunities for the commodities produced on the farm – the produce, feed and animal products – to be transformed into goods, services and experiences. The design supports the development of different revenue streams and business models for the Co-op and allied services by providing space for the upscaling of products. For instance, the eggs collected

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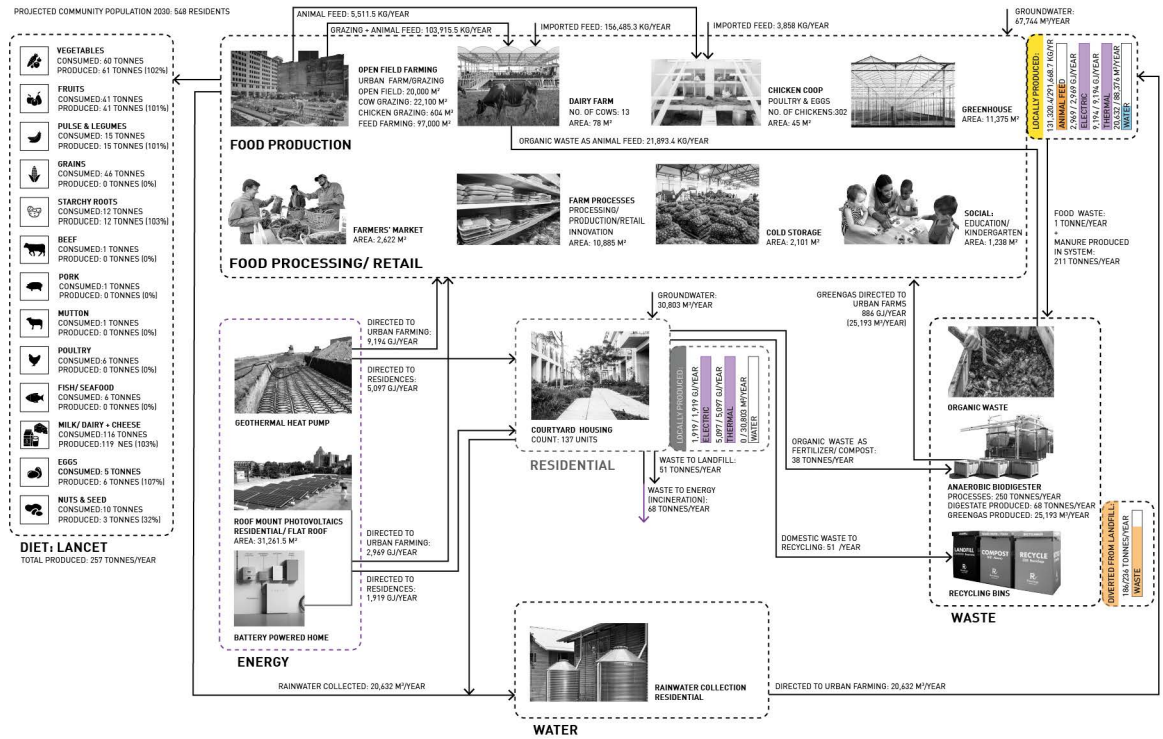
from the chicken coops can be sold as a commodity or as prepared items (value added) in the service-economy-oriented farmers' market, locally delivered in the city as a value-added service or served as dishes to patrons in a farm-to-table (experience-economy) model. The experience of witnessing and participating in the farming and food-preparation process or engaging with domesticated animals in different capacities creates socioecological consciousness while simultaneously engaging Joseph Pine's 'Experience Economy' framework – a value-creation model that has yet to be fully explored in Detroit's urban agriculture scene.[64] The proposal aims to create a safe and nurturing educational environment for all ages by offering opportunities for actively training and working on the farm to passively interacting with plants and animals and learning about ecology and sustainable systems. The design thus alters a 'post-domestic paradigm' by creating a space for 'social, economic, and intellectual engagement' with domestic animals in the daily life of the urban dwellers that generates multiple economic, ecological and environmental benefits.[65] While the project imagines clear benefits for metrics such as circular-systems performance and food access (defined by the USDA through proximity to affordable, healthy food sources), a deeper understanding of the social and educational benefits of cohabitation described here is difficult to quantify.

