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The Value of Urban Farming in Oslo, Norway: Community Gardens, Aquaponics and Vertical Farming

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ABSTRACT

Urban agriculture is increasingly recognized as an important sustainable pathway for climate change adaptation and mitigation, for building more resilient cities, and for citizens' health. Urban agriculture systems appear in many forms – both commercial and non-commercial. The value of the services derived from urban agriculture, e.g., enhanced food security, air quality, water regulation, and high level of biodiversity, is often difficult to quantify to inform policymakers and the general public in their decision making. We perform a contingent valuation survey of four different types of urban agriculture Where the citizens of Oslo are asked about their attitudes and willingness to pay non-commercial (urban community gardens and urban gardens for work training, education and kindergartens) and for commercial (i.e. aquaponics and vertical production) forms of urban agriculture. Results show that the citizens of Oslo are willing to increase their tax payments to contribute to further development of urban farming in Oslo.

Keywords: *Willingness to pay; community garden; aquaponics; vertical farming; Oslo*

1 Introduction

Currently, about 56 percent of the world's population lives in urban areas (World Bank, 2020). By 2050, it is expected to increase to 68 percent with an extra 2.5 billion inhabitants occupying urban spaces (United Nations, 2018). Rapid urbanization threatens the sustainability of agriculture in the face of climate change, resource depletion and limited land resources. In Norway, there are pressures to convert land from a green status into constructed urban areas. Due to past and present anthropogenic and industrial activities, soils in the urban areas have become contaminated and cannot be used for food production until remediation measures have been implemented. Moreover, Norway imported more than 70 percent of all fruits, vegetables, berries, and potatoes people consume (frukt.no, 2019). The challenge now is for cities to provide their inhabitants with means to increase their own supply of appropriate and healthy food, while simultaneously enhancing self-sufficiency, sustainability, and resilience. Oslo, the biggest city and the capital of Norway, is experiencing record growth in population (Oslo Kommune, 2021). Its urban development is concentrated within the existing built environment, which requires densification and transformation in prioritized areas.

To address this challenge, there is a growing interest in food being grown locally within cities (Guitart, Pickering and Byrne, 2012). Urban agriculture is defined as "an activity located within (intra-urban) or on the fringe (peri-urban) of a town, a city or a metropolis, which grows or raises, processes and distributes a diversity of food and non-food products, (re)using largely human and material resources, products and services found in and around that urban area, and in turn supplying human and material resources, products and services largely to that urban area" (Mougeot, 2005). It is increasingly recognized as an important sustainable pathway for climate change adaptation and mitigation (Lwasa et. al., 2014; Thebo et. al., 2014); for building more resilient cities (Goldstein, et. al. 2016); and for citizens health (Zasada, 2011).

Oslo has many small and larger pockets of unused land or spaces that could be turned into gardens in the city. However, urban agriculture still plays a minor role in improving food security. To implement urban agriculture will require that citizens are willing to pay for it. Food production in urban areas also needs to be a part of the planning processes and urban designs as administered by local and national governments. Without sufficient economic incentives and effective policies in place, it would be difficult to promote and implement urban agriculture as an integral part of the development and planning goals of urban areas in Norway, such as Oslo City.

However, many human decisions, both of policymakers and the general public, are based on good quantifiable information about the benefits and costs associated in the implementation, management, maintenance and operation of urban agriculture. The benefits and costs of urban agriculture have generally public good characteristics (e.g., air quality, water regulation, high level of biodiversity). Hence, these benefits and costs are not priced in existing markets and often difficult to quantify.

There have been qualitative studies on the (i) perceived benefits of urban agriculture (e.g., Colasanti et al., 2012; Hale et al., 2011), (ii) motivations on urban agriculture (e.g., Veen and Eiter, 2018; Sanye et al, 2016; Harris et al., 2016), and (iii) challenges related to urban agriculture (e.g., Wakefield et al., 2007; Beckie and Bogdan, 2010; Kortright and Wakefield, 2011).

