Chapter 3

Urban Gardening: From Cost Avoidance to Profit Making — Example from Ljubljana, Slovenia

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Additional information is available at the end of the chapter

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Abstract

In this study, we compare two economic models of urban gardening in Ljubljana, Slovenia. First is an avoided costs model (ACM) and the second one is a business model (BM). Comparison is made to exemplify the main economic differences between the two models. The difference is that producers under the BM sell surplus products, which is not the case under the ACM. The main aim of this study is to present an analysis of the phenomenon of urban gardening as a BM for small family home or allotment gardens. The survey was performed through Internet questionnaires and in some cases also with on-site interviews. Totally 127 urban gardeners from Ljubljana municipality participated in the research. The average ACM urban gardeners had on 1 m^2 revenue of 4.86 EUR/m^2, costs of 1.48 EUR/m^2 and gross margin (savings) of 3.38 EUR/m^2. Altogether, ACM brings savings of approximately 462.7 EUR per average size garden (136.69 m^2) or 203 EUR per median size garden (60 m^2) to the average gardener. The average BM gardener sold to the wholesale company approximately 107.0 kg of vegetables per year from 32.48 m^2 of production area for an average retail price of 1.46 EUR/kg and earning revenue of 156.44 EUR/year. Costs were approximately 21.27 EUR/year. Therefore, the gross margin or earning from surpluses sold was approximately 135.17 EUR/year for the average BM gardener, which was 4.29 EUR/m^2 or 1.26 EUR/kg of produce. The study offers evidence that the ACM can be upgraded with the BM. For example, if a family of two retired members have an average garden of 136 m^2, they can produce vegetables for four people. Consequent surpluses for two family members can be sold for extra money. The BM should be more promoted among urban gardeners as it can offer additional income and in certain cases, when a hobby becomes a profession, also a full-time job.

Keywords: urban gardening, cost avoidance, profit making, economy, vegetable production, business model

1. Introduction

Urban gardening is a food-growing concept in general covering home (backyard), allotment, community and rooftop gardens, which are taking place in the intra-urban (centre) or peri-urban (suburb) fringe of the city [1]. Urban gardening became increasingly popular in the last decade in the other parts of the world and also in Europe as a modern way of recreation and connecting with nature. Although this phenomenon is not new, it is experiencing great attention from the media as well as from policy makers and experts from various scientific disciplines.

The beginnings of urban gardens date back to Europe in the early 18th century as a response to urbanisation and industrialisation of the cities. With people immigrating at the beginning of the 19th century, this habit began to spread to other continents. At that time, the main reasons for gardens in the urban areas were mitigation of socioeconomic hardships, poverty of the working class as well as the overall weak supply of vegetables in urban areas.

The most recent "boom" in gardening is connected with solving many of the urban area's problems, which are not always related to food security but rather related to social and health (physical and mental) problems of the population, their limited access to green spaces and the economic and cultural revitalisation of degraded urban areas. However, the recent increased interest in gardening is also linked to the increasing concern of the population about food quality and costs as well as food insecurity and self-supply [2].

Urban gardening brings many different benefits, besides just growing food, which are important on personal level as well as on community level. Among them are the most important social networking and societal acceptance, recreation, health, food safety, economic cost avoidance and care for ecological issues. Urban gardening is usually considered as local food production, which enables and improves food security in the cities and contributes to its sustainable management. It also helps to diversify nutrition, development of local business, regulate poverty and social inclusion of underprivileged groups [3, 4].

In this study, we concentrate on the economic benefits of urban gardening for citizens. It is a source of self-provision found to benefit households as cost avoidance. Local residents who grow food in their backyards or in local allotment and community gardens can sell it in local markets, shops or restaurants and profit from this kind of business model (BM) [5, 6]. Certain cities support different urban gardeners groups or associations with offering them public market space as an opportunity to sell or exchange their products. Expansion of urban gardening also offers new business opportunity in producing compost from organic wastes collected at vegetable market or agro industries. Training at urban gardens is a good opportunity for young persons to evolve their environmental, agricultural and food processing skills and in the future careers [7].

On the other hand, urban gardening also contributes to the green infrastructure in the cities and is part of the provisioning ecosystem services. In geographical context, cities only produce a small share of the food they consume; however, in certain areas and time periods (political and financial crisis) this production can play an important role for food security in the city [8, 9]. Ecosystem services' benefits are often difficult to value due to multiple value parameters,

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which need to be taken in consideration. An interesting example for exploring benefits of integrating ecosystem services into real economies is urban gardening, a part of urban agriculture. Urban gardening is considered as a marginal economy mainly as a hobby and cost avoidance activity, although there are examples where it was turned into a profit-making activity.

Scientific literature offers us numerous examples of how urban food producers, individuals or organisations with the knowledge and desire to produce food in the city for the city market sale, succeed to overcome the obstacles to entrepreneurial initiatives [2, 4, 5, 10–12]. Obstacles can be divided into four broad categories related to site (contamination, security and vandalism, lack of long-term site tenure), government (local, federal or state government impediments), procedure (financial resources, qualified staff, time limits, small-scale projects, coordination, conflicts among partners, business planning, start-up costs) and perception of the public (food safety, low economic payback, generation gap, gardening seen as rural activity) [10]. The authors from the global North and South report on actually the same obstacles with a few decades lag time from the north to the south [2, 12–14].