Through this work, we aim to speculate on alternative models for urban design through food-based developments that prioritise circular systems coupled with localised food production (Figure 6). Indeed, such forms of agri-urbanism suggest alternatives to models of developer-lead development that can create sustainable futures in low-density, high-vacancy contexts. Such models have the potential to produce new forms of social infrastructure that can also reduce per capita emissions within cities and point to compelling visions of transformation in post-industrial cities, including multiple social and cultural benefits.

Figure 6. Food-Energy-Water system analysis for Riverbend Farming Cooperative. The material flow diagram depicts the amount of (1) food and feed produced or imported to support the residents and livestock; (2) geothermal and solar energy produced for housing and urban farming processes; (3) rainwater collected and used for residential or farming purposes; (4) additional groundwater required for residential and farming purposes; and (5) waste recycled, composted, converted to green gas through anaerobic bio-digestion, sent to landfill or incinerated for energy (Source © RVTR/U-M, 2021).



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Enabling urban agriculture and animal husbandry

If we are to imagine scaling urban agriculture in post-industrial cities, we must rethink urban relationships to agriculture and domesticity at scale and reshape our expectations for the urban experience. As Grace Boggs and Scott Kurashige state, the 'thousands of vacant lots and abandoned houses provide not only the space to begin anew but also the incentive to create innovative ways of making our living – ways that nurture our productive, cooperative, and caring selves'.[66] This section identifies some of the policy challenges facing urban agriculture and animal husbandry in the city that would enable new design typologies. It is critical not to look at domestic animals solely through the lens of nutrient extraction but also as a potential dimension of urban experience. How will contact with non-human, urban species present opportunities to rethink the way in which future generations learn to engage with biotic systems, circular systems and multi-species contexts? Changes in policy and law are required to test and explore this question, address issues surrounding permit approvals and enable propositions such as the one embodied in Riverbend.

While many scholars believe that future 'codes, ordinances, rules, and policies for urban livestock regulation in Detroit will most likely impact three primary regulatory areas: zoning (including the city's development of a new Master Plan), animal control, and public health', there are a series of challenges that these regulations need to address beyond defining urban agriculture standards, nuisance compliance, zoning and the spatial parameters of a site at scales beyond the single-family, detached parcel.[67] The development of new policies and comprehensive plans for a city requires a systems approach to define and elaborate at all levels of local food-system planning – including the physical environment, building typologies and configurations, economics, politics and social and health impacts.

To see livestock grazing in post-industrial American cities, we need to think about soil. Intensive urban agriculture approaches require significant open space for land-intensive processes and it is the affordance of space availed by vacancy and abandonment that locations such as Detroit possess. While there are extensive areas of land within post-industrial contexts where previous industrial uses have produced toxic legacies in the soil profile, these territories are often accompanied by extensive areas of formerly residential precincts such as those at Riverbend and here, soil is much better suited to such conversion. Local food is often assumed to be organic through regenerative gardening and farming; this assumption must be contested by enacting regulations promoting the required practices, such as minimum tillage, crop rotation, cover cropping, composting, the application of biochar, the 'restoration of riparian habitats, and nutrient management' by preventing agricultural runoff from fertilisers, pesticides and manure.[68] Appropriate sites for such experimentation must couple land capable of supporting urban agriculture occupations with policies that reinforce soil and system health over time.

Urban agriculture and livestock in cities require rethinking stormwater-management practices across the scales of the farm or garden, neighbourhood, city and watershed. Detroit's water infrastructure and its operations resist the expansion of urban agriculture at the city scale. Detroit currently relies on combined, single water and sewage systems. Water-billing rates remain the same for residential and farming use and there are no policies that enable a more equitable distribution of water and subsidy for urban farming.[69] Many scholars suggest 'enacting mandatory rainwater harvesting and creating porous surfaces for all new construction or new use; outlining detailed fees associated with all likely forms of agricultural and commercial runoff; adopting tax and grant incentives for additional rain catchment systems and other rainwater diversion methods; installing nonpotable water systems (water not suitable for drinking and cooking) where practicable; and a permitting system for fire hydrant tapping for urban agriculture'.[70] Some of these strategies have been tested as forms of urban prototyping in Detroit, and the Riverbend proposal offers a model that would depend upon their uptake as policy and practice.

