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URBAN FARMING – UNDERESTIMATED SOURCE OF ECOSYSTEM SERVICES. ALLOTMENT GARDEN CASE STUDY

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STRESZCZENIE: W miastach i metropoliach na całym świecie rosnąca populacja mieszkańców, aby osiągnąć wysoki standard życia, potrzebuje więcej terenów zielonych. Tymczasem stare ogrody działkowe stają się zagrożone z uwagi na wysokie ceny gruntów w centrach miast. Konieczne staje się wypracowanie i wprowadzenie nowych argumentów na rzecz ochrony tych obszarów jako właściwych dla rolnictwa miejskiego. W takim przypadku nierynkowe metody wyceny mogą być pomocne w szacowaniu z punktu widzenia wszystkich mieszkańców miasta wartości usług ekosystemowych związanych z ogrodami działkowymi. Uwzględnienie wartości tych usług, wpływając dodatnio na cenę działek, powinno ułatwić ich zachowanie w dotychczasowym zastosowaniu.

SŁOWA KLUCZOWE: usługi ekosystemowe, rolnictwo miejskie, metody wyceny

Ecosystems and ecosystem services

Before discussion, the problem of ecosystem services provided by allotment gardens in cities should be defined the basic concepts: In accordance to the UN Convention on Biological Diversity, an ecosystem is a dynamic complex of plant, animal and micro-organism communities and non-living environment interacting as a functional unit. The interpretation of ecosystems in this paper also entails agricultural and semi-natural systems. Functions of ecosystems, defined as the capacity of the ecosystem to provide directly or indirectly goods and services, that satisfy human needs, may result in the supply of ecosystem services. Ecosystems provide a wide variety of economically valuable services, including gas regulation, climate regulation, waste treatment, water regulation, water supply, disturbance buffering, plant and animal habitat, nutrient cycling and other[1].

Ecosystem services include both economic goods and services provided by ecosystem to society[2]. For instance, the function "capacity to supply fruits and vegetables" may provide two services: 1) recreation and 2) supply of fruits and vegetables as food product, involving two different sets of stakeholders. The user has the choice: valuing services or functions. Both express, in principle, the benefits supplied by the nature to society. The main difference is that valuation of services is based on valuation of the flow of benefits, and valuation of functions is based on the environment's capacity to supply benefits.

In literature following types of ecosystem services are distinguished: provisioning services, regulating services, cultural services and supporting services. Based upon Millennium Ecosystem Assessment short description of these categories is as follows[3]:

- Provisioning services reflect goods and services produced by or in the natural, semi-natural or agricultural ecosystem (for example fruits, wood, fish).
- Regulating services result from the capacity of ecosystem to regulate climate, hydrological and biochemical cycles, earth surface processes and variety of biological processes.
- Cultural services relate to the non-material benefits people obtain from ecosystem via recreation, cognitive development relaxation and spiritual reflection.
- Supporting services represent the ecological processes that underlie the functioning of ecosystems.

[1] T. Żylicz, *Valuating ecosystem services*, „Ekonomia i Środowisko" 2012 no. 2, p. 20.
[2] R. Costanza, et al., *The value of the world's ecosystem services and natural capital*, "Nature" 1997 no. 387, p. 253-260.
[3] MEA, *Millennium Ecosystem Assessment*, *Ecosystems and Human Well-being: Synthesis*, Washington D.C. 2005, p. 10, www.millenniumassessment.org [20-09-2014].

The issue of growing costs of biodiversity loss and ecosystem degradation was described in the study *The Economics of Ecosystems and Biodiversity*, in which "value of nature" has been widely discussed[4].

In this paper these concepts are going to be used to analyze the services provided by ecosystems in association with urban farming in allotment gardens. In this case there are some difficulties in analyzing the supporting services and their value. Hence, only provisioning, regulating and cultural services will be taken into consideration.

Long history of urban farming

Historical examples of urban farming

The best known examples of urban farming are associated with wars. During the First World War president Woodrow Wilson called upon all American citizens to utilize any available open space for food growth. By the year 1919 over 5 million gardening-lots were growing food and over 500 million pounds of agricultural production were harvested. By the time of the Second World War the administration set up a National Victory Garden Program, that concerned the establishment of functioning agriculture within cities. As many as 5.5 million Americans took part in the Victory Garden movement and over 9 million pounds of fruit and vegetables were grown per year, accounting for 44% of U.S.-grown produce throughout that time. Similar in the United Kingdom (the campaign "Dig for Victory") and Canada citizens were successful in growing vegetables in their Victory Gardens. However the history of such urban farming is much longer and has its roots in movement against poverty and food insecurity. The Great Somerford Free Gardens in the Wiltshire village of Great Somerford were created in 1809 following a letter from Rev. Stephen Demainbray to King George III in which he asked the king to spare, in perpetuity, 6 acres from the Inclosure Acts for the benefit of the poor of the parish[5]. In rapid developing industry cities in the early 19th century the idea of allotment gardens came to life in many countries (in the Netherlands first gardens were founded in 1838, in Prussia so-called Schreber Movement in Leipzig in 1864, during the Great Depression in 1893, citizens of a depression-struck Detroit were asked to use any vacant lots to grow vegetables, in Norway the oldest, Etterstad Kolonihager, dates to 1908). With the large number of people migrated from the rural areas to the cities to find employment there had arisen a problem of social neglect in different forms, including malnutrition. To improve overall situation of poor workers', families were allowed to grow their own food. The city administrations, churches or their employers were provided open spaces for gardening purposes. These were initially called the "gar-

