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AGRICULTURAL CITY – ITS FORMAL SHAPE IN THE LIGHT OF HISTORIC THEORETICAL DESIGNS AND EMERGING TECHNOLOGIES

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A b s t r a c t

The progressive degradation of environment and urban sprawl inspired the search for alternative ways of urban development. In this context, the concept of a "regenerative city" has gained significant traction in the field. It encompasses a variety of principles and strategies to ensure that cities can function sustainably and do not just consume resources but also actively regenerate them. In this context, the role of urban farming is particularly relevant. Urban farming, as a multifunctional tool, can contribute to food security, ecological sustainability, community resilience, and social cohesion. By integrating nature into the very fabric of urban design and ensuring that cities can sustainably support their inhabitants, we move closer to a vision of cities that are not just places of residence but thriving ecosystems in their own right. To achieve this goal we need not invent urban theories de novo. Throughout the decades, researchers have proposed cities encompassing agrarian land. The present study aims to present three lesser-known theories of W. Czerny, L. Zimowski and O. Hansen on the backdrop of theories by i.e. L. Migge, F.L. Wright, particularly focusing on the role of agriculture within city framework and their implications for the built structure of cities in the future.

Keywords: urban agriculture, urban farm, agricultural city, urban resilience, sustainable development

1. INTRODUCTION

The origins of the city in Western culture are said to spring from the transition from nomadism to agriculture and the resultant surplus crops, which allowed for a division of labor between agriculture, trade and administration, and paved the way for dense human settlements. Nonetheless, food production has always been closely related to urbanization. The antagonistic relation with "the agricultural" has been the elementary indication, the quintessence of the urbanity. At the same time, the agricylture was the factor stimulationg and enabling the development of cities. Throuought the centuries the amount of agricultural land assigned to a city constituted its welth. The significance of newly "located" cities

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founded on Magdeburg's Rights was illustrated by the size of their market squares. This size was partially based on the amount of the expected grain and horticulture commerce going through the square, etc. This codependence can be traced throuought the ages [1]. However, since the end of the Second World War, the industrialized global food system has put economic results and efficiency first, at the expense of the environmental and social concerns [2, 3]. All the issues related to the production of food have been perceived as rural concerns and therefore food infrastructure is absent in conventional contemporary urbanism [4, 5].

This state of affair is beginning to change with the realization, that the urban condition is becoming the sole form of habitation. Much has been written about the necessity of the systemic introduction of food production into cities and its environmental, technological, logistical, sociological, policy, and economic consequences [6, 7, 8, 9, 10, 11]. In this context, literature overview recognizes issues such as population growth, self-sufficiency, health-related issues, social inequality, urbanization and sprawl, biodiversity and environmental degradation, climate change, energy and resource use, and waste management. However, very little consideration has been given to the influence institutionalized urban agriculture is going to have on the urban form, its development, and the architect's role and there is virtually no planning for the implementation of agricultural city *in cruda radice*, but rather as an addon.

Architecture and urban planning have always expressed the ideals of the eras of their conception, present era not excluded. Thus, taking a reflective look at the history of urban planning ensures an objective and thoughtful assessment of contemporary issues when viewed from a broader temporal and urban tradition perspective. To this aim, the article identifies the characteristics of notable past designs merging agriculture with urbanism, to establish the criteria for effective planning in modern urban design. For this purpose quantitative and qualitative research methods were used to review past projects addressing the synergies between the urban and the rural conditions and the role of the architect in the process. On the backdrop of broader-known theories the study presents three Polish concepts. These analyses serve as the basis for pointing out notions that the most comprehensive of these theories have in common to indicate which urban components and patterns can accommodate the development of a sustainable and resilient agricultural city. Gathered informations is then presented in the form of indicators for a purposefully designed agricultural city. In accordance with already established research calling for systemic introduction of urban agriculture, the goal of this research is to point out urban typologies most suitable for accommodating agriculture and the configuration of a resulting hybrid urban-agricultural metropolis designed *in cruda radice*.

1.1 Key concepts

We face an unprecedented growth spurt in population. The cities take up 2% of world's land surface [12]. The urban population represents 57% of the global population. By 2030 this figure is set to reach 60% [13]. Cities sprawl into the farmland, taking up arable land and forcing/producing carbon footprint with spreading transportation routes. Therefore, as hubs of population and human activity, and as the main cause for increase in agrarian production, cities become central to addressing global sustainability challenges, such as reduced carbon footprint, better public health and the related benefits of pre-industrial farming techniques, including enhanced biodiversity and ecological sustainability. Throughout the history, the notions of agrarian and urban have usually been set apart or against each other [14]. However, urban sprawl, the shrinking of agrarian land and the supply chain disruptions, as well as the advent of food deserts, have placed urban farming at the center of the discussion on sustainable urban growth [15]. Cities across the globe are undergoing significant transformations to become more sustainable, resilient, and livable. One notable trend in this realm is the shift towards

regenerative urban models that emphasize cyclical resource flows, restoration, and the reintegration of natural systems into urban fabric. This gave rise to the concept of "Regenerative City". It seeks to synergize human activity and natural ecosystems, promoting resilience, sustainability, and self-sufficiency. Regenerative cities are characterized by their ability to restore and revitalize their own sources of energy and food, sustainably manage waste, and promote biodiversity. The approach is holistic, considering social, economic, and environmental aspects, and it fosters innovation and community engagement [16]. A regenerative city aims to operate on cyclical processes, minimizing waste, and optimizing resource use. This circular economy has gained widespread attention in the past decade [17]. Ellen MacArthur Foundation [18] defines the circular economy as one that "designs out waste and pollution, keeps products and materials in use, and regenerates natural systems". Instead of the traditional linear model of "take-make-dispose", it emphasizes a circular approach, where resources are reused, recycled, and regenerated. While the circular economy focuses on resource flow, a circular society extends this concept to human interactions, societal structures, and cultural norms. Building on the principles of the circular economy, which prioritizes regenerative design and the closed-loop use of resources, the concept of a circular society has a potential to contribute to sustainable development. A circular society minimizes resource extraction and waste, contributing to the preservation of ecosystems and biodiversity [19]. It could also contribute to economic resilience to global economic shock, by reducing dependencies on imported goods and creating localized value chains [20]. One of the pillars of a circular society is the idea of shared ownership and usage of resources, reducing the need for new product creation: shared economy. Collaborative consumption platforms, such as Airbnb and Uber, have popularized the concept [21]. Shared economies and collaborative platforms can foster stronger community ties, leading to enhanced societal well-being and social cohesion [22].

The regenerative city approach goes beyond sustainability to actively restore and renew its ecological and social systems. Its key features include: renewable energy infrastructure, water harvesting and recycling systems, integrative waste management, green and blue infrastructure networks and community-driven design and governance. Urban agriculture serves as a critical element in this paradigm, addressing food security while contributing to ecological restoration and community well-being. Urban agriculture is an industry (…) using and reusing natural resources and urban wastes, to yield a diversity of crops and livestock [23, 24]. Urban agriculture relates not only to the practice of cultivating, but also processing, and distributing food in or around an urbanized area, i.e. village, town or city [25]. It can involve animal husbandry, aquaculture, agroforestry, beekeeping, and horticulture. The importance of urban agriculture in regenerative cities cannot be deprecated. Plants absorb carbon dioxide, playing a role in climate change mitigation [26] through carbon sequestration. Moreover, community gardens can improve social cohesion [27], promote well-being and improve mental health by fostering social interactions [28]. Their value is also educational, because they serve to counteract the detachment of urban populace from the actual reality of origins of their sustenance [29]. Knowledge dissemination and building awareness about sustainability can instigate behavior changes, fostering a collective consciousness around circularity [30]. Additionally, urban agriculture has economic and public-wellbeing benefits, through creating jobs, promoting local entrepreneurship [31] and diminishing the risk of "food desert" occurrence [32]. Food deserts occur when neighborhoods lack access to affordable fresh produce because of the distance to a supermarket, median household income, vehicle ownership rates, and a measure of the availability of healthy food at local businesses. It could be mitigated by reducing reliance on external supply of goods and creating localized affordable food sources, like community gardens or allotments [33]. Having a local and resilient food supply reduces reliance on long supply chains, which are vulnerable to disruptions [34]. Urban farms can become a part of a city's green infrastructure, helping manage storm water, mitigate the urban heat island effect and

improve air quality. Therefore leveraging local resources and skills to produce goods and services fosters community resilience, at the same time reducing the carbon footprint [35].

In a constantly urbanizing world, making regenerative city a reality through the introduction of urban agriculture on a large scale becomes a sine qua non condition. This forces the overall integration of the concept into policies and the curriculum of academia. One of the initiatives, which promote biodiversity, sustainability, aesthetics and inclusivity in the design of urban spaces, is The New European Bauhaus (NEB), instigated by the European Commission; another is the United Nations' Sustainable Development Goals (SDGs), also known as the Global Goals. The New European Bauhaus leverages its platform to promote design innovation, education, policy advocacy, community engagement, cross-sector collaboration, and research and innovation, all of which play a pivotal role in promoting the introduction of urban agriculture into cities across Europe. The integration of agricultural practices within urban environments aligns with the NEB initiative by addressing the issues of sustainability and self-sufficiency but also resonates with the NEB's vision of creating aesthetic yet functional urban spaces. The United Nations' Sustainable Development Goals are a set of 17 interconnected goals adopted by all United Nations Member States in 2015 as part of the 2030 Agenda for Sustainable Development. These goals aim to address various social, economic, and environmental challenges facing the world. The SDGs provide a framework for countries, organizations, and individuals to work towards a more sustainable and equitable future. In 6 of the 17 goals (2, 11, 12, 13, 15, 17) urban agriculture can serve as at least a partial solution to the problem [36]. With initiatives like New European Bauhaus and The United Nations' Sustainable Development Goals in place, we are likely to see ever more farmland being accounted for systemically in zoning plans, as part of a paradigm shift in the food system.

The realization of the notion of regenerative city and urban farming is going to have profound implications not only for the philosophy of city-life but mostly for the shape and structure of the city itself. To fully appreciate the extent to which agriculture will affect urban morphology we need to acknowledge how many forms of urban agriculture and horticulture there are [37, 29]. First, there are community gardens. A community garden is a single site, which may or may not be broken into individual plots, that is gardened by multiple people. Produce is consumed directly by the gardeners. Sometimes it is shared or donated, but is not typically used to generate income. Community gardens and allotment gardens serve as hubs for community engagement and education; they foster local food production and resilience. Second, there is the urban farm. An urban farm is a type of urban agriculture that has a primary emphasis on income-generating agricultural activity. The urban farms are not simply farms located within cities, but rather unique projects that lay at the nexus of food production and community development. Urban farms may or may not be for-profit endeavors. In some cases, urban farms provide fresh produce to the communities. The most appreciated service that urban farms provide is counteracting urban blight by the transformation of vacant land and creating new jobs in the neighborhoods, as well as by providing space for recreation and education of young children. The distinction between urban gardening and urban farming lies also in the personal investment of the stakeholders. While the community gardening is mostly a pastime activity and therefore can be taken up or discarded at a whim, urban farming is a way of generating income, and therefore is a more permanent endeavor.

Incorporation of food production within surrounding urban areas is a sustainable method of regenerating existing cities and an ideal solution for regenerating brownfields to their productive potential. However it requires free space [38]. So far, urban agriculture was not usually factored in into spatial development plans, but was secondarily introduced into unused city areas [39]. Alongside vacant lots, brownfields, such as former railway yards, industrial areas, parking lots of abandoned supermarkets, former warehouses or even decommissioned airstrips became allotment gardens and

urban farms. Urban farming in this form includes a myriad of practices like rooftop farming and vertical farming [40]. Rooftops offer vast potential for farming, and rooftop gardens equalize the use of space in the city, as the same surface, which is occupied by the building is also bioactive. They can also improve thermal insulation of buildings [41]. The issue of limited space in urban settings can also be addressed by vertical farms: multi-story greenhouses, making use of hydroponic and aeroponic systems [42]. Because of this, compared to rural farms, urban farms are small, measuring up to a hectare (in the USA a few acres) [43]. Consequently, there is no need for heavy machinery like tractors and harvesters. The crops (as described by studies, e.g. [44]) are diverse and frequently comprise of vegetables and herbs rather than commodity crops. Animals that are farmed in the city are the small ones like poultry or bees. To yield sufficient crops under such constraints and with the scarcity of horizontal space within cities, AI and IoT and devices like drones, can help in maintenance, optimize plant health and resource use [45].