Urban gardening production in the cities is in many aspects quite different from agriculture in rural areas. On one hand, numerous agricultural inputs, such as mineral fertilisers, plant protection products, irrigation water, soil medium and other, are the same. However, as urban gardening is not part of EU common agricultural policy needs on the city level special regulation and inspection. This includes specification of conditions under which this type of production is possible such as physical infrastructure, land availability and soundness with the city spatial plan, all with the purpose to expand urban gardening and avoid potential food safety risks [1, 15]. Nevertheless, cities worldwide are becoming more and more aware of the benefits of urban gardening because it can bring food security as one of the most important provisional ecosystem services. It is estimated that with potential yields of up to 50 kg/m^2 per year and more (in greenhouses), vegetable production is the most significant component of urban food production improving the food resilience of cities and contributing to global food security [15].

In this study, we compare two economic models of urban gardening in Ljubljana. First is an avoided costs model (ACM) and the second one is a BM. Comparison is made to exemplify the main economic differences between the two models. The main general difference is that producers under the BM sell surplus products, which is not the case under the ACM, where the products are consumed by producers and where surpluses are given to family members and friends for free or exchanged for other goods, rather than sold.

The main aim of this study is to present an analysis of the phenomenon of urban gardening as a BM for small family home or allotment gardens. We examine the economic benefits of urban gardening for producers beyond the food self-provision ACM and concentrate on possible entrepreneurial initiative for improving the economic status of certain social groups in the cities and for improving long-term food resilience of the cities.

2. Materials and methods

2.1. Study area

The city of Ljubljana is the capital of the Republic of Slovenia, administratively a part of the City Municipality of Ljubljana (CML) and, in broader terms, a part of the Ljubljana Urban Region (LUR) (**Figure 1**). The CML covers an area of 275 km^2 and encompasses 1.36% of Slovenian territory (20,273 km^2) and has 278,789 inhabitants, making up 13.5% of the population of Slovenia (2,062,874) [16].

The dense core of Ljubljana is integrated with other municipalities in the LUR encompassing 26 municipalities with a total of over 500,000 residents. The MOL has the highest population density 1.044 inhabitants per km^2 in Slovenia (102 per km^2), is economically one of the most developed and has the highest index of living standard among all municipalities in Slovenia. The MOL plays a key role in the entire area of the LUR and Slovenia, connecting the region and country into an integral whole with its administrative and economic power, traffic ways and daily labour migration.

In 2010, CML had 826 farms with average size of 6.9 ha. Dairy milk production is concentrated in the flatland and beef production in the hills around the city. Cereals production is constantly in decline and is subordinated to livestock and vegetable production. Fruits grown in the MOL are strawberries, blueberries and apples. Vegetable production in winter is concentrated on lamb's lettuce, rocket, lettuce and radish and in the summer months on tomatoes, potatoes, peppers, cucumbers, cabbage and lettuce. Asparagus and oil pumpkins are becoming more and more economically interesting for growing. CML systematically encourages development of integrated and organic farming. In 2009, 19 farms were included in the control of the organic farming. This type of farming is especially suitable for water protection zones in the northern part of the municipality with restriction on use of fertilisers and plant protection products.

Urban gardening is a very popular activity in the city of Ljubljana because around 10,000 inhabitants of different age groups, occupations and social status are engaged in this activity. Through history, city authorities always dedicated special areas owned by the municipality for allotments. Due to strengthening the urban gardening regulations in the past 30 years and new construction development, the number of allotment garden sites and hectares has declined from year 1984 with 200 ha, 1995 with 267 ha, 2005 with 186 ha, 2008 with 130 ha to 2014 with 158 ha. In 2010, MCL adopted a municipal spatial plan and dedicated 46 ha on 23 sites for public allotment gardens, out of which 20 ha were in production by the year 2014. Beside public areas for allotments, this is a very wide-spread private initiative in Ljubljana with home gardens and allotment gardens on hired private land. Out of 158 ha of allotment gardens, 138 ha is on private land (**Figure 1**).

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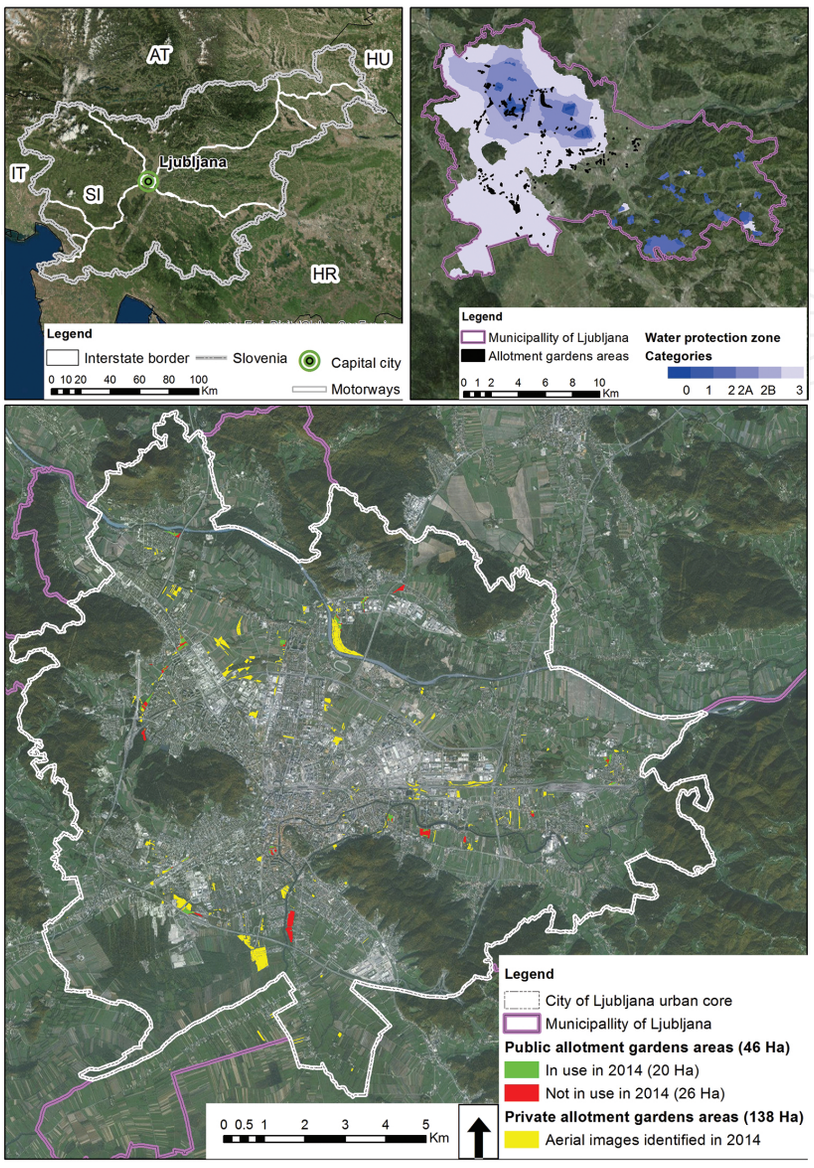