Considering the socioeconomic needs of residents through the lens of environmental justice and food security, a comprehensive food-system plan is needed in cities. Such plans should be based on an analysis of local food demand that can be supported by local food production, the environmental impact of the food produced, last-mile logistics, the economic benefits of local food consumption and the movement of food outside the city for revenue. Local food-system planning needs to address the plight of marginalised communities experiencing barriers to 'full participation in urban agriculture, including difficulties securing funding, political support, and long-term land tenure'.[71] Highlighting the social and environmental benefits of subsistence farming is critical as urban agriculture practitioners most often

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supplement their diets, share with, or donate, surplus perishable products after sale with their workers, friends, family and the disadvantaged and provide food literacy to communities.[72]

Looking at land-use planning and zoning with the aim of raising urban densities, the land available for food production is pressurised and thus urban farms and grazing plots require protection to resist real-estate speculation. The American Planning Association report suggests that cities need to account for the upfront time and cost needed to gain permits and site visits from animal control.[73] The future of urban agriculture and animal husbandry requires thinking through issues faced by rural, agrarian societies following regenerative farming practices, including crop and livestock insurance and financing mechanisms.[74]

While considering the health, safety and education of citizens engaged with local food production, animal husbandry and the sale, distribution and consumption of food items, scholars suggest that cities need to partner with organisations such as 'State Extension offices, the Humane Society, or citizen groups' that have experience with micro-livestock and which can offer training and mentorship to those inexperienced in dealing with livestock.[75] Jacqueline P. Hand and Amanda Gregory discuss the fact that the drafting process of Detroit's livestock ordinance includes a proposal for the formation of 'The Urban Livestock Guild', which would provide training in animal husbandry. At the ordinance's inception, it was envisioned that

> animal husbandry permits would be conditional upon membership in the Guild and compliance with certain Guild-set standards or training. Such a guild would also have some level of self-policing authority inherent in its charter with the city. This, in turn, was expected to relieve the City of some of the regulatory and inspection burden by establishing peer accountability and permitting standards. In addition, the Guild would provide training for owners of city livestock and city employees.[76]

The exclusion of the guild resulted in hesitation in passing the new ordinance due to issues of funding, lack of formal training for livestock owners and the potential risk of excluding small-scale animal husbandry. Moreover, animal husbandry requires infrastructure and expertise to ensure animal health.[77]

To advance the potential urban and societal benefits of urban agriculture operations inclusive of livestock at scale within post-industrial contexts, a panoply of modifications is required across local by-laws, zoning ordinances, state laws governing livestock management and incentives to reduce the cost of resource provision and prioritise circular and sustainable systems. The production of an imaginary regarding agri-urbanism and its benefits is required in order to catalyse and advance such conversations.

Conclusion

The Riverbend proposal is an urban design scheme for urban agriculture at scale that offers a plausible, utopistic vision to address inequitable food access; the creation of local, vertically integrated economic opportunities; the integration of learning and health systems to reduce the carbon footprint of urban neighbourhoods; and the imagining of new ways of living together and with animals in the design of the built environment (Figure 7). In the spirit of previous designers exploring agri-urbanism, we offer here the model of the superblock farm as a design typology that can be accommodated within areas of former residential use and high-vacancy precincts such as those found in Detroit. The perimeter courtyard assists in mediating the relationship between farming and animal-husbandry activities and their urban surroundings while creating gateways for public interface with the multiple benefits that such agricultural activity may yield. The courtyard farm produces new conditions, vistas and encounters with agricultural production and livestock for residents, affording an alternative experience of the urban. We frame a discussion that might advance and address the various legal and policy changes required to enable such an experiment as outlined above. The project offers a model that couples circular, sustainable systems surrounding food, energy, water and waste, and centres on social, economic and emotional engagement with domestic animals through farming, education and commerce. The work reframes domestic animals as a catalysing force that might help us rethink the possibilities of urban life, what we eat and our relationship to food and its cocreators in designing urban futures.

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Figure 7. Creating a cultural imaginary for an agri-urbanism building model for development on scalable urban farming practices: (top) Images depicting Riverbend's courtyard perimeter as an urban agricultural interface; (middle) teaching and training, immersive learning and engagement; (bottom) public gateways of commerce and exchange (Source © RVTR/U-M, 2021).