There are multiple challenges and considerations to take into account while planning the introduction of urban farming into historic cities. However, the biggest challenge is overcoming competing interests for space in urban settings [33] and ensuring adequate and sustainable water supply. However, the biggest challenge in this format of urban farming might be the so-called community buy in: ensuring communities have the knowledge to welcome and skills to maintain urban farms. Presently, practicing of urban farming depends in part on social perception of agriculture in the city. Urban farming challenges preconceived imagery people have of urban living. It also creates new challenges for farmers. Placing of the farm may depend on whether urban residents accept the idea of having a farm in their vicinity or whether urban communities see farming as an acceptable use of city space. Studies show that urban farmers depend on the good will of residents of neighborhoods to start and develop their businesses that, in the end, benefit the community.

The concept of the “Regenerative City” is underpinned by sustainable and resilient urban design, integrating urban agriculture as a fundamental component. Urban farming emerges as a pivotal solution to address the multifaceted challenges urban centers face, including food security, biodiversity loss, and environmental degradation. If urban agriculture is to become a viable factor in food production it must take up a significant portion of city land. Studies conducted e.g. in the UK have estimated, that current production is sufficient to supply the urban population with fruit and vegetables for about 30 days per year [43]. The results of models suggest that existing land cultivated for food could supply over half of the annual demand for vegetables and fruits, 25% of both poultry and shell eggs, and 100% of honey with numbers reaching up to 100% in most favorable models [29, 15]. Therefore, dispersed urban gardening, farming and allotments, even combined, cannot suffice to feed the cities. As a result, the model advanced in future city planning should be planned city farming. Thus, it cannot be dependent on potential community’s approval, but must become a part of systemic planning: a zoning code, which would allow for urban farming in certain designated places depending on spatial merits not voluntariness of the communities. Agricultural production must become a formative element of city structure, rather than an attachment to already existing structure.

The 21-century is not the first moment in history, when city farming is posed as a solution to forming a comprehensive city of future. There were quite a few propositions in the history of urban form perceived through the spatial, ecological and infrastructural import of agricultural production. The choice of projects presented in the paper is based on the principle of creating innovative urban morphologies integrating agrarian and urban notions, incorporating urban agriculture as a fundamental component to city planning. This elective recapitulation seeks to construct a useful foundation for determining the economic, ecological and spatial order of the city projects organized specifically around the role of agriculture. This paper explores urban farming's role in realizing regenerative cities, with a

focus on futuristic urban scenarios both presenting historic propositions and exemplified by several present agricultural urbanism initiatives and technological advancements.

2. THE STATE OF RESEARCH

The significance of urban agriculture (UA) lies in its multidimensional positive effects on the urban environment from crisis readiness through social wellbeing to sustainability and economic profitability. These aspects have already been researched and proven by various authors.

2.1. Positive effects on the urban environment

Urban agriculture has profound implications for the sustainability of cities: economic, environmental as well as social. It has the potential to become an effective tool and solution to many contemporary challenges, as examined by Nicholls et al. [47, 48]. First, urban green space is a necessary component for delivering healthy, sustainable and livable urban settings particularly among lower socioeconomic groups as stated by the WHO [49] and the SDGs [50]. Studies such as [42, 51, 41, 48] demonstrate, that by utilizing vacant lots and rooftops, urban agriculture adds volume to urban green zones, offering numerous environmental benefits, including air quality improvement as well as reduction of heat island effect and greenhouse gas emissions [6, 49, 50]. The greening of vacant plots counteracts soil erosion [54, 55, 56], provides shade and evaporative cooling, helping decrease temperatures and improve air quality in cities [57]. The presence of vegetation in urban areas mitigates the urban heat island effect, which occurs when urban surfaces absorb and retain heat, leading to higher temperatures compared to surrounding rural areas. In some cases, the green canopy of urban farms might be used as nature based solutions in maintaining climate control in buildings [58]. Moreover, urban agriculture enhances carbon and other air pollutants sequestration in urban soils and in biomass [59].

In addition to improving air quality, urban agriculture contributes to the reduction of greenhouse gas emissions through several mechanisms [60]. Firstly, urban agriculture promotes local food production and distribution. Placing agricultural production closer to cities reduces the supply chain lengths, decreasing the ecological impact of cities while fostering greater synergy among urban residential, industrial, and agricultural sectors [61, 62, 63, 64]. There is also less need for secondary storages, further reducing the carbon footprint. What's more, urban agriculture promotes the adoption of sustainable agricultural practices such as composting, which reduces methane emissions from organic waste decomposition in landfills [65].

2.2. Crisis management

Furthermore, by establishing a local food supply, cities can bolster their self-sufficiency enhancing their ability to withstand crises and natural disasters, therefore increasing their resilience to climate change impact [66]. Reducing supply chain lengths might serve as a safety measure for urban communities during emergencies, particularly when the transportation of food from rural to urban areas and from abroad is disrupted. Urban agriculture has the potential to serve as a buffer for food security mitigating vulnerabilities in urban communities during economic crises [67], when prices of imported foods soar.

2.3. Economic Opportunities and Social Impact

Urban agriculture can benefit the urban society as a whole by adding to the pool of its available sustenance sources. More importantly, it can give the underprivileged incipient access to proper nutrition. UA can also help provide a healthier diet and nutrition to the urban poor [68]. However, the benefits are not only one track. There are multiple forms of urban agriculture, from recreational to almost

industrial. Even allotments, which are mainly a source of fresh vegetables and fruits for those who cultivate them, can be a source of income, if proprietors sell the surplus. The large-scale controlled environment vertical farms, plant factories, and greenhouses [69] work for profit, yealiging 7-8 times more food through a year-round production [70]. Such efficient urban agriculture might become a valid livelihood strategy for city dwellers by creating "green jobs".

Large-scale urban agriculture operations will create new jobs for both manual workers and in trading and food processing in local communities. This might help ease some of the immediate challenges experienced by urban residents with low income or unskilled manual workers by widening the pool of job positions attainable to them, diversifying the income sources for households and thus enhancing their ability to cope during periods of financial hardship [9]. Consequently, efficient urban agriculture has the potential to give people widespread access to fresh products [71] while reducing their food expenditures [72], and without widening environmental impact [64]. Therefore, the inception of urban agriculture and the resultant creation of "green jobs" in the cities has the potential to make them resilient to external threats and self-sustaining in terms of economy and sustenance.

Moreover, the legitimization and institutionalization of UA will dissolve the very real problem of the exodus of rural populace into the cities, which impairs the agricultural capabilities of some regions and contributes to the urban sprawl. The predictions show that 68% of the global population is going to migrate to cities by the year 2050 [47]. Implementation of farms in the cities could prevent those rural migrants from becoming low-skilled manual laborers or from the necessity to requalify. This would also solve the problem of loss of traditional agricultural professions and knowledge. Experienced and seasoned farmers could practice their skills in the city, taking advantage of the amenities of city life, while retaining and passing on their knowledge. Therefore, the question of depopulating country and overpopulated city will devaluate, for the reason that the city will take over some of the agricultural production and therefore become a new form of agricultural development.

However, even with the obvious merit in integration of urban agriculture with local policy, little has been done in this direction yet. Unregulated rapid urbanization brought fourth the concept of sustainable cities, which prioritize a balance between economic development, environmental preservation and equity in various aspects such as income, employment, housing, basic services, social infrastructure, and transportation [73]. Granting, that UA has been, to a certain degree, considered in policy planning, it has generally been marginalized as compared to other aspects of urban development [74, 39]. Even with the advent of New European Bauhaus (NEB) the UA has not been addressed directly, but can be deduced only indirectly as a desired solution to boundary conditions set by certain policies, e.g. New European Bauhaus Compass (NEB Compass) or United Nations' Sustainable Development Goals (SDGs). Specifically, governments in The Global South are hesitant when it comes to allocating precious space within city centers and downtowns for urban agriculture [75, 73]. Consequently, large urban farms are for the most part situated on post industrial land, brownfields or on the outskirts of the cities due to lower land prices [73]. Given that assigning urban land for agricultural purposes can generate all the additional social, economic and environmental benefits, soon it will become essential to recognize Multifunctional Land Use, Smart Growth and the Compact City Concept as the necessary components of land development policies [58]. In other words, UA should be integrated with wider development objectives if municipalities are to make the most of all it has to offer [76, 77].

However, despite its promising aspects, urban agriculture also presents limitations and drawbacks. The main concern is the availability of land which could in urban areas be transformed into farms, particularly as cities continue to expand [78]. Efforts are underway to address this issue through innovations like vertical crop cultivation. However, the price of the installations and the know-how is significant and might be inaccessible for the poorer population, as certain specific know-how is required for the large-scale operation of UA installations for commercial gain. Moreover, while the data indicate

that conventional urban gardening has the lowest yields (1.20–1.35 kg/m^2/year) and thereby the largest land requirements, while hydroponic urban rooftop gardening has the highest yield (19.53 kg/m^2 /year) and thus the smallest land requirements, the more effective technologies are at the same time most energy-consuming [79]. The next concern is, that the UA might be used for gentrification or that the introduction of UA might lift the rents in the neighborhood, leading to accidental gentrification [33]. Another obstacle is the defunct or insufficient legislature constitutes the ultimate problem. In densely developed and populated areas, the introduction of UA is problematic. The agripreneurs must adapt to the existing conditions and customs in local communities, gain trust of local inhabitants and negotiate their way through clandestine regulations. There can be resistance from businesses that rely on the linear economic model [80]. The resistance might also arise in parts of the societies themselves stemming from deep-rooted consumerist values [81]. Also essential for the success of a circular society are adequate technological solutions for recycling and repurposing of goods [82]. In some cases, this has hindered or completely prevented the integration of UA initiatives into cities [79].

The cities will keep growing and encroaching on the periurban and arable land. Constantinos Doxiadis even envisioned a city taking up the whole of the planet [83]. Agriculture must therefore form a symbiosis with the city, they must become entwined. The city must become permeable to the village and become "entopia", as envisaged by Doxiadis – a place for everybody. We are dependent on agriculture to sustain cities and agriculture is dependent on the city to be its market. Instead of expediting agricultural production outside, these two should be combined. The analysis of the advantages and the disadvantages of urban agriculture shows, that the pros outweigh the cons and that most of the negative aspects stem from the fact, that the farms are added to existing cities with established urban structure. Those limitations and liabilities connected to "introducing" UA to the cities would be mitigated if an agricultural city was planned from the beginning.

3. RESEARCH MATERIAL: REGENERATIVE CITY (A HISTORIC PERSPECTIVE)

Urban and rural lifestyles have always stood in opposition. Nonetheless, contrary to popular conviction food production was always a part of urban life [23], gaining in prominence in times of crisis, like war or recession and taking up the form of war gardens or allotments. It was no different with the resurgence of urban agriculture in modern times. It also stemmed from the emergence of food deserts and the food injustice, as a strategy to minimize economic disparities in urban spaces. However, this time those notions were the effect of the dynamics of current city life itself. Therefore, to counteract a problem which is all-encompassing and stems from systemic policies, the solution needs to be much more widespread and institutionalized. However, the focus of this research is the formal aspect of an agricultural city, without socio-political differentiation. Therefore, political conditions surrounding the creation of the specific theories are not covered in the research.

Architects such as Leberecht Migge, Frank Lloyd Wright, Kisho Kurokawa and Władysław Czerny acknowledged the necessity of marrying farmland and city and anticipated possible forms for urban farming. Their designs and theories explore a concept of a city where agriculture is a formative element of urban structure, included in spatial policy and introduced systemically. Their analysis will serve as the point of departure for elaboration of possible policy for an agricultural city for the 21st century.

The early grand designs of a city, which incorporated much greenery and embraced its connection to the country date back to the mid-19th century. Rapid industrialization and the social changes that resulted gave impulse for the creation of numerous visions of a healthier, more dignified life in the city.

In 1795–1834 the allotment gardens appeared in England, at first beyond urban areas [84, 85]. Starting from 1814 [84], allotment gardens (ger. Kleingärten) started appearing in the German Confederation as gardens for the underprivileged social strata: unemployed, poor or the factory workers set up by the prominent factory owners [86]. In major cities in German realm allotment gardens were founded between 1830 and 1840: in Cologne, Leipzig, Berlin, Frankfurt and Wrocław [87]. The movement gained traction due to activism of Leipzig doctor Daniel Schreber (1808-1861) - an orthopedic surgeon and scientist from Leipzig – who promoted the creation of urban playgrounds for the betterment of children's health. First Schreber garden (*Schrebergärten*) was established in Leipzig in 1864, with others appearing in Germany since the 1870s. Schreber gardens were carefully planned with a common square and a central playground as their main feature. These were the first allotment gardens for use by all social classes. In addition to cultivation of vegetables, fruits and flowers, the gardens provided a place for outdoor activities for children, providing economic, educational, health, cultural and recreational benefits, integrating local populace in the process. Following World War I, allotment garden areas grew all over German cities to provide food for impoverished population.