Figure 1. Study area land use by the City of Ljubljana Spatial Plan in 2014.

The city of Ljubljana started with stricter regulation in 2009 with two documents regulating allotment gardens in the ownership of the Municipality of Ljubljana. The decree on the organisation and delivery of gardens into the lease (83/2009) and Regulation for management of the allotment garden areas in the Municipality of Ljubljana (28/2009). The definition of allotment gardens and gardening in the Regulation and Decree is very strict. An allotment garden in the decree is land intended for the production of vegetables and fruits and cultivation of ornamental plants for gardeners' own purposes—self-supply. Allotment gardening is a leisure activity that involves the cultivation of vegetables and fruits and cultivation of ornamental plants with the aim of self-sufficiency and non-economical production.

Allotment gardens owned by the Municipality of Ljubljana are given in to lease to persons residing in the area of the Municipality of Ljubljana, who do not own land in the Municipality

of Ljubljana, suitable for an allotment garden, and also if such land is not owned by any of the other household members. Allotment gardens can be rented for a minimum period of 1 year and a maximum of 5 years. The leasehold relationship can be extended at the request of a tenant after the expiry of the lease period for a period of 1–5 years, unless the Municipality of Ljubljana needs the land for other purposes. Only plant protection products and fertilisers allowed by regulations for organic production may be used in the garden. In gardens, which are in water protection areas, it is only permitted to grow vegetables, fruits and ornamental plants in a manner which is prescribed by the regulations in force for this area. Tenants are obliged at all times to allow sampling of soil and plants to control the use of plant protection products and fertilisers. For watering the allotment garden, rainwater collected in a uniform format storage tanks or containers is primarily used. However, all allotment sites are in general connected to the water supply system.

On the other hand, gardens on private land (home, allotment or community) which are in majority are not regulated in any way. As they represent small-scale production, they are not part of common agricultural policy subsidy payments and cross compliance to which the majority of EU environmental directives is practically attached (Nitrate and Water Directive). Small-scale urban gardening can have an impact on the quality of environment in the case of unprofessional management of production, which can be seen in pollution of soil, air, water and yield. This kind of problem could be observed when gardeners are shifting from the cost avoidance to the BM where higher yields are desired. A lack of basic agriculture knowledge and skills, which leads to unprofessional use of fertilisers and plant protection products (PPP), is especially dangerous for the environment. While legislation on the availability of PPP for non-professional use is very strict in Slovenia and they are almost unavailable for small-scale gardeners, it is different with fertilisers, which are not regulated. The results of a study on 100 allotment gardens show a high potential of possible over fertilisation of gardening plots [17]. Average soil content of phosphorus and potassium in gardening plots was 91 mg P_2O_5/100 g of soils (maximum was 366 mg) exceeding optimal values of 13–25 mg/100 g and 31 mg K_2O/100 g of soils slightly exceeding optimal values of 20–30 mg/100 g. Residues of PPP were detected only once among all samples, but concentration was below the level of detection.

2.2. Data collection

2.2.1. ACM data collection

The data in this chapter were obtained from a survey carried out in 2014 within the framework of the international project 'Food Planning and Innovation for Sustainable Metropolitan Regions' FOODMETRES (7th Framework Project, subsidised by the European Commission). A special questionnaire was developed to analyse the phenomenon of urban gardening depended on local natural resources and to examine the socio-economic benefits of urban gardening beyond the provision of food. Additionally, the aim of this questionnaire was to get an insight into specific positive and negative externalities that urban gardening is bringing to metropolitan areas. In this regard, a survey questionnaire encompasses 44 questions covering seven topics addressing different perspectives, such as (1) characteristics of grown space; (2)

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growing methods applied by gardeners; (3) gardeners' skills and knowledge; (4) gardeners' motivations for gardening; (5) contribution of gardening to food supply and household budget; (6) the impacts of growing one's own food and (7) gardeners' socio-demographic characteristics. In our analysis, we took into consideration particularly the characteristic of growing space, contribution of gardening to food supply and household budget and the impact of growing one's own food.

The survey was performed through Internet questionnaires and in some cases also with on-site interviews. Participants were informed about the questionnaire by e-mails with the help of allotment gardeners' associations. Overall, 127 urban gardeners from Ljubljana municipality participated in the research. The reach window lasted from 6 January 2014 to 31 January 2015. Gardeners were categorised by four garden types. Gardeners with home gardens in their backyards (55) with 43.3% represent the majority of sample. Allotment gardeners with gardens on public land and with legal contracts (34) represent 26.8% of the sample. Allotment gardeners with gardens on private land with a contract (29) represent 22.8% of the sample. Allotment gardeners on private or public land without any contract (3) represent 2.4% of the sample population. The last group with 4.7% represent gardeners with gardens as part of a community garden, with mixed ownership or balcony gardening (6).