There are also a few studies that attempted to attach value to multifunctional components of urban agriculture on: (i) health and well-being (e.g., Algert et al., 2016; Oladeji 2008; Ruggeri et al., 2016), (ii) sanitation and food safety (e.g., Kouame et al. 2017; Murray et al. 2011; Abdu et al. 2011), and (iii) income and cost savings on food (e.g., Smith and Harrington 2014; Aina et al., 2012). Nevertheless, there is still limited understanding of the benefits and costs of urban agriculture that will enable to assess whether these benefits outweigh costs of adopting urban agriculture and compare the benefits and costs of different forms of urban agriculture.

The objective of this research is to assess the willingness to pay of Oslo residents towards urban agriculture. To our knowledge, this is the first to quantitively assess the value of different forms of urban agriculture in Norway and the willingness of citizens to support it through increased tax payments. The study focuses on the city of Oslo. Results of this study can inform government officials and city planners in integrating food production in urban areas into city land-use planning and other related activities.

2 Background: Urban Agriculture in Oslo

Oslo has experienced an increased focus on urban agriculture over the last decade (Landbruks og matdepartementet, 2021). Urbanization in combination with limited land resources and an increased focus on food security has made urban agriculture a popular topic for the city. As a result, development and facilitation of green spaces and cultivation opportunities has been prioritized. Several different types of urban agriculture can be found around Oslo today, for environmentally, recreational, and educational purposes, as well as commercial urban agriculture.

Generally, urban agriculture in Oslo can be classified into either non-commercial or commercial. Non-commercial type of urban agriculture includes urban community gardens, urban gardens for work training, education and kindergartens and urban gardens for recreational purposes. The adoption of urban community gardens is supported by the Oslo Municipality's Urban Environment Agency, which developed a strategy for urban agriculture called "Sprouting Oslo" (Spirende Oslo) running from 2019 to 2030. The strategy provides subsidies to various urban agriculture projects that will contribute to increased knowledge development and more urban agriculture activities in Oslo. These subsidies come in the form of support for measures to implement urban agriculture such as the preparation of communal gardens and construction of growing boxes, beehives, and hen houses (Oslo Kommune, 2020a). "Sprouting Oslo" is also currently working on mapping of existing projects and potential areas for urban agriculture in Oslo.

Urban gardens for learning purposes is also a part of Sprouting Oslo, where facilitation of school gardens and green schoolyards for both new and existing schools in Oslo is a stated goal (Bymiljøetaten, 2019). Oslo Municipality currently has 30 school gardens, most of them publicly owned and are used by about 40 schools. In addition, Oslo has 7 visitor's farms where different forms of agriculture are involved – from growing herbs, vegetables, fruits, and berries, to animal husbandry. The visitor's farms invite the general public to experience and learn how traditional farming works.

Urban agriculture for recreational purposes has long traditions in Oslo and is popular among many of the city's inhabitants, through operation of various allotment gardens among other things. There are allotment gardens with or without cabins located in Oslo (The Norwegian Allotment Garden Association, 2020; Oslo Kommune, 2020b). People in the local community is often prioritized.

Commercial type of urban agriculture includes vertical farming and aquaponics. Vertical farming is where the plants/crops are grown upwards to (i) save space for growing, to (ii) use technology to make the production of crops efficient and to (iii) control fully the environment for the plants. This makes vertical farming ideal for urban areas where space may be an issue. Hydroponics, the predominant growing system used in vertical agriculture, is where plants grow in a substrate or water with nutrients, instead of soil. Hydroponics makes it easier to regulate the supply of water and nutrients needed for the plants. It also reduces soil-related cultivation problems such as soil-borne diseases and decreases the use of fertilizers or pesticides (Al-Kodmany, 2018). While hydroponics is fairly new and not very adopted widely in Norway, there are some operators who adopt it including BySpire, the largest vertical farm. They are located in Oslo's sub-district Økern, where they have used an old office building for vertical farming to produce herbs supplied to restaurants and online retail (BySpire, 2021).