At the same time, in 1898 Ebenezer Howard published "To-morrow: A Peaceful Path to Social Reform", later reissued in 1902 as "Garden Cities of To-morrow" [88]. In this book, he proposed the founding of "garden cities". They were intended as self-sufficient entities, consisting of single-family housing districts, with a population of around 30,000 and each ringed by an agricultural belt unavailable to builders. Howard did not advocate own food production, despite rooting for a private garden in every house. However, his mention here is due to the fact that he was the first to create a holistic approach to the city *in cruda radice* using greenery as a component equal to gauge. He was attempting to reverse the overpopulation of cities and create settlements with the economic opportunities and the amenities of large industrial cities, but the amount of greenery a rural area would provide.

3.1. Leberecht Migge and a self-sufficient man

The first to introduce regular agriculture to cities was Leberecht Migge. Taking incentive from the experiences of the First World War, Leberecht Migge looked for solutions to the catastrophic approvisation situation and the increasing housing shortage. In 1918, Migge published a pamphlet "Jedermann Selbstversorger!" [89] (every man self-sufficient). In it he presented a detailed concept of a settlement, self-sustaining in terms of accommodation and food supply. Leberecht Migge's aim was to free people from the instability and fluctuations of the city market economy by returning them to the land, as he proclaimed in "The Green Manifesto" [90]. Migge counted on establishing a new connection between the countryside and the city. The plans he developed, often in collaboration with architects, followed the principles of the Garden City. His settlement for a self-sufficient man was composed of simple residential buildings with adhering garden plots and of the communal fields outside of the private gardens. The size of the productive garden and leasable land varied depending on the number of residents, starting with 200 m^2 garden and 200 m^2. field for a 5 person family (for comparison reasons 400 m^2 equals 0.098 ac). The communal fields accommodated not only the arable land and livestock farm but also fish ponds, communal spaces for festivities and sport fields with playgrounds. Migge was also interested in the urban form of a settlement composed of houses with productive gardens. He championed the establishment of allotment gardens, which in addition to self-sufficient garden housing also played an important role in providing the population with independent food source. What enabled families to become completely self-sufficient and to generate additional income by selling possible surpluses was intensive horticulture. Migge's concept was very detailed and dealt, among other things, with the question of the ideal property size. He also predefined structure of the gardens to make it easier to get started with self-sufficiency. He encouraged the use of machines to maximize crop yields: "Mehr

Arbeitskraft durch Maschinen" ("The Green Manifesto", 1919). However, what he proposes is in no way a return to the country but a rejuvenation of the city. He saw gardening as a factor in uniting the family. After performing daily duties, the whole family was to gather in the garden for work: maintenance and harvesting.

3.2. Frank Lloyd Wright's Broadacre City

Broadacre City, was a visionary urban design concept proposed by Frank Lloyd Wright as a response to the inadequacies of 20th-century urbanization he perceived. Similar to today, during the early 20th century, rapid urbanization, alongside the Great Depression's socio-economic effects, made cities a grim place to live. Wright, already known for his Prairie House style, presented Broadacre City as a panacea to urban ills, emphasizing individual freedom and connection with nature. Conceived during the 1930s, this model envisioned an idealized decentralized urban landscape where every family would be granted an acre of land to build and cultivate. Wright's Broadacre City was presented in his 1932 book "The Disappearing City" and was further elaborated in subsequent writings and lectures.

Design Principles of Broadacre City stemmed from uniquely American expectations towards freedom and the way of living. Wright insisted that the big city was against freedom and against natural impulse of individuality. He saw city life as oppressive and degrading, and argued that "the big city is no longer modern". To him it was a way for a primeval human to breed safely and that was the reason why he surrendered his natural nomadic nature, his individuality and allowed "real life" to be substituted by the "expedients" of a big city.

Wright observed that the development of electrification and communication methods contributed greatly to human freedom. He predicted a rise in car ownership, expecting aircrafts would be as common means of personal transportation as a car thereby allowing people to live further apart. He also spoke of the telegraph, the telephone, radio and television as means of thwarting the difference between distance in miles and in thousands of miles. Therefore, the compactness of big cities was no longer necessary and viable. In addition, he reasoned that improved mechanical systems of refrigeration, heating and lighting upstaged the dependence upon the centralized service systems of the city. To him, modern architecture was no longer the vertical architecture of a big city, but a horizontal architecture, which corresponded to life, therefore was organic.

All the inventions of a mechanized big city made possible the departure from dense urban centers and the progression to an ultimate way of living, which corresponded, with the primary, most natural means of habitation. Broadacre City design favored low-density, sprawling urban layouts, contrasting sharply with the high-rise, dense urban centers of its time. He perceived detached houses and the only natural way of habitation for a human, who was by nature an individual and could be productive only when exercising his individuality. Each family would own at least one acre of land (4000 m^2), ensuring a degree of autonomy and closeness to nature. It provided ample space for a house, garden, and other outdoor amenities. This would ensure a harmonious blend of built environment and nature, allowing for self-sustenance and a closer connection to the land. Wright believed in the importance of personal transportation, predicting a rise in car ownership, and thus, the need for an efficient road network and ample parking. He also believed the car was integral to personal freedom, thus he undertook automobile-centric planning: designing road networks as a significant feature. Public transportation, in contrast, had a reduced role, given the vast distances and the envisioned self-reliance of the automobile. To alleviate congestion and the centralized bureaucracy of cities Wright proposed decentralization. Unlike traditional cities where commercial and administrative buildings clustered in a centralized downtown, Broadacre City dispersed these throughout the urban fabric. This decentralized approach reduced congestion and created a balanced distribution of services and amenities. Given the emphasis on self-

sustenance and connection to nature, large tracts of land were reserved for farming and recreational purposes. These areas were interspersed with residential and commercial zones, promoting a holistic living experience.

Fig. 1. A bird's-eye view of the mock-up presenting Wright's proposition for Broadacre City (elaborated by author)

In keeping with Wright's organic architecture principles, the road network was not superimposed but integrated with the natural topography. This approach reduced the environmental impact, preserving natural landscapes and ecosystems. The roadways in Broadacre were to be expansive, incorporating new design techniques to ensure high-speed, safe travel across long distances. The hierarchical road structure ensured seamless connectivity between various urban functions—residences, farms, industries, and recreational areas. This interconnectedness fostered both efficient transportation and the decentralization principle, as residents could easily access resources without long commutes.

Broadacre City was therefore not just about dispersing populations. It had a set of defining principles established to assure freedom, self-sufficiency and resilience of households, prevent social exclusion and homelessness – induced by the big city. Each family would cultivate their land, supported by advanced technology, ensuring self-sufficiency and resilience. Farms would be self-sustaining units, producing not only food for their inhabitants, but also furniture and clothing. They would also constitute

the primary educational facility for adolescent pupils, who would participate in educational process through radio, television and by postal service.

The guiding principle here was that by living off your own land, you are cushioned by the inertia of harvesting process from sudden market swings and inflation in food prices. In addition, it is less plausible that you are evicted on the street. While there might be difference in opinion in the family, it takes care of its own, weather less capable, senile or disabled, preventing homelessness and displacement of seniors to care facilities.

3.3. Ludwig Hilberseimer: The New Regional Pattern

Same as previously discussed designers, Hilberseimer presented decentralization as a remedy for the ailments of the city in the industrial age: pollution and insalubrities, crime and slackening of the morale, traffic and dehumanization of residential environment. Born and educated in Karlsruhe, Germany, Hilberseimer worked with Mies van der Rohe at the Bauhaus, evolving his designs for a metropolis *Hochhausstadt* (Highrise City): strict, totalizing, even totalitarian – with architecture fit for a big city (*Großstadtarchitektur*) [91]. First urban models of Hilberseimer were the embodiment of the new social order of an industrial society. He was interested in theorizing a modern architectural practice that responded to the development of industrial technologies and the corresponding transformation of the individual in society [92]. He used to see the city as a space of concentration of capital, industry and people, built to serve the dynamic of the relation of the three and boost the productive potential of the society. He also perceived that the role of an architect has changed. The architect was no longer responsible for the development of architecture and urban structure, but rather responsible for organization of the efficiency of the metropolis. He reflected upon the minimum dwelling space of an apartment as means of provisioning each citizen with equal hygienic living space. As avid supporter and propagator of a high rise metropolis as he was, Hilberseimer nevertheless noticed the impact of the crisis of the 1929 and the great depression. He still believed that the innate feature of a metropolis, setting it apart from other urban typologies, was the specific relationship between its inhabitants and industry. However, after the crisis, he softened his views on how much it should affect the spatial disposition of an urban center. He searched for ways to mitigate the impact of the nature of the metropolis on the lives of its inhabitants. He turned away from his initial dedication to high-rise and begun developing myriad of designs interconnecting low-rise with effective land use and public amenities planning. This he tried to achieve by dissolving the built fabric of the through the use of the single-family home and its insertion into the landscape. He came to a conclusion, that the metropolis should be constructed of mixed-height housing to create settlements of lower density. Residential districts would become decentralized; citizens would have a small plot of land in proximity to the natural environment. Beginning with the sketch he made of the "View of the Heerstrasse and the University of Berlin, Germany, Perspective" (1935) Hilberseimer elaborated his version of the modern superblock, a form of planning that dissolved the traditional city grid in favor of larger tracts of land that could support single and multiple family dwellings with walkable cul-de-sacs for residential areas and framed by larger streets and transit. This decentralized model of city planning was conceived in Germany, however the development of his thought was sped up, when after the Nazi rose to power he joined Ludwig Mies van der Rohe, in emigration to the United States in 1938.

Starting with the design of *Mischbebauung* (Mixed Height Housing) in the 1930s, Hilberseimer worked to develop a general solution to all the parts of the city in relation to each other, so as to allow unrestrained future urban growth without encroaching on space allotted to other activities, e.g. industry and agriculture. By the mid-1940s, Hilberseimer's notion of the Settlement Unit clarified, articulating precise relationships between transportation networks, settlement units, and the regional landscape.

Moving to Chicago Hilberseimer published his first English-language book on planning, The New City: Principles of Planning (Hilberseimer, 1944) which explained his commitment to spatial order as an expression of social order. He associated social equity with arable land and access to sunlight proposing a proto-ecological urbanism. This Decentralized City used landscape as a medium of urbanism for the modern metropolis [93]. His second English language book published on urbanism in 1949, The New Regional Pattern built upon The New City: Principles of Planning, reaffirming some principles and reusing several key concepts along with diagrams and drawings. The New Regional Pattern presented a decentralized urban design, focused on region, its geological determinants and ecological potential: topography, hydrology, vegetation, wind patterns and insolation patterns.

He recognized several components that make up the city and he proposed their arrangement based on their interdependencies. The components depended on uses: the road system, the dwellings, the industry, the civic spaces, services and commerce and the nature and agriculture. Each of these was conceptualized to independently work to its best capacity and then integrated into the whole in a way preventing present and future conflicts. Hilberseimer organizes the components in self-sustaining units structured as a "semilattice" or "tree" structure [94]. It would not exist as a centrally focused city, but as a decentralized network of settlements of varying scales that would branch from a regional highway system almost in a fractal like pattern. The road system consisted of highways accompanied by railroads, with exit lanes and merge lanes allowing access to and from thoroughfares to settlement units. The merge lanes adhered strips of land allotted for commerce and industry, allowing for swift debarkation of raw materials and goods. Each connected through circular node to a single thoroughfare, which in turn bifurcated into multiple cul-de-sac neighborhoods. The residential areas were constructed of single story buildings with gardens. These neighborhoods were separated by green belts where Hilberseimer placed schools and sport facilities. An agricultural area was meant to adjoin these parks. The interconnection between the greenery of the gardens and the vegetation gave an impression of being surrounded by nature, allowing a more direct relationship with it. The residential areas would be within walking distance of the working area. The settlement unit was the basic unit for conducting all the day-to-day affairs of the community: production, agriculture and industry. These settlement units could be combined into groups. In urban planning these groups would assume linear form or fanlike pattern, resulting from specific land and economic conditions.

Such unit should preferably be self-sustaining and balanced in extraction of raw materials and production: agriculture and industry should process the raw materials that the region provides and would create diverse employment. A region ought to consume mostly its own goods and harvest, importing nothing that it might produce itself. The function of trade should be reduced to supplement the deficiencies of one region with the abundance of another.

Each of the components could freely expand: the industry along the highway and the settlement units along the thoroughfares, until it was time to start another section of this decentralized megalopolis. The Decentralized City would have no hierarchical center, instead using the existing historic cities as the regional centers. Such centers, evidence of the achievement of a nation, would continue to remain as economic, cultural and administrative focal points. He did not perceive concentration and decentralization as mutually exclusive. He accepted their potential coexistence, as long as each fulfilled its function, therefore saw no need for eliminating the existing metropolises. He assumed that the fact, that they constituted economic and cultural centers need not imply that vast numbers of people must crowd into them [95].