For the economic evaluation of the ACM model, we used data on growing space area (m^2), crop varieties and harvested yield (kg), total costs for production (euro) and surplus vegetable management. Additionally, we also used labour invested in management of gardens (hours). All data were self-reported by participants. The data on produce harvested were the most time demanding and challenging for the gardeners to report because they usually do not measure yields or areas of growing spaces. For this matter, we developed a questionnaire where they were able to report about their vegetable production in three different ways: as harvested yield in kilograms (e.g. 1 kg of onions) or as surface area of production in square metres (e.g. 1 m^2 of onions) or as number of individual plants of produced vegetable (e.g. five plants of onions). If any of the values was missing, it was later converted with transfer tables developed specially for this research (**Table 1**). For example, 1 kg of onions is equivalent to 0.2 m^2 of land or 10 individual plants of onions.

This enabled us to calculate average harvest yields for each of the different types of vegetables grown and also a single harvest value in kilograms per square metre made up of a weighted average of vegetables grown in the average size garden.

Vegetable type	**Harvested yield (kg)**	**Area (m^2)**	**Number of plants or amount of seed**
			for 1 kg of yield
Beans green	1	0.6	25
Broccoli	1	0.5	2
Cabbage	1	0.4	1
Carrot	1	0.15	15

Vegetable type	Harvested yield (kg)	Area (m^2)	Number of plants or amount of seed for 1 kg of yield
Cauliflower	1	0.33	1.33
Celery	1	0.2	2
Cherry tomato	1	0.15	0.4
Cucumber (for pickling)	1	0.25	1
Cucumber salad	1	0.125	0.5
Egg plant	1	0.25	1
Garlic	1	1.4	28
Green cabbage	1	0.25	1
Kohlrabi	1	0.25	5
Leek	1	0.2	6
Kale	1	0.25	4
Corn salad	1	1	80
Onions	1	0.2	10
Paprika	1	0.25	1
Parsley	1	0.33	33
Peas	1	1.33	130
Pepperoni	1	0.25	1
Potatoes	1	0.33	2
Pumpkin	1	0.5	0.5
Radicchio	1	0.5	4
Red Beet	1	0.25	12
Salad	1	0.25	3
Tomato	1	0.20	0.7
Turnip	1	0.25	10
Zucchini	1	0.25	0.25

Table 1. Vegetable conversion table between yield (kg), area of production (m^2) and number of plants or seeds for 1 kg of yield—for most common vegetables grown in Ljubljana.

2.2.2. BM data collection

The data for the BM model were obtained from FOODMETRES SME project partner. The partner wishes to stay anonymous, therefore, we refer to it as the Company. The Company is a medium-size private company with a 12% share in distribution of vegetables and fruits in Slovenia and with an annual turnover of 18 million EUR. It deals with the import and export

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of vegetables and fruits. In an average year, the Company purchase food products from 160 individual producers (professional farmers) and from 5 cooperatives from Slovenia and from 30 urban gardeners from Ljubljana. The main reason for buying vegetables from small urban gardeners in Ljubljana is customer demand for locally produced food and local varieties of vegetables (e.g. Ljubljanska ledenka/Ljubljana iceberg lettuce). This way, the Company has access to products that are not produced in mainstream agricultural production, but are highly valued on the market.

The data were obtained from an interview with a representative of the company that buys and sells produce from urban gardeners in Ljubljana and their database. Data for the years 2014 and 2015 were used to ascertain how many urban gardeners are selling their products to the Company, what the total amount of vegetables sold by urban gardeners was and how much an average gardener earned per year.

2.2.3. Calculation of savings and earnings

In the first step of calculating savings of ACM, we calculated the area of an average garden from the data gathered with questionnaires. In the second step, we used the supplied data from the questionnaires on vegetable varieties grown in an average garden (kg, m^2). We extracted the 15 most grown vegetables by an area in an average garden and calculated the share of each. Then, we calculated the average annual harvested yield (kg/m^2) for each of the most common vegetables. This enabled us to multiply the share and average yield of the most common vegetables and obtain harvested yield (kg/m^2) for an average garden. In the third step, we obtained average retail prices (EUR/kg) for the most common vegetables from the Statistical Office of the Republic of Slovenia for the year 2014, as correspondents reported production for that year. In the fourth step, we calculated revenue, cost and gross margin for average garden size. Revenue for an average garden (EUR/m^2) was calculated by multiplying yield (kg/m^2 average garden) and retail price (kg). Costs of gardening production were gathered from questionnaires as total cost for garden management per year, including seeds, seedlings, fertilisers and plant protection products. Costs per kilogram of produced vegetable (EUR/kg) were also calculated. The gross margin in Euros per average garden was calculated as total revenue (EUR) multiplied by total cost (EUR). The fifth step was recalculation of revenue, cost and gross margin numbers to arbitrary areas of 1 m^2, 100 m^2 and 1 ha, municipality designated area for gardening (46 ha) or total gardening area observed from aerial images (158 ha).

For calculating earnings of BM, we took the total bought vegetables (kg, EUR) from the urban gardeners and divided it by the total number of urban gardener suppliers to the Company. The result was average yield sold and average earning per individual gardener.

3. Results and discussion

3.1. Average garden size in Ljubljana

Based on the survey results, it was determined that the average urban garden size in the Ljubljana is 136.69 m^2 (**Table 2**). However, the amount of land used for vegetable production varied considerably. The data collected by questionnaires show that garden size ranged from approximately 1 m^2 to 5000 m^2. An average is not always useful for representation of a central tendency so we therefore calculate a median of 60 m^2 which is a better estimation of the usual garden size. The city of Ljubljana offers its citizens a uniform public urban garden of exactly this size.