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Notes

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[2]Toynbee, *Cities on the Move*, 8.
[3]Pothukuchi, 'Five decades of community food planning in Detroit'.
[4]Collingham, 'The United States'; Lawson, *City Bountiful*.
[5]Pothukuchi, 'Five decades of community food planning in Detroit'; Horst, McClintock and Hoey, 'The intersection of planning'; Beavers, Atkinson and Alaimo, 'How gardening and a gardener support program'; Herrmann et al., 'Agroecology for the shrinking city', 675.
[6]Hill, *Detroit Food Metrics Report 2019*; Econsult Solutions Inc., Urbane Development, LLC, *Economic Analysis*.
[7]Pothukuchi, 'Five decades of community food planning in Detroit'.
[8]Detroit Future City, *139 Square Miles*, 20–71; City of Detroit, 'Detroit sustainability action agenda'.
[9]Mondry, 'Detroit's farmers are losing patience'; 'Detroit should legalize keeping of farm animals'; 'Detroit considers changing rules'; Stateside Staff, 'Fences and good neighbors'; Hurley, 'Detroit is designing a city'.
[10]Hoff, 'Understanding the nexus'.
[11]Yan and Roggema, 'Developing a design-led approach'.
[12]Yan and Roggema, 'Developing a design-led approach'; Hoff, 'Understanding the nexus'.
[13]IPCC, 'Global warming of 1.5C'; ten Caat et al., 'Towards fossil free cities'.
[14]Goldstein et al., 'Urban versus conventional agriculture', 9.
[15]Detroit, Mich., Zoning Ordinance, § 61 (1984).
[16]Bulliet, *Hunters, Herders, and Hamburgers*, 3.
[17]Bulliet, *Hunters, Herders, and Hamburgers*, 3.
[18]Robichaud, *Animal City*, 2.
[19]Robichaud, *Animal City*, 2.
[20]Robichaud, *Animal City*, 7.
[21]Robichaud, 'The war on butchers'.
[22]Hedden, 'The revolutionary activities of the refrigerated car', 37.
[23]Robichaud, 'Cow town'.
[24]Hand and Gregory, 'The Detroit frontier', 497.
[25]Hand and Gregory, 'The Detroit frontier', 497.
[26]Bouvier, 'How cities are responding', 85.
[27]Bouvier, 'How cities are responding', 85.
[28]Lawson, 'Garden patches'.
[29]Lawson, 'Garden patches'.
[30]Pothukuchi, 'Five decades of community food planning in Detroit'.
[31]Keep Growing Detroit, *2018 Annual Report*.
[32]Horst, McClintock and Hoey, 'The intersection of planning'; Pothukuchi, 'Five decades of community food planning in Detroit'; Boggs and Kurashige, 'Detroit, place and space'; White, 'Sisters of the soil'; City of Detroit, 'Detroit sustainability action agenda'.
[33]Horst, McClintock and Hoey, 'The intersection of planning'; Pothukuchi, 'Five decades of community food planning in Detroit'.
[34]Lawson, 'Garden patches', 11.
[35]Gómez-Villarino and Briz, 'With sustainable use of local inputs'.
[36]Lawson, 'Garden patches', 7; DeCoito et al., *Teaching and Learning*.
[37]Detroit Black Community Food Security Network, 'About us'.
[38]Detroit Black Community Food Security Network, 'About us'.
[39]Allnutt, 'A Black-led food co-op'.
[40]'Detroit should legalize keeping of farm animals'; Hurley, 'Detroit is designing a city'.
[41]Bouvier, 'How cities are responding'.
[42]Mondry, 'Detroit's farmers are losing patience'; Hurley, 'Detroit is designing a city'.
[43]Bouvier, 'How cities are responding'.
[44]Mondry, 'Detroit's farmers are losing patience'.
[45]Hurley, 'Detroit is designing a city'.
[46]Detroit, Mich., Zoning Ordinance, § 61 (1984); Hand and Gregory, 'The Detroit frontier'.