This abstracted settlement unit was meant to adapt to the peculiarities of location it was going to occupy: the land, geography, topography, man-made landscape and resources of the region. In the settlement unit, everything was meant to be surrounded by vegetation. It was decorative - treated as a screen: to shield single-story buildings from potential curiosity of the neighbors; to shield southernly

exposed elevations from overheating. It was recreational: allowing men a direct contact with nature. It was utilitarian: consolidating agricultural and industrial production. Vegetable gardens next to the settlements would be used for both recreation and agricultural production as "production park system" decreasing the need for superficial maintenance in recreational areas.

This new network pattern of development allowed for the seemingly infinite growth of the urbanism. Hilberseimer argued that city planning must become more and more the regional planning of interdependent economic units [96]. The project of the Decentralized City was not a "city" sensu stricte, but a pattern for regional growth anticipating a dispersing of the city into the countryside. It merged infrastructural systems with built landscapes and used environmental conditions to produce a radically place-specific settlement pattern. In this regard, the project offers a profound critique of traditional urban form and the inadequacy of traditional city planning discourse to deal with the social and technological conditions of the modern age.

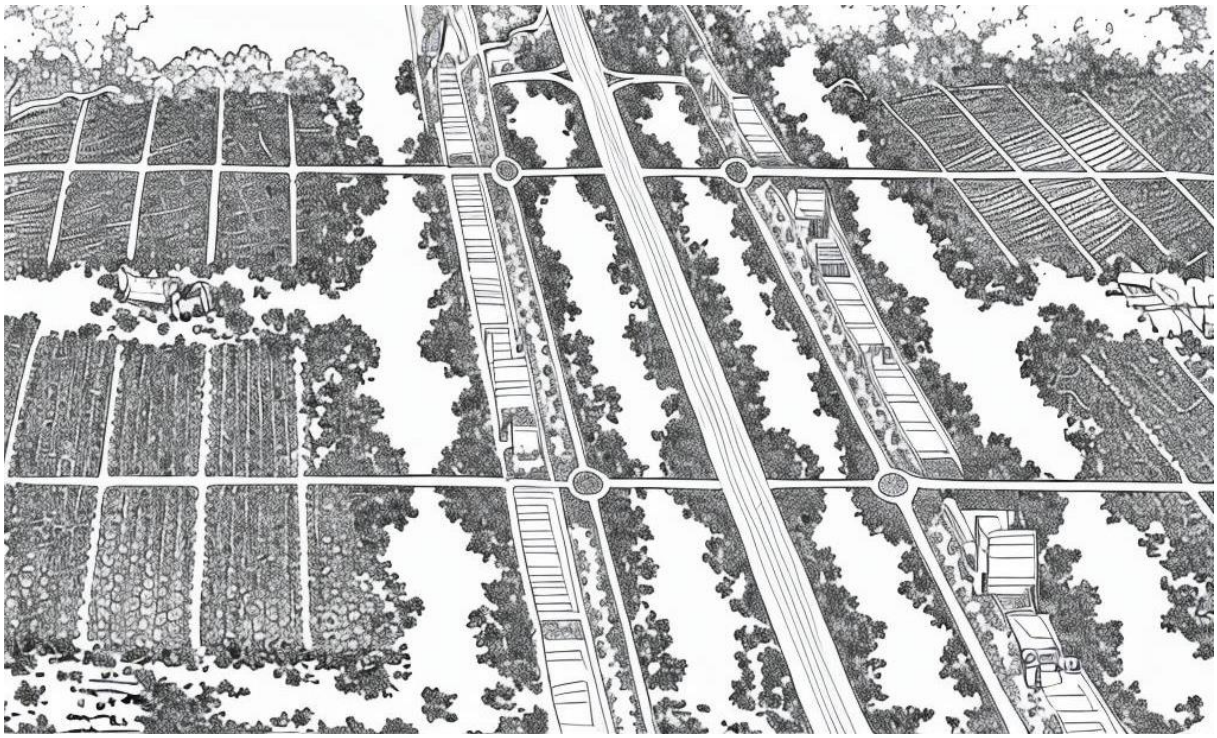


Fig. 2. A bird's-eye view of Hilberseimer's design for a decentralized urban pattern (elaborated by author)

3.4. Kisho Kurokawa: Agricultural City

Kisho Kurokawa (1934–2007) was a Japanese architect and one of the founders of the Metabolist movement in architecture. Metabolism emerged in Japan during the 1960s, emphasizing flexibility, modularity and the idea of buildings as living organisms capable of growth and change over time. Kurokawa's work often featured futuristic designs and innovative use of technology, with a focus on creating adaptable structures that could evolve with the needs of society. One of his notable projects was the Agricultural City 1960 [97], which he proposed as a futuristic vision for urban agriculture. Concerning urbanism, Metabolists proposed new concepts such as megastructures, group form and capsules. Kurokawa promoted a "Master System" for city planning, which he defined as a "Four-dimensional Master Plan," taking Time Module into consideration ([98] cited after [99]). Agricultural

City was the example of such megastructure, designed to facilitate safe and resilient habitation on land frequented by tsunamis. Kurokawa witnessed the Ise Bay Typhoon in 1959 and its damage to actual agricultural settlements. This experience inspired the idea of Agricultural City.

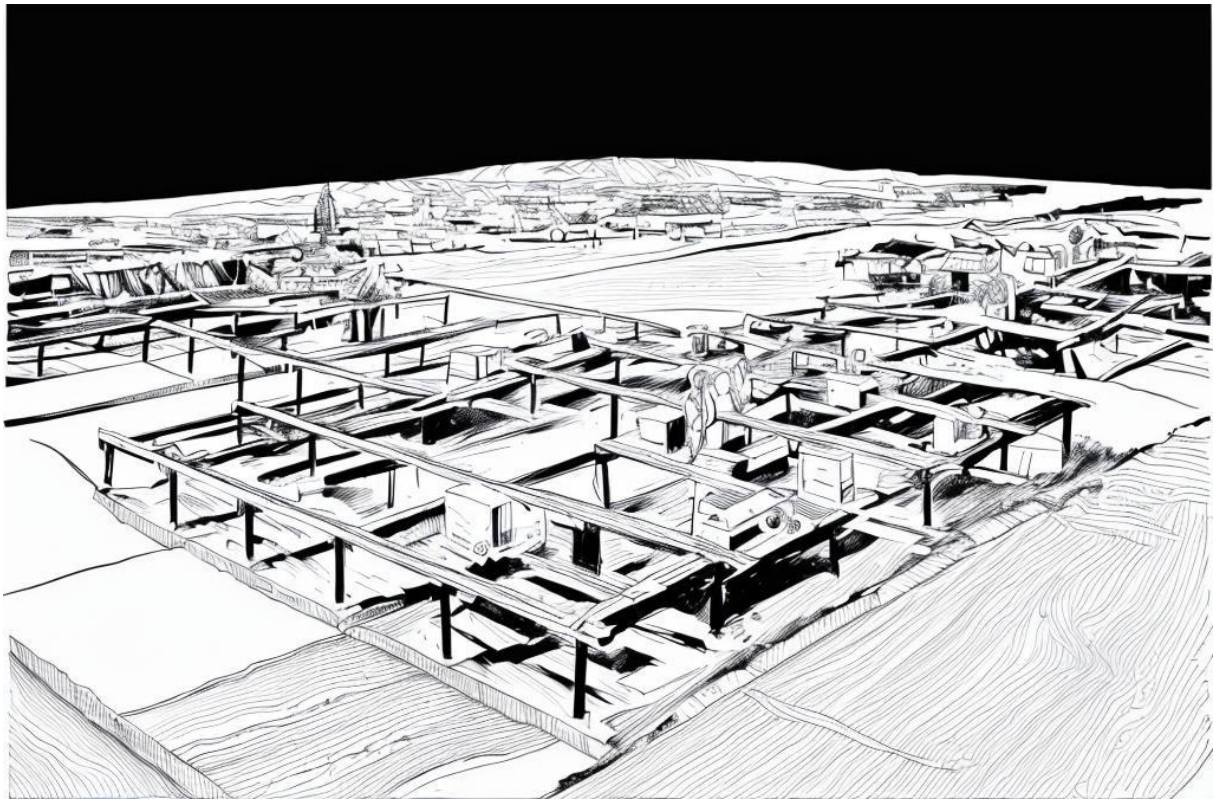


Fig. 3. A bird's-eye view of the Agricultural City megastructure (elaborated by author)

Kurokawa's design intended to offer a solution that allowed the nature to have its course without having devastating effects on human development. It proposed a radical solution of elevating the whole city on concrete slabs raised on pillars 4 m over the soil to prevent the habitat from flooding. The Agricultural City was also a group form. The average size of a rural settlement in Japan at the time of the development of the prototype was 500 m by 500 m. This became the measurement for the basic unit of the prototypical structure of Agricultural City, which could be expanded by another such megastructure unit. A grid of streets, which accommodated supply lines and utilities as well, organized the form. Each megastructure in the group form was a square 5 by 5 units, each measuring 100 m by 100 m. While each of the square units composed of several households is autonomous, linking these units together creates a village. This 25000 m^2 prototype was planned to house an average size of an existing community, approximately of 5000 people as well as public buildings, such as Shinto shrines, grammar schools, and community centers. The use of grid structure allowed for varied placement of elements, creating different urban patterns and diversified landscapes within this highly hierarchical scheme. Housing was designed in the form of "mushrooms shaped" edifices, one to three floors tall, and opening to the sky through a skylight. The construction of the houses resembles the "capsule idea" of the Metabolists. The facility has a sort of a central service shaft to which living quarters are attached. Water, electricity, and gas are provided as municipal facilities. The equipment shaft is the center of the mushroom structure.

Agricultural City was as much a practical solution to a natural disaster, as a challenge to a dichotomy of urban and rural. It contested the prevailing assumption that urban and rural environments were inherently antagonistic, instead promoting harmony between agriculture and urban living. This reflected Kurokawa's adherence to the principles of Metabolism, an architectural movement that sought to combine architectural megastructures with organic growth and renewal. He stated: "I believe that rural communities are cities whose means of production are in agriculture" [98]. He argues that, Agricultural cities, industrial cities, consumption cities, and recreation cities should each form an integral part of a compact community. A distinct urban system should exist between those cities. Agricultural cities have potential as future cities. And that is the reason why it is necessary to have a basic plan for their future expansion.

3.5. Władysław Czerny: The Architecture of Settlement Complexes

Władysław Czerny was a Polish architect, urban developer and academic teacher. In 1972 he published a comprehensive study diagnosing the current state of urban built environment and presented his own proposal for the advancement of urban planning – "The Architecture of Settlement Complexes" (translated by author, original title "Architektura Zespołów Osiedleńczych").

Czerny strived to debauch claims, that high-rise cities are more economic in terms of land use and amenities development. He stipulated that perceived by some "special value" of urban areas is only the utility value measured by the ability to meet the bureaucratic needs. In his argumentation a person must not be disadvantaged in terms of living and settlement conditions as a result of the "market" value of the area in which he or she lives. The socially justified value of the area depends only on its availability through appropriate communication policy and its equipment in utilities, the densification of which towards the city center is not justified. The main principle of his theory of settlement complexes was land policy, communication and infrastructure development should serve the bio-urban needs of residents, and cannot be driven solely by what he calls "technocratic pseudo-economics" of "using richly developed land" at the expense of human living conditions. He claims that the pyramid shaped arrangement of residential zones, consisting in the increase of density and pilling up of buildings towards the center of the city, was born from land speculation and rent boosting. It is contrary to contemporary requirements rationale behind land development. Therefore, the same conditions of development and housing should be maintained both in neighborhood units located directly adjacent to the commercial and service centers of downtowns, as well as in estates located furthest from the central district. One should also always keep in mind that every estate should be properly connected to the rest of the settlement by means of public transportation with commuter rail and properly structured road system. All varieties of "megalopolism" or the "cult of metropolitanism" should be rejected as anti-humanistic tendencies, arising either from land speculation or from attraction to wrongfully comprehended monumentality.

The basic criterion set by Czerny for the rational development of the estate are equal development, accommodation and living conditions, depending only on the characteristics of the needs of individual groups of households occurring in the appropriate proportion in each settlement. He argues that a resident, regardless of the location of his residence in the city, has the same right to the biological space directly adjacent to his apartment. The concentric, compact development of cities corresponding to the 19th-century network scheme (checkerboard or radial-ring system), based on the requirements of horse-drawn transport, should be stopped. Czerny's proposal assumes urban complexes should be developed in the form of chains of independent housing estates strung on electrified commuter railway lines.

In this model, 16% of a population of 110,000 live in semidetached houses. These houses occupy 20% of the total land, which amounts to 5-7 km². The center of this area covers 20 ha, with the remaining

area being equally divided between residential estates and their associated utilities. The urban design of such an autonomous city would be fragmented and resemble branching patterns. Using a fragmented layout was meant to promote healthier urban conditions. Additionally, he perceived fragmented systems as resilient as they are less sensitive to changes in living conditions because of their superior adaptability. Owing to this decentralized system residents are always within 80 m of a green recreational area and no more than 500 m from open landscapes. Another distinctive feature of this urban system is its intimate connection with the open landscape, particularly arable land. This fosters favorable bio-urban conditions and establishes a direct relationship between the city's inhabitants and horticulture as a potential workplace.