Using ArcGIS, we determined from the municipality spatial plan that the city of Ljubljana has designated 46 ha of urban gardening areas for allotments. From aerial orthophoto images, we determined that the city currently has 158 ha of allotment garden areas of which 20 ha is publicly owned and 138 ha privately owned. Based on these numbers, lowered for 10% of functional land (paths and garden sheds), we can estimate that there are approximately between 10,000 (average size) and 23,000 (median size) allotment gardens within the city borders.

Type of gardeners	Gardens		Area (m^2)	
	Number	Percent (%)	Sum	Average
Gardeners with home gardens at their backyards	55	43.31	10,753	195.51
Allotment gardeners with garden on public land and with legal contract	34	26.77	1797	52.85
Allotment gardeners with garden on private land with contract	29	22.83	4080	140.69
Allotment gardeners on private or public land without any contract	3	2.36	90	30.00
Gardeners with gardens as part of community garden, with mixed ownership or balcony gardening	6	4.72	640	106.67
Total	**127**	**100.00**	**17,360**	**136.69**

Table 2. Number and area (m^2) of gardens by gardener's type included in the study for Ljubljana in 2014.

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We estimated that the use of average garden size (136.69 m^2) for economic calculation is the best value because in further calculations we also used averages for production yield, costs, saving and earning.

3.2. Crop types in production

All urban gardeners in the survey report on growing 43 different species, sorts or varieties of vegetables. The average gardener grows 15 different crops (**Figure 2**). More than 15 types were grown by 44.5% or 39 gardeners. The maximum number of vegetable types was 32, grown by three gardeners. All surveyed gardens together harvested 15,711 kg of vegetable in 2014. Out of which the 15 most common crops represent 78.6% or 12,348 kg of harvested vegetables.

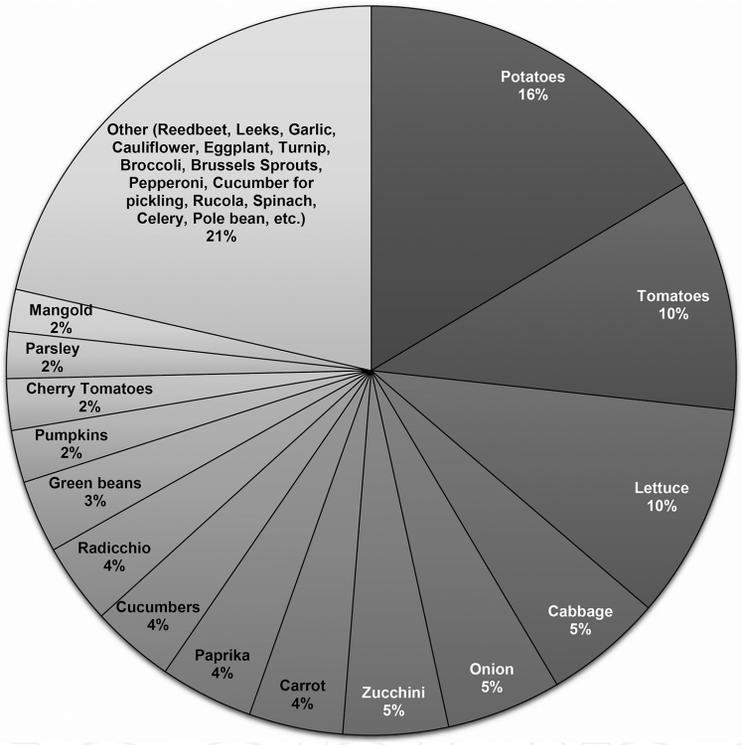

Figure 2. Shares (%) of the crops (kilograms harvested) across surveyed gardens.

The most grown crop in surveyed urban gardens is potatoes with 45.2 kg grown on 15.9 m^2 of the average garden area, representing 16.4% (2575 kg) of the total harvest (15,711 kg). Tomatoes were the next most common crop with 19.8 kg on 5.9 m^2 of area representing 10.3% of the total harvest. Third, lettuces (leafy greens) were with 16.7 kg on 6.3 m^2 of area representing 9.5% of the total harvest in the reported year. Shares of other grown crops based on harvested yields in the surveyed gardens are shown in **Figure 2**. In further economic calculations, we use only the data for the 15 most represented crops as a proportion (%) of weighted harvested yields (potatoes, tomatoes, lettuce, cabbage, onion, zucchini, carrot, paprika, cucumber and radicchio). This enables us to exclude some marginal crops and uncertainties in correspondents' reporting.

3.3. Production yield

The results of the survey showed that 127 gardeners produced an average of 2.16 kg of yield per m^2 with a standard deviation of 1.51 kg/m^2 and the range of 7.48 kg/m^2. Statistics shows considerable variation among gardening respondents. The top 10%, top 20% and top 30% of the respondents harvested on average 5.58 kg/m^2, 4.57 kg/m^2 and 4.09 kg/m^2, respectively. Almost 35% or 44 gardeners produce more than the average. This group of gardeners is very productive and shows that high yields are possible also in small urban backyard or allotment gardens. This could be connected to the fact that the average gardener has 17 years of gardening experience (minimum 1 and maximum 60 years).