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[47]Bouvier, 'How cities are responding'.
[48]Bouvier, 'How cities are responding'.
[49]Boggs and Kurashige, 'Detroit, place and space'; Detroit Future City, *2012 Strategic Framework Plan.*
[50]Thün, Sanyal, and Velikov, 'Mapping the FEW-Nexus'.
[51]Waldheim, 'Notes'; Waldheim, 'Agrarian urbanism'.
[52]Waldheim, 'Agrarian urbanism',124.
[53]Wright, *The Disappearing City*, 44.
[54]Waldheim, 'Agrarian urbanism'.
[55]Waldheim, 'Agrarian urbanism'.
[56]Branzi, 'Agronica (1995)'.
[57]Branzi, 'Agronica (1995)', 432.
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[59]City of Detroit, 'Neighborhood plans'.
[60]RVTR, 'M-NEX'.
[61]Krebs and Bach, 'Permaculture', 3218.
[62]ten Caat et al., 'Towards fossil free cities'.
[63]Willett et al., 'Food in the Anthropocene'.
[64]Pine and Gilmore, *The Ie Economy.*
[65]Bulliet, *Hunters, Herders, and Hamburgers,* 3.
[66]Boggs and Kurashige, 'Detroit, place and space', 105.
[67]Hand and Gregory, 'The Detroit frontier'.
[68]Hand and Gregory, 'The Detroit frontier'; McBride, *Redefining Value and Risk*, 8.
[69]Hand and Gregory, 'The Detroit frontier'; Hester, 'Growing pains for Detroit's urban farms'.
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[71]Horst, McClintock and Hoey, 'The intersection of planning'.
[72]Horst, McClintock and Hoey, 'The intersection of planning'.
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Figure sources

All original maps and drawings have been generated and processed by the RVTR research team into visualisations.

- Figure 1: map sources: City of Detroit Open Data Portal (2019) Master Plan Neighborhood https://data.detroitmi.gov/datasets/master-plan-neighborhoods (accessed 15 January 2019); United States Department of Agriculture: Economic Research Service (2017) Food Access Research Atlas https://www.ers.usda.gov/data-products/food-access-research-atlas/download-the-data/ (accessed 2 February 2019); Mergent Intellect (2016) https://www.mergentintellect.com/index.php/search/index (accessed 24 October 2019); Keep Growing Detroit (2013) 2013 Gardens with City Council District https://detroitography.com/2014/05/09/map-2013-gardens-with-detroit-city-council-districts/ (accessed 20 February 2019); Homeland Infrastructure Foundation-Level Data (2019) Public Refrigerated Warehouses https://hifld-geoplatform.opendata.arcgis.com/datasets/public-refrigerated-warehouses (accessed 14 October 2019); United States Department of Agriculture: Agriculture Marketing Service (2019) Local Food Directories https://www.ams.usda.gov/services/local-regional/food-directories (accessed 10 October 2019); United States Census Bureau (2018) Tiger/Line Geodatabases: Rails National Geodatabase: https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-geodatabase-file.2018.html#list-tab-1258746043 (accessed 13 June 2023); United States Census Bureau (2018) Tiger/Line Geodatabases: Roads National Geodatabase: https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-geodatabase-file.2018.html#list-tab-1258746043 (accessed 13 June 2023).

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- Figure 3: map sources: City of Detroit Open Data Portal (2019) Parcels: https://data.detroitmi.gov/datasets/detroitmi::parcels-2/about (accessed 13 June 2023); Detroit Land Bank Authority (2019) Completed Auction Sales: https://data.detroitmi.gov/datasets/detroitmi::auction-sales/about (accessed 13 June 2023); Detroit Land Bank Authority (2019) Detroit Demolition https://data.detroitmi.gov/apps/detroitmi::demolition-tracker-map/explore (accessed 13 June 2023); City of Detroit Open Data Portal (2019) Vacant Property Registrations: https://data.detroitmi.gov/maps/detroitmi::vacant-property-registrations/about (accessed 13 June 2023); Detroit Strategic Neighborhood Fund (2020) https://theneighborhoods.org/story/130m-investments-coming-seven-detroit-neighborhoods (accessed 13 June 2023);
- Figure 4: 'Riverbend, Detroit, MI', Google Earth Pro (accessed 5 March 2021). World Imagery.

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Declarations and conflicts of interest

Research ethics statement

The authors conducted the research reported in this article in accordance with all applicable requirements of the University of Michigan's Responsible Conduct of Research and Scholarship (RCRS) policies, practices and standards.

Consent for publication statement

Not applicable to article.

Conflicts of interest statement

The authors declare no conflicts of interest with this work. All efforts to sufficiently anonymise the authors during peer review of this article have been made. The authors declare no further conflicts with this article.

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