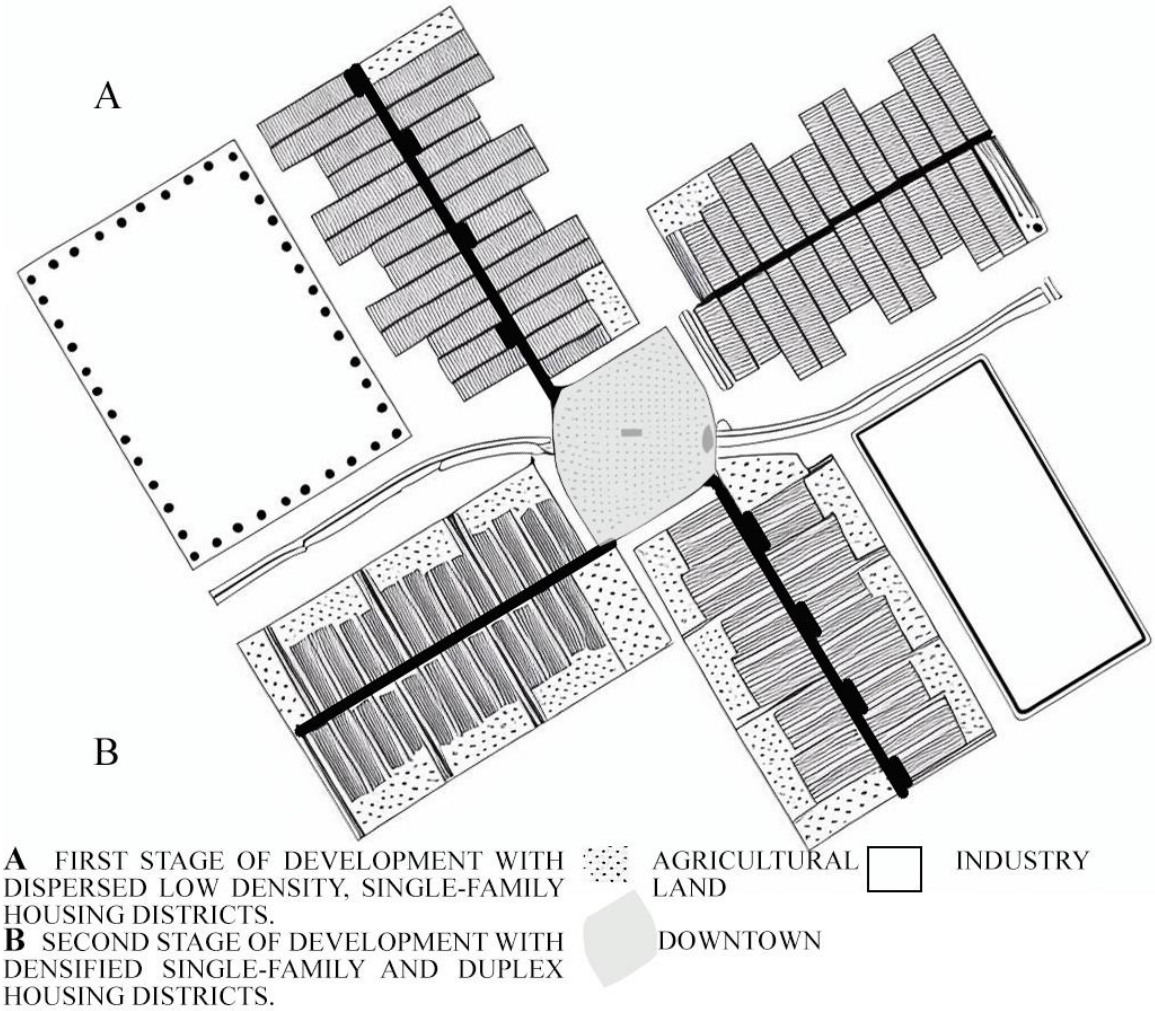


Fig. 4. A plan of a city implementing Czerny's idea of gradual formation from agricultural settlement to union of self-sufficient settlement complexes of semi-agricultural provenience (elaborated by author)

Czerny emphasizes the importance of intensively cultivated green spaces that permeate the city's built-up areas. This is because only well-maintained greenery can provide the city with the necessary conditions for a healthy climate. Such well-maintained, "living" greenery provides a supreme setting

for pedestrian and recreational pathways. The responsibility of maintaining such green spaces primarily lies with the municipal authorities. This cultivation can also offset some of the agricultural yield losses brought about by urban development. The areas adjacent to the planned individual cities could contain at least 240 ha of intensive horticulture and agriculture areas and would provide significant employment to city residents. The urbanization mode used in this system would create a clear division into construction and non-construction areas. It would put an end to wild parceling and development and, instead of sudden changes in land use; it would gradually and organically develop the intensification of urbanized areas.

3.6. Andrea Branzi: Agronica

Andrea Branzi (born 1938) is an Italian architect, designer, and theorist known for his contributions to the Radical Design movement in Italy during the 1960s and 1970s. Radical Design sought to challenge conventional notions of design and architecture, advocating for greater experimentation, social engagement, and sustainability. Branzi's work often explored the relationship between architecture, society, and the environment, proposing alternative visions for the future of cities and urban life. The Second World War had many implications for society and architecture similarly as the first one did. Shortages of food in besieged cities caused starvation and inspired the citizens to plant vegetables in parks. The internet, digitalization and social networking at the end of the 20th century, changed the way of life and work. In response, Andrea Branzi proposed novel ways of looking at architecture and urbanism, conceiving a new urban form: Agronica (1995), which sought to overcome the concept of opposition between two territorial realms, agriculture and architecture. He saw them as two different "morphologies" of the same logic. Branzi argued that architectural forms should no longer be determined by function. Instead, architecture should encourage living and working that is more flexible. Branzi's Agronica project illustrated the neoliberal economic paradigm with a horizontal spread of capital, and ultimately urban tissue, over the territory, and the resultant "weak urbanization" that the paradigm affords. The author explains its definition in seven points: the separation of technology and form, the separation of function and form, overcoming the traditional urban planning, the understanding of the urban as an intangible condition that matches the market, the split between material and virtual metropolis, hybridization between town and country and the absence of symbolic apparatus [100].

Agronica is a design based on a hybrid between the rural and the urban form. According to the concept the city and the countryside would no longer exist separately. Instead, parts of settlements would become elements of a metabolic and symbiotic systems in which functions separate and disperse, only to group together in new combinations. This new metropolis is what Branzi calls a "weak system that guarantees the survival of the agricultural and natural landscape" [101]. In the absence of restrictive clichés and precognitions, agriculture could become just another mean of production, compatible with the urban condition and fully integrated into a homogeneous economic system– entwined with all the other industries in the city [14]. In Agronica the spatial layout is not associated with social and political structures, opting instead to derive itself from virtual networks – ephemeral, changeable dependencies. It embraces and promotes formlessness as an urban characteristic, but also demotes the impact of physical space on social structure: the city needs not be structured, because contemporary society is not structured [14]. The pyramid relations between members of specific industrial social strata are replaced by a rhizomatic network diagram.

In formal terms Agronica resembles Kurokawa's Agricultural City and aims to synthesize agriculture and urbanism and the permanence of dwelling with the transience of social evolution. It is imagined as a plane with a regular grid of pillars on green fields, supporting an array of infrastructure such as solar panels, antennas, diaphragms, pergolas, sunshades or platforms designed for installation above the

ground [14]. On this seemingly infinite plane, fields are cultivated and cows graze freely between architectural objects and engineered constructions. In this concept agriculture is capable of self-regulating the inhabited space through the means of advanced support technologies. The design is open and adaptable – unlike any other urban morphology – enabling diffused territorial organizations, consistent with the changing conditions of a society in constant fluctuation. However, the fluctuation is based not on a whim, but on the passing of seasons [14]. Branzi's "weak" urbanization interprets agriculture as a highly evolved industrial system capable of adapting to production cycles that change over time and utilize reversible modes of organization [102]. The construction system used for this design is light and adaptable. It is modular and designed specifically to facilitate change and minimize impact on the actual plot it occupies.

Similarly to what Frank Lloyd Wright proposed in Broadacre City and Ludwig Hilberseimer in The New Regional Pattern, Branzi presented a vision of a metropolis with no structure and no hierarchy. The position of elements was random and there were no fixed spatial relations, even the roads in Branzi's diagram were not fixed arteries. The design was open, leaving space for flexible, reversible patterns of inhabitation and secondary systems of circulation.

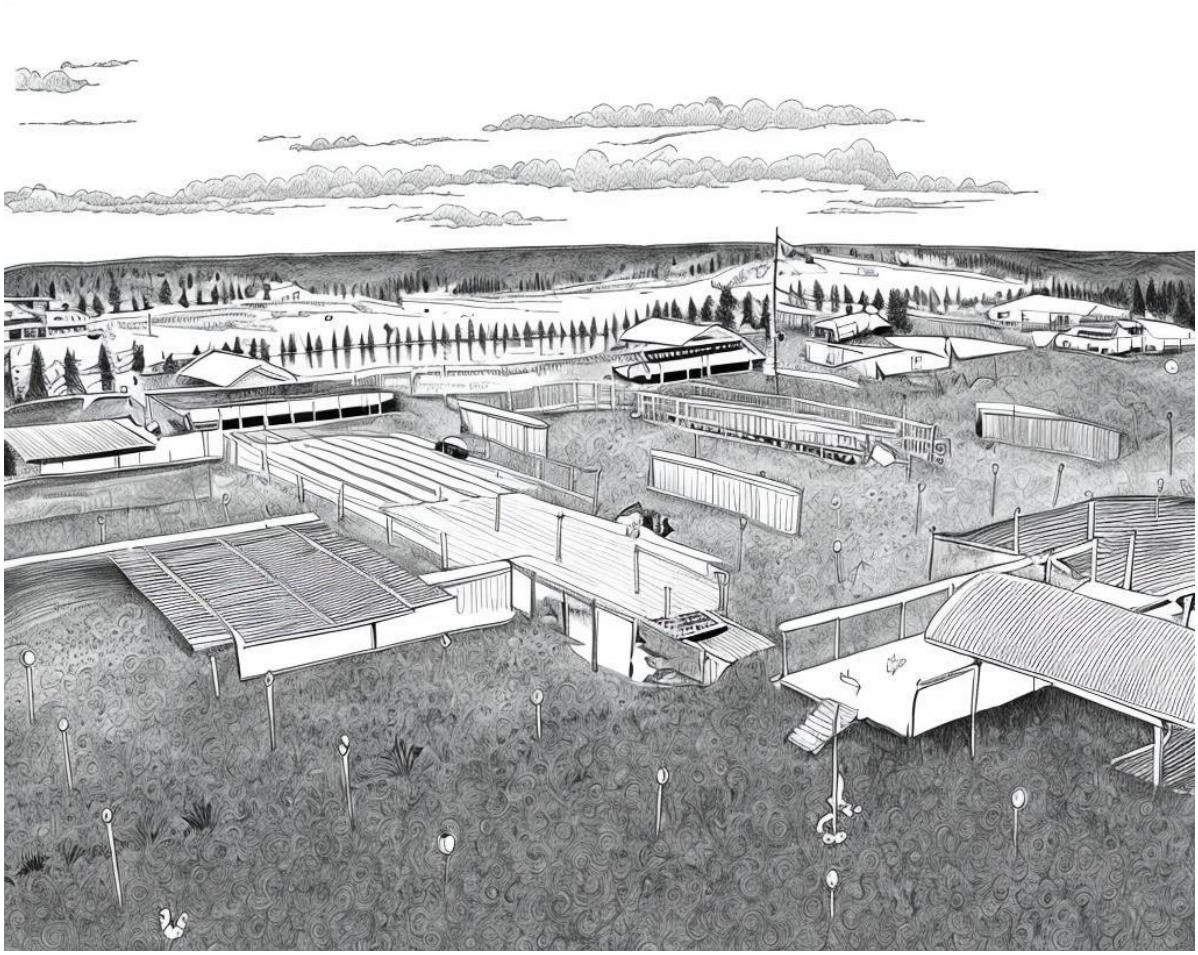


Fig. 5. A bird's-eye view of Andrea Branzi's agricultural project Agronica (elaborated by author)

3.7. Lech Zimowski

Another notable Polish architect and urban planner active since the 1960. until the 2000., Lech Zimowski, is recognized for his contributions to the theories of “transurbations” and “bioms” in architecture. Zimowski's work has significantly influenced contemporary urban and spatial planning, introducing concepts that draw parallels between natural ecosystems and urban environments.
The theory of bioms, as proposed by Zimowski, integrates principles from the natural sciences into urban planning. This approach views urban areas as ecosystems, emphasizing the need for sustainable, self-regulating urban environments that mimic natural biomes. This theory advocates for the creation of urban spaces that support biodiversity, promote ecological balance, and enhance the quality of life for inhabitants. Zimowski's urban ideas are akin to modern concepts of biomimicry, where architectural designs are inspired by natural processes and structures.