The most grown 15 crop varieties in average garden	**Area in average garden**		**Yield in average garden**	
	(%)	**(m^2)**	**(kg/m^2)**	**(kg)**
Potatoes	20.86	28.51	3.52	100.35
Tomatoes	13.16	17.99	3.87	69.61
Lettuce (leafy greens)	12.14	16.59	2.98	49.45
Cabbage	6.65	9.09	3.50	31.83
Onion	6.48	8.86	2.96	26.21
Zucchini	5.93	8.10	3.93	31.85
Carrot	5.30	7.24	3.85	27.87
Paprika	5.26	7.20	2.90	20.87
Cucumbers	4.71	6.43	5.70	36.66
Radicchio	4.55	6.22	2.09	12.99
Green beans	4.10	5.60	1.94	10.86
Pumpkin	2.96	4.04	3.28	13.25
Cherry tomatoes	2.90	3.97	4.05	16.08
Parsley	2.63	3.60	2.00	7.19
Mangold (Chard)	2.38	3.25	2.92	9.50
Sum	**100**	**-**	**3.40**	**-**
Average size garden	**-**	**136.69**	**-**	**464.59**
Median size garden	**-**	**60.00**	**-**	**203.93**

Table 3. Areas of production (%, m^2) and yields (kg, kg/m^2) for the most common 15 crop varieties grown in average garden.

In a further calculation, we considered only the most common top 15 crops with more than 2% of share of the harvested yield. The average production among sampled respondents was 3.40 kg/m^2 (**Table 3**). This means that a gardener with an average-sized garden produced 465

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kg of vegetables in the year 2014. A gardener with a medium-sized garden (60 m^2) produced 204 kg of vegetables.

3.4. Cost of production

Gardeners participating in this study spend on average 75.13 EUR per garden and 1.48 EUR/m^2 of garden area. If we multiply the last value by the average garden size of 136.69 m^2, we get a cost of 202.30 EUR for the average garden size in the study. Costs per garden varied widely from a minimum of 5 EUR/m^2 to a maximum of 360 EUR/m^2. These values represent only variable costs, such as buying fertilisers, seeds, seedling plants, plant protection products and small equipment. Rent for the garden plot, water and labour is not included in this value. Respondents were also asked to estimate the active time spent in the garden. Labour is estimated below. If we extrapolate the average cost per m^2 to total allotment gardening area (158 ha) in Ljubljana, not including home backyard gardens, results show that gardeners in the city spent approximately 2.3 million EUR on gardening material during the growing season of 2014.

The labour involved in maintaining the garden plots varied widely. On average, they spend 0.134 hours/m^2 per week actively working and keeping crops, which is 7.8 minutes/m^2 per week with standard deviation of 0.130 hour/m^2 per week, respectively. As the vegetation period in Ljubljana lasts from April to October (7 months or 28 weeks), we can estimate for the growing period of 2014 that the average gardener invested 3.752 hour/m^2 or 512.8 hours per average garden of 136.69 m^2. Using the areas identified as allotment gardens (158 ha) in the city of Ljubljana, these results show that gardeners invested approximately a total of 5.9 million of labour hours in the growing period of 2014. As agricultural calculation models as well as gardeners do not account labour hours as costs, they were not included in the final calculation of savings as an actual cost but rather as an informative result for calculating labour efficiency.

3.5. Savings with ACM

When we express cost in EUR/kg of vegetable produced by surveyed gardeners, our results show that each kilogram costs 0.44 EUR. This is one third of the price than what the same vegetable would have cost in local grocery stores in 2014. Retail prices of the 15 most common vegetables (from potatoes to mangold) were obtained from Statistical Office of the Republic of Slovenia (2015) and calculated as a price for 1 kilogram of mixed vegetables with the same shares as presented in **Table 3**. The price of a kilogram of vegetables ranged from 0.67 EUR/kg for potatoes to 2.22 EUR/kg for paprika with average of 1.49 EUR/kg (**Table 4**). This shows that average urban gardener in Ljubljana avoids costs and saves 70% of what he would pay in stores by producing his own vegetables.

The ACM urban gardeners produced 465 kg of vegetables in an average-sized garden in 2014 with an average retail price of 1.49 EUR/kg, which resulted in average revenue of 664.7 EUR (**Table 4**). The costs for production in an average garden were 202.3 EUR. This finally resulted in the total average annual gross margin of 462.7 EUR (**Table 5**). If we recalculate this to 1 m^2, average revenue was 4.86 EUR/m^2, costs were 1.48 EUR/m^2 and gross margin was 3.38

EUR/m^2. Gross margin can be understood as avoided costs or savings for the gardener. Using these values with the city designated area for allotment gardens (45 ha) and total allotment garden areas identified from above (158 ha), results suggest that the allotment gardeners of Ljubljana avoided approximately 1.5 million and 5.3 million EUR costs annually, respectively. These values could be lowered by approximately 10%, as part of these allotment areas is also used as functional lands for walking paths and garden sheds. Taking this into account in the final calculation, the avoided cost would amount to approximately 1.4 million EUR for the total public allotment area and 4.8 million EUR for the total allotment area in the city of Ljubljana for the year 2014.

Average 15 crop varieties grown in average garden	**Yield (kg)**	**Retail price (€/kg)**	**Revenue (€/year)**
Potato	100.35	0.67	67.23
Tomato	69.61	1.97	137.14
Salad	49.45	1.82	90.00
Cabbage	31.83	0.58	18.46
Onion	26.21	0.91	23.86
Zucchini	31.85	1.25	39.81
Carrot	27.87	1.08	30.10
Paprika	20.87	2.22	46.33
Cucumber	36.66	1.72	63.06
Radicchio	12.99	2.16	28.06
Green beans	10.86	3.95	42.92
Pumpkin	13.25	1	13.25
Cherry tomato	16.08	1.97	31.67
Parsley	7.19	2	14.39
Mangold (Chard)	9.50	1.94	18.44
Sum	**464.59**	**-**	**664.71**
Average	**-**	**1.49**	**-**

Table 4. Calculation of retail price and revenues for average garden.

When taken all together, we can state that ACM brings to the average gardener savings of approximately 3.38 EUR/m^2 or 462.7 EUR per average size garden (136.69 m^2) or 203 EUR per median size garden (60 m^2).