When a hydroponic production system is integrated with aquaculture, i.e. fish farming, it is referred to as aquaponics. The notion of aquaponics is to create a symbiotic relationship between the plants and the fish (Al-Kodmany, 2018). The water from the fish tanks' biofilters is used for fertilizing the greenhouse plants. Also, the hydroponic beds function as a bio-filter that remove gases, acids, and chemicals, such as ammonia, nitrates, and phosphates from the water. Some research has been done on aquaponics in Norway in recent years (see Nordic Innovation, 2021; Senter for tverrfaglig forskning i rommet, 2020; Oslo Aquaponics, 2017), and there is an increasing focus on this type of food cultivation, as the methods are both area-efficient and climate-friendly (Spilling, 2015).

There exists a policy document on strategies for developing urban agriculture in cities and municipalities to satisfy inhabitant demands through various measures to facilitate cross-sectorial and interdisciplinary cooperation (Landbruks og matdepartementet, 2021). The strategy addresses three focus areas: (i) sustainable urban and local development, (ii) increased knowledge about sustainable food production, and (iii) facilitation to support new ideas to create sustainable values and business development.

The state administrator of Oslo and Viken states that urban agriculture is one of the focus areas in their regional business program (RNP). The RNP follows up national policy for business development in agriculture and contributes to the regions working to achieve national goals. Their goal with urban agriculture is to increase knowledge about Norwegian food production in the population, and that urban

agriculture should be a bridge-builder between agriculture and the population. Traditional farming in and around cities and towns, development of cooperative farming and various urban cultivation activities are therefore important (Statsforvalteren i Oslo og Viken, 2019).

Oslo has different ways of funding urban agriculture today: Direct grants is the responsibility of the city administration. In 2020 63 recipients were supported with total of about 250 000 EUR (Oslo kommune, 2020a). The support was given to both private and public enterprises: schools and kindergartens; health and health care; commercial businesses; communities; housing cooperatives; NGOs; and private individuals. In addition to the grants from the central city administration, the 13 city districts each have 25 000 EUR – 100 000 EUR to green city development. Some of these means is also paid to urban agricultural production.

While Norway has instituted policy strategies that can facilitate the diffusion of urban agriculture, the allocated budget is very limited to implement these strategies. The interest of urban agriculture is expanding in Norway. For instance, from 2010 to 2017 the roster of those waiting for an allotted area in parcel gardens have quadrupled. In the last years there has also been a sharp growth in demand for establishing cooperative farms and for small-scale production for direct sales on local market or to supply restaurants with special products.

Moreover, an overriding dilemma with a limited land area is that several different purposes for its use may be in conflict. In local land management, various considerations must be weighed in line with national laws, i.e., with the Planning and Building Act. The need for infrastructure, buildings, densification, and the need for land for urban agriculture must be weighed against other considerations such as soil protection, natural diversity, cultural environment, outdoor life, and recreation.

The monetary valuation of the benefits of urban agriculture will help justify public expenditure on urban agriculture and inform policymakers in the selection of appropriate plans and policies for implementation of urban agriculture. Our paper focuses on the four different forms of urban agriculture, namely: community parcels, community gardens for learning and work purposes, vertical vegetable farming, and vegetable farming with aquaponics.

3 Data and Empirical Methods

3.1 Data and Survey Design

Government officials need to know how their constituents feel about their planned government programs in general, and about paying taxes to fund them in particular (Kline & Wichelns, 1994). We use the contingent valuation method (CVM) to elicit general public knowledge and attitudes towards adopting many different types of urban agriculture in Oslo. The CVM uses a survey instrument to ask respondents questions regarding food consumption, attitudes, socioeconomics and willing to contribute to the extension of UA in Oslo. By varying the size of the payment across different respondents, the demand curve for urban agriculture can be traced out and the mean willingness to pay of the respondents can be estimated for urban agriculture. One limitation of this method is that the responses are based on stated rather than observed preferences.

An increase in taxes is the payment vehicle used in this study, and a payment card approach was used to retrieve the maximum willingness to pay. A payment card presents a list of possible bids, asking the participants to choose the amount they would be willing to pay for a given alternative. The payment card for nonmarket goods was introduced by Mitchell and Carson (1993) in the early 1980s and is frequently used in contingent valuation. The advantage with this tool is that it is easy to understand, and herby avoids nonresponses. In addition, by construction it circumvents extreme values.