Zimowski could be considered a pioneer of sustainable architecture. He argued that ecological elements, treated as the environment in which man exists, can be differentiated into natural and artificially introduced by man, and that excessive dominance of the latter disrupts the ability of the ecological system to self-regulate. In order to harmonize the evolutionatry needs of man with the self-regulating capabilities of nature, he proposed the use of the biome in all design instances. In such an instance, the ally in maintaining the ability of the environment to self-regulate is the horticultural-settlement biome. Its use would provide an effective tool for conducting agricultural production in cities for the needs of city dwellers. It would also be an excellent way to preserve existing patterns of regional architecture and their restoration to contemporary design. Zimowski postulated the introduction of horticultural settlements especially in the zone of contact between the city and forest areas, which was to have a stabilizing and normalizing effect on urbanization in this critical zone.

The biome theory also concerns the self-regulation of energy in forest, meadow and lake complexes, as well as horticultural-settlement. It finds its application in the aspect of partial economic and energy autonomy of selected areas, e.g. cities together with the feeding area and is applied to achieve psychosomatic balance of the inhabitants. The author promotes the arrangement of permanent structures of horticultural settlements around cities, as interdisciplinary development [103]. Zimowski postulated actions for the revitalization of small towns as more effective and economical in comparison to new, industrially created, big-city infrastructures. He perceived those as a threat to the local biome, as they usually expand at the expense of territories and natural and population resources of the agricultural feeding region.

Another concept developed by Zimowski were transurbations, focusing on the transitions and transformations of rural settlements under the influence of nearby cities. This notion examines the expansion of urban infrastructure into rural areas, influenced by various social, economic, and environmental factors. A specific case of transurbation is demographically-deglomerative, consisting in the escape of people from highly urbanized city center districts to suburban areas, causing an effective urban sprawl and limiting the productive potential of the rural areas. He describes it as a threat to existing biotope and degenerative in nature.

He assesses this tendency as negative both in social, economic and spatial terms. Zimowski notices that it leads to irrational use of land and depletion of agricultural areas and so-called open areas, through the creation of residential areas on arable land, which are to constitute a food base for the city, and on green areas (on meadows along the stream - development of a local ecological corridor) [104]. As a result of urbanization pressure, not only does the function of the analyzed suburban areas change from agricultural to residential. There are also settlement forms that do not fit into the traditional concept of village and city. Single-family housing is being built in the vicinity of the farmstead. Farm plots ca. 3000m^2, sometimes including farm buildings such as a pigsty, stable and barn, are subject to secondary

partitions and are mixed with single-family plots with an area as limited as 700m^2 [105]. Therefore, localities lose their typically rural character and the cultural landscape deteriorates. Often, the development is dispersed, there is no connection between the existing settlement network and the newly built estates, forcing an increase in the costs of building the municipal infrastructure network and its maintenance costs. The resulting lack of areas with a public space character, or the dependence of new development on existing and basic services, increases the intensity of road traffic (negative consequences for both suburban areas and the city). The development of urban space, especially large agglomerations and metropolises, takes place in Polish realities at the expense of their natural and agricultural surroundings, leading to the creation of structures with substandard functional conditions.

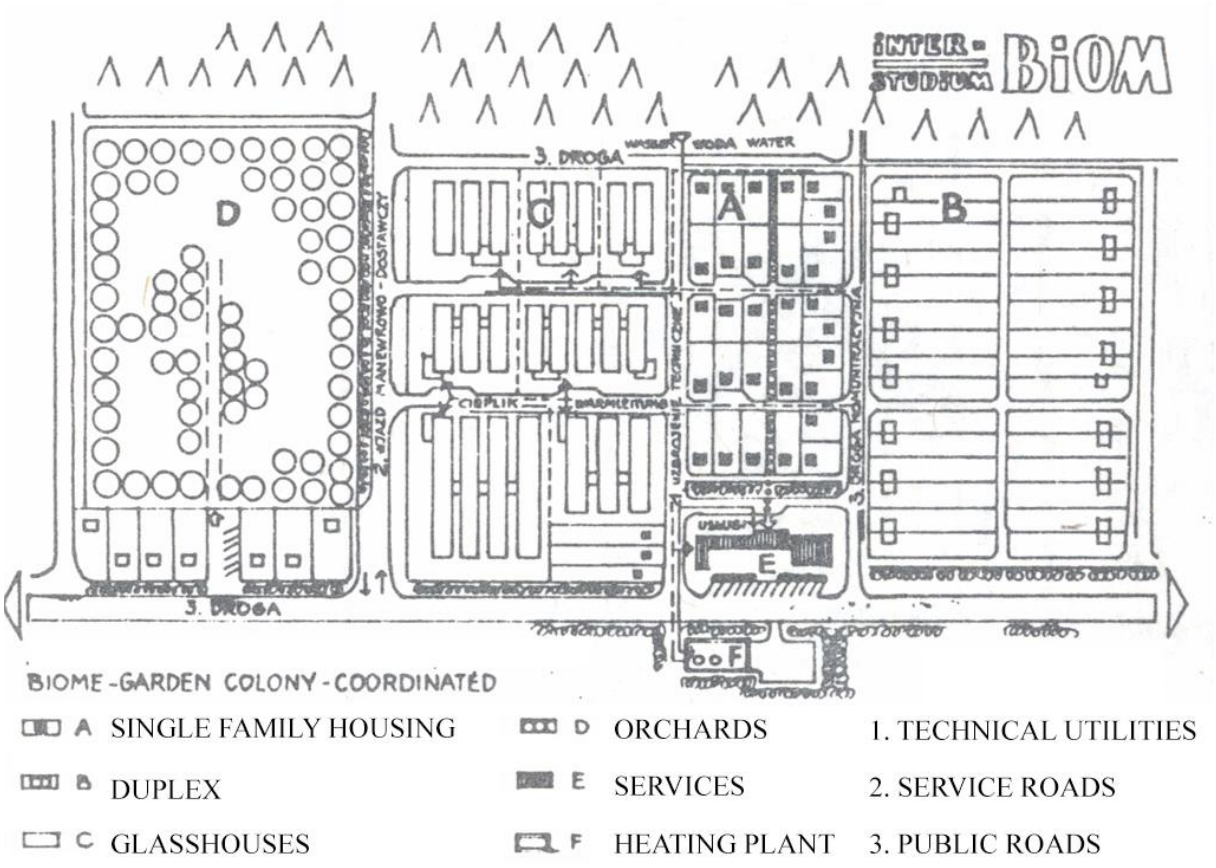


Fig. 6. The BIOM concept, (source "Rewitalizacja miast i struktur podmiejskich w konstelacji biomu" by Lech Zimowski, caption elaborated by author)

Zimowski points out, that suburban garden and habitat structures result from the logical - existential process of functioning of cities and towns. Greenery has always accompanied urban development in the form of groves and arable land assigned to the medieval city, in the form of gardens accompanying weavers' houses, etc. This process is reflected in the retrospective and contemporary land-use and in the spatial development of the zones of the city, especially suburban, through the occurance of parks, gardens and orchards. This entirely natural evolution was interrupted in the 19th century with the industrialization encouching rapidly on suburban land with large-scale development.

Zimowski argues that urabn typologies with the acompanying greenery constitute a biome in the same sense as any other habitat. In order to protect the integrity of both the city and the forest complexes, especially in the area of a large city, gardening and orchard biomes existing in between them should be revitalized and the formation of new suburban plantations and livestock breeding grounds should be promoted. This applies in particular to the cultivation of vegetables, herbal plants, the establishment of tree nurseries, fruit orchards, as well as beekeeping and sheep and fish farming. One of the most important tasks that Zimowski sets for urban planners and architects in this context is to prevent the densification of suburban areas through the secondary division of plots and the change of the character of agricultural towns in the area of influence of large cities into residential monoculture. He proposes an introduction of modern coordinated horticultural settlement biome with mixed residential and farm buildings, near a complex of greenhouses (for more intensive farming) and orchards.

Zimowski's theories have been instrumental in promoting sustainable urban design in his collaborative circle. His work encourages architects and urban planners to think beyond traditional methods and consider the long-term ecological and social impacts of their designs. In summary, Lech Zimowski's theories of bioms and transurbations advocate for sustainable, adaptive, and ecologically integrated urban planning, providing a framework for creating resilient and dynamic urban environments, while preserving the agrarian, semi urban transition areas between the dense urbanization and farmlands and woodlands.

3.8. Oskar Hansen

Some similarities can be found between the idea of a city integrated with agriculture and the famous proposal of another Polish architect, Oskar Hansen. The development of the Linear Continuous System (LCS) occurred during a period of rapid urbanization and technological advancement in post-war Europe. Hansen's ideas were influenced by the broader modernist movement, yet they diverged from the rigid, top-down approaches of some of his contemporaries. Instead, Hansen sought to create a more organic, user-centered form of urbanism. The most important theory, which the author developed in cooperation with Zofia Hansen, was the LCS. It was a project of linear sequences of residential buildings, stretching along the length of the entire country. Each of them was intended for 10 to 15 million inhabitants, and the distances between them were to fluctuate between 100 and 150 km. The inspiration for this system was the reciprocal biological dependence of the supply system on the needs of the supplied organism, as well as the dependence of the serviced zone on the servicing zone.

The postulated parameter of the width of the individual zones would be the isochrone of getting to work within 30-40 minutes, and getting to the most important goals of everyday life within 10 minutes. This resulted in the width of the zones subservient to the residential zone depending on the population intensity. The width of the agricultural zone was in part dependent on the soil conditions as well. The core of the system was to be a fast urban railway allowing for the rapid movement of residents without standing in traffic. It must however be noted, that Hansen’s vision was uncompromising. In terms of worldview, these new linear cities were to shape a new society of people working for the common good, standing in opposition to the capitalist, concentric city of the past.

Hansen saw the prototype of his LCS in a street village. The axis of the system is the residential and service zone. It is adjacent to the zone of agricultural crops and forests, which encompass historical settlements and infrastructure as well. Further on, the industrial zone is planned. All three zones are connected by a collision-free transverse communication. The principle forming the settlement system is balancing the cross-section from the point of view of the employment and population programming. The space was to be arranged so that both city and village residents had equal opportunities for access to

places of work and recreation, centers of science and culture, living in a way in one large, integrated urbanized zone.

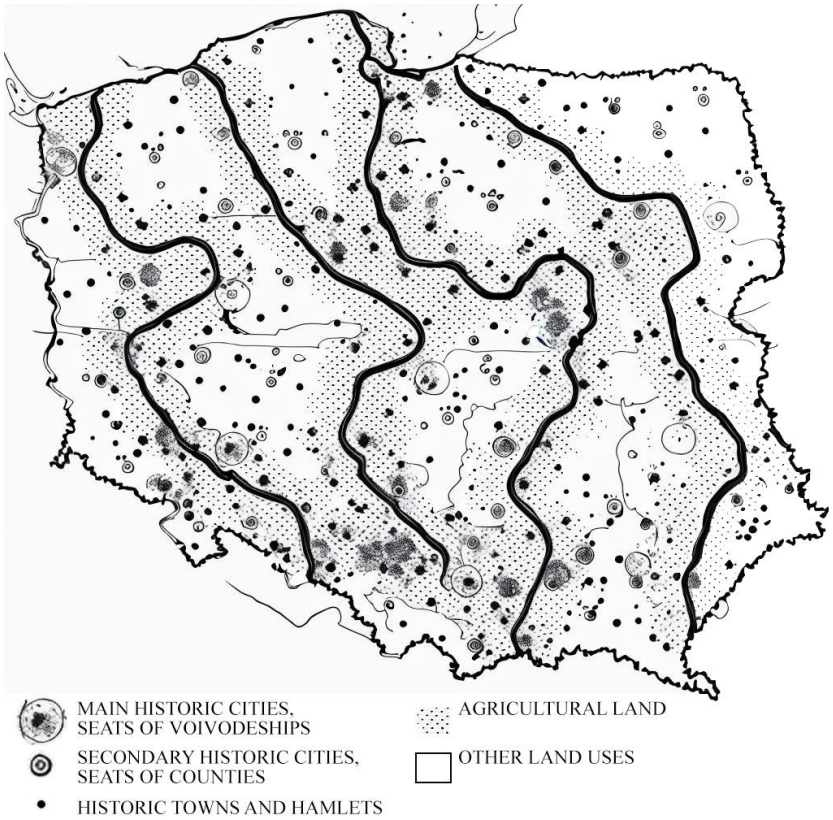


Fig. 7. The LCS concept, (elaborated by author based on "Towards Open Form" by Oskar Hansen, caption elaborated by author)

Hansen's concept of "open form" [106] underpins the LCS, promoting an architectural style that is open-ended, participatory, and responsive to its context. It prioritizes the human scale, ensuring that architectural elements are designed with the needs and experiences of individuals and communities in mind. Hansen emphasized the importance of social interaction and community engagement in urban design. He envisioned urban spaces that could evolve over time, allowing for changes in population, technology, and social needs. This flexibility is achieved through modular design and scalable infrastructure [107]. The LCS is a flexible - open-ended approach to urban design that seeks to create dynamic, adaptable environments that respond to the needs of their inhabitants.