The results of the survey also show that gardeners involved a lot of hours of their own work in managing gardens and crops (**Table 5**). Based on the calculation of production and labour hours, we were able to define the labour efficiency or productivity of an average gardener. Average production and labour invested in urban gardens reported by survey respondents

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were 3.39 and 3.75 hours/m^2, respectively. One labour hour for agricultural seasonal work in Slovenia was valued to range from 2.2 to 5 EUR/hour approximately in 2014, with an average of 3.5 EUR/hour. An average labour efficiency was calculated at 0.89 kg/hour per m^2 of garden. Further calculations suggest that work on 1 m^2 during 28 weeks (April-October) of growing period was worth 13.13 EUR. If we would also factor in the value of labour to the calculation of gross margin, the cost of self-provisioning for urban gardeners would rise remarkably to the level when it would no longer be sustainable.

Calculation	Urban gardening area					
	1 m^2	**100 m^2**	**136.69 m^2**	**1 ha**	**45.89 ha**	**158.06 ha**
Production (kg)	3.39	339.9	464.6	33,989	1,559,755	5,372,165
Revenue (EUR/year)	4.86	486.3	664.7	48,629	2,231,591	7,686,128
Costs (EUR/year)	1.48	148.0	202.3	14,800	679,172	2,339,229
Gross margin (EUR/year)	**3.38**	**338.3**	**462.4**	**33,829**	**1,552,419**	**5,346,899**
*Gross margin reduced for 10% of area (EUR/year)	-	-	-	-	1,397,177	4,812,209
Labour (hours/year)	3.75	375.2	512.8	37,520	1,721,793	5.930.261
†**Labour (EUR/year)**	**13.13**	**1313.2**	**1794.8**	**131,250**	**6,023,063**	**20,744,850**
*Labour (EUR/year)	-	-	-	-	5,420,756	18,670,365
Labour efficiency (kg/hour)	0.89	-	-	-	-	-

*Allotment garden area used as functional lands for walking paths and garden sheds where actual production of vegetable is not possible.
†Labour hour for seasonal works in agriculture was valued with an average of 3.5 EUR/hour in 2014.

Table 5. Calculation of avoided costs model (ACM) gross margin for different areas of vegetable production in urban gardens in the city of Ljubljana for the year 2014.

3.6. Earnings with BM

BM urban gardeners sell surplus produce to obtain an additional source of income, which is not the case of ACM urban gardening for self-supply where the produce is consumed and where surplus produce is given to members of family and friends or exchanged for other goods rather than sold. The Company representative reported that BM urban gardeners are mostly highly educated people of which half are retired and half are employed. It often happens that retired urban gardeners transfer their cooperation with the Company to the younger generation (their children). The younger they are, the more willing they are to use the opportunity, although it is typical for them to have less experience, less skills and less knowledge about gardening. The cooperation of the Company with the urban gardeners sometimes results in urban farmers becoming real farmers. A BM urban gardener rents or buys agricultural land and starts with the registered production of fruit and vegetables as agricultural holdings, from which the Company buys produce. Urban gardeners sell produce produced within 1–3 km radius from the Company. They have no contract agreement because gardeners bring produce

whenever they have surplus. Price is negotiated based on the market supply and demand with a Company representative. Sometimes, the Company calls reliable regular urban gardener suppliers in advance to provide them with specific local varieties of vegetables like Ljubljana iceberg or Ljubljana bog green beans.

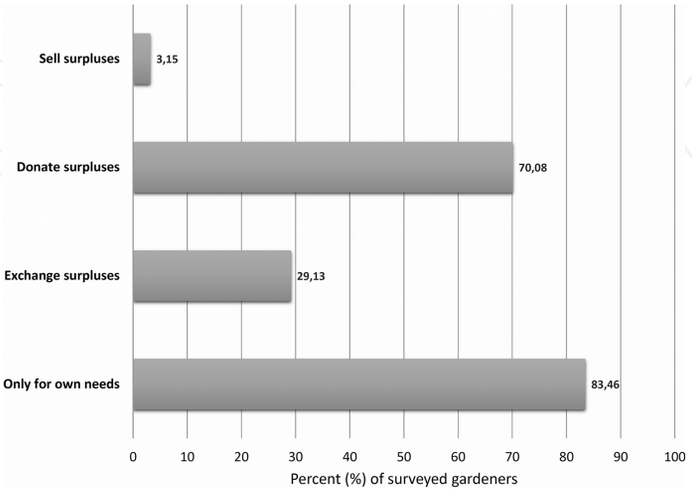

Figure 3. Paths of vegetable surplus production of surveyed urban gardeners in Ljubljana in the year 2014.

In the period 2014–2015, the Company purchased on average approximately 3209 kg of vegetables per year from 30 gardeners in the amount of 4301 EUR for an average retail price of 1.46 EUR/kg. The BM gardeners (on average 30 per year) have sold on average 107.0 kg of produced vegetable surpluses, and thus earned (revenue from surplus) 156.44 EUR/year. Results of the urban gardener's survey showed that only four gardeners (3.15%) are selling their produce (**Figure 3**). In further calculations, we made two assumptions, production and cost per square area of urban garden are the same as for ACM. Dividing the average amount of sold vegetable (107.0 kg) by average production (3.39 kg/m^2), we got 31.48 m^2 of garden area needed for BM production. Multiplying this value with average costs of production (1.48 kg/m^2) in an ACM urban garden, we got the total cost. The cost for 107.0 kg of produce amounted to approximately 21.27 EUR/year. Therefore, the gross margin or earning from surpluses sold (revenue minus cost) was approximately 135.17 EUR/year for an average BM gardener, which was 4.29 EUR/m^2 or 1.26 EUR/kg of produce. Higher earnings of BM in comparison with ACM are expected because they sell special local varieties with higher added value.