When developing the bid values there were no relevant studies about urban agriculture. Hence, we looked to the valuation literature of urban parks, and urban green areas and anchored our bids to similar values (Mell et al, 2013, Sirina et al., 2017).

The CVM survey was performed by IPSOS-Norway in September 2020 in a representative sample for the population of Oslo. The sample consists of 1005 respondents with age from 18 to 88 years. The survey questionnaire was carefully designed to provide the respondents with adequate and accurate information related to UA in Oslo. The questionnaire consisted of the following parts: (1) explanation about UA in Oslo and the strategies for UA by the city council of Oslo and the Department of Agriculture in Norway; (2) some information about the benefits (e.g. health, environment, climate, local food and increased self-sufficiency of food in the city of Oslo) and costs (e.g. areas that are used for other purposes need to be adapted to UA, and teaching and guidance of different types of UA are needed) related to the expansion of UA in Oslo; (3)

description of assumed scenario and key questions; and (4) questions related to socio-economic information of the respondents, including age, education, income, and membership of environmental organizations.

Respondents were shown pictures related to different forms of UA with a brief explanation:

Figure 1. Community parcels for the habitants of Oslo (Photo: Sebastian Eiter)

This initiative is to arrange suitable areas, run the community gardens and provide teaching and guidance for the users. The intention is that renting a parcel in a community garden should be strongly subsidized to the habitants of Oslo and allocated through a queue system.

Figure 2. Community gardens for kinder gardens, education and labour training (Photo: Ester J. Veen)

This initiative is to arrange suitable areas, run the community gardens and provide teaching and guidance for the users.

Figure 3. Vertical farming of vegetables (Photo: Randi Seljåsen)

This initiative is to arrange suitable areas for vertical farming of vegetables. The production will be done by commercial parties.

This initiative is to arrange suitable areas for production of vegetables with aquaponics. The production will be done by commercial parties.

Figure 4. Vegetable farming with aquaponics (Photo: Randi Seljåsen)

For each of the four types of UA the following question was asked*: Assume that resources for UA may be earmarked, i.e. through a trust, how much will you personally be willing to contribute to each of the four proposed initiatives? Please state the maximum amount you will be willing to contribute through increased taxes each year.* Every participant was informed that increased funding would lead to more areas being available for UA activities and for adaptation of such areas.

In this study each participant was given a preset list of nine possible willingness-to-pay amounts (payment card), with bids ranging from: Nothing, 1 EUR, 2 EUR, 5 EUR, 10 EUR, 20 EUR, 50 EUR, 100 EUR, More than 100 EUR[1]. Each participant checked one of these alternatives, thus revealing their true value within an interval. For example, if a participant bids 1 EUR for a given alternative, the participant`s true value resides in the interval [1 EUR, 2 EUR), see section 3.2. Table 1 summarizes the frequencies for the willingness to pay in the four cases.

Table 1.
Frequencies of Maximum willingness to pay for each of the four types of UA

WTP (EUR*)	UA for the population (%)	UA for education and training (%)	Vertical production (%)	Aquaponics (%)
Nothing	28	24	33	35
1	7	7	7	9
2	8	8	8	7
5	12	14	12	13
10	15	17	15	15
20	13	11	10	9
50	10	12	8	8
100	4	4	4	3
More than 100	3	3	2	2

*The payment card was presented in NOK. To facilitate the reading for an international audience table 1 is shown in EUR where 10 NOK is approximated as 1 EUR (The actual average exchange rate in September 2020: 1 EUR=10.7769 NOK, Norges Bank, 2021)

About 50% of the sample is willing to pay between 5 EUR and 50 EUR a year in terms of increased taxes for each of the four types of urban agriculture. The most popular is the urban agriculture for kinder gardens, educating and training. The least popular is contributing to aquaponics for commercial production of vegetables. Between 24% and 35% answered Nothing when asked how much they are willing to contribute to each of the four different types of UA.

[1] The payment card was presented in Norwegian kroner (NOK). To facilitate the reading for an international audience table 1 is shown in EUR where 10 NOK is approximated as 1 EUR (The actual average exchange rate in September 2020: 1 EUR=10.7769 NOK, Norges Bank, 2021). When used in the estimation, the actual exchange rate for September 2020 was used.