4. RESULTS

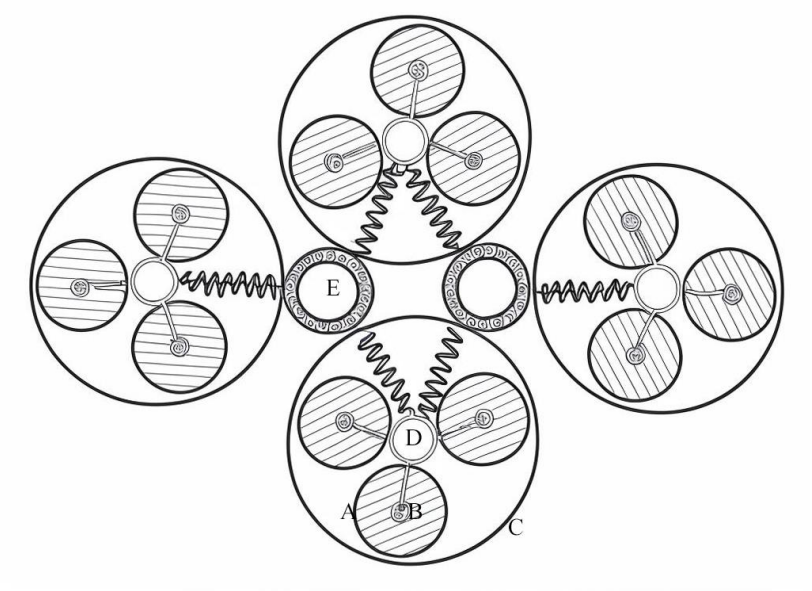
This paper reviews the architectural theories and ideologies of eight prominent architects: Leberecht Migge, Frank Lloyd Wright, Ludwig Hilberseimer, Andrea Branzi, Kisho Kurokawa, Władysław Czerny, Lech Zimowski and Oskar Hansen to identify corresponding ideas on urban agrarianism that are common to all of them and therefore seem indispensable in creating a regenerative city integrating agriculture into urbanism. Despite working in different time periods and cultural contexts, these architects share significant similarities in their approaches to urban development, often reflecting

broader cultural, social, and technological trends. Through an analysis of key principles of their design philosophies and notable works, this paper uncovered common threads in their thinking, highlighting those that have enduring relevance in contemporary architectural discourse-and the implications for the role of the architect in the future of sustainable food systems. Following the analysis of these case study urban design theories pertaining systemic urban agriculture, several common principles can be found.

4.1. Decentralization and the rise of a horizontal city

All the studied authors stressed the importance of decentralization for the development of the cities suitable for the new age. Throughout the studied theorems, decentralization was the common denominator, although the approach varied from author to author. Wright, Kurokawa and Branzi promoted all-consuming webs of low-density development that could be infinitely multiplied to spread out population, reducing congestion and ensuring each household had ample space for living and cultivation. Hansen proposed linear urban development (LCS), decentralizing the city along transportation lines, ensuring equal access to work and amenities within a defined time frame similarly to Hilberseimer who proposed settlement units perpendicularly attached to an interstate highway. Hilberseimer and Czerny each in their own manner envisioned a network of self-sustaining units with low-density development set within green landscapes. Both Migge and Czerny promoted decentralization focused more on integrating agriculture within urban areas to achieve self-sufficiency by allotting land for agriculture to each single family home. Czerny saw this as a transitory solution to a more dense development with communal fields, bringing him closer to Zimowski's biom theorem, highlighting the need to maintain the cultural landscape through preservation of gradation of development so that it dispersed at the fringes of cities into productive land and forests instead of sprawling housing estates. They also promoted the revitalization/creation of small towns over creating new large urban centers. At the same time Kurokawa, Branzi and Hansen proposed a decentralized urban system by integrating agricultural production as a source of income for city dwellers equal to any other occupation.

Indeed, if cities were to continue their growth, they would unavoidably become decentralized. There will organically arise the need for a new kind of development. The distance from the historic center would mean that in the absence of the formal strictness of downtowns, character of the architecture would become more lax. Each of the abovementioned projects proposed a thorough reconceptualization of the city, starting with a radical decentralization and dissolution of the urban skyline silhouette into a low-rise productive landscape. The customary suburban setup would become the proper urban tissue and spread over the whole region — a suburbanized regionalism [7] - replacing urban development with regional development [108]. This dissolution of figure into field would have the effect of rendering the classical distinction between city and countryside irrelevant in favor of a conflated condition of agrarian industrial economy.



A SETTLEMENT UNIT WITH INTEGRATED URBAN AGRICULTURE
B BASIC SERVICES (SCHOOLS, LOCAL VENDORS ETC.) AND LOCAL COMMUNITY CENTER WITHIN WALKING ISOHRONE
C NETWORK OF SETTLEMENT UNITS WITH THE SAME PROXIMITY TO MAIN SERVICE UNIT AND ACCOMPANYING HORTICULTURAL TOWNS (COMPARE BIOM) AND ARABLE LAND
D MAIN SERVICES UNIT
E HISTORIC CITY WITH OUTER RING ROAD

Fig. 8. Scheme schowing spatial relations in a portion of open-end self-sufficient agricultural cities of the future –based on designs by Wright, Hilberseimer, Kurokawa, Branzi Czerny and Zimowski (elaborated by author)

4.2. The significance of landscape as a mean of shaping urban form

This would inevitably bring cities into contact with agricultural land. With the accelerated growth of cities the opposition and competition between these two would become an impossibility and they would have to be merged. One of key features in all the presented theories is the omnipresence of green spaces – parks, private gardens, kitchen-gardens, fields etc. The urban landscapes in the projects of Migge, Wright, Hilberseimer, Kurokawa, Branzi, Czerny and Zimowski were productive agricultural landscapes — with farms and fields. The projects encompassed large territorial or regional networks of urban infrastructure that brought existing natural environments into new relationships with planned agricultural and industrial landscapes. In the discussed designs the landscape became the medium of urban form. The authors did not attempt to tame the landscape or to transform it. Instead the formal aspect of the city adapted to the landscape (in Hilberseimer) in the form of fish spine ladder-like districts; (in Branzi) by semi open ephemeral structures; (in Kurokawa) by raising the whole city above the ground so that the nature could have its course unobstructed. Migge, Wright and Czerny endowed each individual property with agricultural land which scale varied according to project. Zimowski's bioms theory advocates for decentralized, self-regulating urban ecosystems that mimic natural biomes, integrating agricultural production within urban areas to create a balanced urban-rural interface. These large estates adapted freely to landscape, because local conditions stimulated and influenced the agricultural production and became a tool in land cultivation, which every owner valued. Although

Hansen's LCS integrates agricultural and forest zones into the fringes of urban fabric only, it ensures that landscape elements shape the functional and spatial organization of the city by limiting its perpendicular sprawl in favor of following the meridianal layout.

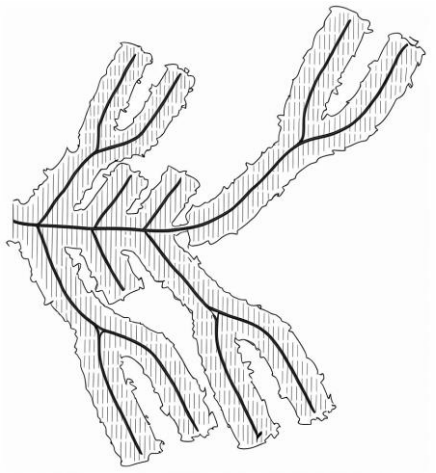


Fig. 9. Scheme showing placement of settlement complexes accepting the nuances of the landscape: meandering regional road with a network of forking closed-end local roads enveloped by belts (width dependent on walking isohrone) of low intensity urbanization - based on Hilberseimer and Czerny (elaborated by author)

4.3. Emphasis on Organic Forms

All these thinkers exhibit a profound appreciation for organic forms in their work, although differently understood. Wright famously championed organic architecture, advocating for designs that harmonize with their natural surroundings. His principle of "form follows function" underscores the importance of integrating built structures seamlessly into the environment, mimicking the organic processes found in nature. Wright's philosophy of "organic architecture" emphasizes a holistic approach to design that respects the integrity of natural systems. Similarly, Hilberseimer's later designs of mixed-height housing and decentralized model allowed for a fluid and adaptable urban form while Zimowski's Bioms Theory draws inspiration from natural ecosystems, creating urban forms that mimic organic processes of self-regulation. Migge's urban design principles created an amalgam of man-made development and productive landscape, subjecting both single family house development and urban planning on a neighborhood level to landscaping. His focus on sustainability was such that he accounted not only for composting but also local waste disposal (all sanitary aspects aside). His integration of gardens and village commons within the urban fabric reflected an organic approach to urban planning which accommodates both dwelling, employment and the source of sustenance. Kurokawa's quasi-biological theories emphasize the interconnectedness and adaptability of engineered structures, similar to organic systems. Agricultural City proposed elevating entire cities to prevent flooding, simulating natural process of evolutionary adaptation. His architectural concepts propose a kind of "symbiosis" between built structures and the natural habitat which they occupy and posits that urban areas evolve in dynamically (capsules, homo movens), forming complex ecosystems characterized by resilience and diversity. Czerny as well accounted for evolution in his urban theory, advocating for fragmented, adaptable urban forms that can respond to changing conditions. His theory took into account e.g. increasing population density, factoring it in the divisions of plots, their size and ownership schemes. Branzi utilizes organic sensibility in the realm of design advocating for forms that evoke natural growth patterns and biological structures. His concept of "weak architecture" proposes flexible, open-ended

frameworks that accommodate evolving human needs, mirroring the adaptive strategies observed in biological systems. Hansen's LCS, while more structured, was designed to be responsive and adaptable, promoting an open-ended architectural style. His use of modular factors ensures a scalable infrastructure, allowing for organic growth and adaptation over time. This holistic view of urbanism resonates with the vision of architecture as an organic extension of the environment.

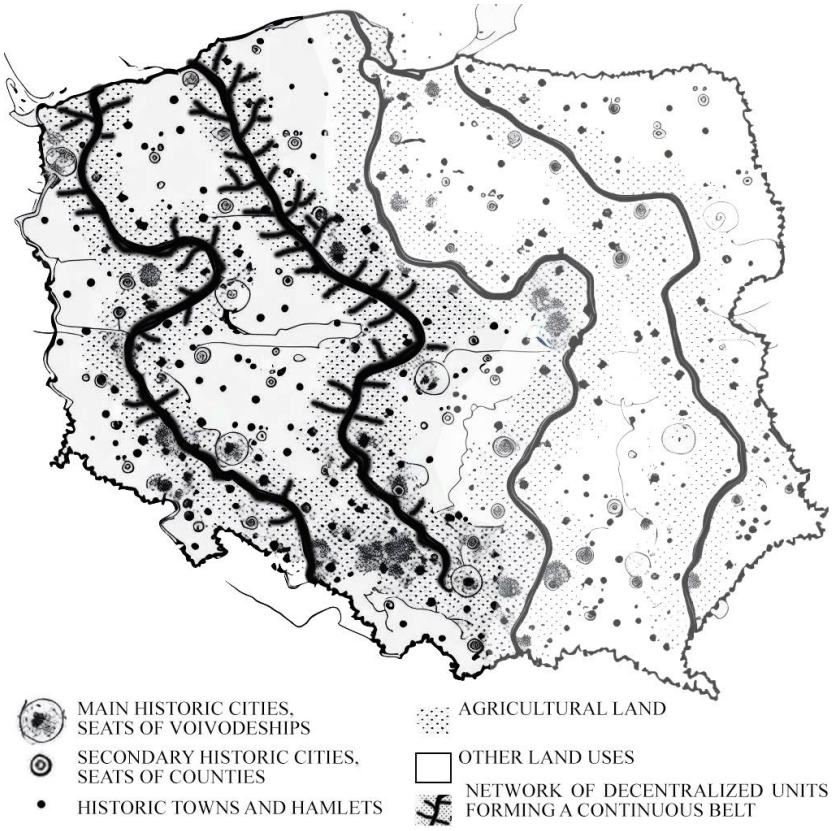


Fig. 10. Schematic elaboration of an open-end urban design on the basis of LCS (Fig.7) with incorporated constraints elaborated in Fig. 9 (elaborated by author)

4.4. Agricultural production as a daily routine

In the considered studies authors perceived agricultural production at least as a mandatory element of pastime if not a full-time job. Migge granted every family a kitchen-garden for individual cultivation as a part of personal daily routine and a share of a neighborhood field for community-building food rearing activities. Wright builds his whole project around family farming as a fundamental element of every citizen's daily activity. In Broadacre City, the public landscape was primarily formed by agricultural uses at a variety of scales. Instead of kitchen-gardens citizens worked in small-scale cooperative farms and markets. Czerny granted kitchen-gardens to all citizens, even those living in apartment buildings. He observed that horticulture and agriculture were optimal forms of urban green. Given that all the citizens performed their food producing duties, no superficial public maintenance of greenery would be required. Hilberseimer based the Settlement Unit upon pedestrian public parkland forming the confluence of individual semiprivate courtyards and connecting to the agrarian land surrounding the unit. The "production park system" integrated vegetable gardens within residential areas, promoting a

balance between recreation and agricultural production. Branzi and Kurokawa foresaw agriculture permeating the city with food production becoming just another type of urban employment. Kurokawa's Agricultural City aimed to harmonize urban living with agricultural practices, challenging the urban-rural dichotomy. Branzi's Agronica proposed a metabolic and symbiotic system where agriculture was fully integrated into the urban economy. Zimowski's bioms and horticultural settlements emphasized the importance of agriculture in maintaining ecological balance, traditional crafts and historic landscape and providing suitable employment for those living on the fringes of great cities, reducing the need for commuting. Hansen's LCS incorporated agricultural zones as essential components of the urban fabric, ensuring accessibility to green areas for all residents – be it for recreational purposes or employment. All the authors foretold the elevation of agriculture to the status of another industry and the levelling of agricultural crafts with other occupations in the city and their routine practice by city dwellers.