Urban gardening is not subject to the traceability of goods and quality control (certification rules) in comparison with classical agriculture. As soon as an agriculture holder enters with their products into the real economy, he is obliged to follow the certification and quality control rules. All produce supplied to the Company is examined by their food technologist, and then the quality analysis of the products follows before they enter the official food chain and market. The financial cost of one quality analysis is approximately 100–500 EUR, which normally exceeds what urban growers are willing or can afford to spend. For this reason, the Company covers all the cost of food quality control.

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4. Conclusions

4.1. Strengths

This is one of the rare agro-economic evaluations of the two urban gardener economic models. This study illustrates how much ACM gardeners save with self-provision gardening and how much BM gardeners earn with selling surpluses of their production. The sample of surveyed respondents filling out the on-line questionnaire was relatively wide in number of correspondents allowing us to make a good comparison between urban gardeners and their behaviour. One of the important strengths of this research was that the growing season covered in the study passed without any serious damaging weather events (drought, hail), which could cause a loss in productivity.

4.2. Limitations

This study has some limitations impacting on the reliability of the results. The first is that only one city was studied so it would be difficult to extrapolate results beyond the city of Ljubljana. However, we could say that results are transferable to other cities in Slovenia with continental climate as weather conditions, and prices of vegetable and cost are even all around the country with a population of 2 million. The part of the country with a Mediterranean climate is an exception because the growing period for certain crops (lettuce, leeks, radicchio, etc.) lasts all year round.

Although the sample of participating gardeners in the research was relatively wide, the selection of participants was random with no fixed pattern of selection. The total number of gardeners starting filling out the online survey was greater, however due to the length and data requirements, many of them quit before finishing and were finally deleted from the database. Further, all data in the study were self-reported by gardeners based on their memories for the last growing season. For that reason, it could have happened that results would not be representative for gardeners in Ljubljana. However, as we were aware of the limitations of the on-line questionnaires, we also performed random field surveys at urban garden allotment areas with the same form of questionnaire as for on-line participants. The next limitation was connected to the BM data. According to our knowledge, the Company involved in the research is the only one among the wholesale companies in the region with a BM involving buying vegetable and fruit production from small home or allotment urban gardeners. This type of model requires the company to invest more time, financial resources and labour and is for that reason unattractive to businesses because they do not profit enough from this relationship.

Another limitation was that during the course of the research we were not able to make any contact with small urban gardeners producers that sell to the Company. The managing director of the Company helped us on that with personal involvement, however with no success. BM urban gardeners main reasons to decline an interview were concern and fear of possible subsequent visitation by the agricultural, food or even tax inspectors. They believe that their way of production is prohibited and count themselves in the grey zone of the economy.

4.3. Knowledge acquired

The study showed that gardeners were growing a wide variety of crops, on average 15 different types, and this required a lot of different knowledge and production skills. It also means that the diet of an average gardener was quite diverse. On a yearly basis, the average gardener (136.69 m^2) produced 465 kg of total vegetables or 364 kg without potatoes.

The Slovenian Ministry for agriculture, forestry and food, following World Health Organisation (WHO) recommendations, advises for a grown person to eat a minimum of 250 g of vegetable per day without potatoes. This means that the vegetable quantity produced by an average urban gardener is sufficient for 1457 daily servings, which was enough for a family of four members to be self-sufficient in vegetables for a whole year. If we compare this to a median garden (60 m^2) in the study, they produce 160 kg of vegetable without potatoes, which account for 640 daily servings of vegetable or 1.8 family members per year. The results offer us an evidence of high potential for families to be self-sufficient. There is also plenty of room and opportunity to expand the city of Ljubljana's self-provision of vegetables.

The study offers evidence that the ACM can be upgraded with the BM. For example, if a family of two retired members has an average garden of 136 m^2, they can produce vegetables for four people. Consequently, the surpluses for two extra family members can be sold for extra money.

In present times, the BM is quite rare in Ljubljana, however, in the past centuries before population growth after the World War II, this type of vegetable production was very common in Ljubljana. Housewives, living in small houses on the edge of the city wall, sold their vegetable produce from home gardens to the citizens on the main market every morning. This was additional money for their household budget, and it also meant financial independence for women. The earnings are not great but it seems that people are doing it for a two combined motives as additional income whereas food is not wasted.

4.4. Future of urban gardening

The long history of urban gardening in Ljubljana is the best guarantee for a bright future. Urban gardening is currently a subject of many social and aesthetic studies dealing with the involvement of different social groups in co-shaping the city's green areas. The municipality is spatially arranging urban gardening allotment areas with an accelerating speed putting in to use few hundred new garden plots each year. While cooperation with ACM urban gardeners was open and correct and they were always available to help us, this was not the case with BM gardeners. In future studies, a great deal of work will have to be invested in strengthening the trust between BM producers and researchers to convince them to cooperate and provide them necessary anonymity.

The BM should be promoted more because it can offer additional income and in certain cases when a hobby becomes a profession, also a full-time job. However, currently gardeners who hire gardens from the municipality are in a worse position, as municipality regulations for urban gardens on public places require only non-profit gardening for self-supply of the family. The municipality will have to reconsider its strict regulations in the future. However, urban gardeners are always one step ahead of the authorities. In the light of the lack of public urban

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garden plots, citizens hire privately owned fields from farmers and divide them into smaller plots. Currently, areas of this type represent 87% (138 ha) of all urban allotment garden areas (158 ha), showing that the municipality will never be able to fulfil the demand for garden plots by citizens.

This shows that the municipality of Ljubljana will have to concentrate also on possible entrepreneurial initiatives originating from the urban food chain (production and sale), which could improve self-provision and the long-term food resilience of the city.

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