3.2 Empirical methods

To analyse the WTP from the survey data, we assume that the true value of the WTP for each participant lies somewhere between the indicated value and the value above (Cameron and Huppert, 1989). Since we don't know how much the individuals who responded that they are willing to pay more than 100 EUR in fact are willing to pay, we need to take this censored data into account. To find the mean with a censored value, we estimate the expected value and the standard deviation with maximum likelihood.

Assuming that WTP is normally distributed censored values can be included in the likelihood function in the following way: If y_i is the observed value of a variable for person *i*, y_i^* is the true value and C is the censoring point:

$$Y_i = \begin{cases} y_i^* \; if \; y_i^* \leq C \\ C \; if \;\; y_i^* > C \end{cases} \quad (1)$$

The contribution to the likelihood function (the probability of y_i^* greater than the censoring point) is the area above the censoring point of the standard normal:

$$P(y_i^* > C) = \int_C^{\infty}((1 - \emptyset(y_i^* \mid \mu, \sigma) = 1 - \Phi\left(\frac{C-\mu}{\sigma}\right) = \Phi\left(\frac{\mu-C}{\sigma}\right)) \quad (2)$$

Where $\emptyset$ is the probability density function (pdf) of the standard normal, Φ is the cumulative distribution function (cdf) of the standard normal, μ is the expectation of y_i^*, and σ is the standard deviation of y_i^*. Then the likelihood function is given by

$$L = \Pi_{y<C}\emptyset(\frac{y_i-\mu}{\sigma})\Pi_{y=C}\Phi(\frac{\mu-C}{\sigma}) \quad (3)$$

In our case, according to Cameron and Huppert (1989), we use the midpoint between the WTP indications as data: Nothing is set to 0.5, 1 is set to 1.5,,…., 50 is set to 75, 100 remain 100. Our likelihood function is given by:

$$L = \prod_{y\leq 100} \emptyset\left(\frac{y_i-\mu}{\sigma}\right) \prod_{y>100} \Phi\left(\frac{\mu-C}{\sigma}\right) \quad (4)$$

Our point of departure is the likelihood function (4). But there still is one problem: Among those individuals who answered "Nothing" in the willingness pay questions, some of them might be real zero observations, i.e., they might not be willing to pay between 0 and 1 EUR per year for urban farming in Oslo. To identify the real zero observations, we made use of two other questions in the survey: "It is important that food is produced in Oslo" and "Urban agriculture is important for the environment in the city". The individuals answered one of the following: "Totally agree", "Partially agree", "Partially disagree", "Totally disagree", and "Impossible to answer". Table 2 shows the answers to these questions.

Table 2.
Questions used to identify real zero willingness to pay. Numbers of individuals answering each of the questions*

	Totally agree	Partially agree	Partially disagree	Totally disagree	Impossible To answer
Urban agriculture is important for the environment in the city	298 (29.7)	375 (37.3)	186 (18.5)	74 (7.4)	72 (7.2)
Urban agriculture is important for the environment in the city	327 (32.5)	429 (42.7)	123 (12.2)	58 (5.8)	68 (6.8)

*Percentages in parentheses

We used the answers to the two questions in table 2, together with the "Nothing" in table 1 to identify the real zero observations: We assumed that those individuals who answered "Partially disagree" or "Totally disagree" on one of the two questions in table 2 and "Nothing" on the willingness to pay questions in table 1 where real zeros. They are not willing to increase their tax payments to fund urban farming in Oslo. Our data showed that 14% were not willing to pay anything at all to fund community parcels for the habitants of Oslo; 11% were not willing to pay anything to fund urban agriculture for education, kindergartens, and labour training; 16% were not willing to fund vertical farming; and 16% were not willing to fund aquaphonics.

We dropped the individuals identified as real zeroes from the data, and estimate μ_i , i=1,2,3,4 for each of the four cases. However, to find the expected willingness to pay in the data without the real zeroes we account for the probabilities to be included in the sample. The willingness to pay for the four cases of urban farming in Oslo is then

$$E(WTP_i) = (1 - P_i)\,\mu_i \quad (5)$$

Where P_i are the probabilities to be a real zero. As probabilities we used the rates of the real zeroes: P_1=0.14, P_2=0.11, P_3=0.16 and P_4=0.16.