4.5. Temporality, changeability in time

Most of the analyzed authors noticed the accelerated dynamics of changes in urban organisms and proposed adapting to it with the form of architecture or urban layout. In these concepts, the city lost its permanence and materiality. Due to this fact, both Branzi and Hilberseimer chose to illustrate the city as a continuous system of relational forces and flows, as opposed to a collection of objects. Hilberseimer strove to generate organizational models rather than a design to follow. Branzi's architecture is modular, light and adaptable. Migge accepted as a given the instable market conditions, that might require citizens to become self-sufficient in terms of sustenance and the resulting change from industrial workers to agricultural workers. Czerny proposed changes in the form of districts – from less dense and exclusively low-rise with large gardens, through densification of low-rise through secondary divisions of plots, to mix-height neighborhoods. Kurokawa and Wright, on the other hand, focused on the unstoppable change of seasons and natural occurrences connected to those. Wright concluded that the traditional city deprived man of his nature because it deprived him (amongst others) of seasonality. Kurokawa wanted to prevent urbanization from going against the grain of climate specificity (like floods) therefore placing the city above the fluctuating ground. The architects' concept indicates that architecture and city should sustain through continuous growth and renewal – a process, Metabolists believed, as important as the natural metabolism [109]. The group form is always ready to accommodate new additions and changes as it grows, but is complete in form in each stage [109]. Zimowski based his whole theory on trying to find such forms of urbanization that would guarantee self-regulation and sustainability, basing his theory of urbanized bioms on biological bioms. Hansen designed his system to evolve with changing population needs and technological advancements, ensuring long-term sustainability and adaptability. All the studied authors presented an attitude that saw the city more as a process or event than as an artifact.

4.6. Adaptability, Flexibility and Ecological Integration

Kurokawa's Metabolist principles and Branzi's vision of the "No-Stop City" both advocate for flexible, adaptable architecture capable of responding to changing human demands and environmental conditions. Kurokawa's Agricultural City featured modular units that could expand as needed. Branzi's Agronica promoted flexible urban forms that could adapt to production cycles and societal changes. Similarly, Wright's emphasis on open floor plans and modular design reflects a commitment to creating spaces that can evolve over time. Indeed, his Broadacre City was to expand and encompass all available land. Hansen's LCS was modular and scalable, allowing for responsive urban development. He proposed a linear urban layout where residential and service zones are integrated with agricultural and industrial zones. Hansen emphasized the reciprocal dependence between urban and rural areas, aiming to balance population and employment. Zimowski's bioms emphasized sustainable urban design that mimicked

natural ecosystems. He proposed urban areas should function like natural ecosystems, supporting biodiversity and ecological balance. He advocated for integrating horticultural settlements at the urban-rural interface to stabilize urban expansion. Central to these theories is the notion of ecological integration — the seamless incorporation of human interventions into the larger ecological context. To achieve that the cities must become more adaptable in their functions and more flexible in their design.

4.7. Social Engagement

Social engagement was a fundamental aspect of the urban designs proposed by these architects. Whether through Wright's vision of democratic design, Kurokawa's focus on symbiosis, or Branzi's proposals for alternative urban futures, each architect seeks to create architecture that serves the needs of people and enhances quality of life. Wright promotes meaningful proximate relationships between work, family, food system and civic life. He perceives family as the basic social unit, capable of taking care of its members against all odds, even in dire straits. Hilberseimer seeks the shortening of worker's commute through design. Society is seen as a whole and the city as a web of codependences of equal parts, which need to be solved simultaneously as a complete organism for the benefit of all dwellers. Kurokawa's designs aimed to create cohesive communities with shared public spaces and equal opportunities. Czerny emphasized equivalent development conditions and the importance of accessibility to amenities for all residents. Branzi's work in the Radical Design movement and his exploration of the relationship between architecture and society highlight a concern for the social impact of architecture. Agronica promoted a hybrid urban form that integrated social and economic functions along rhizomatic networks – unthwarted by social status or creed. Zimowski's theories advocated for sustainable urban environments that supported community well-being. Hansen's LCS prioritized human-scale design and community engagement, ensuring that urban spaces were responsive to the needs of their inhabitants. Hansen envisioned the LSC as a means to foster a new society focused on collective well-being, standing in contrast to capitalist urban models. Each theory offers a unique perspectives on decentralization, landscape integration and social well-being. They all emphasize adaptability, and the integration of agriculture into daily urban life, reflecting a shared commitment to creating sustainable, resilient, and socially cohesive urban environments. Each theory brings unique insights into the importance of landscape, organic forms, and ecological integration, offering valuable frameworks for rethinking urban design in the context of contemporary challenges and future needs.

5. DISCUSSION

While ambitious, the presented designs stumbled on the overdependence on automobiles and lack of public transport. The designs heavily favored car ownership, which could lead to issues like pollution and resource depletion in a full-scale implementation. In today's context, where sustainability and inclusivity are paramount, the crucial thing to do would be to revisit their transportation paradigm to include public transportation. All the while, the decentralization and sprawling nature of Broadacre City, Agricultural City or Agronica might make public transport systems, like buses and trains, inefficient or nonviable. Even in a dispersed city, central hubs or shared amenities might experience congestion. Therefore, it would be necessary to create loops and networks for an efficient transportation system.

Three of the abovementioned (Migge, Wright, Czerny) urban scenarios call for every household to have a garden or to tend to a piece of land, which would require a significant effort on the part of the citizens. This might need either to be introduced in steps or substituted for other three of the concepts, in which agriculture becomes just another industry, serviced by skilled workers for the benefit of those,

who do not participate in the production. Nevertheless, since the introduction of agriculture into the cities must become a reality, most of the urban green would become productive land.
This brings forth the question of waste management, fertilization and water management in the face of increased usage. The important aspect in solving this issue are hybridization and overlap. Hybridization of land development adds flexibility to the use by means of creating synergies between functions. The synergies are best exploited, when different functions or land uses overlap in spatial proximity to increase diversity and come in symbiotic relationships between programmatic elements and actors, which can have a radiating influence outside of the cluster [110].

Migge perceived a household as a self-sustaining unit. The garden was a hybrid of recreational and production functions. He described amenities for water sorption from waste and composting. Zimowski's biom theory envisioned gradation of urbanization from larger cities through thaditional towns to villages and hamlets, allowing for differentiated degree of coexistence with the agriculture. Wright's Broadacre City concept incorporated hybridization through family farming. The residents lived off the land they farmed and they also resided on it. Similarly Hilberseimer sought to create neighborhoods, where the distance between home and work would not exceed a 20-minute walk, reducing the need to commute. He reasoned that the solution was not the increase in transportation amenities but the exclusion of their need. Similarly, the isochrone was a significant factor in developing Hansen's LSC. In, Branzi's Agronica and Kurokawa's Agricultural City as well as in Hensens LSC the rural and the urban functions form a hybrid on regional planning level. Cities can expand to form megastructures. Agriculture is highly specialised and efficient, based on the availability and flows of natural resources in a specific location. Following crop rotation in agriculture, the functions of different building might change from residential, scientific, commercial, leisure. To this end however we could use the emerging technologies described in state of the research as well.

Nonetheless these designs offer a visionary take on the interplay between urban development and agriculture. They offer profound insights into alternative urban planning strategies. While not without its challenges, the concepts prompt urban planners and policymakers to reimagine the boundaries between the built environment and agricultural landscapes. They embody the principles of decentralization, self-sufficiency, and mobility and help modern urban planners work towards more sustainable, resilient, and food-secure urban futures in harmony with the land. They envision structures in harmony with humanity and its environment, essentially promoting the natural landscape as an integral part of the architectural design. While many of the principles seem outdated, the idea of decentralization resonates with the modern trend of deurbanization, especially with the rise of remote work and digital connectivity.

6. CONCLUSION

As food-related challenges intensify alongside a growing global population and greater reliance on the centralized food system, environmental and social issues are magnified. The agricultural industry's demand for more land escalates, leading to competition for space with other urban functions. The prevailing centralized food system, which emphasizes economic and efficiency concerns, contributes significantly to environmental and social problems. Recognition of food-related issues is expanding beyond rural areas to encompass urban settings. In this process architects are in a unique position to tackle these spatially intertwined challenges on a systemic level.

Drawing upon architectural philosophy and principles, as well as pertinent literature on urbanization, agriculture, and sustainability, this study evaluated the feasibility, implications, and potential benefits of implementing agriculture in cities in the context of modern urban planning. By synthesizing theoretical frameworks with practical considerations, this research contributes to the

ongoing discourse on sustainable urban development and offers insights into the future introduction and possible structures of regenerative cities.

Establishing food production in the city would require considerable natural resources including land, water and fertilizing nutrients as well as buildings, all of which might be targeted for their competing uses. However, as shown in the study, urban agriculture cannot be left to voluntary implementation by the communities. Policies must be put in place to include UA systemically in city development. To identify suitable plots and realign available resources local administrative organs should cooperate in this matter with architects, city planners, researchers and community leaders.

Architects and urban planners will play a key role in facilitating the implementation of UA since the integration of the food system in urban areas is not only an issue of infrastructure but a multi-sectoral and multi-scalar spatial undertaking. It will require a reconceptualization of the very idea of city itself, as half-measures in the form of green roofs and community gardens appear to yield insufficient crops. Therefore it will fall to the architects to associate urban and rural functions in city organisms for a sustainable food systems and resilient cities. Drawing from historic examples of "Self sufficient man", "Broadacre City", "Agricultural City", "Agronica", "Settlement Units", the"LSC" and "BIOMS" architects must conceptualize how the integration might occur on different levels: program new synergies, design symbiotic relationships and project hybridizations. The architecture has an effect not only as the built environment, but can also influence the behavior of users, facilitating behavioral changes which can ease the transition from metropolis to agricultural city. By envisioning redesigned future urban food systems, architects can initiate conversations with stakeholders who have the potential to turn those visions into actuality.

The paper presents eight theories on agricultural city and on that basis offers seven-point comprehensive framework for the development of spatial form of an agricultural city. Firstly the cities must become decentralized and dispersed to accommodate agriculture. This will make landscape one of the key factors in shaping of the form of cities. The density of urban settings will decrease prompting a shift towards single-family architecture as the dominant form of development. Urban green will, in its prevailing share, become agricultural and will be placed in custody of private caretakers (in the form of kitchen-gardens) cooperatives (allotment gardens and communal fields) and industry (urban farms). The inhabitants of cities will practice agriculture both as pastime and employment. The fluctuations and temporality associated with seasonality of agriculture will influence the form of architecture and regional development making it less permanent and more adaptable to changing conditions and way of life. Self-sufficiency in terms of sustenance will be promoted and facilitated on all levels – from household to local communities. This will reduce the need for heavy transportation and commute, decreasing the stress on road infrastructure. The cumulative effect of these strategies is to transform the local conditions of individual dwelling and the broader civic realm of public infrastructure toward a more mature and robustly realized set of relationships with their ecological contexts. Given contemporary need for urban agriculture, these propositions offer a convincing alternative to what has become the canonical city form.

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