[4] *The Economics of ecosystems and biodiversity*, European Communities 2008, www.unep.ch [29-10-2014].

[5] R. Savill, *England's oldest allotments celebrate 200 years*, www.telegraph.co.uk [12-05-2014].

dens of the poor". It existed in two forms: allotment and community garden. Allotments are parcels cultivated individually, contrary to other community garden types where the entire area is attended collectively by a group of people[6].

New wave of urban farming

Nowadays, the idea of supplemental food production beyond rural farming operations and distant imports is still inspiring new activities both in highly developed and developing countries. For example, new wave of urban farming as a response to the problems associated with the crisis started after 2008 in many big cities in U.S. The New York City Department of Environmental Protection offers a grant program for private property owners in combined sewer areas of New York City. The minimum requirement is to manage 1" of stormwater runoff from the contributing impervious area. Projects include green roofs, rooftop farms, and rainwater harvesting on private property in combined sewer areas. Because of the special municipal grant programs, such as The Green Roof Tax Abatement Program, and Green Infrastructure Grant Program, New York City now has the world's largest rooftop farms[7]. Some urban gardeners have used empty lots. The City has a composting program. There are also provided free seedlings, courses on growing and selling food. NGOs are also involved in this activity.

Similarly in California in response to the recession of 2008, a coalition of community based organizations, farmers and academic institutions formed the Pomona Valley Urban Agriculture Initiative. It is addressed to the poorest inhabitants, mostly Latino and African–American, among those the aggregate poverty and aggregate unemployment are very high[8].

Another interesting example is a town Todmorden in Yorkshire (United Kingdom), which has successfully developed innovative urban agriculture model in "propaganda gardens". In the project, which began in 2008, food crops have been planted at forty locations throughout the town[9]. Initiative Incredible Edible Todmorden was born after the meeting "against the tide of the Americanization of the British diet, of the Tesco-ization of food retailing, of the dissociation of food from its agricultural and geographic provenance, as well as of a centuries-late response to the off-shoring of British agricultural biodiversity and of food pro-

[6] E. MacNair, *The Garden City Handbook: How to Create and Protect Community Gardens in Greater Victoria*, Polis Project on Ecological Governance, Victoria BC 2002.
[7] F. Fabricant, *From roof to table*, "The New York Time" 2010, July 27, www.nytimes.com, www.treehugger.com [20-09-2014].
[8] Demographic information from the U.S., www.Quickfacts.census.gov [25-08-2014].
[9] J. Paull, *Please Pick Me – How Incredible Edible Todmorden is repurposing the commons for open source food and agricultural biodiversity*, in: J. Franzo, D. Hunter, T. Borelli, F. Mattei (eds.), *Diversifying Foods and Diets: Using Agricultural Biodiversity to Improve Nutrition and Health*, Oxford 2013, p. 336-345.

duction generally"[10]. However the most important issues ware social and educational aspects, biodiversity was taken into consideration.

In many cities in less developed countries urban farming movement is actually present with support received from local authorities, NGOs and volunteer workers. In Bangkok (Thailand) in early 2000, two urban gardens were started under the direction of the NGO Thailand Environment Institute (TEI). The main tasks were to[11]:

- teach members of the communities the benefits of urban green space.
- create the social framework to plan, implement, and maintain the urban green space.
- create a process of method to balance the needs of the community with the needs of the larger environmental concerns.

Different forms of urban farming are successfully developed in Cairo (Egypt), Beijing (China), Mumbai (India). Gardens organized by schools to reach at the same time two goals: teaching and diversifying the diet of students from dwellers' families, are popular.