To estimate the expected willingness to pay for the different types of urban agriculture in Oslo we first used (4) and modified the algorithm in Gelman and Hill (2007, p 404-405) to maximize the likelihood function for the different cases. Then μ_i and P_i were included in (5) to find the expected willingness to pay. To find the standard deviations the whole process was bootstrapped with 500 iterations.

We also hypothesize and test the following:

(i) Females (F) are willing to contribute more to urban agriculture than males (M).

$$H_0: u_F > u_M$$

Males and females often have different opinions, attitudes and willingness to pay. For example, In Gustavsen and Hegnes (2020) females on average purchase more organic foods than males, they think that organic foods taste better than other foods, females consider organic is healthier and females are more willing to pay extra for organic foods than males.

(ii) Individuals who reported to have affected by the Covid-19 pandemic are willing to pay more than those who are not.

The reason for that is a paper by Büssing et al. (2021) who analysed changing behaviour in Germany during the Covid 10 pandemic. They found, *inter alia*, a more interest in nature, quite times in life and reflection of meaning of life in Germany. And this might have a connection to urban farming.

(iii) that individuals with positive and individuals with not so positive attitudes about climate change and the environment might have different views about *WTP* for different kinds of urban agriculture in Oslo.

To test these hypotheses, we performed ordinary t-tests for differences. Bootstrapped standard deviations for the differences were used in the *t*-tests.

4 Results and Discussion

In table 3 the expected willingness to pay for the four types of UA is shown. This table also includes results from a minimum mean model which is calculated directly from the data: nothing=0 EUR, 1 EUR=1 EUR,..,100 EUR=100 EUR and more than 100 EUR is set to 100.1 EUR. The minimum mean may be interpreted as a lower bound.

Table 3.
Willingness to pay for urban agriculture in the censored normal model, and the minimum mean model.

	Expected Willingness to pay (EUR)		Minimum mean (EUR)	
	Mean WTP	sd	Mean WTP	Sd
UA for the people of Oslo	20.80	0.89	15.25	0.79
UA for education purposes	21.57	0.87	15.82	0.76
Vertical production	17.26	0.84	12.70	0.73
Aquaponics	15.77	0.77	11.58	0.66

The expected mean *WTP* among the citizens of Oslo for urban agriculture is between 15.8 EUR and 21.6 EUR per person per year. The individuals in Oslo are most willing to contribute for urban agriculture intended for education purposes with 21.6 EUR per person per year, and the least contribution to aquaponics with 15.8 EUR per person per year.

Table 4 shows that the differences in the expected WTP for different forms of urban agriculture by gender, whether an individual is affected by Covid-19 or not, and individual's attitude toward the environment. There is no difference in *WTP* by gender and for those who are affected/not affected by Covid-19. However, the *WTP* is different between those with positive attitude and those with not positive attitude towards the environment for all the four UA cases.

Table 4.
Expected *WTP* (EUR) in different groups* and t-statistics for the differences.

	Gender			Affected by covid-19			Attitude toward environment		
	Male	Female	Diff-t	Yes	No	Diff-t	Positive	Not positive	Diff-t
UA for the people of Oslo	20.87 (1.26)	20.73 (1.23)	0.08	21.35 (1.04)	19.29 (1.70)	1.04	22.04 (0.97)	13.88 (2.01)	3.66
UA for education purposes	21.22 (1.31)	22.14 (1.27)	-0.50	22.34 (1.08)	19.91 (1.74)	1.17	23.38 (1.00)	12.33 (1.83)	5.30
Vertical production	16.33 (1.18)	16.76 (1.15)	-0.26	16.97 (0.99)	15.46 (1.53)	0.83	18.13 (0.94)	8.35 (1.41)	5.66
Aquaponics	15.31 (1.10)	15.33 (1.12)	-0.01	15.24 (0.87)	15.57 (1.61)	-0.17	16.54 (0.85)	8.78 (1.47)	4.56
n	492	513		735	270		852	153	

*Standard deviation in parentheses.