Allotment gardens in Poland

First allotment gardens in the territory of the present Republic of Poland were created in 1901. Post-second-war history and development of allotments started from 9 March 1949, when the Parliament adopted the Law "On employee allotments" (Journal of Laws No. 18, item. 117). The new law came into force on the 19th January 2014. This allowed to save the legacy of allotment gardening in Poland, including almost 5.000 gardens. In the years 1960-2011 the number of allotments has increased by 62.4%, their area of almost 210% and the number of plots of 242%. In turn, average size gross of a plot (together with the area of general purpose) decreased of 496 m^2 in 1960 to 449 m^2 in 2011. In the same period average gross area of garden allotment was increased from 4.6 ha to 8.8 ha, and the number of plots per each of them has more than doubled (from 93 to 196).

Table 1
Allotment gardens (AG) in Poland

Category	1960	1970	1980	1985	1990	1995	2000	2005	2011
Number of AG	3042	3069	5404	7488	7938	5285	5169	4960	4941
Area in hectars	14033	18873	27124	40059	43097	43951	43706	43523	43427
Number of plots (in thousands)	283	393	614	899	970	980	965	968	968

Source: *Environmental Protection Yearbook* GUS, Warszawa 2012.

[10] Ibidem, p. 337.
[11] E.D.G. Fraser, *Urban Ecology in Bangkok Thailand: Community Participation, Urban Agriculture and Forestry*, "Environments" 2002 no. 30(1).

The role of urban farming in contemporary cities and metropolises

In the long history of allotment gardens and urban farming around the world the most important were provisioning services. The production of fruits and vegetables had developed to provide food for citizens who suffered because of malnutrition caused by heavy life conditions during wars or connected with unemployment and poverty. On the second place were cultural services. Gardening in allotment garden has positive impact on society in several aspects. These include recreation and leisure, individual health and well-being, community health and well being, environmental health, opportunities for outdoor activities[12].

Nowadays, the allotment gardens (like other green areas) are considered as source of several regulating services, which play an increasingly more important role in expanding and crowded cities.

Taking into consideration that already more than half the world's population lives in cities and the number of urban citizens is still growing, not only the problem of providing access to fresh food in proper amount is becoming more and more severe. Another difficult issue is air pollution, particularly in rapid developing big cities with strong pressure on transport development. Permanent smog and noise are a health hazard. Worsening living conditions for all city – residents stimulates the quest for new patterns of construction and land management. Empty plots, roofs and walls are potential space for urban farming, which could play different social, economical and environmental roles. Under such conditions the old allotment gardens gaining importance because of regulating services provided by: carbon sequestration, regulation of temperature, control of erosion, regulation of species reproduction and biodiversity conservation, pollination, protection against noise and dust, water retention. They play also an important role in landscape beautification and environmental restoration and remediation (by using and reusing natural resources and urban wastes to yield a diversity of crops and livestock)[13].

Positive environmental impact of food production in allotment gardens results from energy efficiency and reduction of carbon footprint – locally grown food could save transport-related emissions[14] and thereby can reduce each city's carbon footprint by reducing the amount of transport that occurs to deliver goods to the consumer. Also allotment gardens can act as carbon sinks[15] offsetting some of carbon accumulation in urban areas, where pavement and buildings outnum-

[12] L. Butler, D.M. Moronek (eds.), *Urban and Agriculture Communities: Opportunities for Common Ground*, Iowa 2002.
[13] J. Smit, A. Ratta, J. Nasr, *Urban Agriculture: Food, Jobs, and Sustainable Cities*, UNDP, New York 1996, NY.
[14] M. Xuereb, *Food Miles: Environmental Implications of Food Imports to Waterloo Region*, Public Health Planner Region of Waterloo Public Health, November 2005.
[15] D.B. Rowe, *Green Roofs as a Means of Pollution Abatement*, National Center for Biotechnology Information, U.S. National Library of Medicine, n.d. Web. 25 Mar. 2013.

ber plants. Plants absorb atmospheric Carbon Dioxide (CO_2) and release breathable Oxygen (O_2)[16].

The reduction in ozone and other particulate matter can benefit human health[17]. Reducing these particulates and ozone could reduce mortality rates in urban areas along with increase the health of those living in cities[18].

The implementation of allotment gardens in vacant lots can be a cost-effective method for removing chemicals and other wastes. In the process known as phytoremediation, plants and the associated microorganisms are selected for their chemical ability to degrade, absorb, convert to an inert form, and remove toxins from the soil[19]. Phytoremeditation is both an environmentally friendly, cost-effective, and energy-efficient measure to reduce pollution. Phytoremediation only costs about $5–$40 per ton of soil being decontaminated[20]. Implementation of this process also reduces the amount of soil that must be disposed of in a hazardous waste landfill.

Plants and green areas help also to reduce noise pollution. The exposure to continual noise is a serious public health problem which it can cause hearing impairment, hypertension and ischemic heart disease, annoyance, and sleep disturbance[21].

Valuation of allotment gardens ecosystem services

The mentioned benefits provided by allotment gardens ecosystems have a wide range of recipients. Stakeholders are not only owner of plots, who produce their crops, but all people residing in or otherwise depending upon the area affected by the ecosystems services.

In the discussion about the role of allotment gardens in the contemporary cities and metropolises economical arguments are of high importance – in particular price of land where plots are situated. Competitive against the allotment gardens' possibilities to use as sites for residential or other purposes inevitably

[16] M. Xuereb, op. cit.

[17] H. Mayer, *Air pollution in cities*, "Atmospheric Environment" 1999 no. 33, p. 4029-4037.

[18] In the article written by D.B. Rowe, *Green roofs as a means of pollution abatement*, the author argues that a rooftop containing 2000 m^2 of uncut grass has the potential to remove up to 4000 kg of particulate matter. According to the article, only one square meter of green roof is needed to offset the annual particulate matter emissions of a car; "Environmental Pollution" 2011 no. 159, v. 8-9, p. 2100-2110; Selected papers from the conference Urban Environmental Pollution: Overcoming Obstacles to Sustainability and Quality of Life (UEP2010), 20-23 June 2010, Boston, USA.

[19] H. Black, *Absorbing Possibilities: Phytoremediation*, "Environ Health Perspectives" 1995 no. 103(12), p. 1106-108.

[20] M.M. Lasat, *Phytoextraction of metals from contaminated soil: a review of plant /soil/metal interaction and assessment of pertinent agronomic issues*, "Journal of Hazardous Substance Research" 2000 no. 2, p. 1-25; C. Cluis„ *Junk-greedy Greens: phytoremediation as a new option for soil decontamination*, "Biotechnology Journal" 2004 no. 2, p. 61-67.

[21] W. Passchier-Vermeer, W.F. Passchier, *Noise exposure and public health*, "Environmental Health Perspectives" 2000 no. 108(1), p. 123-131.

Table 2

Valuation methods and value types – possibilities of apply in valuation of allotment gardens ecosystem services

Valuation method	Suitable for valuation of	Suggestions of analyze			
		direct use values	indirect use values	option values	non-use values
Market valuation	goods and services traded on the market	x	x		
Contingent valuation methods	goods and services that are easily to comprehend for respondents	x		x	x
Hedonic pricing	environmental amenities reflected in the prices of specific goods, in particular property	x			
Damage function approach	losses of ecosystem services which cause economic damage (e.g. through an increased noise and dust pollution)		x		
Travel cost method	recreation services	x			
Ecological valuation	biodiversity conservation service				x

Source: own description based on L. Hein, *Economics and Ecosystem, Efficiency, Sustainability and Equity in Ecosystem Management*, Cheltenham UK, Northampton, MA USA, 2010, p. 41.

leads to liquidation of the gardens. In typical calculation, the market value of fruits and vegetables produced in allotment gardens is not able to offset the revenues from alternative uses of these sites. Moreover, the provisioning function is often replaced by cultural functions, primarily related to recreation, which is harder measurable in money. Local governments, seeking for higher budget incomes, are ready to change local plans. Such problems were observed in the last two decades in several cities in Poland. Many allotment gardens, still situated in cities centers, are "tasty morsel" for developers. Based on the theory of ecosystem services and their valuation arguments can be formulated for the protection of allotments in cities. Methodological suggestions are presented in Table 2.

All provisioning services (e.g. fruits, vegetables) and some cultural services (e.g. recreation) have direct-use value. Indirect use value stems from the indirect utilization of ecosystems, mainly by the positive externalities that ecosystems provide to society (e.g. air purification, noise suppression, beautification of space). Option value relates to future demand for services when people are willing to pay to keep the option of using a resource in the future for well known and new (unknown) purposes (e.g. new herbal medicine). Non-use value is imminent attribute to ecosystem. From anthropocentric point of view it could be beauty of gardens but ecocentric point of view is worth noting as well. Example is "right to exist" of plants and animals species in urban space[22].

[22] L. Hein, *Economics and ecosystem, efficiency, sustainability and equity in ecosystem management*, M.A. 2010, p. 36.

Conclusions

New arguments based on valuation methods particularly of ecosystem regulating services could add to the discussion on urban farming in allotment gardens noteworthy input.

Space is at a premium in cities and is accordingly expensive and difficult to secure. Maintaining lands of allotment gardens in their current use could be easier through the estimation of value of regulatory and cultural services, which are rather not reflected in the price of these plots. It means, that new research should be conducted to find more precise information what is real the value of non-market services of urban semi-natural ecosystem in allotment gardens for all citizens and not only for plots owners.

This will enable to look from a different perspective at the issue of existence in the urban centers of old allotment lots. Its value is now underestimated, which makes it difficult to protect this area "as gardens for all".