We then use the expected *WTP* in Table 3 and the total number of taxpayers in Oslo as bases to estimate the expected potential taxes increases to pay for new urban agricultural sites in Oslo. While Oslo has 693 494 inhabitants as of January 1, 2020 (Statistics Norway, 2021), the numbers of individuals 17 years and older living in Oslo and paid personal taxes to the county of Oslo in 2019 was only 432 160, and their average personal income was 48 307 EUR (520 600 NOK). Using the number of individuals who paid taxes we can scale up the willingness to pay to find the potential for increasing yearly taxes to fund urban agriculture in the city. Table 5 shows that the potential for increased taxes to pay for more urban agriculture in Oslo varied from 6.8 million of EUR for aquaponics to 9.3 million EUR for UA for education purposes. The total willingness to increase taxes to fund urban agriculture in Oslo was 32.6 million EUR.

Table 5.
Potential for increased taxes to pay for urban agriculture in Oslo.

	Expected total value (Millions EUR)	Standard deviation (Millions EUR)
UA for the people of Oslo	8.99	0.38
UA for education purposes	9.32	0.38
Vertical production	7.46	0.36
Aquaponics	6.82	0.33
Total	32.58	1.26

Compared to the current funding today of 250 000 EUR, this is more than 10 times the funding. This will support the national strategy to stimulate local communities to increase urban agriculture in Norway, which was launched in February 2021 (Ministry of Agriculture and Food, 2021a). The strategy was produced by seven different ministries in cooperation, which shows the interdisciplinary importance of urban agriculture. The ministries of agriculture and food; Climate and environment; Health; Local government and modernization; Education; and Labor, were all involved in constructing the strategy. The main priority is sustainable urban development, increased knowledge of sustainable food production and sustainable value creation and business development. Among the instruments the government will use to increase urban agriculture in Norway is to prepare a guide for urban agriculture for use in local area planning; evaluate the need for changes in laws or regulations to better prepare for urban agriculture; prepare educational guides for school gardens and urban food production; courses; stimulate to increased value creation and business.

5 Summary and conclusions

In this paper an online survey about willingness to pay for urban agriculture in Oslo, the capital of Norway, is performed. Using the method of Contingent Valuation, a payment card was presented for a representative sample of citizens of Oslo in which they were asked how much they were willing to increase yearly taxes to fund four types of urban agricultural productions: Community gardens for the habitants of Oslo, community gardens for education and labor training purposes, vertical food production, and aquaponics. The potential for increased taxes amounts to between 6.8 million EUR and 9.3 million EUR for the four different types of UA. Not surprisingly we found a significant positive association between "engagement in environmentally-friendly behavior" and "willingness to support urban agriculture". Gender differences or differences due to covid-19 affection were not significant. The UA for education seems to be the most favored type of UA among the respondents. Meanwhile the mean *WTP* for the purpose to set aside areas to UA for the people of Oslo gave the second largest score. The technical solutions using "vertical production" and Aquaponics run by commercial firms received the lowest support as revealed by the respondents' WTP.

We assume that the interest in environmental attitudes (i.e. because of the last report from the IPPC, 2021) and thereby the interest of UA will grow in the future. Both the National government and the City Council of Oslo have lanced strategies of supporting already established instruments and measures for general business development and non-commercial UA. For instance, built into the agricultural agreement with the government, are instruments that will contribute to mobilization in business development for increased value creation where the target group is organizations, R&D institutions, the municipal sector and others.

However, as the government express with the final words of the strategy paper, in the next five years there are no plans to increase financial means for UA purposes: "the measures discussed in the strategy can be implemented within the current budget framework. No increased administrative costs are expected" (Ministry of Agriculture and Food, 2021a). This fits well with the idea of not letting public funds crowd out contributions from private sector. It might however go against the intension of the strategy which is to make UA sector grow. It might be fair at least to let the AU funding budget grow at the same pace as the general agricultural agreement. Here farm associations are the parties that negotiates and usually the results are added subsidies. Maybe the AU organizations also should be given negotiation power.

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